



**Review and Summary of Studies  
Containing Information Relating to  
Density Reduction / Groundwater Resource (DR/GR) Lands  
Southeastern Lee County, Florida** May 2007

Prepared for  
Board of County Commissioners  
Lee County, Florida

Prepared by

McLane Environmental, LLC  
Princeton, New Jersey

Amy S. Greene Environmental Consultants, Inc.  
Flemington, New Jersey

Head First, Inc.  
Jacksonville, Florida

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## ACRONYMS

ACOE	U.S. Army Corps of Engineers
ASR	Aquifer/Storage/Recovery
BMPs	best management practices
BOD	biochemical oxygen demand
CEM	conceptual ecological model
CM	conceptual model
CSM	conceptual site model
DCA	Department of Community Affairs
DO	dissolved oxygen
DOT	Department of Transportation
DR/GR	Density Reduction/Groundwater Resource
ESBA	Endangered Species Biological Assessment
ET	evapotranspiration
FDEP	Florida Department of Environmental Protection
FLUCCS	Florida Land Use and Cover Classification System
FLUCFCS	Florida Land Use, Cover and Forms Classification System
FNAI	Florida Natural Area Inventory
FS	feasibility study
FWC	Florida Fish and Wildlife Conservation Commission
GIS	Geographical Information Systems
GW	ground water
HGM	hydrogeomorphic
IHA	Indexes of Hydrologic Alterations
NEP	national estuary program
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resources Conservation Service
NWI	National Wetlands Inventory
NWL	normal water level
PM	performance measure
QA/QC	quality assurance/quality control
RMSE	root mean square error

SAV	submerged aquatic vegetation
SFWMD	South Florida Water Management District
SHCA	strategic habitat and conservation areas
SWFFS	Southwest Florida Feasibility Study
SWIM	surface water improvement and management program
TKN	Total Kjeldahl Nitrogen
TMDL	total maximum daily loads
TN	total nitrogen
TSS	total suspended solids
UMAM	Uniform Wetland Mitigation Assessment Method
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WMD	water management district
WRAP	Wetland Rapid Assessment Procedure
WT	water table

## DEFINITIONS

<u>Term</u>	<u>Definition / Software / Model Description</u>
arcGIS 9.1	A software package designed to manipulate, analyze and display geographic information.
CH3D	Curvilinear-grid Hydrodynamic 3D Model calculates circulation, wave, sediment transport, water quality, light attenuation, and seagrass models.
ground-truthing	A term associated with remote sensing, satellite imagery, cartography, and other fields which refers to a process in which a pixel or node on an image is compared to what is located at that particular point in reality in order to verify the image's contents.
ha	hectares (1 ha = 10,000 sq m = 2.471 ac)
IWR	The IWR-MAIN Water Demand Management Suite© is used by water planners to project future water demands and analyze water conservation measures at the end use level.
kriging	A geostatistical technique to interpolate random field data (e.g. the elevation Z of the landscape as a function of the geographic location) at an unobserved location from observations of its value at nearby locations.
landscape mosaic	A common theme noted in all the documents that pertain to wildlife and habitat. The scale and specific habitat types (e.g. cypress swamps, mesic pine flatwoods, wet prairies, etc) at which these connections are important varies from species to species, however, the concept of an integrated “landscape mosaic” is thought to be of crucial importance to a wide range of species. For example, the Florida black bear uses many habitat types, such as pine flatwoods, cypress swamps, and mixed hardwood-pine, but may travel to specific locations to feed on palmetto berries in the fall. An interconnected habitat mosaic can also be important to animals with a smaller range. As another example, many species of salamanders cannot complete all phases of their life-cycle without wetlands (in which eggs must be laid) and high-quality uplands (crucial food supply habitat for adults). Therefore, the current practice of preserving small patches of wetlands without adequate attention to the integrity of the larger landscape is resulting in declines in the populations of many species of wildlife.
m	meter (1 m = 3.28 ft)



MIKE	MIKE is a 3-D modeling software tool designed to simulate hydrology, water quality, and sediment transport in estuaries, rivers, irrigation systems, and other bodies of water.
MODFLOW 2000	A USGS model which simulates both steady and non-steady groundwater flow in an irregularly shaped flow system in which aquifer layers can be confined, unconfined, or a combination of both.
PRISM	The Parameter-elevation Regressions on Independent Slopes Model (PRISM) is used to estimate climate parameters using both point data and a Digital Elevation Model (DEM).
SHE	MIKE SHE is a model used to simulate the land phase of the hydrologic cycle, aiding in both planning and management of water resources and environmental problems associated with groundwater and surface water bodies.
taxa	Groupings of organisms based upon biological relationships to each other. Taxa can refer to classifications at many levels of biological similarity.

## **Executive Summary**

Lee County, in 1990, responded to concerns regarding growth rate, dwelling unit capacity, groundwater recharge, and future water supply within the County by creating a new Density Reduction / Groundwater Resource (DR/GR) future land use category. These lands allow a residential density of one dwelling unit per ten acres, and certain other uses including agriculture and resource extraction. Of the three original DR/GR land use areas in Lee County, this review focuses only on the DR/GR land located east of interstate highway I-75 and south of State Route 82.

One of Lee County's leading community development challenges is the current and future management of the DR/GR lands. Development pressures continue, as do concerns regarding the environmental health and integrity of these lands and the near-shore ecological communities with which they are connected.

As one step in ensuring a more informed approach to the management of DR/GR lands, Lee County commissioned a project in which a substantial number of the most important studies with relevance to DR/GR lands were reviewed to determine what information, if any, they contained about the current environmental conditions within the DR/GR area. This report describes that project and its findings.

To conduct the DR/GR study review, the County selected a team composed of the founding Principals of McLane Environmental, LLC; Amy S. Greene Environmental Consultants, Inc.; and Head First, Inc. These leading professionals in their respective fields, along with selected members of their staff, formed a team of consultants with complementary training and experience to address the many facets of the resources and interrelationships of ecological and hydrological processes that operate within the DR/GR lands.

At the outset of the review, the project team was aware that the DR/GR lands were designated to achieve (1) density reduction and (2) protection of groundwater recharge and resource areas. What became clear during the review is that the lands are also important because of their (3) ecological resources (wetlands, uplands, plant and animal species listed as threatened, endangered or of special concern by federal or state agencies, habitats, biodiversity hot spots, etc.). The lands are also very important because of their (4) surface water hydrology features, including flow ways. Finally, the DR/GR lands are not only

important on a piecemeal basis for the particular resource that might exist in a parcel, but because (5) the lands support overall landscape integrity due to an extensive, interconnected mosaic of habitats, allowing for wildlife range and migration corridors, interconnected flow ways that interlink wetlands and differing habitats, and connect the land to nearby coastal ecosystems.

Objectives of the DR/GR study review project included (1) reviewing and evaluating studies to glean from the best studies data that are most applicable to decision-making regarding the area of interest, (2) identifying the most important issues by linking commonalities among the various studies, and (3) evaluating the completeness of information contained in the documents reviewed. The resulting report is specifically designed to be a scientific summary, not a planning policy document. The study review report prepared by the project team does not contain conclusions regarding the appropriateness of the current density restrictions and currently permitted uses; does not examine the perceived value or suitability of any portion of these lands for future preservation or development; and does not make any recommendations regarding future land use within Lee County DR/GR lands.

The documents reviewed by the project team were selected by Lee County staff. Approximately two dozen documents were reviewed and are summarized in this report. Additionally, numerous other documents that provided background and context to the DR/GR lands were reviewed by the project team. These additional documents were also selected by Lee County staff.

The project team initiated its review with an examination of Lee County's planning documents. A list of key environmental resources, features, and issues relevant to DR/GR lands was identified in the planning documents. The selected DR/GR studies were then reviewed to determine the types of, and quality and completeness of, the information and scientific data contained in each study as it pertained to the key resources and issues list. As part of the review, key maps and overlays from each study report were identified and prioritized for possible future incorporation into the County's computerized geographic information system.

Common DR/GR resources, features, and attributes emerged from the review of the documents and studies. These commonalities comprise five major categories, as follows.

## **1. Density Reduction**

### **1. Reduced residential density in the DR/GR area allows Lee County to meet State requirements and manage future growth.**

This factor is as important today as it was when this land use category was created in 1990.

## **2. Groundwater Resource/Recharge**

### **2. Groundwater in DR/GR lands is an important source of potable water.**

Lee County currently relies on groundwater from existing well fields for a significant portion of its water supply from both public utilities and private wells.

### **3. Aquifer recharge occurs within the DR/GR.**

A recent draft study has concluded that some of the higher-recharge land cover categories in Lee County are located within the DR/GR area.

### **4. Groundwater in the DR/GR area sustains important surface water bodies.**

Shallow groundwater contributes flow to surface waters which are important for sustaining certain DR/GR ecological resources (e.g. wetlands) and in linking DR/GR lands to coastal ecosystems.

### **5. DR/GR aquifers are a potential source of new water supply for Lee County.**

Future water use in Lee County is projected to increase, and the DR/GR contains areas that have the potential for new water supply development.

### **6. Computer models may serve as valuable tools for managing groundwater resources in DR/GR lands.**

Development of potential water supplies that may affect the DR/GR water budget must be evaluated on a case-by-case basis. Quantitative tools such as computer models of groundwater flow can be used in evaluations of current and proposed future groundwater withdrawals.

### **7. Mining activities in DR/GR lands may have both positive and negative effects on the natural hydrologic system.**

A recent draft study concluded that the effects of mining activities on groundwater



can be both positive and negative. Lakes created by mining can increase water storage capacity and the opportunity to enhance regional storage through the design and management of the mining-related lakes. However, lakes may increase susceptibility for the introduction of contaminants into the aquifer and there may be increased water losses due to evaporation.

### **3. Ecology**

#### **8. Existing wetlands are important ecological features of the DR/GR lands.**

Several studies identify wetlands as important ecological features of the DR/GR because they provide a host of functions including: filtration and assimilation of rainfall runoff, groundwater recharge of groundwater aquifers, stabilization of sediment carried during storm flows and other surface water flows, hydraulic controls on floodwaters, nutrient cycling, and habitats for a wide variety of plant and animal species.

#### **9. Native uplands are important habitat areas in DR/GR lands.**

Similarly, native uplands are critically important to natural resources within the DR/GR. A healthy upland often provides similar functions to those provided by wetlands including sediment stabilization, nutrient cycling, habitats for a variety of plant and animal species, including refuge during floods for wetland species that are not aquatic, and aquifer recharge, especially in uplands with loose well-drained soils. One study noted specific areas within the DR/GR that are considered to be among the best remaining areas of pine flatwoods in this section of Florida, but they are not currently protected adequately by regulations.

#### **10. Many State or federally listed or endangered species have been observed or have suitable habitat areas mapped within DR/GR lands.**

DR/GR lands are home to a great number of State or federally listed or endangered species. These include mammals such as the Florida panther, Florida black bear, mastiff bat, and fox squirrel; birds including wood stork, little blue heron, red-cockaded woodpecker, southern bald eagle, and burrowing owl; and several reptiles and amphibian species. Various listed plant species were noted to occur in the DR/GR. These species may include beautiful pawpaw, birds nest fern, and lattice-vein fern.

**11. DR/GR lands host a rich diversity of plant and animal species.**

The DR/GR lands are important not only for the individual species that have been observed there, but for the overall diversity of species that the DR/GR lands support. The Florida Fish and Wildlife Conservation Commission has recommended certain lands referred to as Strategic Habitat Conservation Areas for additional protection, and the largest aerial extent of Strategic Habitat Conservation Areas determined to be important to the largest number of species in Lee County is concentrated within the DR/GR area. The Lee County Master Mitigation Plan embodies the concept of biodiversity areas and has been updating maps to reflect new information obtained for these areas within the County and within DR/GR lands. The Florida Fish and Wildlife Conservation Commission report also includes a separate set of maps, referred to as Regional Biodiversity Hot Spots, and one of the studies reviewed shows that there are many biodiversity “hot spots” within Lee County and that they are concentrated in the DR/GR area.

**12. DR/GR lands are prime areas for wetlands mitigation and ecological restoration efforts.**

The studies reviewed indicate that the DR/GR lands include extensive areas that, while they have been impacted, have good potential to be successful ecological restoration and/or enhancement areas including Florida panther primary and secondary habitat zones and many areas identified as Strategic Habitat Conservation Areas or biodiversity hot spots and/or lands directly adjacent to these areas. There is also extensive potential for these restoration areas to be used to enhance connectivity between existing protected and managed lands within the DR/GR if the appropriate actions are taken. The Lee County Master Mitigation Plan recognizes numerous potential habitat restoration sites within the DR/GR lands. Many of the documents reviewed contain information regarding potential restoration areas.

**4. Surface Water**

**13. Surface water bodies within DR/GR lands are important hydrologic and ecological features.**

While the DR/GR lands were originally designated for groundwater protection, studies reveal that surface waters are also important because they represent

hydrologic features with great significance for the ecological systems of the DR/GR lands. Wetlands and sloughs provide a habitat for a wide variety of plant, animal, and aquatic species.

**14. Flows through the extensive system of channels, sloughs and wetlands within the DR/GR lands can act to remove nutrients, sediment, and contaminants from surface water to lessen impacts to surface water within the DR/GR and in nearby coastal waters.**

Surface water ecosystems in DR/GR lands have the capacity to perform a cleaning process to some degree on the water that flows through them, thereby acting to lessen nutrient, sediment, and pollutant impacts on waters of rivers and creeks, and bays along the western coastline of Lee County to which the DR/GR lands drain.

**15. DR/GR surface water systems are important for removing storm waters and reducing flood impacts.**

DR/GR surface waters including channels, sloughs, and flow ways are important pathways that remove storm waters from DR/GR watersheds, thereby reducing impacts associated with flooding. The studies reviewed indicated that areas for mitigation of surface water flows have been identified within the DR/GR and mitigation projects are planned or underway.

**16. Surface water systems may serve as sources of recharge to groundwater aquifers and well fields.**

Groundwater in the shallow aquifer below the land surface and the surface water that flows in rivers, canals, wetlands, and sloughs are interconnected within the DR/GR. Surface water flows in the DR/GR in areas of groundwater withdrawals may serve as a source of recharge to the aquifer system.

**5. Connections**

One of the most important overall attributes of the DR/GR lands is the connections between the resources and systems that have been discussed above, and the scale over which these connections operate. Many of these connections have been alluded to in the previous discussions in this section, but the paragraphs below will describe them in more detail and make their importance clear.

**17. DR/GR lands provide a large contiguous habitat area that is important to wide-ranging species.**

DR/GR lands include large-scale (at a minimum of several kilometers in diameter) areas (landscapes) that consist of patches of interconnected, inter-dependent types of habitats which are repeated in a pattern (mosaic), at a scale that is unique to Lee County. From a natural resource perspective, this feature makes this area important to many wildlife species, especially the wide-ranging species such as the Florida panther, the Florida black bear, and the Eastern indigo snake.

**18. DR/GR lands contain extensive areas of interconnected wetlands.**

The DR/GR contains large areas of wetlands. While the studies reviewed provided no quantitative comparisons regarding wetlands within the DR/GR area in relation to the rest of Lee County or the rest of South Florida, the DR/GR does contain extensive acreage of many different types of wetlands (e.g. wet prairie, cypress dome, hydric pine flatwoods, mixed hardwood swamp), including the northernmost portion of the 60,000-acre Corkscrew Regional Ecosystem Watershed. These extensive wetlands, in combination with the mosaic of upland habitats described in the environmental studies, provide important nesting, roosting, denning, feeding, and refuge area for a diverse range of animal species and allow for the growth and reproduction of a diverse range of plant species.

**19. DR/GR lands provide important connections to nearby and farther-reaching ecosystems.**

In a similar fashion, because the concept of a mosaic of interrelated habitats is also important on a scale that includes external connections between the DR/GR lands and surrounding ecosystems, the DR/GR lands provide an important “link” in the “chain” of conservation areas throughout South Florida. On an even larger scale, the DR/GR contains habitats that provide important “stopover” locations for migratory birds. Several of the reports include discussions of the importance of habitats within the DR/GR lands to birds that migrate between North America and South America.



**20. DR/GR lands connect both hydrologically and ecologically to nearby bays and coastal ecosystems.**

The majority of the DR/GR lands drain via a number of rivers into the Estero Bay, an estuarine system recognized federally as a National Estuary and by the State of Florida as an Aquatic Preserve. The Estero Bay is home to abundant plant and animal species, including many that are listed federally and/or by the State of Florida as threatened or endangered. Estero Bay and inland waters, including the riverine systems connecting the DR/GR lands to the Estero Bay, exhibit water quality problems, including low dissolved oxygen, high nutrients (especially as measured by chlorophyll-a), and high levels of copper. Studies reviewed in this project indicate that water quality impairments and the changes in timing and quantity of freshwater entering the estuary have negative effects on a wide variety of plant and animal life, particularly the seagrasses, many invertebrates, and larval fish that are critically important to the maintenance of the area's many commercial fisheries. For these reasons, the connection of coastal areas to interior watersheds, and the preservation of interior habitats such as those located within the DR/GR lands, is crucial to some wildlife species.

At the beginning of the review process, the project team examined the Lee County Comprehensive Plan and identified more than 50 environmental resources, features, and issues potentially associated with the DR/GR lands that the County considered to be important for land use planning and management. At the conclusion of the review, the project team determined that the studies and reports revealed substantial descriptive information and scientific data regarding the DR/GR lands. The team found that every one of the 50-plus environmental resources, features, and issues identified in the Lee County Comprehensive Plan are discussed, addressed, or characterized to some extent in one or more of the studies.

This correlation between the County's stated environmental features of interest and the corresponding information provided in the documents indicates the following:

- There is a strong awareness on the part of the Lee County staff charged with managing the DR/GR area that these lands possess a large number of important resources, features, and issues.
- There is confirmation from the studies reviewed that numerous investigators also consider these DR/GR-related features to be important, and that the features (habitats, species, resources, recharge areas, etc.) have been identified as being present in the DR/GR area in southeastern Lee County.

- The studies, when viewed as a whole, reveal that the resources and ecological systems within the DR/GR area are interrelated in complex ways.
- The functioning of the DR/GR environmental system (both in terms of individual resources and interrelated systems) can be adversely impacted by certain land uses.
- There is the potential for a balance between use of the land and protection of the ecological and groundwater resources, with the nature of that balance requiring careful consideration of the DR/GR information and scientific data contained in the studies reviewed as part of this project and other similar studies.
- There is the potential for restoration of impacted portions of DR/GR lands.

The project team also found that there were a few major components of the overall character of the DR/GR lands that were not described in sufficient depth in the documents reviewed as part of this project to permit the project team to evaluate their importance or significance. These include possible saltwater intrusion effects on southeastern Lee County wellfields, ecological impacts associated with mining activities, and environmental impacts (both hydrologic and ecological) associated with agricultural activities. In the absence of information on these topics from the reports reviewed, it can not be determined whether they are important for the future management of DR/GR lands in southeastern Lee County. The topics are identified here for possible consideration by Lee County staff, which may be aware of additional studies that the project team has not reviewed, and not as recommendations for further study.

## **1.0 Introduction**

Lee County, in 1990, responded to concerns regarding growth rate, dwelling unit capacity, groundwater recharge and future water supply within the County by creating a new Density Reduction / Groundwater Resource (DR/GR) land use category. These lands, located in several portions of the county, allow a residential density of one dwelling unit per ten acres, and use of the lands for agriculture, natural resource extraction and related facilities, conservation uses, publicly-owned gun range facilities, and private recreation facilities. This review focuses only on the DR/GR land located east of interstate highway I-75 and south of State Route 82.

One of Lee County's leading community development challenges is the current and future management of the DR/GR lands. Development interests continue as do concerns regarding the environmental health and integrity of these lands and the near-shore ecological communities with which they are connected.

In the years since the inception of the DR/GR land use category, numerous studies have been completed for the interconnected environmental systems, both ecological and hydrological, of Southwest Florida, and some studies have been performed specifically for the DR/GR lands in Lee County. As one step in ensuring a more informed approach to the management of DR/GR lands, Lee County commissioned a project in which a substantial number of the most important of those studies were reviewed to determine what information, if any, they contained about the current environmental conditions within the DR/GR area. This report describes that project and its findings.

To conduct the DR/GR study review, the County selected a team of consultants with complementary training and experience to address the many facets of the resources and interrelationships of ecological and hydrological processes that operate within the DR/GR lands. The team's project manager is Charles McLane, President of McLane Environmental, LLC. Dr. McLane is an environmental scientist who specializes in groundwater science. He has more than 20 years of experience in analyzing scientific data and performing quantitative studies, including computer modeling, for natural and development-impacted groundwater systems. Dr. McLane has served as an expert panel member to assist branches of the U.S. Government in managing response to various groundwater pollution problems, and regularly publishes and lectures to professional groups on topics related to the analysis and

interpretation of groundwater data. Dr. McLane was assisted in reviewing the hydrologic modeling portions of various studies by McLane Environmental staff members Dr. Liliana Cekan and Mr. Gregory Nelson.

Ecological expertise was provided by Amy Greene, President of Amy S. Greene Environmental Consultants, Inc. and by Ann Ertman, a member of her staff. Ms. Greene is recognized as an expert in the field of wetland science, environmental permitting, natural resources inventory, and environmental impact assessment. She has more than 20 years of experience in the performance and management of environmental studies. She has prepared wetland evaluations, delineations and mitigation plans for coastal and inland wetlands; has conducted wildlife habitat evaluations and surveys, endangered species surveys, natural resources inventories and environmental impact assessments; and has been involved in numerous projects involving environmental planning for residential, commercial, industrial and recreational and educational development and wastewater, sludge, solid waste and transportation facilities and for municipal, open space, and conservation planning.

Ms. Ertman has a strong background in inventory and analysis of ecological resources and the application of environmental regulations for the protection of those resources. With more than 12 years of experience, she has contributed to regional planning studies, and contributed to the development and application of a state-wide methodology for assessing the quantity and quality of wetland mitigation sites. Ms. Ertman has experience studying Florida ecosystems and in the application of relevant resource protection regulations from 1994 to 1998, as a member of Florida DEP, which she served as an environmental manager in charge of statewide oversight of mitigation and mitigation banking.

Geological and hydrological expertise was provided by Andrew Miller, President of Head First, Inc. With more than 20 years experience in the field of groundwater consulting, Mr. Miller has designed and implemented numerous water resources investigations and evaluations for private, municipal, and industrial clients. His work, which focuses on the sustainability of water supplies and a reduction or elimination of impacts due to excessive withdrawals, also includes investigations of the movement of contaminants and nutrients in groundwater systems. Mr. Miller operates a consulting firm based in Florida and has extensive experience with Florida aquifer systems and water supply issues.



## **2.0 Purpose and Methods**

### **2.1 Purpose and Scope**

As described in the original statement of work for this project, Lee County desired to review environmental studies and regulatory documents that the County had identified as important in characterizing the valuable resources in or regulating growth in the DR/GR portion of Lee County. Lee County has restricted land uses within the DR/GR to agriculture, mining, conservation and residential development at a maximum of one dwelling unit per 10 acres. The goal of the DR/GR designation was to control density and sprawl and to protect groundwater resource lands.

Defensible decisions regarding allowable density and the granting of permits requires a basis in sound science developed from available data and studies. Lee County retained the McLane Environmental project team to use multi-disciplinary skills to evaluate existing environmental studies and planning and mitigation documents. Within the designated studies and documents, the team searched for important and valid data, information and maps relevant to the DR/GR lands that would assist Lee County Staff and the Board of County Commissioners in making informed land use decisions. The resulting report is specifically designed to be a scientific summary, not a planning policy document. The County purposefully selected a consultant who would be unbiased, with no current or previous stake in any specific development or general growth or environmental objective in Lee County or its contiguous counties that could be perceived as a potential conflict of interest.

Objectives of the DR/GR study review project, as outlined in the statement of work included:

- Separating those studies that are more up-to-date and useful, from those that may be dated and less useful;
- Working with Lee County staff to identify studies not on the initial list that may be worthy of review;
- Gleaning from the best studies data that are most applicable to decision-making regarding the area of interest;
- Identifying the most important issues by linking commonalities among the various studies; and
- Evaluating the completeness of information contained in the documents reviewed.

The DR/GR study review project was guided by two primary concepts. The first is that there are numerous environmental resources, features, and issues that have been identified as having relevance to current conditions within, and future management of, DR/GR lands in southeastern Lee County. Those features were identified through a review of Lee County planning documents as described in Section 2.0.

In addition, it is clear that policy and plans for DR/GR land use in Lee County are intended to be based on sound science developed from available data and studies.

Based on this approach, a review of DR/GR-related studies was conducted to extract scientific information from the available studies, and that information was summarized as described in Section 3.0. During the review, a number of key attributes of DR/GR lands, and commonalities among environmental features of DR/GR lands, were identified as discussed in Section 4.0. Also during the review, potentially useful maps and overlays were identified as described in Section 5.0, for possible inclusion by the County into its existing Geographic Information System (GIS) data and map system. A summary of the information compiled during the review is presented in Section 6.0.

It is important to note that this study review report:

- does not originate land use planning or policy statements for Lee County DR/GR lands;
- does not provide recommendations regarding a particular status that should be attributed to DR/GR lands (e.g. “preservation lands”, “conservation lands”, “lands worthy of protection”, etc.)
- does not offer opinions regarding the appropriateness of the current density restrictions and currently permitted land uses;
- does not consider any factors relating to the perceived value or suitability for future development of one portion of the DR/GR lands over another; and
- does not provide any recommendations regarding particular activities that should be prohibited, restricted or monitored within DR/GR lands.

## **2.2 Documents Reviewed**

The project plan specified that the project team was to review an initial set of 12 documents, with two additional studies to be added once the project was under way. Lee County, through an internal process and discussions with the project team, identified 12 documents and studies with relevance to DR/GR lands as the initial set to be reviewed (documents 1 through 12 in Appendix A). As the review progressed, two additional studies were identified by the County and submitted to the project team for consideration and review (documents 13 and 14 in Appendix A). Summaries of those documents are presented in Section 3.1 and in Appendix D.

In addition, the project team reviewed other documents relating to Lee County land use, and management of DR/GR lands, to provide context for the primary document review. These supplemental documents are summarized in Section 3.2.

## **2.3 Method and Objectives**

As described in the project statement of work, the County wished to retain a consultant or team that had no stake in Lee County land use policy and decisions, and which possessed the requisite set of multidisciplinary skills to be able to conduct a review of studies that covered a wide range of environmental processes and issues. The McLane Environmental project team was assembled to provide expertise in the various scientific disciplines, as well as specific knowledge of geologic, hydrologic and ecological conditions in southern Florida, without any direct past or present involvement that could constitute a conflict of interest.

As the first step in the project, the team members briefly reviewed all of the initially selected documents in preparation for a meeting with the County Project Manager, Assistant County Manager, and various County Department staff. At the project kickoff meeting, the review team gained valuable insight into the rationale for the formulation of the DR/GR land use designation, and were provided with a number of useful background documents to provide context for the review. County staff provided information on a range of topics including operation and information reporting for the County's well fields, and background information on the County's GIS system which may be supplemented with certain map and overlay data identified as part of this project.

As part of the initial project meeting, project members participated in a one-hour fly-over of DR/GR lands. During the flight Lee County Department Directors described key features of the lands. Also, at the meeting a discussion was held regarding the appropriate framework for the review, which eventually led to the approach described below.

### **DR/GR Study Review Project Methodology**

The following steps were taken by the project team in planning and conducting the DR/GR study review and in preparing this report:

1. The project team reviewed all initially selected documents shown in **Appendix A** to prepare for the project kickoff meeting and to begin formulating an approach for the review process and work products. Participated in the kickoff meeting with Lee County staff to discuss the history of DR/GR lands, to identify supporting background documents to enrich the review process, to conduct a DR/GR land fly-over, and to discuss an approach for review.
2. The project team reviewed key Lee County planning and mitigation documents to identify the sections of those documents most relevant to management of DR/GR lands. The summary of those key planning document sections is presented in **Appendix B**.
3. From the relevant sections of Lee County planning documents (in particular the Lee Comprehensive Plan), the project team identified key environmental resources, features of interest, or issues of concern that appear to be taken into consideration by the County in the land use planning. The list of more than 50 items is presented in **Appendix C**. Those key environmental features with relevance to the DR/GR lands were used to guide the review of the selected environmental studies so that relevant information and scientific data could be identified and recorded.
4. The project team reviewed the selected studies and prepared, for each study, a document review matrix (summary form) that captured key information from the study in an easy-to-access format. Those document summaries, which are presented in **Appendix D**, contain section and page numbers for each summarized item of information or data so that the interested reader can return to the original study for additional information on a particular topic.
5. During the review of the various studies, the project team identified more than 100 key maps and overlays that may be useful to Lee County in DR/GR land planning efforts or to enhance the current GIS map base for these lands. The list of key maps with relevance to DR/GR lands in southeastern Lee County is presented in **Appendix E**.

6. Upon completion of the document review, the project team reexamined the original list of key environmental features and noted that the review had identified information or data for every one of the more than 50 items in one or more of the documents. The list of key features and the sources that contain information regarding a particular feature is presented in **Appendix F**.
7. Finally, the project team integrated the information contained in the individual documents into a cohesive findings report. Brief summaries of each document are presented in **Section 3.0**. These summaries are intended to provide a brief capsule of each report in a way that might not be readily ascertained from the lengthier and more detailed summary matrices compiled in Appendix D. The project team's summary of the key features and characteristics of DR/GR lands in southeastern Lee County is presented in **Section 4.0**. The summary includes a discussion of the commonalities observed among the studies, both in terms of environmental features that are common to several of the reports, as well as connections among the environmental features that are apparent among and across the studies when they are viewed as an ensemble. Key maps from the various studies that may be useful to Lee County in future management of information relating to DR/GR lands are listed in **Section 5.0**. This section identifies approximately 40 key maps that may be considered of higher priority than others listed in Appendix E. **Section 6.0** presents a summary of the findings and conclusions of the project team. Each finding is presented as a statement supported by a brief explanation that draws on information contained in the documents reviewed. Key maps are summarized under four categories, and a brief discussion is provided of a small number of DR/GR land characteristics that were not discussed in the documents reviewed as part of this project.

### **3.0 Brief Summaries of DR/GR-Related Studies**

The following sections present summaries of the 14 primary documents reviewed as the main focus of this project (Section 3.1), as well as summaries of the supplemental documents supplied by Lee County (Section 3.2). The additional documents, although not subjected to a formal review and not summarized more completely in Appendix D, provided valuable background information for the project.

#### **3.1 Primary DR/GR Documents**

Presented below are brief summaries of the 14 documents reviewed during this project. Because several of the documents contained separate volumes or multiple related studies, a total of 25 documents, with more than 4,000 pages were reviewed. The brief summaries presented below are meant to cover the highlights of each study or document. If the reader is interested in a more detailed summary for one or more of the documents, these are provided in Appendix D. In addition, the summaries in Appendix D are keyed to specific sections and/or pages of the original document or study report, so that a particular topic, statement, or set of data can be traced to the source and explored further if so desired.

#### **Documents Reviewed**

##### **1. Lee County Comprehensive Plan Update - December 2005**

**Sponsor/Publishing Agency: Lee County Department of Community Development, Division of Planning.**

**Applicability to DR/GR: Plan describes County's land use plans, guidelines, and requirements for DR/GR lands.**

The Lee Plan, as reviewed, is designed to depict Lee County as it will appear in the year 2020. The Plan acknowledges that, due to a number of factors including the projected increase in population and the probable rate of technological change through 2020, it is impossible to describe the future face of the county with any degree of certainty or precision. However, the Plan lists a number of themes that will be of great importance as Lee County approaches the 2020 planning horizon, including the following:

- Growth patterns of the county will continue to be dictated by a Future Land Use map that will not change dramatically during the time frame of this plan.
- The county will protect its natural resource base in order to maintain a high quality of life for its residents and visitors.
- The Lee Plan's land use accommodation is based on an aggregation of allocations for 22 Planning Communities. These communities have been designed to capture the unique character of each of these areas of the county. Lee County DR/GR lands in southeast Lee County are designated as one of the County's unique Planning Communities.

The Lee Plan is intended to manage growth, land use, and future development within the County. It should be noted that, at the time of this report, the Lee Plan is being updated to extend the planning horizon to 2030.

**2. Groundwater Resources and Mining Study - June 2005**  
**Greg F. Rawl, PG, Michael Voorhees, PhD, PE.**

**Sponsor / Publishing Agency: Lee County.**

**Applicability to the DR/GR: The areas studied in this report cover all of the DR/GR.**

This report provides an evaluation and assessment of groundwater resources and mining resources within Lee County; particularly in the southern portion of the County that encompasses the DR/GR lands. Geologic units underlying Lee County, and three main groundwater aquifers are identified and shown on maps and cross sections. The study is based on data from more than 1,700 wells. The report contains evaluations of groundwater levels and groundwater quality trends. Data are used to create a groundwater model. Recharge for the model area is estimated based on land use and land cover, and the estimates for the various land cover types are refined during calibration of the groundwater flow model.

The locations of former, current, and potential rock pits/mines are shown along with an evaluation of the current and future potential for the use of mining products. The report states there are nine rock mines currently operating in Lee County, and 329 excavations were inventoried for the report. The discussion in the Section "Mining Impact Analysis" is largely general and conceptual with essentially no calculations of quantitative analyses, with the

exception of a comparison of mining-related evaporation losses to other evaporation and plant transpiration losses in Lee County. The study considers agricultural areas within the county and within the DR/GR lands in estimating recharge as an input to the groundwater model, but the study includes no detailed discussion of agricultural operations or impacts.

Regarding the hydrology of the area, the report concludes that net recharge to the surficial aquifer is high in agricultural areas, due to agricultural withdrawals of groundwater from the aquifers and application of the groundwater to the land surface. Based on the recharge estimation method and the results of the groundwater model, the study concludes that regional net recharge capability to the aquifer is most significant in southeastern Lee County. An analysis of groundwater levels in the aquifers through time leads the investigators to the conclusion that major water level declines in the Sandstone and Mid-Hawthorne aquifers have occurred in the last 10 to 15 years.

The study compared water losses associated with mining to losses that occur in the natural hydrologic system due to evaporation from lakes and reservoirs, evaporation and transpiration from wetland areas, and transpiration from the invasive plant species melaleuca, and concluded that the volume of mining losses were no more significant than these other losses. The study concludes that mining can have both positive and negative effects on the water resources of Lee County, but does not elaborate. The report also states that surface water drainage features have significantly impacted groundwater levels in many areas of Lee County.

Hydrologic recommendations included in the report generally suggest more monitoring wells to measure aquifer water levels with an updating of the water level data base; collection of additional data to better define the geology of the area; further studies of the effects of drainage and land use alterations; and a recommendation that Lee County should continue its efforts to optimize groundwater storage for groundwater recharge purposes. Mining recommendations primarily target the design, permitting, and reporting requirements for rock mines; suggest that land uses with the potential to pollute groundwater be restricted in the vicinity of mines; and suggest additional evaluations, including the use of groundwater modeling, to examine potential rock mine impacts (both from borrow pits and surface water bodies), and to estimate more accurate groundwater travel times for wellfield protection.



**3. Lee Master Mitigation Plan (LMMP) - August 9, 2004  
Lee County**

**Sponsor/Publishing Agency: Lee County, Southwest Florida Regional Planning Council**

**Applicability to DR/GR: Mitigation Plan identifies resources to be protected and restored, and mitigation activities for DR/GR lands.**

Lee County is proposing the Master Mitigation Plan to address environmental impacts associated with various infrastructure improvement projects. The Mitigation Plan points out that, while all public works projects are designed to avoid negative impacts to natural resources, there are times when impacts cannot be avoided. The Mitigation Plan is intended to provide consistency and a cumulative accountability for the primary and secondary impacts of its public works program. Such impacts, even when minimized, must be mitigated for, and such mitigation cannot always effectively occur on the site of the project. The Mitigation Plan states that the County proposes to pursue restoration and preservation opportunities for water pollution, fire hazards, wildlife and natural habitats.

The Mitigation Plan has three main purposes:

- 1) to provide a master strategy by which critical environmental features continue to be preserved.
- 2) to get conceptual concurrence from permitting agencies regarding planned mitigation projects that are required for the infrastructure needed to accommodate growth, which in turn will provide greater predictability in the budgeting and permitting processes, and
- 3) to restore degraded resources that are important for the health, safety, and welfare of the public.

The population growth and development in Lee County has, in many cases, caused fragmentation of important aquatic systems, destruction of upland areas, and filling or draining of freshwater, saltwater and tidal wetlands. These activities have led to the loss of important ecological values including water retention functions, drought-buffering capacity, and wildlife habitat. Freshwater and estuarine systems alike within Lee County have been listed as impaired by the Florida Department of Environmental Protection in recent years, and concern is mounting about the effects of human activities on the Gulf of Mexico.

The County has stated that offsetting the impacts of infrastructure projects that are necessary

to accommodate ongoing growth is of paramount importance. The Mitigation Plan is being developed to facilitate planning and budgeting for projects that will restore and protect natural resources of significant importance and foster the continued growth that has been forecast in the County.

As part of developing the Mitigation Plan in 2003 and 2004, private and publicly owned parcels that could be candidate projects for preservation, restoration, or mitigation activities were identified. These parcels were assessed in a preliminary manner and deemed potentially suitable for such activities. A map series has been created to facilitate the initiation of more detailed analysis. While the Mitigation Plan is not intended to provide an in-depth analysis of potential projects, the maps will serve as a starting point for efforts to select appropriate preservation, restoration, or mitigation sites.

The Mitigation Plan will be a component of the implementation of the Lee County Comprehensive Plan. Once in place, the Mitigation Plan will allow Lee County to more effectively accommodate the growth that is occurring and ensure the restoration and protection of the important natural resources that provide the framework for local economy and quality of life.

**4. Water Resources Management Project – October 5, 1988  
James M. Montgomery, Consulting Engineers, Inc.**

**Sponsor / Publishing Agency: Lee County Board of County Commissioners.**

**Applicability to the DR/GR: The areas studied in this report cover all of the DR/GR.**

This report provides an identification and mapping of the upper aquifers in Lee County, a determination of water budgets (for the aquifers), aquifer storage, aquifer safe yields, and identifies aquifer recharge areas and potential well fields. The report also includes strategies for the protection of groundwater resources and wetlands, and water use projections and conservation strategies. Data sources and data quality assurance and quality control procedures are well-defined.

Some of the conservation strategies identified in the report may have already been implemented and some of the potential well fields already developed. A potential drawback related to this report is that the data may be slightly out of date.

5. **Engineering Analysis for Properties Designated within the City of Bonita Springs as “Density Reduction/Groundwater Resource” (DR/GR) - July 2005**  
**Greg Rawl, R.M. Edenfield, Paul Sebert.**

**Sponsor / Publishing Agency: City of Bonita Springs.**

**Applicability to the DR/GR: The report covers a portion of the DR/GR.**

This report describes the existing land uses, environmental characteristics, upland and wetland plant communities, listed plant and animal species, geology, and hydrogeology of the study area. Several different land use scenarios and their potential impact on surface water quality are modeled and presented.

The report concludes that the use of best management practices for surface water management can lead to minimizing the potential impacts to surface water bodies and receiving waters (Estero Bay), and may improve recharge quality and quantity. The report also concludes that low density residential development appears to have the least impacts to the ecosystem.

## **6.0 Estero Bay: State of the Bay Reports**

### **6.1 Estero Bay: State of the Bay Report- January 2000** **Estero Bay Agency on Bay Management**

**Sponsor / Publishing Agency: Southwest Florida Regional Planning Council**

**Applicability to the DR/GR: The study area covers the entire DR/GR.**

**Conclusions not specific to DR/GR lands.**

The Estero Bay State of the Bay Report (2000) is a summary of issues surrounding Estero Bay and its watershed. It was written with the intent of informing the general public on these issues. The entire Estero Bay Watershed is included within the study area, which is large in comparison to the DR/GR area. However, no specific mention of the DR/GR area lands is included in the report. The report includes a historic overview of the study area, a discussion of land use trends, and a discussion of plant and animal life, including plants and animals listed federally or by the State of Florida as threatened, endangered, or of special concern. Much of the document focuses on the Estero Bay Aquatic Preserve and the factors that negatively affect this water body, including effects of upland drainage areas, which include the DR/GR area.

## **6.2 Estero Bay: State of the Bay Update- May 2004**

### **Estero Bay Agency on Bay Management**

**Sponsor / Publishing Agency: Southwest Florida Regional Planning Council**

**Applicability to the DR/GR: The study area covers the entire DR/GR.**

**Conclusions not specific to DR/GR lands.**

The Estero Bay State of the Bay Update (2004) provides an update to the 2000 State of the Bay Report and focuses on water quality and wildlife status and trends within the Estero Bay and associated watershed. The study area and its relation to the DR/GR area are the same as the 2000 State of the Bay Report discussed above. Based on 2001 Florida Department of Environmental Protection water quality data, much of the DR/GR area is impaired for dissolved oxygen. The report identifies surface waters in the southern portion of the DR/GR as impaired for chlorophyll-a (an indicator of nutrient levels) and copper. Analysis of Florida Fish and Wildlife Conservation Commission data indicates negative trends in the number of red-cockaded woodpeckers and number of wading bird and brown pelican rookeries; extinction of the Florida scrub jay from the Estero Bay basin; positive trends in number of bald eagle nests from 1995-1999; and varying sources of negative impacts to gopher tortoise habitat from 1999-2003. A number of other negative trends such as altered hydrology resulting from a variety of intensified land use activities are discussed. A number of Estero Bay Agency on Bay Management recommendations regarding these trends are listed and discussed. The majority of these recommendations are relevant to land use and regulatory decisions within the DR/GR area. They include recommendations regarding zoning and variances, land management and acquisition, vegetation (mostly pertaining to planting of native vegetation, eradication of invasive vegetation, and the importance of isolated and seasonal wetlands), consideration to historic topography, including flow ways, new construction guidelines, biological controls as preferred methods of mosquito control, incentives for ecologically sensitive agriculture, effects of urban areas on the Estero Bay watershed, and guidance for future roadways.

**7. Lower Charlotte Harbor Reconnaissance Report - 2005**  
**Prepared by the Charlotte Harbor National Estuary Program**

**Sponsor / Publishing Agency: Charlotte Harbor National Estuary Program**

**Applicability to the DR/GR: The report covers areas larger than the DR/GR area; conclusions not specific to the DR/GR lands.**

The Lower Charlotte Harbor Reconnaissance Report is a review and summary of existing information about the Lower Charlotte Harbor system in accordance with the Surface Water Improvement and Management program authorized by the State of Florida (F.S. 373.453). This document will be used by the South Florida Water Management District to develop the Surface Water Improvement and Management plan and includes a list of actions to be implemented to maintain and improve the water body. The study area includes a number of watersheds and is very large compared to the DR/GR area. This report includes extensive background information regarding a range of natural resources in the region. In general it was concluded that the Lower Charlotte Harbor area is an area that has experienced widespread growth in recent years. This growth is projected to continue into the foreseeable future. Surface waters in the DR/GR and the water bodies into which these waters discharge have been listed by the Florida Department of Environmental Protection as an area where water quality standards are not obtained. The study area is subject to many layers of government regulation. There are a number of existing programs currently being implemented by a variety of federal, state, regional, and local agencies and non-profit organizations within the study area to evaluate and manage the impacts of growth through research, planning, and regulatory measures. The study emphasizes the importance of making a concerted effort to coordinate these programs in order to maximize efficiency and reduce overlap.

**8. Water Quality Data Analysis and Report - August 27, 2003.**  
**Janicki Environmental, Inc.**

**Sponsor / Publishing Agency: Charlotte Harbor National Estuary Program**

**Applicability to the DR/GR: The report provides data for Estero Bay, which is the receiving water for lands within the DR/GR and the associated Estero Bay Watershed, in which most of the DR/GR is located.**

This report compiles initial data sets for surface and ground water quality, hydrology, and rainfall. The data are reviewed and the data sets that meet the project criteria for availability, documentation of metadata, and quality control are provided.

The report prepares a summary of the data sets that meet the project criteria and will be used in the analysis of water quality status and trends. Analyses of temporal water quality variations (changes and trends) in the study area are conducted.

Potential drawbacks to this report are that there may be a data bias in that most of the data may have been collected in areas that have been impacted, and the report utilizes very few groundwater and surface water data points within the southern DR/GR.

The document is a review of water quality monitoring data collected from 1980 to 2000. Data sets for surface water quality, groundwater quality, hydrology, and rainfall were compiled and analyzed for the purposes of prioritizing areas of the estuary for improvements, identifying conditions that threaten habitats or provide opportunities for habitat enhancement, identifying water quality responses to sources of pollution in support of source reduction efforts, identifying impacts to freshwater inflows and salinity regimes, providing background scientific results for incorporation into public education materials, and providing a statistical framework for future monitoring of the effectiveness of management actions.

The study area includes many watersheds and is relatively large compared to the DR/GR area. The Estero Bay watershed (in which most of the DR/GR is located) is at the southernmost part of the study area. The DR/GR area and the tributaries into which the DR/GR area drains, especially the southern area of the DR/GR, are relatively underrepresented in this report.

Estero Bay tributaries show declining trends in surface water quality, especially for nutrients, dissolved oxygen, and turbidity. According to the report, "Many of the water quality changes in these areas were characterized as declining water quality. These results do not indicate directly that changes in stream flow were the primary reason for the changes in water quality, but the results do present a coincidence over the years of changes in stream flow timing and volume with changes in surface water quality. Other potential sources of surface water quality declines include increased pollutant loading from non-point sources in the watershed, point sources, and or atmospheric deposition."

No trend in the rainfall data was detected. Rainfall varied from year to year and was predictable throughout the year. Changes in water quality can not be attributed to changes in rainfall alone. Stream flow data indicate that many alterations to the hydrology have

occurred in the tributaries of the Estero Bay watershed, in which most of the DR/GR is located. There were not enough ground water samples to do large regional evaluations. There was however enough sampling to indicate problem areas – for instance, the primary fluoride standard was frequently exceeded in the Floridan Aquifer in the Estero River portion of the Estero Bay basin.

**9. How much is enough? Landscape-scale Conservation for the Florida Panther - February 2005**

**Randy Kautz (FWC), Robert Kawula (FWC), Thomas Hoctor (Univ. of Florida), Jane Comiskey (Univ. of Tennessee), Deborah Jansen (Big Cypress National Preserve), Dawn Jennings (USFWS), John Kasbohm (USFWS), Frank Mazzotti (Ft. Lauderdale Research and Education Center), Roy McBride (No affiliation information given), Larry Richardson (USFWS), and Karen Root (Bowling Green State University)**

**Sponsor / Publishing Agency: Science Direct – Biological Conservation/ELSEVIER**

**Applicability to the DR/GR: All DR/GR lands are within the study area.**

This scientific study was conducted by a team of wildlife biologists from government agencies and academia to review and analyze existing information regarding Florida panther telemetry and habitat data to guide implementation of recovery actions for this species. The authors used compositional and Euclidean distance analysis (two of many statistical techniques used to analyze data, which include clustering and fragmentation issues) to identify regions of south Florida that are of value to support a self-sustaining population and create a model of important landscape components. The model was used in combination with radio telemetry data, home range overlaps, land use/land cover data, and satellite imagery.

The authors concluded that much of the DR/GR area is primary habitat for the Florida panther. This primary zone has been identified as “essential to the long-term viability and survival of the Florida panther.” The DR/GR lands also contain secondary habitat which is not as high quality for Florida panthers and not utilized as heavily but could still provide resources for Florida panthers, especially where environmental restoration or enhancement could be implemented. The DR/GR also includes areas identified as “least-cost” paths most likely to be taken by Florida panthers dispersing out of South Florida. This dispersal could provide genetic intermixing between future sub-populations which could increase long-term species viability. The authors recommend that any proposed activities within the primary

zone should achieve no net loss of landscape function and should avoid reduction of aerial extent of habitat, degradation of habitat, further habitat fragmentation, and changes in land use moving along a gradient from natural conditions to pasture, to urban.

**10. Closing the Gaps in Florida's Wildlife Habitat Conservation System (Gaps Report) - 1994**  
**James Cox, Randy Kautz, Maureen MacLaughlin, and Terry Gilbert, Florida Fish and Wildlife Conservation Commission (Formerly Florida Game and Fresh Water Fish Commission)**

**Sponsor/Publishing Agency: Florida Fish and Wildlife Conservation Commission - Florida Marine Research Institute – Florida Department of Environmental Protection**

**Applicability to the DR/GR: The study area covers DR/GR lands as well as the entire state.**

Although the originally published maps regarding aerial extent of vegetation cover, wildlife habitat, and wildlife distributions have been updated extensively since the publication of this report, it remains an important planning document in terms of conserving scarce government resources and taking a proactive approach to land use planning and acquisition issues. This study was conducted to assess the habitat conservation needs and identify lands that must be preserved to meet the long-term habitat needs of Florida's flora and fauna using a focal species approach, to identify areas important to several globally endangered species of plants and animals, to identify regional areas of high biological diversity "hot spots", and to focus on-going land conservation efforts where they will provide the most protection to Florida's biodiversity. The report presents findings regarding these topics and extensive introductory material discussing why it is important to preserve Florida's biodiversity in terms of economic issues, public opinion, and factors not as easy to quantify, such as aesthetics. The report also includes extensive summaries of many topics relevant to wildlife and conservation biology.

The authors concluded that existing conserved lands are not adequate to protect Florida's biodiversity and recommended that future land acquisitions should target key areas identified in studies. These areas are available in regional scale and are updated periodically. Agencies wishing to use this information should contact the Florida Fish and Wildlife Conservation Commission for most up-to-date information. They also recommend that land identified as high priority can be most effectively protected through acquisition or through conservation easements and land-use agreements. Although outright acquisition is considered to be the



best way to assure protection, it is noted that the area needed to sustain the populations of Florida panther and black bear alone would consume all the funds currently available for land acquisition. The document includes a summary of recommendations developed for each of the focal species.

## **11. Southwest Florida Feasibility Study**

### **11.1. Southwest Florida Feasibility Study: Feasibility Scoping Meeting Documentation- Nov. 2005 US Army Corps of Engineers (Corps) – Jacksonville District – South Atlantic Division**

**Sponsor / Publishing Agency: South Florida Water Management District  
Applicability to the DR/GR: The areas studied in this report cover all of the DR/GR.**

This report is a regional plan of action to address the health of aquatic and upland ecosystems; the quantity, quality, timing, and distribution of water flows; agricultural, environmental, and urban water supply; the sustainability of economic and natural resources; flood protection; fish and wildlife; biological diversity; and natural habitat.

The report presents selected models for hydrologic, water quality, salinity, and coastal mixing modeling purposes, as well as the Southwest Florida management measures.

This study covers a large area in comparison to the DR/GR lands and for information regarding natural resources it can be difficult to evaluate the DR/GR area on the maps, because the maps are based on large cell sizes (i.e., 20 acres for the vegetation map).

### **11.2. The Caloosahatchee Conceptual Model - May 22, 2006**

**Tomma Barnes, South Florida Water Management District and Mark Salvato, U.S. Fish & Wildlife Service**

**Sponsor / Publishing Agency: South Florida Water Management District**

**Applicability to the DR/GR: The report covers Caloosahatchee River watershed, adjacent to the DR/GR lands (No map of Caloosahatchee River watershed).**

This report describes the study area to understand how this system responds to stressors, to improve management decisions.

For Caloosahatchee River watershed the ecological stressors are: altered hydrology and freshwater flow; habitat alteration and loss; changes in water quality and increased sediment contaminants; and boating and fishing.

The ecological attributes identified as indicators of biological/ecological stress are: submerged aquatic vegetation, oyster bar, mesohaline benthic community (organisms living in the bottom substrates of moderately brackish water bodies), fisheries, manatee, shoreline, algal blooms and wading birds community structure and function.

The ecological effects are: loss of shoreline habitat and function, altered salinity regime, increased manatee mortality, decrease of submerged aquatic vegetation, increased nutrients and contaminants, changes in sediment, and decrease of fish populations.

The report also presents a summary of water quality assessments in the Caloosahatchee Estuary, San Carlos Bay, Pine Island Sound and Matlacha Pass. The Florida Department of Environmental Protection classified three water bodies in the Caloosahatchee Estuary and Lower Charlotte Harbor as potentially impaired based on chlorophyll-a, dissolved oxygen, fecal coliform, copper, lead, and or biology. The report presents the S-79, Shell Point, and San Carlos Bay freshwater inflow limitations to maintain salinity in the targeted ranges.

### **11.3. The Big Cypress Conceptual Model - May 22, 2006**

**Art Roybal, U.S. Fish and Wildlife Service**

**Sponsor / Publishing Agency: South Florida Water Management District**

**Applicability to the DR/GR: Report covers Big Cypress region, adjacent to the DR/GR lands (No map of Big Cypress Basin).**

This report describes the study area to understand how this system responds to stressors, to improve management decisions.

For the Big Cypress region, the ecological stressors are: development for agricultural and residential use, which will not only cause habitat loss on the affected lands, but also fragmentation of the habitat mosaic.

For the Big Cypress region the ecological attributes are: vegetation community gradients and habitat mosaic; breeding birds (including red-cockaded woodpecker); aquatic fauna; wood stork and wading birds; Florida panther and prey.

The ecological effects are:

- 1) for vegetation community gradients and habitat mosaic: relationship of vegetation to reduced hydrologic regime; to habitat loss and fragmentation; to exotic plant invasion; to exotic hog impacts; to fire; and to nutrient inputs;
- 2) for wetland aquatic fauna: relationship to habitat loss; to hydroperiod; to exotic fishes; to health of aquatic fauna to environmental contaminants; and relationship of macroinvertebrate and herpetofauna (reptile and amphibian) populations to controlling variables and functional importance.
- 3) for wood stork & wading birds: relationship of wood stork nesting to density, size structure and seasonal concentration of marsh fish populations
- 4) for Florida panther: relationship of Florida panther population to habitat loss and fragmentation; and relationship of Florida panther health to bioaccumulation of environmental contaminants.

Florida Department Of Environmental Protection indicates that three water bodies influencing water quality within the Big Cypress Swamp are potentially impaired for dissolved oxygen, fish consumption (for mercury), cadmium, and copper in the Tamiami Trail; dissolved oxygen and nutrients in the L-28 Interceptor, and dissolved oxygen in the L-28 Gap.

**11.4. The April 2006 Scoping Letter – April 27, 2006**  
**Marie G. Burns, Chief, Environmental Branch**

**Sponsor / Publishing Agency: Department of the Army, Jacksonville District Corps of Engineers, P.O. Box 4970, Jacksonville, FL 32232-0019**

**Applicability to the DR/GR: The SWFFS study area covers approximately 4,300 square miles including all of Lee County (including DR/GR lands east of Interstate 75), as well as other nearby counties.**

This letter announces the initiation of the US Army Corps of Engineers Southwest Florida Feasibility Study, which represents a more recent and more localized phase (with respect to Lee County DR/GR lands) of the study described in the 1999 South Florida Feasibility Study report. The objective of the Feasibility Study is to develop a comprehensive regional plan for addressing water resource problems and opportunities. The study will develop and evaluate alternative plans and recommendations for structural, non-structural, and operational modifications and improvements in the region. The study will compile information on and consider a wide variety of environmental factors and issues including: restoration of estuarine, aquatic, wetland and upland ecosystems; water flows; future agricultural, environmental, and urban water demand and supply; socio-economic resources; aquifer recharge; conversion of public conservation lands to water storage areas; water quality; impacts to the estuaries; flood protection; land acquisition; fish and wildlife resources; impacts to protected species; cultural resources; fragmentation and/or loss of habitat; and other impacts identified as the study progresses.

**11.5. The Project Component Map - September 19, 2006**  
**US Army Corps of Engineers**

**Sponsor/Publishing Agency: Department of the Army, Corps of Engineers**

**Applicability to DR/GR: The study covers 4300 square miles including all of Lee County, including DR/GR lands east of Interstate 75.**

The Southwest Florida Feasibility Study area covers approximately 4,300 square miles including all of Lee County (including DR/GR lands east of Interstate 75), as well as other nearby counties. This map was prepared to show the location of feasibility study components in southwest Florida including Lee County. Certain of the designated (yellow-colored) areas on this map show the location of feasibility study components within the DR/GR lands of southeast Lee County.

This map, which is useful in depicting the location and geographic interrelationships of the planned components of the Southwest Florida Feasibility Study, was designed to accompany other documents that describe the study area and feasibility study components.

#### **11.6. The Comprehensive Everglades Restoration Plan System-wide Performance Measures - April 27, 2006** **Comprehensive Everglades Restoration Plan**

**Sponsor / Publishing Agency: Central And South Florida Project**  
**Applicability to the DR/GR: Covers Caloosahatchee Basin**

This report identifies and documents the specific set of system-wide performance measures (PM) developed by the RECOVER technical teams to date, and reviews the processes for developing and revising performance measures. The report also describes the application of performance measures in Comprehensive Everglades Restoration Plan planning and some of the uncertainty associated with this application. To fully understand the performance measures and how they are to be properly used, the document discusses the scope and purpose of performance measures, history of PM development, criteria for choosing performance measures, detailed review process for new and revised performance measures, the place of performance measures in the Comprehensive Everglades Restoration Plan Adaptive Management Strategy, connection between performance measures and other aspects of the Comprehensive Everglades Restoration Plan Adaptive Management Strategy (i.e., Monitoring and Assessment Program, interim goals and targets), simplification of conceptual ecological models for application to the Comprehensive Everglades Restoration Plan and how performance measures relate to these models, application of performance measures in evaluating alternative plans and assessing system response to Comprehensive Everglades Restoration Plan implementation, and uncertainty associated with using performance measures. A documentation sheet is provided for performance measures, which are organized into six categories: four physiographic regions (Lake Okeechobee, Northern Estuaries, Greater Everglades Wetlands, and Southern Estuaries), the total system, and water supply and flood protection of urban and agricultural areas.

**11.7. The Greater Everglades Wetlands Conceptual Ecological Model –  
March 16, 2006  
Comprehensive Everglades Restoration Plan**

**Sponsor/Publishing Agency: South Florida Water Management District**

**Applicability to DR/GR: The study reports on wetlands which could influence DR/GR lands.**

This report (or section of the report) describes the Greater Everglades Wetlands' Conceptual Ecological Models. The study covers many wetlands in South Florida including the wetlands near Lake Okeechobee which could influence the DR/GR lands downstream. The various conceptual ecological models used by the Comprehensive Everglades Restoration Plan to describe the Greater Everglades Wetlands are discussed. The Comprehensive Everglades Restoration Plan has designed projects to improve certain ecological aspects of the study area based on the ecological models described in this report. Performance measures used to track the progress and success/failure of Comprehensive Everglades Restoration Plan projects on restoring the Greater Everglades are listed.

**11.8. The Northern Estuaries Conceptual Model - March 16, 2006  
Comprehensive Everglades Restoration Plan**

**Sponsor/Publishing Agency: South Florida Water Management District**

**Applicability to DR/GR: The Caloosahatchee Estuary is within Lee County and alongside DR/GR lands.**

This describes the Northern Estuaries' Conceptual Ecological Model. The various conceptual ecological models used by Comprehensive Everglades Restoration Plan to describe the Northern Estuaries are discussed. Comprehensive Everglades Restoration Plan has designed projects to improve certain ecological aspects of the study area based on the ecological models described in this report. Performance measures used to track the progress and success/failure of Comprehensive Everglades Restoration Plan projects on restoring the Northern Estuaries are listed.

**11.9. The Caloosahatchee Estuary Salinity Envelope - September 9, 2005**

## **Comprehensive Everglades Restoration Plan**

**Sponsor/Publishing Agency: South Florida Water Management District**

**Applicability to DR/GR: Proximity of Caloosahatchee Estuary to DR/GR lands.**

One of the Comprehensive Everglades Restoration Plan performance measures on the Northern Estuaries is the Caloosahatchee Estuary Salinity Envelope. This performance measure is described in this paper. Various ways of controlling and monitoring the salinity envelope are described – i.e. controlling the inflow to the estuary would control the salinity fluctuations caused by large influxes of fresh water. It is suggested that the salinity of the estuary be monitored through measurements of the valued ecosystem components, such as tape grass or American oyster.

### **11.10. NE-7 Caloosahatchee Estuary Nutrient (TP and TN) Loading and Concentration - September 9, 2005 Comprehensive Everglades Restoration Plan**

**Sponsor/Publishing Agency: Comprehensive Everglades Restoration Plan**

**Applicability to DR/GR: Lands can be affected by estuary.**

The purpose of this report is to describe the Caloosahatchee Estuary Nutrient Loading and Concentration performance measure as defined by the Comprehensive Everglades Restoration Plan. Nutrients, total phosphorous (TP) and total nitrogen (TN), will be used as performance measures for determining the effectiveness of the Comprehensive Everglades Restoration Plan projects. Target load reductions are suggested to meet Florida Estuary median values for TP and TN in the upper estuary. Comprehensive Everglades Restoration Plan projects that will be constructed upstream from the estuary may also affect water quality nutrient loads to the estuary. TP and TN must be measured to determine if the projects are improving or degrading water quality.

### **12. The South Florida Multi-species Recovery Plan - May 18, 1999**

## **U.S. Fish and Wildlife Service**

**Sponsor/Publishing Agency: U.S. Fish and Wildlife Service**

**Applicability to DR/GR: Study covers all of South Florida including Lee County and DR/GR lands.**

This document includes a plan to aid in the recovery of 68 listed species (including State of Florida listed species) through the landscape-level restoration of natural ecological communities throughout South Florida in ways that will optimize benefits to the greatest number of species. It includes recovery criteria, actions needed to achieve recovery plans, and estimates of costs of recovery implementation. The report includes a section listing important ecological communities (a group of plants and animals that occur together in an area and interact with each other) such as pine flatwoods, cypress swamps, and wet prairies; and a discussion of how each of these communities interact with one another to provide the habitat that is crucially important to support Florida's diversity of plant and animal species. The document includes input from a diverse team of government, conservation agency, industry, and academic members.

The authors conclude that many listed species are habitat limited. For these species, limiting factors are similar and include upland and wetland habitat loss, fragmentation, and degradation resulting from urbanization and other land-use conversions, wetland drainage and alteration of hydrology, invasion of exotic species, fire suppression, soil subsidence, and increased levels of contamination. These are all issues pertinent to land use decisions within the DR/GR area and are discussed in greater detail in Section 2 of this document. They found that for some species, including the Florida panther, recovery will require more suitable habitat than currently exists. The document includes a summary of plans to form the Multi-Species/Ecosystem Recovery Implementation Team to coordinate implementation of the Multi-Species Recovery Plan. This will be accomplished through an adaptive management approach focusing on multi-agency coordination. The Multi-Species/Ecosystem Recovery Implementation Team was formed as planned and was instrumental in the development of the draft implementation schedule (published in the Federal Register, April 2, 2004) and final implementation schedule (published in the Federal Register, March 26, 2007) of the Multi-Species Recovery Plan.

### **13. County Road 951 Project Development & Environmental Study Wetland**



**Evaluation and Endangered Species Reports. Assessments of wetland and environmental resources within the right-of-way of proposed highway alignments. - July 2006**

**Quest Ecology, Inc. in association with Dyer, Riddle, Mills & Precourt, Inc.**

**Sponsor/Publishing Agency: Lee County Department of Transportation**

**Applicability to DR/GR: Study area overlaps with DR/GR and includes the southern part of the DR/GR lands.**

These studies were conducted to evaluate the impacts of the proposed extension of County Road 951 on wetlands and endangered species. This information was gathered to aid in determining type, design, and location of the proposed extension. The study area includes the southeastern portion of the DR/GR area and extends south. It includes a delineation of wetlands within the study area in accordance with State of Florida and U.S. Army Corps of Engineers rules. Wetland quality was assessed using the Wetland Rapid Assessment Procedure, a wetland assessment method developed by the South Florida Water Management District to track compliance of permitted wetland mitigation projects.

The study area consists of a mosaic of upland and wetland habitats including a variety of ecological communities (a group of plants and animals that occur together in an area and interact with each other). Federal and State wildlife species listed as threatened, endangered, or of special concern (listed species) observed in the study area during field surveys include Big Cypress fox squirrels, wood storks, gopher tortoises, and American alligator. Listed species identified as using the study area based on a literature search and input from wildlife experts include Florida panther, Florida black bear, and Eastern indigo snake. Agency correspondence is included with the document which suggests that the following species should also be considered to be likely to occur within the study area: swallow-tail kite, American crocodile, burrowing owl, red cockaded woodpecker, and Florida mastiff bat. No federally listed plant species were observed. State-listed plant species observed within the project area were cinnamon fern, royal fern, bromeliads, giant wild pine, stiff-leaved wild pine, and inflated wild pine. Based on the information provided in the report, these plant and animal species could be expected to occur within the DR/GR area.

**14. South Lee County Watershed Plan– July 1999**

**Johnson Engineering, Inc., Agnoli, Barber & Brundage, Inc., Boylan Environmental Consultants, Inc.**

**Sponsor / Publishing Agency: South Florida Water Management District, Contract C-8812.**

**Applicability to the DR/GR: Report includes all of the southern DR/GR.**

This report describes the southern Lee County flood event of summer 1995. The study identifies the problems associated with "piecemeal" permitting, not integrating the potential effects of developments, and not recognizing the cumulative effects of developments on the entire resources of the watershed (e.g., ecological, groundwater, surface water runoff).

Basin boundaries have been changed through development and man-induced activities (e.g., berms, ditches, roads, housing developments). Results of changes are a constriction of flow and re-routing of sheet flow (e.g., culverts under US 41 and I-75). An additional and significant result of the changes induced within the basin is that under high rainfall periods, the basin boundaries overlap and existing flow structures cannot handle the flow, resulting in flooding.

### **3.2 Supplemental DR/GR Documents**

Prior to and during the review of the 14 primary documents, the project team was provided with a number of other documents relating to Lee County land use planning and/or the resources within, and management of DR/GR lands. These documents provided background information that was valuable in providing context for the review. Brief summaries of these documents are presented below. Because these documents were provided for reference, and were not subjected to the full review and summary process, summary forms for these documents are not prepared for inclusion in Appendix D.

### **Origins and History of DR/GR, last updated June 2003**

The Origins and History of the DR/GR is a binder of state mandates, settlements, ordinances, and other documents compiled by Lee County staff to record the history of the Density Reduction/Groundwater Resource Lands from 1984 through June 2003.

## **Arnold Committee Report and Recommendations – October 1996**

In 1991-92 the Florida Board of Regents, through a siting process, selected a site in southeast Lee County for the new Florida Gulf Coast University campus. Federal agencies and challengers to the permits that were to be issued for the site raised concerns about the direct and secondary impacts of construction on sensitive on-site and off-site natural resources. Negotiations over permit issuance led to the creation of the Arnold Committee and an assessment of overall land uses and natural system, environmental protection, and mitigation tools for this area of Lee County.

One of the major purposes of the Committee report was to identify key information needs that should guide growth and development. By identifying ongoing studies, and suggesting additional information that should be collected or considered in planning for sustainable growth, the Committee provided a forum to discuss many DR/GR issues in Southeast Lee County and Estero Bay.

The Committee's report appears to attempt to take a consensus-building or middle ground approach, recognizing that growth may continue in some manner in this portion of Lee County, but arguing that growth should occur in a coordinated program of sustained resource management that attempts to maintain connections and a balance between public and private needs. This report mentions the Lee County Comprehensive Plan, the "Closing the Gaps" study, and numerous other plans. In mentioning these documents it is neither consistent nor inconsistent with them, but demonstrates the interconnectedness of Lee County's guidelines, management agencies, scientific studies, and planning efforts.

## **The Seventh Annual Ecological Monitoring of the Corkscrew Wellfield, Lee County Florida**

*The Seventh Annual Ecological Monitoring Report for the Corkscrew Wellfield Lee County, Florida* documents the ecological monitoring performed near the Corkscrew wellfield in Florida in 2002. Invading grasses that were thought to have been removed with herbicide the year before were found in the study areas. More herbicide was recommended to remove them. The exotic melaleuca plant was also observed in the monitoring; it is unknown whether the implemented remedy for the melaleuca plant will work. No analysis of correlation between pumping and vegetation was performed.

### **Green Meadows Wellfield 2005 Annual Ecological Monitoring Report**

The *Green Meadows Wellfield 2005 Annual Ecological Monitoring Report* documents the ecological monitoring performed in wetlands near the Green Meadows Wellfield. Monitoring is conducted annually in May and October with a report published at the end of each year. The monitoring is conducted to determine and/or track the influence on nearby wetlands of pumping the surficial aquifer. Based on observations made in May and October, a “prevalence index” is calculated using the frequency of occurrence of several categories of wetland and upland species. Correlation between the “prevalence index” and rainfall and between the “prevalence index” and pumpage at the wellfield was examined and an R-squared value was computed. Both R-squared values calculated for 2005 are 0.31, indicating low correlation. With respect to pumping of the wellfield, the low R-squared value reaffirms (as has been noted in the past) that there is little correlation between the amount of surficial aquifer groundwater withdrawals and the prevalence index for the ecological species examined. The health of the wetlands is reported as good, and the report concludes that pumpage from the wellfield does not appear to have adversely affected onsite wetlands at the Green Meadows Wellfield to date.

### **Lee County Utilities Pine Woods Wellfield Monitoring Report**

The *Lee County Utilities: Pine Woods Wellfield Monitoring Report* documents the ecological monitoring performed near the Pine Woods Wellfield in May of 2006. Several years before this monitoring event, melaleuca was removed from most areas and still show signs of its removal; this removal opened the canopy which is now being replaced by native species. Human influence can be seen/inferred through damage to the fence and from human collectors of arboreal bromeliads. “With control of access and melaleuca regeneration, the vegetation system remains in dynamic ecological equilibrium.”

### **Lee County Future Land Use Map**

The Lee County Future Land Use Map was developed by the Lee County Department of Community Development and approved by the Florida Department of Community Affairs as a planning tool for growth and development through the year 2020.

### **Lee County Flow Ways Map**

The Lee County Flow Ways Map was compiled as part of the 2005 Groundwater Resources and Mining Study to illustrate historic and current (circa 2005) water flow ways throughout Lee County.

### **Lee County Conservation 20/20 Map**

The Lee County Conservation 20/20 Map illustrates the status of land acquired or suggested for acquisition by Lee County Government to preserve environmentally sensitive land through the county's tax-supported willing sellers program.

### **Florida Natural Areas Inventory Database**

The Florida Natural Areas Inventory (FNAI) is an office of the Florida State University Institute of Science and Public Affairs. The Florida Natural Areas Inventory is dedicated to gathering, interpreting, and disseminating information pertaining to Florida's biological diversity. The Inventory includes occurrences of rare plants and animals and high quality natural communities that provide habitat for these plants and animals. The Inventory is continually updated by staff. This information is used by public agencies, private firms, and citizens as a tool for public decision-making and education.

#### **4.0 Key Features of Lee County DR/GR Lands**

This section presents the key environmental features of DR/GR lands that were identified during the review of the various studies. Many of these features were identified in several of the studies, indicating by their commonality that they are generally recognized as being important to the proper management of resources or mitigation of problems within DR/GR lands.

At the outset of the review, the project team was aware that the DR/GR lands were designated to achieve (1) density reduction and (2) protection of groundwater recharge and resources. What has become clear during our review is that the lands are also important because of their (3) ecological resources (wetlands, uplands, plant and animal species listed as threatened, endangered or of special concern by federal or state agencies, habitats, biodiversity hot spots, etc.). The lands are also very important because of their (4) surface water hydrology features, primarily flow ways. Finally, the DR/GR lands are not only important on a piecemeal basis for the particular resource that might exist in a parcel, but because (5) the lands support overall landscape integrity due to an extensive, interconnected mosaic of habitats, allowing for wildlife range and migration corridors, interconnected flow ways that interlink wetlands and differing habitats and connect the land to nearby coastal ecosystems.

The following sections describe the various factors that were identified during this review of existing studies as imparting to the Lee County DR/GR lands their special character.

##### **4.1 Density Reduction**

As the name implies, a primary motivation for the designation of DR/GR lands was to provide a mechanism to reduce or manage residential population density within the County. DR/GR lands are still important for that reason. By one agency's estimate, Lee County's population is projected to grow steadily and reach an estimated 979,000 by the year 2030, increasing the population density of 649 to 1,127 persons per square mile (Florida Bureau of Economic and Business Research 2006). Maximum density in the DR/GR area was lowered to one dwelling unit per ten acres when the new land use category was designated in 1990, and remains at that level today.

## 4.2 Groundwater Recharge/Resource

DR/GR lands are important areas within Lee County for groundwater resources. Studies demonstrate that significant amounts of recharge enter the subsurface within DR/GR lands. This recharge feeds underground aquifers which store groundwater and provide flow to well fields that supply Lee County water for public use. A number of the ways in which DR/GR lands are important from a groundwater resource perspective are discussed below.

- Land areas within the DR/GR are recharge areas.

There is agreement among the groundwater-related documents that recharge occurs within the DR/GR land areas. The amount of recharge depends largely upon land use/land cover. Some of the higher-recharge categories are within the DR/GR and include non-vegetated lands, native vegetation areas, and possibly agricultural areas. Recharge could possibly be increased through the elimination of exotic species, such as melaleuca.

- The DR/GR contains areas that have the potential for water supply development.

Lee currently draws a significant portion of its water supply from underground aquifers in the DR/GR area, and Lee County's studies and plans indicate that additional development of water from these aquifers is feasible. An important aspect for the potential for groundwater withdrawals from the water table aquifer is whether a balance between groundwater withdrawals and surface water levels necessary for the maintenance of ecosystem health can be achieved. The development of water supplies from deeper aquifers within the DR/GR is possible as well. Hydrogeology reports reviewed as part of this project contain maps that show aquifer thickness and storage within the DR/GR.

- Development of potential water supplies that may affect the DR/GR water budget must be modeled on a case-by-case basis.

The evaluations must take into account the regional and seasonal impacts of water withdrawals on surface water bodies. The model areas must also be large enough to evaluate potential impacts to flow ways. Additionally, the evaluations must take into account the cumulative effects of all water withdrawals that may affect the water balance within the DR/GR.

- Some of the current Lee County well fields depend on recharge that occurs within the DR/GR.
- Groundwater recharge within the DR/GR directly affects surface water levels.

Surface water is important for sustaining certain DR/GR ecological resources (e.g. wetlands) described in Section 4.3 and in linking DR/GR lands to coastal ecosystems as discussed in Section 4.5. The relatively flat topography within the DR/GR area means that even small changes in aquifer levels can have significant effects on surface water-related habitats and ecosystems as discussed further in Section 4.3.

Additionally, shallow groundwater from the DR/GR may discharge to the Estero Bay area, which currently may be at critical nutrient loading levels. Additional nutrient loading from any sources, including sources of nutrients from within the DR/GR may further damage the resource.

- The quality of surface water runoff and recharge may be declining.

Some studies show that point sources of nutrients may be entering the Estero Bay receiving waters. There is also the possibility of non-point sources of nutrients entering Estero Bay waters. Best management practices for runoff and recharge could reduce nutrient loading.

### **4.3 Ecology**

Lee County DR/GR lands are rich in ecological resources. Ecosystems function and interact to sustain a wide variety of species and habitats. Key ecological features identified during the review are summarized below.

#### **4.3.1 Wetlands**

- There was general agreement among the studies reviewed that wetlands are an important ecological resource within the DR/GR lands.

The Lee County Comprehensive Plan and the Lee County Master Mitigation Plan indicate that Lee County recognizes the important ecological functions of wetlands including: filtration and assimilation of runoff, groundwater recharge, sediment stabilization, flood control, and habitat for wildlife. The other documents reviewed discuss the importance of wetlands in terms of these functions and in the context of a large-scale pattern of interconnected habitat types that is critically important to a wide variety of plant and animal species within the State of Florida.

- The DR/GR area includes many seasonal wetlands. Regulatory and land-use decisions are resulting in inadequate protection of this ecologically important type of wetland.

Three of the documents reviewed – the Lower Charlotte Harbor Reconnaissance Report, the Multi-Species Recovery Plan, and the Estero Bay State of the Bay report make special mention of seasonal wetlands. These wetlands only contain standing water or water at the soil surface for part of the year. Many species of wildlife, including amphibians, reptiles, and mammals are listed by the State of Florida as dependent on seasonal wetlands for survival (obligate). These seasonal wetlands are particularly vulnerable to even small changes in the water table and therefore any hydrologic alteration within the area can have negative effects on seasonal wetlands even in cases



where the footprint of the wetlands is not directly altered.

#### **4.3.2 Native uplands**

- Native uplands within the DR/GR, particularly pine flatwoods, are ecologically important to a large range of plant and animal species. This type of upland was once the most common upland habitat in South Florida but has been extensively impacted.

There is also general agreement among the studies, including those conducted by the U.S. Fish and Wildlife Service (Multi-species Recovery Plan) and the Florida Fish and Wildlife Conservation Commission (Closing the Gaps Report), both of which include extensive input from federal, state, and local government experts, academia, and the private sector, that native uplands are crucially important to the natural resources within the DR/GR area and throughout Florida.

The Multi-species Recovery Plan notes specific areas within the DR/GR that are not currently protected that are also considered to be the “best remaining areas” of pine flatwoods in this section of Florida. This document also notes that attempts to create pine flatwoods have been unsuccessful. However, the DR/GR contains many areas that were historically pine flatwoods that could likely be restored successfully.

#### **4.3.3 Listed species**

DR/GR lands are home to a great number of state or federally listed, endangered, and threatened species (i.e., those plant and animal species listed federally or by the State of Florida as endangered, threatened, or of special concern).

- The DR/GR provides habitat for a variety of state and federally listed plant and animal species

The following list includes plant and animal species likely to occur within the DR/GR area based on the documents reviewed and Florida Natural Area Inventory data regarding locations of plants and animals within the State of Florida.

##### **4.3.3.1 Animals**

###### *Mammals*

- Florida panther

The Florida panther is a wide-ranging mammal for which large, relatively unfragmented areas like the DR/GR lands are critically important. Due to the extremely imperiled status of the Florida panther population, there is extensive quantitative information regarding the importance of habitat to the Florida panther at a level that is not available for other species. One study conducted by a group of scientists from the Florida Fish and Wildlife Conservation Commission, the U.S. Fish and Wildlife Service, and a number of universities focused on specific regions of the South Florida landscape that are of high value to support a self-sustaining Florida

panther population. The investigators developed an ecological model based on telemetry data and habitat locations that allowed them to identify Primary habitat (critically important to a self-sustaining population), Secondary habitat (lands immediately adjacent to Primary habitat but of lower quality with fewer occurrences of Florida panther use), and habitat linkages of importance to the Florida panther. Extensive Primary habitat is located within Lee County, specifically within the DR/GR area. Secondary habitat is also located within Lee County and the DR/GR area. Although some modifications have recently been made to these maps by the U.S. Fish and Wildlife Service, the majority of the DR/GR area is still designated as Primary or Secondary habitat.

- Florida black bear
- Florida mastiff bat
- Big Cypress fox squirrel

#### *Birds*

- Wading birds, including wood stork, white ibis, little blue heron, limpkin, tri-colored heron, snowy egret, great egret, and roseate spoonbill

Habitat fragmentation and hydrologic alterations have resulted in an overall decline in most wading bird species. There has been a particularly dramatic decline in the populations of wood storks, white ibis, tri-colored herons, and snowy egrets (see Estero Bay State of the Bay update). Although large colonies once common to the State of Florida prior to extensive habitat fragmentation are now very scarce, these wading birds still congregate in smaller “ephemeral” colonies. The concentration of birds that occur within these colonies can cause the misleading impression that these birds are widely abundant throughout Florida. However, quantitative wildlife censuses consistently show that, in relation to historic numbers, populations of wading birds have seen dramatic declines.

- Snail kite
- Red-cockaded woodpecker
- Southern bald eagle
- Burrowing owl

#### *Reptiles*

- Eastern indigo snake
- Gopher tortoise
- American alligator

#### *Amphibian*

- Florida gopher frog

#### 4.3.3.2 Plants

- Beautiful pawpaw
- Birds nest fern
- Lattice –vein fern
- Toothed lattice-veined fern
- Cinnamon fern
- Royal fern
- Giant wild pine
- Still-leaved wild pine
- Inflated wild pine

#### 4.3.4 Strategic Habitat Conservation Areas

- The “Closing the Gaps” Report identified many Strategic Habitat Conservation Areas within Lee County. The largest aerial extent of Strategic Habitat Conservation Areas determined to be important to the largest number of species in Lee County is concentrated within the DR/GR area.

The Florida Fish and Wildlife Conservation Commission (formerly the Florida Game and Freshwater Fish Commission) conducted a statewide study of lands that are important to the maintenance of Florida’s biodiversity. Lands recommended in the report for additional protection are referred to as Strategic Habitat Conservation Areas. The development of these Strategic Habitat Conservation Areas was based on extensive wildlife conservation biology and ecological theory and took into account the habitat needs of 30 species of wildlife, high quality and/or rare upland habitats, bat maternity caves, wetlands important to the success of eight species of wading birds, and lands important to the long-term survival of 105 globally rare species of plants. The importance of this research is noted by Lee County in the Lee County Master Mitigation Plan. Note that the maps included in the originally published 1994 study have since been updated.

#### 4.3.5 Biodiversity “Hot Spots”

- The “Closing the Gaps” Report identified many biodiversity “hot spots” within Lee County. The largest aerial extent of Strategic Habitat Conservation Areas determined to be important to the largest number of species in Lee County is concentrated within the DR/GR area.

The Florida Fish and Wildlife Conservation Commission report also includes a separate set of maps, referred to as Regional Biodiversity Hot Spots. These maps were created to display information on a regional level and include information regarding areas where large numbers of species co-occur, areas supporting rare plant and wildlife communities, known locations of rare plants, animals, and natural communities, and coastal areas that support key components of biological diversity. A number of these “hot spots” are

located within Lee County and are concentrated in the DR/GR area. See Appendix D for a more detailed review of this study.

#### **4.3.6 Potential habitat restoration/enhancement areas**

- The DR/GR area includes extensive areas that have been impacted but have good potential to be successful ecological restoration and/or enhancement areas.

The Lee County Master Mitigation Plan recognizes numerous potential habitat restoration sites within the DR/GR lands. Many of the documents reviewed contain information regarding potential restoration areas. These include Florida panther secondary habitat zones and many areas identified as Strategic Habitat Conservation Areas or biodiversity hot spots and/or lands directly adjacent to these areas. There is also extensive potential for these restoration areas to be used to enhance connectivity between existing protected and managed lands within the DR/GR.

#### **4.4 Surface Water Hydrology**

- The groundwater and surface water regimes are interconnected within the DR/GR and groundwater withdrawals, if not properly controlled, would adversely effect wetlands and flow ways.
- Topographic relief within the DR/GR is relatively small. Therefore changes to the topography in the form of even small, low drainage control structures (e.g., low dikes) can have significant and far-reaching effects to the entire drainage basins.
- The construction of drainage control structures has constricted flow to relatively few, small drainage ways and has interrupted the natural sheet flow type of surface water discharge.
- Areas for mitigation of surface water flows have been identified within the DR/GR.
- Nutrient loading of surface waters (or groundwater) within the DR/GR may have an adverse effect on the receiving waters (e.g., Estero Bay).

#### **4.5 Connections**

One of the most important attributes of the DR/GR lands identified in several of the documents selected for review is the concept of spatial continuity and interconnectedness of the resources and processes that exist within DR/GR lands, and which connect DR/GR lands to surrounding ecosystems of importance. Examples of these connections, involving hydrologic processes and ecological systems are presented below.

#### **4.5.1 Landscape mosaic – within the DR/GR lands**

- The DR/GR lands include large-scale (at a minimum of several kilometers in diameter) areas (landscapes) that consist of patches of interconnected, interdependent types of habitats which are repeated in a pattern (mosaic), at a scale that is unique to Lee County. From a natural resource perspective, this feature makes this area important to many wildlife species, especially the wide-ranging species such as the Florida panther, the Florida black bear, and the Eastern indigo snake.
- The DR/GR contains some of the least impacted lands within Lee County and the most contiguous inland habitat. These areas lend themselves to a combination of flow ways, recharge areas, and less impacted groundwater/surface water environments.

The importance of this type of large-scale “landscape mosaic” is a common theme noted in all the documents that pertain to wildlife and habitat. The scale and specific habitat types (e.g. cypress swamps, mesic pine flatwoods, wet prairies, etc.) at which these connections are important varies from species to species, however, the concept of an integrated “landscape mosaic” is thought to be of crucial importance to a wide range of species. For example, the Florida black bear uses many habitat types, such as pine flatwoods, cypress swamps, and mixed hardwood-pine, but may travel to specific locations to feed on palmetto berries in the fall. An interconnected habitat mosaic can also be important to animals with a smaller range. As another example, many species of salamanders cannot complete all phases of their life-cycle without wetlands (in which eggs must be laid) and high-quality uplands (crucial food supply habitat for adults). Therefore, the current practice of preserving small patches of wetlands without adequate attention to the integrity of the larger landscape is resulting in declines in the populations of many species of wildlife.

#### **4.5.2 Contiguous upland habitats**

- The DR/GR contains large stands of ecologically important upland habitats.

The “Ecological Communities” (Section 3) of the United States Fish and Wildlife Service Multi-species Recovery Plan provides a good summary of the ecological importance of the upland habitats that occur within the DR/GR area. For example, the DR/GR contains contiguous stands of mesic pine flatwoods, a habitat type the United States Fish and Wildlife Service considers to be “of critical, regional importance to the biota of South Florida”. Mesic pine flatwoods provide habitat for large carnivores, such as the Florida panther; mid sized animals, such as the fox squirrel; deer (important prey for large carnivores); tree-cavity dependent birds such as the red-cockaded woodpecker; a variety of migratory birds; many reptiles including the black racer, Eastern indigo snake, and box turtle; and many tree-dependent frogs. Mesic pine flatwoods are the principal dry ground areas in South Florida and provide critically important dry areas to a wide range of non-

aquatic animals during floods. Mesic pine flatwoods also contain a wide variety of invertebrate species, a group that has not been extensively studied but is recognized as being biologically important in terms of food chain support. It is thought that the wide diversity of invertebrate species in mesic pine flatwoods occurs due to hydrologic variability, vegetation diversity, and the abundance of small-scale habitat types that are available within the mesic pine flatwoods system.

Mesic pine flatwoods are historically the most abundant upland habitats in South Florida. They have also been impacted at a higher rate than most other habitats and are in danger of becoming one of the rarest habitats. Mesic pine flatwoods are not maintainable nor sustainable in small “postage stamp” parcels.

Page 3-228 of the “Ecological Communities” section of the Multi-Species Recovery Plan identifies the area within the DR/GR between the Corkscrew Regional Ecosystem Watershed and the Southwest Airport Mitigation Lands as an important connecting area for mesic pine flatwoods in terms of conservation of wide-ranging state and federally listed species. Page 3-224 identifies a number of potential land acquisition areas, including Save Our River and Conservation and Recreation Lands proposed acquisition areas associated with the Corkscrew Regional Ecosystem Watershed that are considered to be the “best remaining areas” of mesic pine flatwoods in South Florida.

#### **4.5.3 Inland wetlands**

- The DR/GR contains large areas of inland wetlands.

No quantitative comparisons were made regarding wetlands within the DR/GR area in relation to the rest of Lee County or the rest of South Florida. However, the DR/GR does contain extensive acreage of many different types of wetlands (e.g. – wet prairie, cypress dome, hydric pine flatwoods, mixed hardwood swamp), including the northernmost portion of the 60,000-acre Corkscrew Regional Ecosystem Watershed.

These extensive inland wetlands, in combination with the upland habitats listed above, provide important nesting, roosting, denning, feeding, and refuge area for a diverse range of animal species and allow for the growth and reproduction of a diverse range of plant species.

#### **4.5.4 Coastal zone connection**

- The majority of the DR/GR lands drain via a number of rivers into the Estero Bay, an estuarine system recognized federally as a National Estuary and by the State of Florida as an Aquatic Preserve.
- A combination of both surface water and groundwater that originates within the DR/GR discharges to Estero Bay. Changes in the quality and quantity of groundwater discharge will affect the bay.

As in most systems with interconnected groundwater and surface water systems, a portion of the shallow groundwater within the DR/GR discharges to surface water. Additionally, surface water in some areas of the DR/GR recharges shallow groundwater. Modifications to land cover, drainage basins, surface water and groundwater elevations, and flow ways will affect the balance between surface water and groundwater interactions. Changes to nutrient loading (e.g., fertilization, septic systems) will affect the quality of both the surface water and groundwater resources and downstream receptors of the water (e.g., Estero Bay).

The Estero Bay is home to abundant plant and animal species, including many that are listed federally and/or by the State of Florida as threatened or endangered; including the West Indian manatee, loggerhead sea turtle, Florida panther, bald eagle, big cypress fox squirrel, red-cockaded woodpecker, and snowy plover. Thousands of birds, including the brown pelican, frigate birds, herons, egrets, cormorants, and ibises, use this area for nesting, roosting, and feeding.

- Estero Bay and inland waters, including the riverine systems connecting the DR/GR lands to the Estero Bay, have water quality problems, including low dissolved oxygen, high nutrients (especially as measured by chlorophyll-a), and high levels of copper.

A variety of sources including the South Florida Water Management District, the Florida Department of Environmental Protection, and results of a number of volunteer efforts under way within the Estero Bay area were reviewed. These studies indicate that water quality impairments and the changes in timing and quantity of freshwater entering the estuary have negative effects on a wide variety of plant and animal life, particularly the scagrasses, many invertebrates, and larval fish that are critically important to the maintenance of the area's many commercial fisheries.

- The connection of coastal areas to interior watersheds, and the preservation of interior habitats such as those located within the DR/GR lands, is crucial to some wildlife species.

For example, many wading birds in Lee County and throughout South Florida forage in freshwater habitats during the wet season but concentrate nesting or feeding activities in saltwater wetlands on a seasonal basis or during periods of drought (Estero Bay, State of the Bay Report).

#### **4.5.5 Migratory bird pathways**

- The DR/GR contains habitats that provide important "stopover" locations for migratory birds.

The Multi-species Recovery Plan, the “Closing the Gaps Report, and the Estero Bay State of the Bay Report include discussions of the importance of habitats within the DR/GR lands to birds that migrate between North America and South America (neotropical migrants). Florida is important to many of these birds because of its geographic position between North and South America and its close proximity to the West Indies. Southwest Florida in particular is important to birds that must “refuel” after an extended non-stop flight across the Gulf of Mexico. Although there is general agreement that preservation of habitat along the southwest coast of Florida, especially forested habitat, is important to these birds, none of the studies include quantitative data regarding specific species and amounts of habitat required.

#### **4.5.6 Landscape mosaic – regional**

- The DR/GR lands provide an important “link” in the “chain” of conservation areas throughout South Florida.

The concept of a mosaic of interrelated habitats is also important on a scale that includes external connections between the DR/GR lands and surrounding ecosystems. For example, the range of a male Florida panther can be larger than 100,000 acres. Places like the DR/GR lands and other conservation areas within South Florida can be in part, like a link in a chain, of an interconnected series of important habitats that can adequately serve and protect even these wide-ranging species. The scale at which the documents reviewed have been conducted, many spanning the area of several watersheds or even all of South Florida, are an indication that natural resource managers in South Florida are striving to preserve and restore this type of region-wide habitat connection.

#### **4.5.7 Groundwater Connection**

- Shallow groundwater discharges to surface water and surface water recharges shallow groundwater. Changes in the amounts and quality of either will affect the other.
- Groundwater within the DR/GR discharges to Estero Bay, and changes in the quality and quantity of groundwater discharge will affect the bay.

Effects of changes in quality and quantity on the Estero Bay are not well-measured or understood. There is concern that the many drawdowns for activities such as mining, agriculture, and domestic supplies may have significantly reduced this historic supply of fresh water to the Estero Bay.



## 5.0 DR/GR Maps and Overlays

Lee County has developed and maintains a Geographic Information System; a computer-based system of maps and overlays that depict features of interest within the county. As part of the review of DR/GR study reports, the project review team was asked to identify maps and overlays within the reports that depicted hydrologic and ecological resources or features of particular importance for the County's efforts to manage DR/GR lands. Maps of particular relevance and interest are listed by document in Appendix E.

In addition, the review team prioritized the list of maps to identify maps of particular significance, so that the County could approach the incorporation of the maps into its GIS map base in a phased manner as resources permit. The key maps selected are summarized in the table below.

<b>Primary DR/GR-Related Maps and Overlays for Possible Inclusion in Lee County Geographic Information System</b>			
<b>Page</b>	<b>Fig No</b>	<b>Title/Caption</b>	<b>Environmental Resource/Feature</b>
<b>2. Groundwater Resources and Mining Study</b>			
	VI-3	Location map of wells with lithologic data	Map showing wells in Lee County for which geologic data are available to define the aquifer system. The map depicts the locations of those wells from an initial database of 1,080 wells that fall within the study area plus an additional 629 wells in and adjacent to Lee County that were added specifically for this study.
	VI-4	Digital elevation model interpolated to 500 ft grid	Lee County land surface elevation map.
	VI-5	Contour map of Holocene thickness	Map showing thickness of one of the geologic units (the Holocene unit) that comprise the drinking water aquifer; supersedes previous

			thickness data from Montgomery 1988 report.
	VI-6	Contour map of Pliocene thickness	Pliocene unit thickness.
	VI-9	Contour map of Ochopee thickness	Ochopee unit thickness.
	VI-11	Contour map of Peace River Sandstone thickness	Peace River Sandstone unit thickness.
	VI-13	Contour map of Arcadia thickness	Arcadia unit thickness.
	VI-36	Location map of wells with water level data	Map showing locations of approximately 550 monitoring wells in the study area in which over 280,000 aquifer water level measurements have been recorded.
	VII-24	Location of existing borrow pits	Depicts the location of approximately 329 borrow pits inventoried for this study.
	VII-37	Net recharge to water table average annual season steady state	Map showing zones of recharge to aquifer in Lee County and, in particular, in the DR/GR area.
<b>4. Water Resources Management Project</b>			
	4-5	Water table aquifer wet season total storage	Depicts magnitude of aquifer storage for drinking water supply in millions of gallons per square mile.
	4-50	Groundwater flow – water table aquifer	Shows groundwater flow entering shallow aquifer in DR/GR lands of Lee County from surrounding counties.
	4-51	Groundwater flow – lower Tamiami aquifer	Shows groundwater flow entering lower Tamiami aquifer in DR/GR lands of Lee County from surrounding counties.
	Plate 79	Recharge area for water table	Depicts recharge areas for shallow

		aquifer	aquifer.
	Plate 80	Recharge area for lower Tamiami aquifer	Recharge to lower Tamiami aquifer.
	Plate 81	Recharge area for Sandstone aquifer	Recharge to Sandstone aquifer.
	Plate 82	Recharge area for mid-Hawthorn aquifer	Recharge to mid-Hawthorn aquifer.
	Plate 83	Potential well development areas for public water supply – water table aquifer	Areas in DR/GR lands identified as having potential for development as a water supply in the shallow aquifer.
	Plate 84	Potential well development areas for public water supply – lower Tamiami aquifer	Areas in DR/GR lands identified as having potential for development as a water supply in the lower Tamiami aquifer.
	Plate 85	Potential well development areas for public water supply – Sandstone aquifer	Areas in DR/GR lands identified as having potential for development as a water supply in the Sandstone aquifer.

<b>6.2 Estero Bay – State of the Bay Update 2004</b>			
6-2	8	Estero Verified 2002 303d	This map shows water quality impairments determined by Florida Department of Environmental Protection in relation to sub-basin geography delineated by South Florida Water Management District. (Note: This map is already included in the Lee Master Mitigation Plan document, and so may already be in the County GIS.)
<b>7. Lower Charlotte Harbor Reconnaissance Report</b>			
55	26	Lands in conservation	Public conservation lands

56	27	Conservation easements	Conservation easements under private management
58	30	Identified lands for potential future acquisition	Proposed acquisition lands
<b>8. Water Quality Data Analysis and Report for the Charlotte Harbor National Estuary Program</b>			
8-3	6-14	CHNEP Basins – Southern Coast – Surface – Dissolved Oxygen	Map depicts trends (improving or declining) for measured concentrations of the named constituent (e.g. Dissolved Oxygen) in the indicated surface water zone (Surface or Bottom) in Lee County and particularly in DR/GR lands.
8-4	6-15	CHNEP Basins – Southern Coast – Bottom – Dissolved Oxygen	Same as above.
8-11	6-32	CHNEP Basins – Southern Coast – Surface – Chlorophyll-a (corrected)	Same as above.
8-12	6-35	CHNEP Basins – Southern Coast – Surface – Nitrate + Nitrite	Same as above.
8-13	6-36	CHNEP Basins – Southern Coast – Bottom – Nitrate + Nitrite	Same as above.
8-20	6-49	CHNEP Basins – Southern Coast – Surface – Total Phosphate	Same as above.
8-21	6-50	CHNEP Basins – Southern Coast – Bottom – Total Phosphate	Same as above.
8-26	6-62	CHNEP Basins – Southern Coast – Surface – Fecal Coliform	Same as above.

<b>9. How Much is Enough? Landscape-scale Conservation for the Florida Panther</b>			
120	1	South Florida study area for habitats important to the conservation of the Florida panther	Map of entire Florida panther study area.
128	5	Locations of Primary, Dispersal, and Secondary habitat zones as important lands for conservation of Florida panther	Depicts those areas that the study has determined to be: Primary Zone – areas of suitable habitat that have been consistently occupied by panthers in the past 20 years (Note: these lands are primarily located south of the Caloosahatchee River, with a portion lying in Lee County DR/GR lands); Secondary Zone – adjacent areas that would be most likely to be occupied by an expanding panther population; and Dispersal Zone – areas that would best facilitate dispersal and population expansion.
<b>10. Closing the Gaps in Florida’s Wildlife Conservation System</b>			
53	48	Potential black bear habitat in and around Big Cypress National Preserve	Black bear habitat.
68	65	Proposed Strategic Habitat Conservation Areas for the Florida Panther	Florida panther habitat.
123	141	Overlay of coarse habitat distribution maps for 120 rare species	Rare species habitat.

172	170b	Strategic Habitat Conservation Areas	(Note: A map representing these or similar Strategic Habitat Conservation areas has already been included by the County in the Lee Master Mitigation Plan.)
173	170c	Hotspots of biological resources.	(Note: A map representing these or similar Biodiversity Hotspot areas has already been included by the County in the Lee Master Mitigation Plan.)
<b>11.1 Southwest Florida Feasibility Study – Scoping Meeting November 2005</b>			
6	1	Southwest Florida Feasibility Area boundary	Study area encompassing Lee County and surrounding counties.
83	10	Potential restoration sites in study area	Depicts numerous natural areas in the Southwest Florida region that have been identified as potential sites for ecological and hydrological restoration. All delineated areas have experienced some degree of habitat quality degradation, and most are from a variety of causes. Several of these areas are located in Lee County DR/GR lands.
91	11	Species richness	Map indicates a high degree of biodiversity in Lee County DR/GR lands.
92	12	Biodiversity hotspots	Depicts a concentration of biodiversity hotspots in DR/GR lands. Map includes 44 focal species as well as other factors including globally rare plant species; bat maternity and winter roosting caves; pine rockland

			communities, sandhill communities; scrub communities; tropical hardwood hammock communities; and wetlands important to wading birds.
97	13	Unnatural flows to the coast	Depicts the location and interconnections of surface water drainage canals and flow ways, many of which are in DR/GR lands. Also depicts location of proposed reservoirs planned as mitigation measures.
107	14	Southwest Florida restoration projects (Phase 1)	Depicts areas of grouped management measures (ideas to achieve the planning goals and objectives). The map indicates that projects in Lee County DR/GR lands are primarily in the "Highest Priority" category.
<b>12. South Florida Multi-species Recovery Plan</b>			
3-198	1	Distribution of hydric and mesic pine flatwoods in South Florida (data from USGS-BRD 1996)	Depicts distribution of pine flatwoods (pine barrens) which are of critical regional importance to biota in south Florida. They provide essential forested habitat for a variety of wildlife species via tree canopy, and by serving as the principal dry ground in south Florida. Hydric pine flatwoods are unique to south Florida. This habitat, which seasonally functions as a wetland and an upland, allows for an abundant diversity of plant life and wildlife. Although the scale

			of the map and the delineated land units makes the map difficult to read as presented in the report, it clearly shows pine flatwoods in Lee County DR/GR lands.



## **6.0 Findings, Key Maps, and Conclusions**

The project team reviewed more than two dozen documents relating to environmental resources and issues in southwest Florida in general and in Lee County DR/GR lands in particular. To meet the objectives of the review project, the team identified scientific data and information contained in the documents that provide a description of conditions, processes, species, features, and issues within Lee County's southeastern DR/GR lands. The team also identified in the various studies key maps or spatial data overlays that might be worthy of consideration for eventual incorporation into Lee County's planning Geographic Information System. Finally, the team has identified a number of "data gaps" for which more information might prove beneficial as Lee County continues to formulate land use policy and plans for its DR/GR lands. Summaries of the results of the project team's review are presented in the following sections.

### **6.1 Review Team Findings**

The project team noted that almost all the documents contained information (guidance, requirements, scientific data, issues, mitigation projects) that were directly and specifically relevant to Lee County DR/GR lands. Many of the documents focused specifically on Lee County DR/GR lands; while several studies were conducted at a larger scale that encompassed the DR/GR. Two of the studies, one a study of groundwater and mining in Lee County and the other an engineering report for Bonita Springs DR/GR lands, were commissioned specifically to study the DR/GR lands. Several other investigations encompassed the DR/GR lands within the area of study; for example, a study of the Florida Panther, and certain of the watershed studies.

A number of studies contained valuable information regarding the coastal zone and bay areas to which DR/GR lands are connected through surface water drainage, and groundwater discharge into the near-shore coastal environments. Several other studies provided information on DR/GR lands from the perspective of infrastructure projects (e.g. the County Road 951 project) or mitigation projects currently planned or under way (e.g. certain of the Southwest Florida Feasibility Study documents).

Based on the documents reviewed, the project team identified five categories of attributes or features that give the DR/GR its unique character. These are summarized as follows:

## **6. Density Reduction**

### **1. Reduced residential density in the DR/GR area allows Lee County to meet State requirements.**

The DR/GR land use category was originally created in 1990, in large part, to provide a mechanism for reducing or managing residential population density within the County. With the steady increase in population within the County that has been observed in recent years, and which is projected to continue for the next several decades, this feature of DR/GR lands remains as important today as it was when it was instituted.

## **7. Groundwater Resource/Recharge**

### **2. Groundwater in DR/GR lands is an important source of potable water.**

Lee County relies on groundwater for a significant portion of its water supply from both public utilities and private wells. The County utility system currently provides for approximately 48,000 water customers and has a potable water capacity of approximately 27 million gallons per day. Additional water needs are met by other utility companies and private wells. Projections for future water needs show that the County's utility system capacity will need to increase to 45 million gallons per day by 2020, and additional withdrawals will be met by other utilities and private wells. Water supply development, treatment capacity expansion, conservation, and innovative water supply strategies such as aquifer storage and recovery will need to be utilized to meet that need. These developments will likely call for an increase in groundwater withdrawals to meet demand.

### **3. Recharge at the land surface within the DR/GR supplies water to underlying aquifers.**

Land areas within the DR/GR have been identified as areas in which rainfall seeps into the ground to recharge underlying groundwater aquifers. The amount of recharge depends upon land use and land cover. Some of the higher-recharge land categories in Lee County are located within the DR/GR.

### **4. Groundwater in the DR/GR area acts to sustain important surface water bodies.**

Recharge to aquifers within the DR/GR can act to raise groundwater levels and, because the shallow aquifer is connected to overlying surface water bodies, aquifer recharge can also sustain surface water levels and flows. Surface water is important for sustaining certain DR/GR ecological resources (e.g. wetlands) and in linking DR/GR lands to coastal ecosystems.

**5. DR/GR aquifers are a potential source of new water supply for Lee County.**

Current Lee County groundwater supplies (e.g. Lee County utilities, private wells) depend on recharge that occurs within the DR/GR for their current supply of groundwater. In addition, the DR/GR contains areas that have the potential for new water supply development. However, because pumping of groundwater can lower groundwater levels and diminish surface water flows, a balance between groundwater withdrawals and adequate groundwater and surface water levels must be maintained.

**6. Computer models may serve as valuable tools for managing groundwater resources in DR/GR lands.**

Development of potential water supplies that may affect the DR/GR water budget must be evaluated on a case-by-case basis. Evaluations should take into account the regional and seasonal impacts of water withdrawals on surface water bodies including rivers and wetlands. Quantitative tools such as the computer models of groundwater flow can be used in evaluations of current and proposed groundwater withdrawals.

**7. Mining activities in DR/GR lands may have both positive and negative effects on the natural hydrologic system.**

As pointed out in the recent Lee County groundwater and mining study, mining activities have the potential to impact groundwater in both a positive and negative manner. Positive effects include increased capacity for water storage in the open excavations left behind by mining, and the opportunity to enhance regional storage through design and management of the mining-related lakes. Negative effects associated with mining-related lakes include increased susceptibility to introduce potential contaminants into aquifers and increased water loss due to evaporation.

## **8. Ecology**

### **8. Existing wetlands are important ecological features of the DR/GR lands.**

Lee County DR/GR lands are rich in ecological resources. Ecosystems function and interact to sustain a wide variety of species and habitats. Several studies reviewed identified wetlands as important ecological features of the DR/GR because they provide a host of functions, including: filtration and assimilation of rainfall runoff, recharge of groundwater aquifers, stabilization of sediment carried during storm flows and other surface water flows, hydraulic controls on floodwaters, and habitats for a wide variety of plant and animal species.

### **9. Native uplands are important habitat areas in DR/GR lands.**

Similarly, native uplands are critically important to natural resources within the DR/GR. These areas are often not well-protected by current regulations. The Multispecies Recovery Plan notes specific areas within the DR/GR that are not currently protected, but which are considered to be among the best remaining areas of pine flatwoods in this section of Florida.

### **10. Many state or federally listed or endangered species have been observed or have suitable habitat areas mapped within DR/GR lands.**

DR/GR lands are home to a great number of state or federally listed or endangered species. These include mammals such as the Florida panther, Florida black bear, mastiff bat, and fox squirrel; birds including wood stork, little blue heron, red-cockaded woodpecker, southern bald eagle, and burrowing owl; and several reptiles and amphibian species. Various listed plant species may occur in the DR/GR. These species may include beautiful pawpaw, birds nest fern, and lattice-vein fern.

### **11. DR/GR lands host a rich diversity of plant and animal species.**

It is important to recognize that the DR/GR lands are important not only for the species that have been observed there, but also for the overall diversity of species that the DR/GR lands support. The Florida Fish and Wildlife Conservation Commission conducted a statewide study of lands that are important to the maintenance of Florida's biodiversity, and recommended lands for additional protection that are referred to as Strategic Habitat Conservation Areas. The largest aerial extent of Strategic Habitat Conservation Areas determined to be important to the largest

number of species in Lee County is concentrated within the DR/GR area. The Lee County Master Mitigation Plan embodies the concept of biodiversity areas and has been updating maps to reflect new information obtained for these areas within the County and within DR/GR lands.

The Florida Fish and Wildlife Conservation Commission report also includes a separate set of maps, referred to as Regional Biodiversity Hot Spots. These maps were created to display information on a regional level and include information regarding areas where large numbers of species co-occur; areas supporting rare plant and wildlife communities; known locations of rare plants, animals, and natural communities; and coastal areas that support key components of biological diversity. The “Closing the Gaps” Report shows that there are many biodiversity “hot spots” within Lee County and that they are concentrated in the DR/GR area.

**12. DR/GR lands are prime areas for wetlands mitigation and ecological restoration efforts.**

The studies reviewed indicate that the DR/GR lands include extensive areas that, while they have been impacted, have good potential to be successful ecological restoration and/or enhancement areas. The Lee County Master Mitigation Plan recognizes numerous potential habitat restoration sites within the DR/GR lands. Many of the documents reviewed contain information regarding potential restoration areas. These include Florida panther secondary habitat zones and many areas identified as Strategic Habitat Conservation Areas or biodiversity hot spots and/or lands directly adjacent to these areas. There is also extensive potential for these restoration areas to be used to enhance connectivity between existing protected and managed lands within the DR/GR if the appropriate actions are taken.

**9. Surface Water**

**13. Surface water bodies within DR/GR lands are important hydrologic and ecological features.**

The DR/GR lands were originally designated as groundwater protection areas, but the documents reviewed as part of this project reveal that surface water within the DR/GR lands is also very important for a number of reasons. First, the surface water bodies, whether channelized and flowing continuously, broad shallow and ponded, or active primarily during storm events, are hydrologic features with great significance

for the ecological systems of the DR/GR lands. Wetlands and sloughs are broad, shallow, ponded or slow moving bodies of surface water that provide habitat for a wide variety of plant, animal, and aquatic species.

**14. Flows through the extensive system of channels, sloughs and wetlands within the DR/GR lands can act to remove nutrients, sediment, and contaminants from surface water to lessen impacts to surface water within the DR/GR and in nearby coastal waters.**

In addition, these surface water ecosystems have the capacity (due to the slow rate of flow) to perform a cleaning process to some degree on the water that flows through them. Surface water that flows within the DR/GR ultimately discharges to the waters of rivers, creeks, and bays along the western coastline of Lee County. This means that if the ability of the surface water ecological systems to remove chemicals and nutrients become overwhelmed due to development, agriculture, mining, or other sources of pollution, then not only will DR/GR surface waters be impacted, but also the receiving waters in the coastal ecosystems, including the Estero Bay Aquatic Preserve.

**15. DR/GR surface water systems are important for removing storm waters and reducing flood impacts.**

DR/GR surface waters are also important for reasons related to flooding. Topographic relief within the DR/GR is relatively small. Therefore changes to the topography in the form of even small drainage control structures (e.g., low dikes) can have significant and far-reaching effects on the entire drainage basins or watersheds. Studies have determined that construction of drainage control structures in DR/GR lands has constricted flow to relatively few, small drainage ways. These constrictions have interrupted the natural sheet flow type of surface water discharge and may create point sources of potential nutrient and sediment contamination that can impact receiving waters. Areas for mitigation of surface water flows have been identified within the DR/GR and mitigation projects are planned or under way.

**16. Surface water systems may serve as sources of recharge to groundwater aquifers and well fields.**

Finally, groundwater in the shallow aquifer and surface water that flows in rivers, canals, wetlands, and sloughs are interconnected within the DR/GR. As discussed previously, groundwater withdrawals, if not managed properly, could adversely affect

rivers, wetlands and other surface water flows. Conversely, surface water flows in the DR/GR could serve as a source of recharge to the aquifer system if managed properly. This means that surface and groundwater within the DR/GR must be studied, monitored, and managed together to avoid or mitigate hydrologic and ecological problems.

## **10. Connections**

One of the most important overall attributes of the DR/GR lands is the connections between all of the resources and systems that have been discussed above, and the scale over which these connections operate. Many of these connections have been alluded to in the previous discussions in this section, but the paragraphs below will describe them in more detail and make their importance clear.

### **17. DR/GR lands provide a large contiguous habitat area that is important to wide-ranging species.**

Several of the documents reviewed provided information that made clear the spatial continuity and interconnectedness of hydrologic and ecological systems within the DR/GR lands and between DR/GR lands and surrounding ecosystems. For example, DR/GR lands include large-scale (at a minimum of several kilometers in diameter) areas (landscapes) that consist of patches of interconnected, inter-dependent types of habitats which are repeated in a pattern (mosaic), at a scale that is unique to Lee County. From a natural resource perspective, this feature makes this area important to many wildlife species, especially the wide-ranging species such as the Florida panther, the Florida black bear, and the Eastern indigo snake.

### **18. DR/GR lands contain extensive areas of interconnected wetlands.**

The DR/GR also contains large areas of wetlands. While the studies reviewed provided no quantitative comparisons regarding wetlands within the DR/GR area in relation to the rest of Lee County or the rest of South Florida, the DR/GR does contain extensive acreage of many different types of wetlands (e.g. – wet prairie, cypress dome, mixed hardwood swamp), including the northernmost portion of the 60,000-acre Corkscrew Regional Ecosystem Watershed. These extensive wetlands, in combination with the mosaic of upland habitats described in the environmental studies, provide important nesting, roosting, denning, feeding, and refuge area for a diverse range of animal species and allow for the growth and reproduction of a diverse range of plant species.

**19. DR/GR lands provide important connections to nearby and farther-reaching ecosystems.**

In a similar fashion, because the concept of a mosaic of interrelated habitats is also important on a scale that includes external connections between the DR/GR lands and surrounding ecosystems, the DR/GR lands provide an important “link” in the “chain” of conservation areas throughout South Florida. On an even larger scale, the DR/GR contains habitats that provide important “stopover” locations for migratory birds. The Multi-species Recovery Plan, the Closing the Gaps Report, and the Estero Bay State of the Bay Report include discussions of the importance of habitats within the DR/GR lands to birds that migrate between North America and South America (neotropical migrants). Although none of the studies include quantitative data regarding specific species and amounts of habitat required, there is general agreement that preservation of habitat along the southwest coast of Florida, especially forested habitat, is important to these birds.

**20. DR/GR lands connect in important ways both hydrologically and ecologically to nearby bays and coastal ecosystems.**

Finally, as discussed above, the majority of the DR/GR lands drain via a number of rivers into the Estero Bay, an estuarine system recognized federally as a National Estuary and by the State of Florida as an Aquatic Preserve. The Estero Bay is home to abundant plant and animal species, including many that are listed federally and/or by the State of Florida as threatened or endangered. Estero Bay and inland waters, including the riverine systems connecting the DR/GR lands to the Estero Bay, have water quality problems, including low dissolved oxygen, high nutrients (especially as measured by chlorophyll-a), and high levels of copper. The studies reviewed in this project indicate that water quality impairments and the changes in timing and quantity of freshwater entering the estuary have negative effects on a wide variety of plant and animal life, particularly the seagrasses, many invertebrates, and larval fish that are critically important to the maintenance of the area’s many commercial fisheries. For these reasons, the connection of coastal areas to interior watersheds, and the preservation of interior habitats such as those located within the DR/GR lands, is crucial to some wildlife species.



## **6.2 Key Map Information**

Almost all of the studies reviewed contained maps. These maps supplemented and enhanced each report by presenting in a graphic format the spatial aspect of the data described in the text (e.g., the distribution of up and down arrows spread across the DR/GR area that showed the temporal water quality trends described in the Charlotte Harbor Estuary water quality data analysis report). Maps also quantified in a way the text could not, the exact area being described, the patterns of intensity of a particular feature (for example the color shading denoting the degree of biodiversity determined in each area of the DR/GR), and the adjacency and spatial connections between habitats of a certain type (for example the range of panther habitat; or maps that showed rivers, flow ways, and impacted unnatural flows (i.e. canals) draining from DR/GR lands to the coastal waters).

Of the hundreds of maps reviewed, and the 120 or so maps selected in Appendix E as having particular relevance to Lee County DR/GR lands, the review team selected approximately four dozen maps (Section 5.0) of particular significance (many of which could be grouped to form a smaller number of map categories). These map categories are summarized below:

### **1. Hydrology, Hydrogeology and Aquifer Properties**

Several of the key maps depict the thickness of the geologic units that comprise the aquifer beneath the DR/GR that supplies water for residential use, agriculture, and other uses in Lee County. The thickness of the units provides a measure of the capacity of the aquifer to store water and deliver it to well fields. Maps also depicted areas of recharge and potential areas for water supply well fields in the DR/GR area.

### **2. Ecological Habitat and Biodiversity**

Many of the maps depicted habitat for the numerous listed, threatened, or endangered species that have been identified in the DR/GR. Certain of the maps are intended to show habitat for a particular species (e.g. Florida panther or Florida black bear); certain of the maps are intended to depict types of habitat lands (e.g. wetlands, or pine flatwoods); and certain of the maps are intended to show special biodiversity hotspot areas that allow for a diverse interrelated community of species.

### **3. Water Quality**

Several of the maps depict water quality measurements for surface water within

DR/GR lands, in the bays and estuary waters into which the DR/GR drains. Certain maps depict not simply a “snapshot” of water quality, but the patterns over time (improving or declining) in water quality parameters that are measures of the health of the DR/GR-related surface waters.

#### **4. Conservation and Mitigation Lands**

Maps in the Lee County Master Mitigation Plan and in related documents (e.g. Lower Charlotte Harbor Reconnaissance Report) delineate land areas, many of which are located in the DR/GR, that are either under public or private conservation management, or which are targeted for potential future acquisition. In addition, certain maps depict currently impaired or impacted areas that are targeted for mitigation through a number of environmental and engineering projects (e.g. the management measures described and depicted in the Southwest Florida Feasibility Study Scoping Meeting document).

There is a wealth of spatial information that, if integrated, built upon, maintained, and periodically updated, would assist Lee County in characterizing, understanding, monitoring, and better managing the DR/GR lands. The key maps identified in this study, when coupled with information already contained in the Lee County Geographic Information System, were intended to provide a robust map-portfolio base with which to better examine resources, patterns, trends, impacts and restoration efforts in the DR/GR lands.

### 6.3 Conclusions

The first step of the review process by the project team was the identification of more than 50 environmental resources, features, and issues potentially associated with the DR/GR lands. These resources, features, and issues are considered to be of importance to Lee County because they are taken directly from the Lee County Comprehensive Plan. They are shown in Appendix C.

At the conclusion of the review, the project team determined that the studies and reports revealed substantial descriptive information and scientific data regarding the DR/GR lands. As shown in Appendix F, every one of the 50-plus environmental resources, features, and issues identified in the Lee County Comprehensive Plan are discussed, addressed, or characterized to some extent in one or more of the studies.

This correlation between the County's stated environmental features of interest and the corresponding information provided in the documents indicates the following:

- There is a strong awareness on the part of the Lee County staff charged with managing the DR/GR area that these lands possess a large number of important resources, features, and issues.
- There is confirmation from the studies reviewed that numerous investigators also consider these DR/GR-related features to be important, and that the features (habitats, species, resources, recharge areas, etc.) have been identified as being present in the DR/GR area in southeastern Lee County.
- The studies, when viewed as a whole, reveal that the resources and ecological systems within the DR/GR area are interrelated in complex ways.
- The functioning of the DR/GR environmental system (both in terms of individual resources and interrelated systems) can be adversely impacted by certain land uses.
- There is the potential for a balance between use of the land and protection of the ecological and groundwater resources, with the nature of that balance requiring careful consideration of the DR/GR information and scientific data contained in the studies reviewed as part of this project and other similar studies.
- There is the potential for restoration of impacted portions of DR/GR lands.

The review of the individual studies revealed that some were more current than others and some contained more depth and robustness of characterization of the DR/GR land in southeastern Lee County than others. Brief statements regarding the characteristics of the studies in these and other respects may be found in Appendix D.

The review also revealed that there were a few major components of the overall character of the DR/GR lands that were not described in sufficient depth in the documents reviewed as part of this project to permit the project team to evaluate their importance or significance. For example, while one of the earlier water resource studies made brief mention of potential saltwater intrusion impacts for wells in southeastern Lee County, none of the studies provided more detail on this subject. Similarly, none of the studies provided a concise hydrologic water budget for the DR/GR lands. These elements, missing in the documents reviewed, may be addressed in other documents, studies, and reports beyond those reviewed by the project team.

Several of the studies mentioned potential groundwater quality impacts associated with certain land uses, but did not present a current background data set against which future groundwater quality changes could be measured. One of the studies described potential hydrologic impacts associated with mining, but none of the studies described potential ecological impacts. In addition, while several of the documents mentioned agriculture as a permitted DR/GR land use, they did not provide information on the hydrologic, water quality, or ecological impacts associated with agricultural use of these lands.

As stated above, in the absence of information on these topics from the reports reviewed, it can not be determined whether they are important for the future management of DR/GR lands in southeastern Lee County. The topics are identified here for possible consideration by Lee County staff, which may be aware of additional studies that the project team has not reviewed, and not as recommendations for further study.

**APPENDIX A**

**SELECTED DOCUMENTS AND REFERENCE WORKS**

## APPENDIX A

# SELECTED DOCUMENTS AND REFERENCE WORKS

## Review and Summary of Lee County DR/GR Documents

### Primary DR/GR Documents

1. **Lee County Comprehensive Plan Update** December 2005
2. **Groundwater Resources and Mining Study** June 2005
3. **Lee Master Mitigation Plan (LMMP)** August 2004
4. **Water Resources Management Project** October 1988  
By James M. Montgomery
5. **Engineering Analysis for Properties Designated within the City of Bonita Springs as "Density Reduction/Groundwater Resource" (DR/GR)** July 2005  
Prepared By Greg F. Rawl, P.G., and Paul Sebert
6. **Estero Bay: State of the Bay Reports**
  1. **Estero Bay: State of the Bay Report** January 2000  
Prepared by the Estero Bay Agency on Bay Management
  2. **Estero Bay: State of the Bay Update** May 2004  
Prepared by the Estero Bay Agency on Bay Management
7. **Lower Charlotte Harbor Reconnaissance Report** 2005  
Prepared by the Charlotte Harbor National Estuary Program
8. **Water Quality Data Analysis and Report** August 2003  
By David Wade, Anthony Janicki, Susan Janicki, Michele Winowitch
9. **How much is enough? Landscape-scale conservation for the Florida panther** February 2005  
By Randy Kautz, Robert Kawula, Thomas Hctor, Jane Comiskey, Deborah Jansen, Dawn Jennings, John Kasbohm, Frank Mazzotti, Roy McBride, Larry Richardson, Karen Root.
10. **Closing the Gaps in Florida's Wildlife Habitat Conservation System (Gaps Report)** 1994  
James Cox, Randy Kautz, Maureen MacLaughlin, and Terry Gilbert
11. **Southwest Florida Feasibility Study**
  1. **Southwest Florida Feasibility Study: Feasibility Scoping Meeting Documentation** Nov. 2005
  2. **The Caloosahatchee Conceptual Model** May 22, 2006
  3. **The Big Cypress Conceptual Model** May 22, 2006
  4. **The April 2006 Scoping letter** April 2006
  5. **The project component map** September 19, 2006
  6. **The Comprehensive Everglades Restoration Plan System-wide**

Performance Measures.

- |   |                   |
|---|-------------------|
| 7. The Greater Everglades Wetlands Conceptual Ecological Model  | March 16, 2006    |
| 8. The Northern Estuaries Conceptual Model  | March 16, 2006    |
| 9. The Caloosahatchee Estuary Salinity Envelope   | September 9, 2005 |
| 10. NE-7 Caloosahatchee Estuary Nutrient (TP and TN) Loading and Concentration  | September 9, 2005 |
| <br>  |                   |
| <b>12. The South Florida Multi-species Recovery Plan</b><br>U.S. Fish and Wildlife Service  | May 18, 1999      |
| <br>  |                   |
| <b>13. County Road 951 Project Development &amp; Environmental Study</b><br>Wetland Evaluation Report. Assessments of wetland and environmental resources within the rights-of-way of proposed highway alignments.<br>1. County Road 951 Project Development and Environment Study<br>Draft Endangered Species Biological Assessment<br>2. County Road 951 Project Development and Environment Study<br>Draft Wetland Evaluation Report | July 2006         |
| <br>  |                   |
| <b>14. South Lee County Watershed Plan</b><br>Johnson Engineering et al.  | 1999              |

### Supplemental DR/GR Documents

- |   |                        |
|---|------------------------|
| Origins and History of DR/GR  | last updated June 2003 |
| Arnold Committee Report and Recommendations   | October 1996           |
| The Seventh Annual Ecological Monitoring of the Corkscrew Wellfield, Lee County Florida |                        |
| Green Meadows Wellfield 2005 Annual Ecological Monitoring Report                        |                        |
| Lee County Utilities Pinewoods Wellfield Monitoring Report                              |                        |
| Lee County Future Land Use Map  |                        |
| Lee County Flow Ways Map  |                        |
| Lee County Conservation 20/20 Map   |                        |
| Florida Natural Areas Inventories Database  |                        |

**APPENDIX B**

**BACKGROUND INFORMATION REGARDING  
DENSITY REDUCTION/GROUNDWATER RESOURCE (DR/GR) AREA  
LEE COUNTY, FLORIDA**



## APPENDIX B

### Background Information Regarding Density Reduction / Groundwater Resource (DR/GR) Area Lee County, Florida

#### Introduction

The information summarized below is taken primarily from the following documents:

1. Origins and History of DR/GR;
2. Lee County Comprehensive Plan (Lee Plan) 2005 Update; and
3. Lee Master Mitigation Plan (LMMP).

The selected portions of these documents are intended to provide background information relating to the Lee County land use category referred to as Density Reduction / Groundwater Resource (DR/GR) lands (in particular those DR/GR lands located in the southeast portion of Lee County). The information describes the designation of DR/GR lands as a Lee County Planning Community and presents the permitted uses of the lands. It outlines the required review process by Lee County staff and commissioners when a party (1) applies to change land use type within designated DR/GR areas, or (2) applies for a permit for a permissible use within the DR/GR, like resource extraction.

Note: The sentences or paragraphs of each Lee County planning document that contain guidance or requirements with direct relevance to DR/GR lands and resources within those lands are highlighted in yellow in the sections below. Non-highlighted text surrounding the key quotes is provided for context.

#### Origins and History of DR/GR Density Reduction / Groundwater Resource

History of DR/GR – Selected Portions Describing Basis for Designation		
Item	Ref	Information
1	DCA	DCA recommended that Lee County prevent incompatible land use in known aquifer recharge areas
2	Lee Plan 3-89, Sect A	Established a 1990 deadline for creating ordinances to protect Groundwater Resources and Groundwater Recharge
3	Lee Plan, revis 8-90	Mentions DR/GR in context of DCA concern for density reduction and Dept of Natural Resources concern for groundwater resource protection. This new land use category was to be regarded as both limiting development and protecting a natural resource.
4	Lee Plan 1990, Sect A	Contains policy 1.4.3 regarding Density Reduction / Groundwater Resource land use category.

## The Lee Plan 2005 Codification – As Amended through December 2005

<b>Lee Plan – Selected Information Relating to Management of DR/GR Lands</b>		
<b>Item</b>	<b>Page</b>	<b>Information</b>
1	I-1	The growth patterns of the county will continue to be dictated by a <b>Future Land Use map that will not change dramatically during the time frame of this plan.</b> With the exception of Cape Coral and Lehigh Acres, the county's urban areas will be essentially built out by 2020 (pending, in some cases, redevelopment). The county will attempt to maintain the clear distinction between urban and rural areas that characterizes this plan. Its success will depend on two things: the continuing viability of agricultural uses and the amount of publicly-owned land in outlying areas.
2	I-1	<b>The county will protect its natural resource base</b> in order to maintain a high quality of life for its residents and visitors. This will be accomplished through an aggressive public land acquisition program and by maintaining and enforcing cost-effective land use and environmental regulations that supplement, where necessary, federal, state, and regional regulatory programs.
3	I-1	The Lee Plan's land use accommodation is based on an aggregation of allocations for <b>22 Planning Communities. These communities have been designed to capture the unique character of each of these areas</b> of the county. Within each community, smaller neighborhood communities may exist; however, due to their geographic size, a planning community could not be created based on its boundaries. These communities and their anticipated evolutions are as follows: (Amended by Ordinance No. 99-15)  <p><b>[NOTE: Southeast Lee County, which contains the DR/GR lands is one of these Planning Communities; see below. Review of other Planning Communities such as Bonita and Estero will be considered to be beyond the scope of the current review project.]</b></p>
4	I-9	<b>Southeast Lee County</b> - As the name implies, this Community is located in the southeast area of Lee County. South of SR 82, north of Bonita Beach Road, east of I-75 (excluding areas in the San Carlos Park/Island Park/Estero Corkscrew Road and Gateway/Southwest Florida International Airport Communities) and west of the county line. <b>With the exception of a few Public Facilities, the entire community is designated as Density Reduction/Groundwater Resource, Conservation Lands (both upland and wetlands), and Wetlands on the Future Land Use Map.</b> This "community" consists of mining operations, agricultural uses, and very large lot residential home sites. The one exception is the Citrus Park Community. This community will not change in character by the year 2020 and will continue to have a population of approximately 2000 residents. (Added by Ordinance No. 99-15)
5	II-2	<b>GOAL 1: FUTURE LAND USE MAP.</b> <b>To maintain and enforce a Future Land Use Map</b> showing the proposed distribution, location, and extent of future land uses by type, density, and intensity in order to protect natural and man-made resources, provide essential services in a cost-effective manner, and discourage urban sprawl. (Amended by Ordinance No. 94-30)



		<p><b>[NOTE: DR/GR lands form part of the Non-Urban Areas identified on the Lee County Future Land Use Map and treated under Objective 1.4 of the Lee Plan; see description below.]</b></p>
6	II-13	<p><b>POLICY 1.4.5:</b> The Density Reduction/Groundwater Resource (DR/GR) areas include upland areas that provide substantial recharge to aquifers most suitable for future wellfield development. These areas also are the most favorable locations for physical withdrawal of water from those aquifers. Only minimal public facilities exist or are programmed. Land uses in these areas must be compatible with maintaining surface and groundwater levels at their historic levels. Permitted land uses include agriculture, natural resource extraction and related facilities, conservation uses, publicly-owned gun range facilities, private recreation facilities, and residential uses at a maximum density of one dwelling unit per ten acres (1 du/10 acres). Individual residential parcels may contain up to two acres of Wetlands without losing the right to have a dwelling unit, provided that no alterations are made to those wetland areas.</p> <p>Private Recreational Facilities may be permitted in accordance with the site locational requirements and design standards, as further defined in Goal 16. No Private recreational facilities may occur within the DR/GR land use category without a rezoning to an appropriate planned development zoning category, and compliance with the Private Recreation Facilities performance standards, contained in Goal 16 of the Lee Plan. (Amended by Ordinance No. 91-19, 94-30, 99-16, 02-02)</p> <p><b>[NOTE: Little or no mention is made of maintaining or preserving ecological resources in DR/GR lands.]</b></p>
7	II-21	<p><b>OBJECTIVE 2.4: FUTURE LAND USE MAP AMENDMENTS.</b> Regularly examine the Future Land Use Map in light of new information and changed conditions, and make necessary modifications.</p> <p><b>POLICY 2.4.1:</b> The county will accept applications from private landowners or non-profit community organizations to modify the boundaries as shown on the Future Land Use Map. Procedures, fees, and timetables for this procedure will be adopted by administrative code. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 2.4.2:</b> All proposed changes to the Future Land Use Map in critical areas for future potable water supply (Bonita Springs as described in Policy 1.7.10; Lehigh Acres as described in Policy 54.1.9; and all land in the Density Reduction/ Groundwater Resource land use category) will be subject to a special review by the staff of Lee County. This review will analyze the proposed land uses to determine the short-term and long-term availability of irrigation and domestic water sources, and will assess whether the proposed land uses would cause any significant impact on present or future water resources. If the Board of County Commissioners wishes to approve any such changes to the Future Land Use Map, it must make a formal finding that no significant impacts on present or future water resources will result from the change. (Amended by Ordinance No. 92-47, 94-30, 00-22, 02-02)</p> <p><b>POLICY 2.4.3:</b> Future Land Use Map Amendments to the existing DR/GR areas south of SR 82 east of I-75, excluding areas designated by the Port Authority as needed for airport expansion, which increase the current allowable density or intensity of land use will be discouraged by the county. It</p>



		<p>is Lee County's policy not to approve further urban designations there for the same reasons that supported its 1990 decision to establish this category. In addition to satisfying the requirements in 163 Part II Florida Statutes, Rule 9J-5 of the Florida Administrative Code, the Strategic Regional Policy Plan, the State Comprehensive Plan, and all of the criteria in the Lee Plan, applicants seeking such an amendment must:</p> <ol style="list-style-type: none"> <li>1. analyze the proposed allowable land uses to determine the availability of irrigation and domestic water sources; and,</li> <li>2. identify potential irrigation and domestic water sources, consistent with the Regional Water Supply Plan. Since regional water suppliers cannot obtain permits consistent with the planning time frame of the Lee Plan, water sources do not have to be currently permitted and available, but they must be reasonably capable of being permitted; and,</li> <li>3. present data and analysis that the proposed land uses will not cause any significant harm to present and future public water resources; and,</li> <li>4. supply data and analysis specifically addressing the urban sprawl criteria listed in Rule 9J-5.006(5) (g), (h), (i) and (j), FAC. During the transmittal and adoption process, the Board of County Commissioners must review the application for all these analytical requirements and make a finding that the amendment complies with all of them. (Added by Ordinance No. 97-05)</li> </ol> <p><b>POLICY 2.4.4:</b> Lee Plan amendment applications to expand the Lee Plan's employment centers, which include light industrial, commercial retail and office land uses, will be evaluated by the Board of County Commissioners in light of the locations and cumulative totals already designated for such uses, including the 1994 addition of 1,400 acres to the Tradeport category just south of the Southwest Florida International Airport. (Added by Ordinance No. 97-05, Amended by Ordinance No. 00-22, 04-16)</p>
8	II-37	<p><b>GOAL 10: NATURAL RESOURCE EXTRACTION.</b>  To protect areas containing identified natural resources from incompatible urban development, while insuring that natural resource extraction operations minimize or eliminate adverse effects on surrounding land use and natural resources. (Amended by Ordinance No. 02-02)</p> <p><b>OBJECTIVE 10.1:</b> Designate through the rezoning process sufficient lands suitable for providing fill material, limerock, and other natural resource extraction materials to meet the county's needs and to export to other communities, while providing adequate protection for the county's natural resources. (Amended by Ordinance No. 94-30, 02-02)</p> <p><b>POLICY 10.1.1:</b> Natural resource extraction operations intending to withdraw groundwater for any purpose must provide a monitoring system to measure groundwater impacts. (Amended by Ordinance No. 02-02)</p> <p><b>POLICY 10.1.2:</b> Applications for natural resource extraction permits for new or expanding areas must include an environmental assessment. The assessment will include (but not be limited to) consideration of air emissions, impact on environmental and natural resources, effect on nearby land uses, degradation of water quality, depletion of water quantity, drainage, fire and safety, noise, odor, visual impacts, transportation including access roads, sewage disposal, and solid waste disposal. (Amended by Ordinance No. 00-22, 02-02)</p> <p><b>POLICY 10.1.3:</b> Applications for natural resource extraction permits for new</p>



		<p>or expanding sites must include a reclamation plan which provides assurance of implementation. Reclamation plans in or near important groundwater resource areas must be designed to minimize the possibility of contamination of the groundwater during mining and after completion of the reclamation. (Amended by Ordinance No. 00-22, 02-02)</p> <p><b>POLICY 10.1.4:</b> Natural resource extraction activities (and industrial uses which are ancillary to natural resource extraction) may be permitted in areas indicated on the Future Land Use Map as Rural, Open Lands, and Density Reduction/Groundwater Resources, provided they have adequate fire protection, transportation facilities, wastewater treatment and water supply, and provided further that they have no significant adverse effects such as dust and noise on surrounding land uses and natural resources. In order to reduce transport costs and minimize wear on the county's roadways, the extraction and transport of fill material may also be permitted as an interim use in the Future Urban Areas provided that the above requirements are met; however, special restrictions may also be applied to protect other land uses. These determinations will be made during the rezoning process. (Amended by Ordinance No. 94-30, 00-22, 02-02)</p> <p><b>POLICY 10.1.5:</b> Lee County will support efforts by government, community leaders, and the extractive industry owners and businesses to seek incentives that will help to facilitate the connection of natural resource extraction borrow lake excavations into a system of interconnected lakes and flowways that will enhance wildlife habitat values, provide for human recreation, educational and other appropriate uses, and/or strengthen community environmental benefits. (Amended by Ordinance No. 99-15, 02-02)</p> <p><b>OBJECTIVE 10.2:</b> Determine and maintain a balance between the County's petroleum resources and the health, safety and welfare of the residents of its Future Urban Areas. (Added by Ordinance No. 98-09)</p> <p><b>POLICY 10.2.1:</b> By 2000, the county will conduct a study to determine the appropriateness of oil exploration, drilling, or production. The study will address the issues of the compatibility of oil-related activities with the environment and urban uses. This study will include recommendations regarding the appropriateness of such activities within Lee County as well as guidelines under which such activities should be regulated under the Lee County Land Development Code. (Added by Ordinance No. 98-09, Amended by Ordinance No. 00-22)</p>
9	II-49	<p><b>GOAL 16: PRIVATE RECREATIONAL FACILITIES IN THE DR/GR.</b></p> <p>To ensure that the development of Private Recreational Facilities in the DR/GR areas is compatible with the intent of this Future Land Use category, including recharge to aquifers, development of future wellfields and the reduction of density. (Added by Ordinance No. 99-16)</p> <p><b>OBJECTIVE 16.1:</b> To ensure that Private Recreation Facilities are located in the most appropriate areas within the DR/GR future land use category. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.1.1:</b> The Private Recreation Facilities Overlay Map, Map 4, shows those locations that are appropriate for the development of Private Recreation Facilities in the DR/GR area. The areas depicted on Map 4 are consistent with the application of the following locational criteria:</p> <ol style="list-style-type: none"> <li>1. Located outside of those areas designated for public acquisition through the</li> </ol>



	<p>Florida Conservation and Recreational Land Program (C.A.R.L.), the Corkscrew Regional Ecosystem Water Trust (C.R.E.W.), the South Florida Water Management District's Save Our Rivers Program, and the County's 2020 Conservation Program;</p> <p>2. Located in areas characterized as predominantly impacted with agricultural, mining or other permitted uses;</p> <p>3. Located outside of areas depicted as 100 Year Flood Plains, as illustrated on Map 9 of the Lee Plan, as amended through June of 1998;</p> <p>4. Located to minimize impact on "Hot Spots of Biological Resources and Rare Species Occurrence Records," from the Florida Game and Freshwater Fish Commission's, "Closing the Gaps in Florida Wildlife Habitat Conservation System" published in 1994;</p> <p>5. Located in areas characterized by large lot single or limited ownership patterns; and,</p> <p>6. Located in areas with direct access to existing roadways. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.1.2:</b> Private Recreational Facilities within the DR/GR land use category will only be allowed, subject to the other requirements of this Goal, in the areas depicted on Map 4, Private Recreational Facilities Overlay Map. (Added by Ordinance No. 99-16)</p> <p><b>OBJECTIVE 16.2: GROWTH MANAGEMENT.</b> Development of Private Recreation Facilities in the DR/GR areas must be consistent with the growth management principles and practices as provided in the following policies. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.2.1: PRIVATE RECREATION FACILITY PLANNED DEVELOPMENT.</b> By the end of December, 2000, Lee County will amend the Lee County Land Development Code (LDC) to include provisions for a new Private Recreation Facilities Planned Development zoning category. All Private Recreational Facilities proposed within the Density Reduction Groundwater Resource land use category must be reviewed as a Development of County Impact, Private Recreation Facilities Planned Development. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.2.2:</b> Approved Private Recreation Facilities Planned Developments will automatically expire, reverting to the original zoning category, if a Lee County Development Order is not obtained within five (5) years of zoning approval. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.2.3: RESIDENTIAL USES PRECLUDED.</b> Residential uses, other than a single bonafide caretaker's residence or a resident manager's unit, are not permitted in conjunction with a Private Recreational Facility Planned Development. Residential density associated with land zoned as Private Recreational Facility will be extinguished and cannot be transferred, clustered or otherwise assigned to any property. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.2.4:</b> Further, the approval of Private Recreational Facilities on any property within the DR/GR will not be considered as justification for approving an amendment to the Future Land Use Map series which would increase residential density in the DR/GR areas. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.2.5:</b> The boundaries of the Private Recreational Facility Planned Development may not be designed to allow out-parcels or enclaves of residential units to be integrated into the golf course perimeter. (Added by</p>
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	<p>Ordinance No. 99-16)</p> <p><b>POLICY 16.2.6:</b> Private Recreational Facilities must have adequate fire protection, transportation facilities, wastewater treatment and water supply, and provided further that they have no adverse effects such as dust, noise, lighting, or odor on surrounding land uses and natural resources. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.2.7:</b> Private Recreational Facilities within the DR/GR may only be located in the areas depicted on the Private Recreational Facilities Map, Map 4. (Added by Ordinance No. 99- 16)</p> <p><b>POLICY 16.2.8:</b> Applications for Private Recreational Facility development will be reviewed and evaluated as to their impacts on, and will not negatively affect, any adjacent, existing agricultural, mining or conservation activities. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.2.9:</b> Applications for Private Recreational Facility development will be reviewed and evaluated as to their impacts on, and must be compatible with any adjacent publicly owned lands. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.2.10:</b> During the 2010 comprehensive plan Evaluation and Appraisal Report process the County will conduct a comprehensive evaluation of the impacts of Private Recreation Facilities on surface and groundwater quality and quantity. Recommendations from this evaluation will then be incorporated into the Lee Plan. (Added by Ordinance No. 99-16)</p> <p><b>OBJECTIVE 16.3: GENERAL DEVELOPMENT REGULATIONS.</b> The protection of water quality, quantity, natural resources, and compatibility will be addressed by additional development controls that regulate the permitted uses, parcel size, density, intensity and design of Private Recreational Facilities. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.3.1:</b> Private Recreational Facilities will submit a Master Concept Plan at the time of Planned Development submittal that identifies the general location of proposed uses and structures, play fields and golf course routings. Minor adjustments to this Master Concept Plan may be made administratively at the discretion of the Director. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.3.2:</b> Applications for Private Recreational Facilities must include an environmental assessment during the zoning approval process. The assessment must include, at a minimum, an analysis of the environment, historical and natural resources and a protected species survey as required by chapter 10 of the LDC. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.3.3:</b> In addition to an environmental assessment, the applicant must demonstrate compatibility with nearby land uses (by addressing such things as noise, odor, lighting and visual impacts), and the adequate provision of drainage, fire and safety, transportation, sewage disposal and solid waste disposal. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.3.4:</b> The development will incorporate an Integrated Pest Management program for any managed recreational areas. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.3.5:</b> Where buildings or impervious development is located within twenty-five feet of the property boundary, a buffer 15 feet wide, with 5 trees per 100 linear feet, and a solid double row hedge must be provided, unless a more restrictive buffer is required during the Planned Development Review. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.3.6:</b> No illumination may be used which creates glare on adjacent properties. All exterior lighting will be designed with downward</p>
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deflectors to eliminate skyward glare. Parking areas, walkways and paths and maintenance areas may be illuminated for security purposes, provided that light poles do not exceed twelve feet in height. (Added by Ordinance No. 99-16)

**POLICY 16.3.7:** Native and xeriscape vegetation will be encouraged, such that:

1. 100% of all required trees and 75% of all additional trees must be native.
2. 80% of all required shrubs and 50% of all additional shrubs must be native.
3. A minimum of 70% of all trees and shrubs must be xeriscape varieties.
4. The native and xeriscape requirements do not apply to turf areas.
5. No plant species included in the Florida Exotic Pest Plant Council, 1999 List of Florida's Most Invasive Species, will be planted. (Added by Ordinance No. 99-16)

**POLICY 16.3.8:** The following site requirements, regulating lot size, setbacks and open space must be equaled or exceeded:

1. Uses, other than golf courses, permitted under this subdivision must have a minimum lot size of ten acres.

**2. Building Setbacks.**

- a. Fifty (50) feet from an existing right-of-way line or easement.
- b. Seventy-five (75) feet from any private property line under separate ownership and used for residential dwellings.
- c. Fifty (50) feet from any adjacent agricultural or mining operation.
- d. Greater setbacks may be required during the Public Hearing process to address unique site conditions.

**3. Setbacks for accessory buildings or structures.** All setbacks for accessory buildings or structures must be shown on the Master Concept Plan required as part of the Planned Development application. No maintenance area or outdoor storage area, irrigation pump or delivery area may be located less than 500 feet from any existing or future residential use, as measured from the edge of the above-listed area to the property line of the residential use. For purposes of this policy, any property that is 10 acres or less in size and is zoned to permit dwelling units will be considered a future residential property. Properties larger than 10 acres may be considered future residential based on the property's size, the ownership pattern of properties in the surrounding area, and the use, zoning and size of surrounding properties. To allow flexibility, the general area of any accessory buildings, structures and maintenance areas must be shown on the site plan with the appropriate setbacks as noted in this subsection listed as criteria for the final placement of these buildings, structures or facilities.

In addition to the other standards outlined in this policy, any maintenance area or outdoor storage area, irrigation pump or delivery area must meet one of the following standards:

- a) be located 500 feet or more from any property line abutting an existing or planned public right-of-way; or
- b) provide visual screening around such facilities, that provides complete opacity, so that the facilities are not visible from any public right-of-way; or
- c) be located within a structure that meets or exceeds the current Lee County architectural standards for commercial structures.

**4. Open Space.** A minimum of 85% open space must be provided. However, natural and manmade bodies of water may contribute 100% to achieving the minimum requirements. To the extent possible, pervious paving and parking



	<p>areas, and buildings elevated above ground level will exceed the 85% open space requirement.</p> <p>5. <b>Security.</b> All entrances to Private Recreational Facilities must be restricted from public access during non-use hours. (Added by Ordinance No. 99-16, Amended by Ordinance No. 02-04)</p> <p><b>POLICY 16.3.9:</b> Density/Intensity Limitations proposed uses are subject to the following limitations:  Clubhouse/Administrative Area: 20,000 SF/18 hole golf course.  Golf Course Restrooms: Not to exceed two structures per 18-hole golf course, limited to 150 square feet per structure.  Maintenance Area: Not to exceed 25,000 SF of enclosed or semi-enclosed building area, on a maximum of 5 acres of land per 18 hole golf course.  Horse Stable: 40,000 SF of Stable Building/10 acres.  Camping Restrooms: 1 toilet per four (4) camp units, clustered in structures not to exceed 500 square feet per structure. 1 shower per 4 toilets.  Camping Area Office: 1,000 SF per campground.  (Added by Ordinance No. 99-16, Amended by Ordinance No. 02-02)</p> <p><b>OBJECTIVE 16.4: WATER QUALITY, QUANTITY, AND SURFACE WATER RESOURCES.</b> Private Recreational Facilities must be located, designed and operated in such a way that they will not degrade the ambient surface or groundwater quality. These facilities must be located, designed and operated in such a way that they will not adversely impact the County's existing and future water supply. The location, design and operation of Private Recreational Facilities must maintain or improve the storage and distribution of surface water resources. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.4.1:</b> All applications and documentation for the planned development rezoning process must be submitted to the Lee County Division of Natural Resources for their formal review and comment. The Division of Natural Resources Director must make a formal finding that the proposed uses will not have negative impacts on present and future water quality and quantity, and will review and approve modeling submitted to support the Planned Development.  Applicant modeling efforts must be evaluated and approved by the Lee County Division of Natural Resources and the Lee County Utilities Division. Issues of well locations, easements and wastewater re-use must be evaluated and approved by the Lee County Division of Natural Resources and the Lee County Utilities Division during the Planned Development process. Formal agreements addressing these issues will be entered into prior to the issuance of a Development Order. Co-location of recreational and public facilities is encouraged. (Added by Ordinance No. 99-16, Amended by Ordinance No.03-04).</p> <p><b>POLICY 16.4.2:</b> Applications for Private Recreational Facilities in or near existing and proposed wellfields must be designed to minimize the possibility of contamination of the groundwater during construction and operation. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.4.3:</b> Private Recreational Facilities must provide a monitoring program to measure impacts to surface and groundwater quality and quantity (see Objective 16.7). (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.4.4:</b> As part of a rezoning request for a Private Recreational Facility in the DR/GR area, a pre-development groundwater and surface water</p>
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	<p>analysis must be conducted and submitted to the County. This analysis is intended to establish baseline data for groundwater and surface water monitoring for the project area. The analysis must be designed to identify those nutrients and chemicals which are anticipated to be associated with the project. Prior to the applicant commencing this baseline study, the methodology of the study must be submitted for review, comment, and approval by the County. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.4.5:</b> Any “Private Recreational Facility” located in any wellfield protection zone must meet the requirements/criteria for protection zone 1, unless updated modeling is provided by the applicant and is approved by Lee County Division of Natural Resources and the Lee County Utilities Division. (Added by Ordinance No. 99-16, Amended by Ordinance No. 03-04)</p> <p><b>POLICY 16.4.6:</b> The surface water management system design must incorporate natural flowway corridors, cypress heads, natural lakes, and restore impacted natural flowway corridors.</p> <ol style="list-style-type: none"><li>1. Stormwater run-off must be pre-treated through an acceptable recreated natural system or dry retention and water retention system, prior to discharging the run-off into existing lake or wetland (any aquatic) systems. Included within these systems must be an average 50 foot wide vegetative setback measured from the edge of managed turf to the wetland jurisdictional wetland line or top of bank of natural water bodies.</li><li>2. The development must maintain the function and integrity of local and regional flowways. Flowways are precluded from being primary surface water treatment areas. Applications for Private Recreational Facilities must demonstrate adequate hydraulic capacity without increasing flood levels. Private Recreational Facilities must participate in the implementation of the Lee County Surface Water Management Plan as well as the South Florida Water Management District’s South Lee County Watershed Plan.</li><li>3. The Historic Flowway Aerial Map depicts the general flowway paths that exist in the DR/GR area. The lines shown on this map are not regulatory but show the general boundaries of the main conveyances. During the rezoning process, conceptual surface water management plans must be submitted and approved. Prior to the issuance of a Development Order, proposed Private Recreation Facilities will provide detailed hydrologic and hydraulic analysis demonstrating the limits of flow for various storm events and the developed sites ability to convey these flows. Where an existing flowway is not well defined or discontinuous, flexibility will be given to allow different alignments within a site. (Added by Ordinance No. 99-16)</li></ol> <p><b>POLICY 16.4.7:</b> Any Private Recreational Facilities proposed within the DR/GR land use category must cooperate with Lee County and SFWMD in implementing an overall surface water management plan as outlined in Objective 60.2 and 117.1. Compliance with these Policies must be demonstrated during Development Order approval. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.4.8:</b> If a proposed Private Recreation Facilities falls within an area identified as an anticipated drawdown zone for existing or future public well development, the project must utilize an alternative water supply such as reuse or withdrawal from a different non-competing aquifer or show that adequate supply is available in excess of that being used for planned public water supply development. (Added by Ordinance No. 99-16)</p> <p><b>OBJECTIVE 16.5: WILDLIFE.</b> The location, design and operation of</p>
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	<p>Private Recreational Facilities will incorporate preservation and/or management activities that restrict the unnecessary loss of wildlife habitat or impact on protected species, species of special concern, threatened or endangered species. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.5.1:</b> The development will not have an adverse impact on any existing, viable onsite occupied wildlife habitat for protected species, species of special concern, threatened or endangered species. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.5.2:</b> All proposed fencing must be designed to permit wide-ranging animals to traverse the site. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.5.3:</b> Through the development review process, Private Recreation Facilities will be designed and operated to conserve critical habitat of protected species. This will be accomplished through regulation, incentives and public acquisition. (Added by Ordinance No. 99-16)</p> <p><b>OBJECTIVE 16.6: NATURAL RESOURCES.</b> Private Recreational Facilities must be located, designed and operated to minimize environmental impacts, and where appropriate, protect, enhance and manage natural resources such as flowways, waterways, wetlands, natural water bodies, and indigenous uplands. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.6.1:</b> All retained onsite natural areas, must be perpetually managed by the owner(s), or their assignees, with accepted Best Management Practices. The type of management techniques will be determined by the specific plant community. A natural area land management plan must be submitted to the Lee County Division of Planning prior to the approval of a final local development order. Management techniques addressed in the plan must include, but not be limited to the following:</p> <ul style="list-style-type: none"> <li>• Exotic pest plant control;</li> <li>• Removal of any trash and debris;</li> <li>• Restoration of appropriate hydrology;</li> <li>• Prescribed fire;</li> <li>• Native plant restoration, where appropriate;</li> <li>• Discussion of flora and fauna;</li> <li>• Enhancement of wildlife habitat; and,</li> <li>• Retention of dead trees and snags.</li> </ul> <p>(Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.6.2:</b> The development will minimize adverse effects on wetlands and riparian areas; and will result in no net reduction in functional wetland acreage as identified by the South Florida Water Management District Wetland Rapid Assessment Procedure (WRAP). (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.6.3:</b> Private Recreational Facilities must be designed to preserve a minimum of 50% of on-site, indigenous native upland habitat. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.6.4:</b> The development will incorporate energy and resource conservation devices, such as low flow water fixtures, and natural skylights. (Added by Ordinance No. 99-16)</p> <p><b>OBJECTIVE 16.7: MONITORING AND ENFORCEMENT.</b> In order to ensure that Private Recreational Facilities do not degrade the ambient condition of water quality, water quantity, vegetation and wildlife, an ongoing monitoring program must be established by the developer. (Added by Ordinance No. 99-16)</p>
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	<p><b>POLICY 16.7.1:</b> Annual surface water and groundwater monitoring must continue in perpetuity. The monitoring requirements will be established utilizing those nutrients and chemicals that are anticipated to be associated with the proposed project that were identified by the pre-development groundwater and surface water analysis required by Policy 16.4.4. This surface and groundwater monitoring is to be conducted, at a minimum, on a quarterly basis by a qualified third party. This monitoring data must be submitted to the County as soon as it is available. A summary report of this monitoring effort must be provided annually to Lee County Division of Natural Resources for their review. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.7.2:</b> If surface and/or groundwater monitoring shows degradation of water quality the County will notify the property owner that a plan, to correct the identified problem(s), must be submitted. The property owner must submit a plan of action within 30 days after receipt of written notice from the County. The plan must identify actions that will correct the problem(s) within the shortest possible time frame. This plan will be reviewed and must be found to be acceptable by the County. If the plan is not submitted as required, or is found to be unacceptable by the County, the County will require that all activities on the property cease until a plan is submitted and approved. The approved plan must be implemented by the property owner. If the County determines that the approved plan is not being implemented properly, the County can require that all activities on the property cease until the property owner comes back into compliance. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.7.3:</b> The approved Private Recreational Facility must submit an annual monitoring report for a period of five (5) years, addressing the interaction between the use and environment. This report must provide a discussion and documentation on the following activities:</p> <ol style="list-style-type: none"> <li>1. Construction Monitoring – the applicant will submit annual reports detailing construction activities, permitting, compliance with Audubon International Signature Standards and percent complete.</li> <li>2. Land Management Activities – including those used on the golf course, as well as natural and preserve areas.</li> <li>3. Wildlife Monitoring – the applicant will provide a discussion of wildlife, wildlife activity, and wildlife management activities.</li> <li>4. Irrigation Monitoring – the applicant will provide a summary of the monthly irrigation withdrawal and irrigation sources.</li> <li>5. Mitigation/Vegetation Monitoring – the applicant will provide status reports on the viability of any mitigation and/or landscaping conducted on site.</li> <li>6. Integrated Pest Management Monitoring – the applicant will provide a discussion on the pest management techniques, and any pest problems that have occurred on the project. Should adverse impacts in any of the above areas be identified, enforcement and mitigation will be provided through the appropriate regulatory agency and enforcement procedures. These procedures will be spelled out during the development order process. If, after five years, no significant adverse impacts are determined, the reporting on these subjects may be terminated. (Added by Ordinance No. 99-16)</li> </ol> <p><b>OBJECTIVE 16.8: GOLF COURSE PERFORMANCE STANDARDS.</b> The location, design and operation of golf courses located within Private Recreational Facilities will minimize their impacts on natural resources, and</p>
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	<p>incorporate Best Management Practices. A maximum of ten (10) 18-hole golf courses, for a total of 180 golf holes, will be permitted in the next 10 years. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.1:</b> Natural waterways located on the site of a proposed golf course must be left in a natural, unaltered condition. Channelization will not be performed. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.2:</b> An applicant must demonstrate, prior to the issuance of a local development order, that a golf course is designed to minimize adverse effects to waters and riparian areas through the use of such practices as integrated pest management, adequate stormwater management facilities, vegetated buffers, reduced fertilizer use, etc. The facility must have an adequate water quality management plan, such as a stormwater management facility constructed in uplands to ensure that the recreational facility results in no substantial adverse effect to water quality. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.3:</b> If a waterway crossing is necessary, then it must be designed to minimize the removal of trees and other shading vegetation. Any crossings of existing natural flowways and water bodies must be bridged. Created or restored flowways and water bodies may be crossed by bridges or culverts or a combination as approved by Lee County and the South Florida Water Management District. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.4:</b> Waterway crossings by cart paths will be constructed of permeable material, no wider than 8-feet, and placed on pilings from edge of floodplain to edge of floodplain. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.5:</b> A new lake or pond should not be located within an existing natural waterway. Upland ponds must not expose stream channels to an increase in either the rate or duration of floodwater, unless required by the South Florida Water Management District for regional water management objectives. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.6:</b> For golf course developments, all fairways, greens, and tees must be elevated above the 25 year flood level, and all greens must utilize underdrains. The effluent from these underdrains must be pre-treated prior to discharge into the balance of the project's water management system. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.7:</b> Where a golf course is proposed, it must comply with the Best Management Practices for Golf Course Maintenance Departments, prepared by the Florida Department of Environmental Protection, May 1995. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.8:</b> The owners will employ management strategies in and around any golf course to address the potential for pesticide/chemical pollution of the groundwater and surface water receiving areas. The owners will comply with the goals of the Audubon International Signature Program for Golf Courses. The management practices include:</p> <ol style="list-style-type: none"> <li>1. The use of slow release fertilizers and/or carefully managed fertilizer applications.</li> <li>2. The practice of integrated pest management when seeking to control various pests, such as weeds, insects, and nematodes. The application of pesticides will involve only the purposeful and minimal application of pesticides, aimed only at identified targeted species. The regular widespread application of broad-spectrum pesticides is not acceptable. The management program will minimize, to the extent possible, the use of pesticides, and will</li> </ol>
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	<p>include the use of the USDA-SCS Soil Pesticide Interaction Guide to select pesticides for uses that have a minimum potential for leaching or loss due to runoff depending on site specific soil conditions. Application of pesticides within 100 feet of any CREW, or other adjacent public preserve lands, is prohibited.</p> <p>3. The coordination of the application of pesticides with the irrigation practices (the timing and application rates of irrigation water) to reduce runoff and the leaching of any applied pesticides and nutrients.</p> <p>4. The utilization of a golf course manager who is licensed by the State to use restricted pesticides and who will perform the required management functions. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.9:</b> Irrigation systems must utilize computerized irrigation based on weather station information, moisture sensing systems to determine existing soil moisture, evapotranspiration rates, and zone control, to ensure water conservation. For Private Recreation Facilities located outside of the depicted Wellfield Protection zones, re-use water, where available, will be utilized for irrigation. Re-use water within Wellfield Protection zones must be in compliance with the Wellfield Protection Ordinance. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.10:</b> Golf courses must be designed, constructed, managed and certified in accordance with the Audubon International Signature Program. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.11:</b> It is the landowner(s) responsibility to notify the County within ten (10) working days if the status of certification from Audubon changes from being in full compliance. Failure to do so could result in penalties up to and including revocation of golf course use if it is deemed that the violation(s) are a possible threat to the environment. If the golf course loses its certification from Audubon, then the property owner must submit a plan of action acceptable to the County that will achieve re-certification in the shortest possible time. The plan must be submitted within 30 days after receipt of written notice from the County. If the plan is not submitted as required, then all activity on the property must cease until a plan is submitted and approved. An approved plan must be implemented in good faith by the property owner. If the County determines that the plan is not being implemented properly, then all activity on the property must cease until the property owner comes back into full compliance. (Added by Ordinance No. 99-16)</p> <p><b>POLICY 16.8.12: GOLF SITE REQUIREMENTS.</b></p> <p>1. The minimum number of golf holes is 18. The minimum size for an 18 hole golf course is 150 acres. In no instance may the golf course impacts exceed 150 acres per 18 holes. Allowable uses within the impact area are greens, tees, fairways, clubhouses, maintenance facilities, cart and pedestrian pathways, parking areas, i.e. all associated support uses.</p> <p>2. Two hundred (200) acres of indigenous vegetation preserve is required for every 18 holes. The indigenous vegetation preserve requirement may be provided on-site or off-site. On-site preserves must be a minimum of 1 acre in size; minimum 75 feet wide with an average 100-foot width. Indigenous vegetation preserved on site may utilize a two to one (2:1) credit on a sliding scale based on minimum acreage and width criteria to be included in the Land Development Code. However, the indigenous vegetation preserve requirement must be met with a minimum of one hundred (100) actual indigenous acres</p>
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		<p>onsite. Indigenous vegetation preservation requirements must be met outside of the 150-acre golf course impact area.</p> <p>3. All off-site indigenous vegetation preserves must be located within the DR/GR areas. Unless located within or adjacent to existing or designated public acquisition areas, the minimum parcel size is fifty (50) indigenous acres.</p> <p>4. The off-site indigenous vegetation preserves must include a management plan that is approved as part of the Planned Development rezoning. This management plan must include invasive exotic vegetation removal with perpetual management. This does not preclude the transfer of the property to a public entity as long as perpetual maintenance is guaranteed.</p> <p>5. Additional golf development must be in increments of 9 golf holes. For every additional 9 golf holes, the site area must be increased by 75 acres. Additional golf course impacts are limited to 75 acres per nine holes. The on-site or off-site indigenous preserve area must be increased by 100 acres for each nine holes and is subject to the restrictions above. (Added by Ordinance No. 99-16, Amended by Ordinance No. 02-02)</p>
10	IV-10	<p><b>GOAL 60: COORDINATED SURFACE WATER MANAGEMENT AND LAND USE PLANNING ON A WATERSHED BASIS.</b> To protect or improve the quality of receiving waters and surrounding natural areas and the functions of natural groundwater aquifer recharge areas while also providing flood protection for existing and future development.</p> <p><b>OBJECTIVE 60.1: COUNTY-WIDE PROGRAM.</b> Lee County will continue its efforts in developing a surface water management program that is multi-objective in scope and is geographically based on basin boundaries. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 60.1.1:</b> The detailed Surface Water Management Master Plan that was initiated in 1989 to identify the existing watershed basin boundaries within Lee County, to evaluate the storm capacity and establish design criteria, and to determine costs for surface water management within each basin to meet applicable design storm standards will be completed by 2005. (Amended by Ordinance No. 98-09)</p> <p><b>POLICY 60.1.2:</b> Develop surface water management systems in such a manner as to protect or enhance the groundwater table as a possible source of potable water.</p> <p><b>POLICY 60.1.3:</b> Incorporate, utilize, and where practicable restore natural surface water flow-ways and associated habitats.</p> <p><b>POLICY 60.1.4:</b> The county will examine steps necessary to restore principal flow-way systems, if feasible, to assure the continued environmental function, value, and use of natural surface water flow-ways and associated wetland systems. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 60.1.5:</b> Additional public hearings on Lee Plan amendments will be held to incorporate each phase of the Surface Water Management Master Plan. These amendments will specifically address:</p> <ul style="list-style-type: none"> <li>(a) incorporating the additions to the database into the Lee Plan;</li> <li>(b) modifying the interim level-of-service standards; and</li> <li>(c) modifying the Future Land Use, Community Facilities and Services, and Capital Improvements elements as necessary to incorporate the study's initial findings. (Amended by Ordinance No. 94-30)</li> </ul>

	<p><b>POLICY 60.1.6:</b> Lee County will maintain in its land development regulations requirements that proper storm water management systems be installed when land is being redeveloped. Appropriate exemptions will be provided to this requirement for individual residential structures and for historic districts. The regulations may also provide modified storm water management standards for publicly sponsored projects within community redevelopment areas (as defined by Chapter 163, Part III, Florida Statutes). However, this policy will not be interpreted so as to waive any concurrency level-of-service standards. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>OBJECTIVE 60.2: BASIN PROGRAM.</b> Promote water management permitting on a basin-wide basis, as opposed to the current individual-site approach used by Lee County and the South Florida Water Management District, through pilot or demonstration programs in two or more basins by 1996. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 60.2.1:</b> The Surface Water Management Master Plan will identify those basins (or sub-basins) which may be most suitable for basin-wide surface water management, based on:</p> <ul style="list-style-type: none"> <li>• natural flow ways and drainage patterns;</li> <li>• existing development patterns;</li> <li>• land ownership patterns; and</li> <li>• development potential based on the Future Land Use element of this plan. (Amended by Ordinance No. 00-22)</li> </ul> <p><b>POLICY 60.2.2:</b> Taxing/benefit districts or other financing mechanisms established pursuant to Goal 3 of this plan will include an examination of the potential for basin-wide surface water management within the designated area. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 60.2.3:</b> The County will utilize the Water Conservation Utility to implement the provision and maintenance of collection and disposal systems for storm water and the regulation of groundwater. By the end of 1996, the county will establish a dedicated funding source for the effective operation of the Storm water Management Utility. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>OBJECTIVE 60.3: LEVEL-OF-SERVICE STANDARDS.</b> Revise by 1996 the surface water management level-of-service standards for basins and sub-basins identified in the Surface Water Management Master Plan. These future service standards can only be finalized upon the completion of the basin studies and will be based upon providing a defined level of flood protection, balanced with the protection of natural flow ways and associated wetland systems. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 60.3.1:</b> The following surface water management standards are adopted as minimum acceptable levels of service for unincorporated Lee County (see Policy 95.1.3).</p> <p>A. Existing Infrastructure/Interim Standard The existing surface water management system in the unincorporated areas of the county will be sufficient to prevent the flooding of designated evacuation routes (see Map 15) from the 25-year, 3-day storm event (rainfall) for more than 24 hours.</p> <p>B. Six Mile Cypress Watershed (see Map 18) The level-of-service standard for the Six Mile Cypress Watershed will be that public infrastructure remains adequate such that floor slabs for all new private</p>
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	<p>and public structures which are constructed a minimum of one (1) foot above the 100-year, 3-day storm event flood plain level for Six Mile Cypress Watershed will be safe from flooding from a 100-year, 3-day storm event (rainfall). The 100-year level and watershed boundaries are as established in Volume IV of the Six Mile Cypress Watershed Plan. The following additional standards are hereby established as desired future level-of-service standards, to be achieved by September 30, 1994:</p> <ol style="list-style-type: none"> <li>1. The Six Mile Cypress Slough and its major tributaries as identified in the Six Mile Cypress Watershed Plan (February 1990) must accommodate the associated discharge from the 25 year, 3-day storm event (rainfall). [Ref: Six Mile Cypress Watershed Plan (February 1990) -Volume II, Pages 10-5.]</li> <li>2. Water quality will be improved in accordance with EPA's NPDES and Rule 17-40 F.A.C.criteria for storm water discharges.</li> </ol> <p>C. Other Watersheds (see Map 18):  Gator Slough, Yellow Fever Creek, Yellow Fever Creek-East Branch, Powell Creek, Billy Creek, Whiskey Creek, Deep Lagoon, Cow Creek, Hendry Creek, Ten Mile Canal, and Imperial River Watersheds.</p> <p>The level-of-service standard for the above watersheds will be that all arterial roads at their crossing of the trunk conveyances, as referenced in the Lee County Surface Water Management Master Plan, will be free of flooding from the 25-year, 3-day storm event (rainfall). This standard will not apply to Chiquita Boulevard because it is located within the City of Cape Coral. The following additional standards are hereby established as desired future level-of-service standards to be achieved by September 30, 1994:</p> <ol style="list-style-type: none"> <li>1. Floor slabs for all new private and public structures which are constructed a minimum of one (1) foot above the 100-year, 3-day storm event flood plain level will be safe from flooding from a 100-year, 3-day storm event (rainfall).</li> <li>2. Water quality will be improved in accordance with EPA's NPDES and Rule 17-40 F.A.C. criteria for storm water discharges.</li> </ol> <p>D. Regulation of Private and Public Development</p> <p>Surface water management systems in new private and public developments (excluding widening of existing roads) must be designed to SFWMD standards (to detain or retain excess storm water to match the predevelopment discharge rate for the 25-year, 3-day storm event [rainfall]). Storm water discharges from development must meet relevant water quality and surface water management standards as set forth in Chapters 17-3, 17-40, and 17-302, and rule 40E-4, F.A.C. New developments must be designed to avoid increased flooding of surrounding areas. Development must be designed to minimize increases of discharge to public water management infrastructure (or to evapotranspiration) that exceed historic rates, to approximate the natural surface water systems in terms of rate, hydroperiod, basin and quality, and to eliminate the disruption of wetlands and flow-ways, whose preservation is deemed in the public interest. (Amended by Ordinance No. 92-35, 94-29, 00-22)</p> <p><b>POLICY 60.3.2:</b> The county will continue to maintain and update annually the CIP to provide for the needs of the surface water management program. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 60.3.3:</b> The revised levels of service required to guide future investments in surface water management facilities will be based on the recommendations of the Surface Water Management Master Plan, as updated, and procedures will be established to keep current the levels of service,</p>
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remaining capacity of existing facilities, and demand for new facilities.

**POLICY 60.3.4:** Water management projects will be evaluated and ranked according to the priorities adopted into this plan. Major emphasis will be given to improving existing drainage facilities in and around future urban areas as shown on the Future Land Use Map, and to enhancing or restoring environmental quality. (Amended by Ordinance No. 00-22)

**POLICY 60.3.5:** By 1996, complete the preliminary design of storm water management systems for each basin identified in the Surface Water Management Master Plan and develop a capital facility improvement schedule. (Amended by Ordinance No. 94-30)

**OBJECTIVE 60.4: CRITICAL AREAS.** The Six Mile Cypress Basin (as defined in Chapter 10 of the Land Development Code) and the Density Reduction/Groundwater Resource land use category are both identified as "critical areas for surface water management." The county will maintain existing regulations to protect the unique environmental and water resource values of these areas. (Amended by Ordinance No. 94-30, 00-22)

**POLICY 60.4.1:** The county will maintain provisions in Chapter 10 of the Land Development Code that reduce or eliminate the exemptions allowable in the Six Mile Cypress Basin. (Amended by Ordinance No. 94-30, 00-22)

**POLICY 60.4.2:** The county will maintain the elimination of the exemptions in its development regulations for agricultural uses and small subdivisions within the "critical areas for surface water management" and will continue to subject these uses to an appropriate review process. (Amended by Ordinance No. 94-30, 00-22)

**OBJECTIVE 60.5: INCORPORATION OF GREEN INFRASTRUCTURE INTO THE**

**SURFACE WATER MANAGEMENT SYSTEM.** The long-term benefits of incorporating green infrastructure as part of the surface water management system include improved water quality, improved air quality, improved water recharge/infiltration, water storage, wildlife habitat, recreational opportunities, and visual relief within the urban environment. (Added by Ordinance No. 03-06).

**POLICY 60.5.1:** The County encourages new developments to design their surface water management systems to incorporate best management practices including, but not limited to, filtration marshes, grassed swales planted with native vegetation, retention/detention lakes with enlarged littoral zones, preserved or restored wetlands, and meandering flow-ways. (Added by Ordinance No. 03-06)

**POLICY 60.5.2:** The County encourages new developments to design their surface water management system to incorporate existing wetland systems. (Added by Ordinance No. 03-06)

**POLICY 60.5.3:** The County encourages the preservation of existing natural flow-ways and the restoration of historic natural flow-ways. (Added by Ordinance No. 03-06)

**POLICY 60.5.4:** The County will continue to identify and map flow-ways as part of the Lee County Surface Water Management Plan. The Plan provides a general depiction of watersheds and their trunk and major tributaries and has been expanded to some degree in the DRGR area. As new information is assembled, the Plan will be updated for public use. Due to its magnitude and need for site specific information, not all flow-ways will be shown. (Added by Ordinance No. 03-06)



		<p><b>POLICY 60.5.5:</b> The County will continue to coordinate the review of flow-ways with the other regulatory agencies and assist in the development of incentives and /or credits for implementation of regional surface water management systems that address flood protection, water quality/ environmental enhancement and water conservation. (Added by Ordinance No. 03-06)</p>
11	VII-5	<p><b>GOAL 107: RESOURCE PROTECTION.</b> To manage the county's wetland and upland ecosystems so as to maintain and enhance native habitats, floral and faunal species diversity, water quality, and natural surface water characteristics.</p> <p><b>OBJECTIVE 107.1: RESOURCE MANAGEMENT PLAN.</b> The county will continue to implement a resource management program that ensures the long-term protection and enhancement of the natural upland and wetland habitats through the retention of interconnected, functioning, and maintainable hydroecological systems where the remaining wetlands and uplands function as a productive unit resembling the original landscape. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 107.1.1:</b> County agencies implementing the natural resources management program will be responsible for the following:</p> <ol style="list-style-type: none"> <li>1. Identifying upland and wetland habitats/systems most suitable for protection, enhancement, reclamation, and conservation.</li> <li>2. Recommending standards to the Board of County Commissioners for Board approval for development and conservation that will protect and integrate wetlands (as defined in Objective 114.1) and significant areas of Rare and Unique upland habitats (as defined in Objective 104.1).</li> <li>3. Preparing standards for wetland and rare and unique upland mitigation.</li> <li>4. Conducting a sensitive lands acquisition program, which will consist of the following elements (see also Policy 107.2.8):       <ol style="list-style-type: none"> <li>a. A comprehensive inventory of environmentally sensitive lands will be maintained and expanded as new data becomes available.</li> <li>b. Environmentally sensitive lands will include wetlands (as defined in Objective 114.1); important plant communities (as identified by Objective 107.2); critical habitat for listed wildlife species (see also Objective 107.8 and Policies 107.4.1, 107.4.2, 107.10.4, and 107.11.2); environmentally sensitive coastal planning areas (as defined in Policy 113.1.5); natural waterways; important water resources (as defined in Policy 117.1.1); storm and flood hazard areas; and Rare and Unique uplands (as defined in Objective 104.1).</li> <li>c. Beginning in 1997, the county will adopt and implement a program to acquire and manage lands critical to water supply, flood protection, wildlife habitat, and passive recreation. The program will be funded by an ad valorem tax of up to 0.50 (1/2) mil annually for a period not to exceed seven years. A fifteen member advisory group to be called the Conservation Lands Acquisition and Stewardship Advisory Committee (CLASAC) will develop and implement the program. Ten percent of the funds will be used to manage the lands acquired.</li> <li>d. The county will take full advantage of opportunities to cooperatively acquire and manage sensitive lands and to leverage other funding sources by working with state land acquisition and land management agencies such as the Florida Communities Trust and the Florida Game and Fresh Water Fish Commission and by participating in state land acquisition programs such as</li> </ol> </li> </ol>



	<p>the Save Our Rivers program and the Conservation and Recreational Lands program.</p> <p>e. The county (or other appropriate agency) will prepare a management plan for each acquired site for the long term maintenance and enhancement of its health and environmental integrity. The management plan will address any necessary people management (e.g., fences and signage to prevent incompatible uses such as off road vehicle use and hunting); surface water management and restoration; ecosystems restoration; litter control; fire management; invasive exotic plant and animal control; and, where appropriate, compatible recreational use facilities. The plan will also address how maintenance will be funded.</p> <p>f. The county will encourage the establishment of and provide assistance to community based land trusts, whose purpose is the preservation and protection of Lee County's natural resources.</p> <p>5. Maintaining a central clearinghouse for all environmental studies and recommendations by both public and private organizations.</p> <p>6. Compiling, maintaining and regularly updating county mapping of vegetation communities; listed species habitat and sitings; and water resources including watersheds, floodplains, wetlands, aquifers, and surface water features.</p> <p>7. Preparing recommendations for maintaining or restoring the desired seasonal base flows and water quality after reviewing monitoring data.</p> <p>8. Coordinating in the preparation of plans with the municipalities, South Florida Water Management District, and Southwest Florida Water Management District to better control flows of freshwater and reduce pollutant discharges into the Lee County coastal waters.</p> <p>9. Providing an annual progress report to the county commission on the resource management program. The report should address the adequacy of the program and land use regulations to protect and enhance these natural systems.</p> <p>10. Providing an annual report to the County Commission on the status of wetlands and rare and unique uplands by 1996. (Amended by Ordinance No. 94-30, 98-09, 00-22)</p> <p><b>OBJECTIVE 107.2: PLANT COMMUNITIES.</b> Lee County will maintain and routinely update an inventory of natural plant communities and will protect at various suitable locations remnant tracts of all important and representative natural plant communities occurring within Lee County. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.2.1:</b> Coordinate with state and regional agencies to exchange updated natural resources information. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.2.2:</b> Continue to provide regulations and incentives to prevent incompatible development in and around environmentally sensitive lands (as defined in Policy 107.1.1.4.b.). (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.2.3:</b> Prevent water management and development projects from altering or disrupting the natural function of significant natural systems.</p> <p><b>POLICY 107.2.4:</b> Encourage the protection of viable tracts of sensitive or high-quality natural plant communities within developments.</p> <p><b>POLICY 107.2.5:</b> Maintain regulations to control the clearing of natural vegetation, including tree removal and clearing of understory, prior to the development of property or its conversion to agricultural uses. (Amended by Ordinance No. 94-30)</p>
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	<p><b>POLICY 107.2.6:</b> Avoid needless destruction of upland vegetation communities including coastal and interior hammocks through consideration during the site plan review process of alternative layouts of permitted uses.</p> <p><b>POLICY 107.2.7:</b> Require inventories and assessments of the impacts of development in environmentally sensitive lands. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.2.8:</b> Promote the long-term maintenance of natural systems through such instruments as conservation easements, transfer of development rights, restrictive zoning, and public acquisition. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.2.9:</b> Maintain regulations, incentives, and programs for preserving and planting native plant species and for controlling invasive exotic plants, particularly within environmentally sensitive areas. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.2.10:</b> Development adjacent to aquatic and other nature preserves, wildlife refuges, and recreation areas must protect the natural character and public benefit of these areas including, but not limited to, scenic values for the benefit of future generations. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 107.2.11:</b> Prohibit the planting of invasive exotic plants in landscaping requirements for land development projects. Prohibited invasive exotic plant species will be specified in the Land Development Code. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 107.2.12:</b> To ensure that adequate protection of mangroves is maintained, the county will re-evaluate and amend, if necessary, its mangrove protection regulations whenever state mangrove protection regulations are revised. The county will oppose any efforts of other agencies to reduce or eliminate regulations relating to the protection of mangroves and other wetland areas. (Amended by Ordinance No. 93-25, 94-30, 00-22)</p> <p><b>OBJECTIVE 107.3: WILDLIFE.</b> Maintain and enhance the fish and wildlife diversity and distribution within Lee County for the benefit of a balanced ecological system. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.3.1:</b> Encourage upland preservation in and around preserved wetlands to provide habitat diversity, enhance edge effect, and promote wildlife conservation.</p> <p><b>POLICY 107.3.2:</b> Participate with the Southwest Florida Regional Planning Council and the Florida Game and Fresh Water Fish Commission in the development of a regional plan that identifies and protects areas utilized by wildlife, including panthers and bears so as to promote the continued viability and diversity of regional species. (Amended by Ordinance No. 92-48)</p> <p><b>OBJECTIVE 107.4: ENDANGERED AND THREATENED SPECIES IN GENERAL.</b> Lee County will continue to protect habitats of endangered and threatened species and species of special concern in order to maintain or enhance existing population numbers and distributions of listed species.</p> <p><b>POLICY 107.4.1:</b> Identify, inventory, and protect flora and fauna indicated as endangered, threatened, or species of special concern in the "Official Lists of Endangered and Potentially Endangered Fauna and Flora of Florida," Florida Game and Freshwater Fish Commission, as periodically updated. Lee County's Protected Species regulations will be enforced to protect habitat of those listed species found in Lee County that are vulnerable to development.</p>
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	<p>There will be a funding commitment of one full-time environmental planner to enforce this ordinance through the zoning and development review process. (Amended by Ordinance No. 92-48, 94-30, 00-22)</p> <p><b>POLICY 107.4.2:</b> Conserve critical habitat of rare and endangered plant and animal species through development review, regulation, incentives, and acquisition.</p> <p><b>POLICY 107.4.3:</b> Require detailed inventories and assessments of the impacts of development where it threatens habitat of endangered and threatened species and species of special concern.</p> <p><b>POLICY 107.4.4:</b> Restrict the use of protected plant and wildlife species habitat to that which is compatible with the requirements of endangered and threatened species and species of special concern. New developments must protect remnants of viable habitats when listed vegetative and wildlife species inhabit a tract slated for development, except where equivalent mitigation is provided. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>OBJECTIVE 107.5: LOGGERHEAD SEA TURTLES.</b> Continue the sea turtle protection program to minimize the disorientation of sea turtles along the Gulf beaches. (Amended by Ordinance No. 94- 30)</p> <p><b>POLICY 107.5.1:</b> The sea turtle protection program includes at least the following activities:</p> <ol style="list-style-type: none"> <li>1. Distribute a guide for homeowners and builders which explains the detrimental effects of night-time beachfront lighting on hatchling sea turtles.</li> <li>2. Continue to examine public light sources (streetlights, security lights, beach access lights, etc.) and prepare a plan to minimize the amount of harmful light from such sources onto the beach during the nesting season.</li> <li>3. Continue to conduct an educational program to persuade residents to reduce lighting levels on the beach and to publicize other hazards to turtles from activities of people, pets, and vehicles.</li> <li>4. Continue to provide and enforce sea turtle regulations to prevent inappropriate lighting along beaches during the nesting season. (Amended by Ordinance No. 94-30)</li> </ol> <p><b>OBJECTIVE 107.6: SOUTHERN BALD EAGLES.</b> The county will continue to monitor Southern bald eagle nesting activity and offer incentives to conserve buffer areas around Southern bald eagle nests. (Amended by Ordinance No. 98-09)</p> <p><b>POLICY 107.6.1:</b> Maintain a policy of negotiations with owners of land surrounding eagle nests to provide an optimal management plan for land subject to imminent development.</p> <p><b>POLICY 107.6.2:</b> The county Eagle Technical Advisory Committee will continue to conduct nest monitoring through the nesting season for all known eagle nests in Lee County. Information from these assessments will be used to modify, as needed, the adopted nest guidelines and to adopt guidelines for new eagle nests documented in Lee County. (Amended by Ordinance No. 94-30, 98-09, 00-22)</p> <p><b>POLICY 107.6.3:</b> The Committee will continue to inform land owners and the general public of proper practices to minimize disturbances to eagle nests. (Amended by Ordinance No. 94-30, 98-09)</p> <p><b>OBJECTIVE 107.7: WEST INDIAN MANATEES.</b> Minimize injuries and mortality of manatees to maintain the existing population by encouraging the adoption by the state of Florida and local governments of regulations to protect the West Indian Manatee in the Caloosahatchee and elsewhere in Lee</p>
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	<p>County. By 1998, manatee protection plans will be prepared for other waters of Lee County also frequented by manatees. (Amended by Ordinance No. 94-30, 98-09)</p> <p><b>POLICY 107.7.1:</b> Characterize and map important manatee habitats; identify and evaluate potential threats to important habitats; and consider management agreements to protect such habitats.</p> <p><b>POLICY 107.7.2:</b> Identify areas of greatest actual or potential boat/barge mortality and/or injury by 1998, and re-evaluate existing slow or idle speed zones. (Amended by Ordinance No. 94-30, 98-09)</p> <p><b>POLICY 107.7.3:</b> Inform and educate the public through sign posting, lectures, and regulations about manatee protection.</p> <p><b>POLICY 107.7.4:</b> Educational materials regarding manatees should be disseminated to boaters and warning signs placed in areas where both manatees and humans congregate.</p> <p><b>POLICY 107.7.5:</b> Construction and expansion of multi-slip docking facilities and boat ramps will be encouraged in locations where there is quick access to deep, open waters where the associated increase in boat traffic will be outside areas of high manatee concentration. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 107.7.6:</b> State, local, and private interests will work in cooperation to develop and implement area-specific manatee protection plans. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 107.7.7:</b> The county will continue to provide a permanent funding source to assist in the enforcement of vessel regulations for manatee protection. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>OBJECTIVE 107.8: GOPHER TORTOISES.</b> The county will protect gopher tortoises through the enforcement of the protected species regulations and by operating and maintaining, in coordination with the Florida Game and Fresh Water Fish Commission, the Hickey Creek Mitigation Park. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.8.1:</b> The county's policy is to protect gopher tortoise burrows wherever they are found. However, if unavoidable conflicts make on-site protection infeasible, then off-site mitigation may be provided in accordance with Florida Game and Fresh Water Fish Commission requirements. (Amended by Ordinance No. 94-30)</p> <p><b>OBJECTIVE 107.9: RED-COCKADED WOODPECKER.</b> County staff will coordinate with the Florida Game and Fresh Water Fish Commission to determine on a case-by-case basis the appropriate mitigation for the protection of the red-cockaded woodpecker's habitat. Mitigation may include onsite preservation, on-site mitigation, off-site mitigation, and associated habitat management. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.9.1:</b> County staff will note and document other possible red-cockaded woodpecker sites during routine site inspections.</p> <p><b>OBJECTIVE 107.10: WOODSTORK.</b> Lee County will maintain regulatory measures to protect the wood stork's feeding and roosting areas and habitat. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 107.10.1:</b> County protected species regulations will continue to include wood storks as a Lee County Listed Species, requiring surveys for and protection of wood stork habitat. The county will continue to maintain an inventory of documented feeding, roosting, and rooking areas for the wood stork to ensure that surveys submitted through the Protected Species Ordinance include such areas. (Amended by Ordinance No. 94-30, 00-22)</p>
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	<p><b>POLICY 107.10.2:</b> The county will continue to require management plans for existing wood stork feeding, roosting, and rooking areas to utilize "Habitat Management Guidelines for the Wood Stork in the Southeast Region" (U.S Fish and Wildlife Service, 1990). (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 107.10.3:</b> The county will encourage the creation of wood stork feeding areas in mandatory littoral shelf design, construction, and planting. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 107.10.4:</b> By 1995, the county will identify wood stork flight patterns from roosting and rooking areas to feeding areas within the county. By 2000, evaluate the impact of existing tall structures on wood storks within significant flight areas and consider adoption of regulations if it is deemed appropriate. Include significant wood stork roosting, rooking, and feeding areas in the inventory of environmentally sensitive lands for potential acquisition (see Policy 107.1.1.4). (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 107.10.5:</b> The county will continue to permit communication towers in excess of 100 feet only by special exception. The impacts of such towers on woodstorks must be considered in the review of these applications. (Added by Ordinance No. 94-30, Amended by Ordinance No. 00-22)</p> <p><b>OBJECTIVE 107.11: FLORIDA PANTHER AND BLACK BEAR.</b> County staff will develop measures to protect the Florida panther and black bear through greenbelt and acquisition strategies. (Amended by Ordinance No. 92-48, 00-22)</p> <p><b>POLICY 107.11.1:</b> Lee County will maintain and update data on sitings and habitat for the black bear and Florida panther. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.11.2:</b> Encourage state land acquisition programs to include known panther and black bear corridors. The corridor boundaries will include wetlands, upland buffers, and nearby vegetative communities which are particularly beneficial to the Florida panther and black bear (such as high palmetto and oak hammocks). (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 107.11.3:</b> Lee County will inform Collier and Charlotte counties as to Lee County corridor acquisition projects to encourage a regional approach to corridor acquisition. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 107.11.4:</b> The county will continue to protect and expand upon the Corkscrew Regional Ecosystem Watershed Greenway, a regionally significant greenway with priority panther habitat, through continued participation in land acquisition programs and land management activities and through buffer and open space requirements of the Land Development Code. (Amended by Ordinance No. 98-09)</p> <p><b>POLICY 107.11.5:</b> The county will continue to include the Florida panther and black bear in the protected species management section of Chapter 10 of the Land Development Code. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 107.11.6:</b> In any vegetation restoration projects conducted by Lee County for land acquired due to its environmental sensitivity (such as the Six Mile Cypress Strand and the Flint Pen Strand), plant lists will include species that provide forage for the prey of the Florida panther and forage for the black bear. (Amended by Ordinance No. 00-22)</p> <p><b>OBJECTIVE 107.12: MARINE PRODUCTIVITY.</b> Lee County will</p>
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		<p>support maintenance and improvement of marine fisheries productivity, and promote the conservation of fishery resources through the protection and restoration of finfish and shellfish habitat. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 107.12.1:</b> Assist in creating and renourishing artificial reefs in coordination with the Florida Department of Environmental Protection and other appropriate organizations. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 107.12.2:</b> Support state and federal fisheries management programs that protect and enhance the long-term biological and economic productivity of coastal and estuarine waters and their sources for commercial and sport fisheries.</p> <p><b>POLICY 107.12.3:</b> Unmarked channels or passages that have been used to traverse shallow inshore waters may be marked to reduce injury to marine seagrass beds if appropriate (subject to obtaining necessary permit approvals).</p>
12	VII-12	<p><b>GOAL 108: ESTUARINE WATER QUALITY.</b> To manage estuarine ecosystems so as to maintain or improve water quality and wildlife diversity; to reduce or maintain current pollution loading and system imbalances in order to conserve estuarine productivity; and to provide the best use of estuarine areas. (Amended by Ordinance No. 94-30)</p> <p><b>OBJECTIVE 108.1:</b> Establish baseline conditions in all estuarine systems, including pollutant and freshwater loadings by 2000, and maintain an ongoing water quality monitoring program. Maintain communication with other local, state, and federal estuarine water quality studies to ensure that the latest data and recommendations are available. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 108.1.1:</b> The Lee County Division of Natural Resources Management (or its successor) will monitor estuarine water quality and be responsible for:</p> <ol style="list-style-type: none"> <li>1. Setting up and operating a network of water quality sampling sites to fill in gaps in the state sampling program, especially in Estero Bay.</li> <li>2. Maintaining liaison with other local, state, and federal agencies engaged in water quality monitoring, and reviewing their data, conclusions, and recommendations.</li> <li>3. Developing a system for reporting on water quality conditions and trends on a regular basis.</li> <li>4. Recommending actions that are intended to maintain or improve water quality in the estuaries to meet the Department of Environmental Protection's criteria for the appropriate class water body and preserve the "approved for shellfish harvesting" classification where applicable, while attempting to return viable "closed" (due to water quality) shellfishing areas to an "approved" status. (Amended by Ordinance No. 94-30, 00-22)</li> </ol> <p><b>POLICY 108.1.2:</b> Development affecting coastal and estuarine water resources must maintain or enhance the biological and economic productivity of these resources. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 108.1.3:</b> The county will cooperate with the South Florida Water Management District, local utilities, and other appropriate agencies for monitoring and review of freshwater discharge affecting estuarine areas, in order to maintain the biological and chemical balances necessary for optimum productivity. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 108.1.4:</b> The county will cooperate with the Florida Marine Patrol, U.S. Coast Guard, U.S. Army Corps of Engineers, and the Florida Department</p>

		<p>of Environmental Regulation in the enforcement of pollution control standards for marinas, marine dumping, and illegal discharges from water craft. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 108.1.5:</b> Installation of shoreside pumpout stations at marinas that serve live-aboards will be required to provide adequate facilities for subsequent transfer and treatment of boat sewage. The county will consider expanding this requirement to all marinas where central sewer service is available. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 108.1.6:</b> Lee County encourages the on-going efforts by the SFWMD in establishing a Caloosahatchee Water Management Plan for the Caloosahatchee River that recognizes public, environmental and agricultural uses of the river through participation in the Southwest Florida Feasibility Study, Lower East Coast and Lower West Coast Regional Water Supply Plans, Caloosahatchee Study, Minimum Flows and Levels, and the development of maximum flows and discretionary release protocols for Lake Okeechobee. (Added by Ordinance No. 02-02)</p> <p><b>OBJECTIVE 108.2: WATERSHED MANAGEMENT PLANS.</b> By 1996, establish procedures for reviewing all new upland development in terms of its impacts on estuarine systems. Prepare estuarine watershed management plans which maximize stormwater retention and treatment, with priority to the Estero Bay watershed. (Amended by Ordinance No. 94-30)</p> <p><b>POLICY 108.2.1:</b> The county's estuarine watershed management agency will be responsible for:</p> <ol style="list-style-type: none"> <li>1. Preparing management plans for estuarine watersheds, with priority to the watershed of Estero Bay, a critical estuary undergoing development impacts.</li> <li>2. Recommending modifications to the Sanibel causeway in order to improve estuarine water quality.</li> <li>3. Reviewing the feasibility of changing canal patterns and retrofitting existing stormwater collection systems in order to reduce the impact of freshwater on estuaries.</li> <li>4. Assessing the adequacy of disaster preparedness plans for coastal oil storage facilities. (Amended by Ordinance No. 94-30, 00-22)</li> </ol> <p><b>POLICY 108.2.2:</b> The County will review the Comprehensive Conservation and Management Plan for the Greater Charlotte Harbor Watershed by the year 2002 in order to identify key action plans, objectives and policies that relate to Pine Island Sound, Matlacha Pass, the Estero Bay, the tidal Caloosahatchee and attendant watersheds. The review will assess County upland and coastal development management practices and public land acquisition programs as they related to the findings and recommendations of the Charlotte Harbor Plan. Particular emphasis will be placed on evaluating the effectiveness and improvement of County watershed programs as they relate to watershed conservation and public land acquisition programs, watershed management needs prioritization and water quality monitoring. (Added by Ordinance No. 02-02)</p>
13	VII-19	<p><b>GOAL 114: WETLANDS.</b> To maintain and enforce a regulatory program for development in wetlands that is cost-effective, complements federal and state permitting processes, and protects the fragile ecological characteristics of wetland systems. (Amended by Ordinance No. 94-30)</p> <p><b>OBJECTIVE 114.1:</b> The natural functions of wetlands and wetland systems will be protected and conserved through the enforcement of the county's</p>



wetland protection regulations and the goals, objectives, and policies in this plan. "Wetlands" include all of those lands, whether shown on the Future Land Use Map or not, that are identified as wetlands in accordance with F.S. 373.019(17) through the use of the unified state delineation methodology described in FAC Chapter 17-340, as ratified and amended by F.S. 373.4211. (Amended by Ordinance No. 94-30, 00-22)

**POLICY 114.1.1:** Development in wetlands is limited to very low density residential uses and uses of a recreational, open space, or conservation nature that are compatible with wetland functions. The maximum density in the Wetlands category is one unit per 20 acres, except that one single family residence will be permitted on lots meeting the standards in Chapter XIII of this plan, and except that owners of wetlands adjacent to Intensive Development, Central Urban, Urban Community, Suburban, and Outlying Suburban areas may transfer densities to developable contiguous uplands under common ownership in accordance with Footnotes 9b and 9c of Table 1(a), Summary of Residential Densities. (Amended by Ordinance No. 94-30, 00-22)

**POLICY 114.1.2:** The county's wetlands protection regulations will be amended by 1995 to be consistent with the following:

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 DEP or SFWMD dredge and fill permit or exemption.
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.
3. Lee County will incorporate the terms and conditions of state permits into county permits and will prosecute violations of state regulations and permit conditions through its code enforcement procedures.
4. Every reasonable effort will be required to avoid or minimize adverse impacts on wetlands through the clustering of development and other site planning techniques. On- or off-site mitigation will only be permitted in accordance with applicable state standards.
5. Mitigation banks and the issuance and use of mitigation bank credits will be permitted to the extent authorized by applicable state agencies. (Amended by Ordinance No. 94-30, 00-22)

**POLICY 114.1.3:** The Future Land Use Map shows the approximate boundaries of wetlands in Lee County. The map will be updated by 2000 based on the definitions in this plan and new information. If the Future Land Use Map is incorrect due to a clear factual error, or if an exact boundary determination is desired, an administrative process is set out in Chapter XIII of this plan to establish the precise boundary of the wetland. (Amended by Ordinance No. 94-30)

**POLICY 114.1.4:** By the end of 2006, Lee County will amend the Lee County Land Development Code to establish a sufficient setback requirement for the placement of fill adjacent to existing mangroves or require development designs that address the interface of fill areas with existing mangroves to eliminate impacts from fill sloughing or washing into mangrove areas. Techniques to accomplish this include, but are not limited to: setbacks; stabilized slopes; retaining walls; and, rip rap revetments. (Added by Ordinance No. 05-19)

14	VII-21	<p><b>GOAL 117: WATER RESOURCES.</b> To conserve, manage, and protect the natural hydrologic system of Lee County to insure continued water resource availability. (Amended by Ordinance No. 94-30)</p> <p><b>OBJECTIVE 117.1: WATER SUPPLIES.</b> Insure water supplies of sufficient quantity and quality to meet the present and projected demands of all consumers and the environment, based on the capacity of the natural systems.</p> <p><b>POLICY 117.1.1:</b> Natural water system features which are essential for retention, detention, purification, runoff, recharge, and maintenance of stream flows and groundwater levels shall be identified, protected, and managed.</p> <p><b>POLICY 117.1.2:</b> The county will recognize and encourage water and wastewater management, provided that such management does not exceed the natural assimilative capacity of the environment or applicable health standards. Appropriate water and wastewater management includes, but is not limited to, aquifer recharge, dual water systems, use of low volume irrigation systems, use of water-conserving vegetation, and other conservation and recycling techniques. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 117.1.3:</b> Freshwater resources will be managed in order to maintain adequate freshwater supplies during dry periods and to conserve water. (Amended by Ordinance No. 00- 22)</p> <p><b>POLICY 117.1.4:</b> Development designs must provide for maintaining surface water flows, groundwater levels, and lake levels at or above existing conditions. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 117.1.5:</b> The county will cooperate with the United States Geological Survey, South Florida Water Management District, and state agencies to develop an area-wide water resources plan emphasizing planning and management of water resources on the basis of drainage basins; and addressing the needs of the existing and potential built environment, natural hydrologic system requirements, and freshwater flow impacts on estuarine systems. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 117.1.6:</b> The county will continue to support a monitoring program of existing baseline conditions of water resources. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 117.1.7:</b> The county will cooperate fully with emergency water conservation measures of the South Florida Water Management District. (Amended by Ordinance No. 00-22)</p> <p><b>POLICY 117.1.8:</b> The county will support the acquisition and protection of the Flint Pen Strand as a major water retention and aquifer recharge area. (See also Policy 107.11.4.) (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>OBJECTIVE 117.2: XERISCAPE LANDSCAPE.</b> The county will continue to promote xeriscape landscaping techniques. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 117.2.1:</b> The county will continue to encourage xeriscape landscaping techniques for new development in the Land Development Code. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 117.2.2:</b> The county will provide education on water conservation through creative landscaping, and promote the conservation and use of native plant species through xeriscape landscaping techniques. (Amended by Ordinance No. 94-30, 00-22)</p> <p><b>POLICY 117.2.3:</b> The county will establish local guidelines that will assist in</p>
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		efforts to reduce landscape irrigation water use to the lowest and most efficient, practical level. (Amended by Ordinance No. 00-22)
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**Lee Master Mitigation Plan (LMMP) –  
DRAFT August 9, 2004**

<b>LMMP – Selected Sections Related to Resource Preservation</b>		
<b>Item</b>	<b>Page</b>	<b>Information</b>
1	2	<p>The Lee County Master Mitigation Plan (Mitigation Plan) is an investment strategy for economic stability. With tourism and retirement as the major components of the County’s economic base, ensuring that there are a diversity of open space features, quality outdoor experiences, and healthy air and water quality makes tremendous economic sense. The Mitigation Plan has three main purposes:</p> <ol style="list-style-type: none"> <li>1. to provide a master strategy by which critical environmental features continue to be preserved,</li> <li>2. to provide “safe harbor” approaches for mitigation projects that are required for the infrastructure needed to accommodate growth, which in turn will enable the budgeting process to be reliable, and</li> <li>3. to restore degraded resources that are important for the health, safety, and welfare of the public.</li> </ol> <p>The Mitigation Plan will, once adopted, be a component of the implementation of the Lee County Comprehensive Plan. Implementation includes incorporation into the Administrative Code, capital budget direction, and land development code reform.</p>
2	4	<p>While it is impossible to describe the future face of the County with any degree of certainty or precision, the Lee County Comprehensive Plan has identified themes that will be of great importance as Lee County approaches the planning horizon. These themes include:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> The growth patterns of the County will continue to be dictated by a Future Land Use map that will not change dramatically during the time frame of the Comprehensive Plan. With the exception of Cape Coral and Lehigh Acres, the County's urban areas will essentially be built out by 2020 (pending, in some cases, redevelopment). The County will attempt to maintain the clear distinction between urban and rural areas that characterizes this plan. Its success will depend on two things: the continuing viability of agricultural uses and the amount of publicly owned land in outlying areas.</li> <li><input type="checkbox"/> The County will protect its natural resource base in order to maintain a high quality of life for its residents and visitors. This will be accomplished through an aggressive public land acquisition program and by maintaining and enforcing cost-effective land use and environmental regulations that supplement, where necessary, Federal, State, and regional regulatory programs.</li> </ul>

		<p>Offsetting the impacts of infrastructure projects that are necessary to accommodate the ongoing growth of the County is of paramount importance. To be successful in preserving the natural resources of Lee County, we must devise a better way of projecting the impacts of growth and utilize a decision-making process that effectively allows growth to occur without sacrificing the natural systems upon which our economy and quality of life depend. The Mitigation Plan is being developed to facilitate planning and budgeting for projects that will restore and protect natural resources of significant importance and foster the continued growth that has been forecast in the County.</p>
3	5	<p>While all public works projects are designed to avoid negative impacts to natural resources, there are times when impacts cannot be avoided. Such impacts, even when minimized, must be mitigated for, and such mitigation cannot always effectively occur on the site of the project. Lee County is proposing the Mitigation Plan to provide consistency and a cumulative accountability for the primary and secondary impacts of its public works program. In addition, the County proposes to pursue restoration and preservation opportunities for water pollution, fire hazards, wildlife and natural habitats as mitigation requirements are addressed through synergistic planning, budgeting and operational efforts.</p> <p>A team of representatives of public and private entities developed the Mitigation Plan in 2003 and 2004. Members of the team identified private and publicly owned parcels that could be candidate projects for preservation, restoration, or mitigation activities. These parcels were assessed in a preliminary manner and deemed potentially suitable for such activities. A map series has been created to facilitate the initiation of more detailed analysis. The Mitigation Plan is not intended to provide an in-depth analysis of potential projects. The maps will serve as a starting point for efforts to select appropriate preservation, restoration, or mitigation sites.</p>
4	6	<p>Those natural resources that can be depicted through mapping are provided in <i>Map Series One of Appendix A</i>. These resources are the ones commonly identified as materially contributing to the County's economy and sense of being. These are also the resources subject to State or Federal oversight through various permitting processes.</p>
5	8	<p>The County is the supreme land use authority for the areas under its jurisdiction, as is each City. The County's authority lies in the balance of interests and policies that comprise the governance needed for the public health, safety, and welfare. However, there are overriding Federal and State laws guiding how lands may be developed, or further developed,</p>



		also based upon public health, safety and welfare. These laws typically involve issuance of one or more permits.
6	10	<p>D. Local: There are three types of entities involved with County development. They are the Board of County Commissioners, in its general and enterprise capacities; the five cities of Bonita Springs, Cape Coral, Fort Myers, Fort Myers Beach, and Sanibel; and independent special districts, with the School Board being the most far reaching. All have capital capacities, and the County and cities have regulatory components.</p> <p>Lee County Board of County Commissioners (BoCC): The BoCC, the sponsor of the mitigation plan, has the most diverse set of responsibilities and authorities. The BoCC has certain Countywide duties, certain municipal scale duties for the unincorporated area, and certain enterprise duties; all three types of duties involve capital expenditures for infrastructure and the need to obtain permits. Two major departments implement these efforts.</p>
7	15	<p><i>Part V: Mitigation, Restoration and Preservation Opportunities</i></p> <p>Lee County's baseline for preservation and existing mitigation and restoration efforts consists largely of public lands that have tripled in acreage in the last 20 years. This baseline involves a large percentage of its coastal and bay shorelines and related wetlands; the Six Mile Cypress Slough Preserve; the Corkscrew Regional Ecosystem Trust lands; and a smaller host of public and private protection and mitigation lands. A baseline map is included in <i>Appendix A</i>.</p> <p>To address past problems and future needs, as well as continuing to pursue preservation goals, there are multiple efforts underway in Lee County and all of Southwest Florida. These have contributed greatly to the development of the Mitigation Plan and are summarized in <i>Appendix C</i>. While each major study and management program has its own goals and methodologies, for the purposes of this effort, key issues identified in Lee County by these efforts, general Federal and State environmental permitting laws, and the County's own Comprehensive Plan can be organized into three major categories: hydrology, water quality, and habitat/wildlife.</p> <p><i>Hydrology: Wetlands and Freshwater Bodies</i></p> <p>Wetlands cover approximately 22% of Lee County's land surface. They provide essential ecological functions including filtration and assimilation of runoff, groundwater recharge, sediment stabilization, the tempering of flood peak discharges to rivers and lakes, the subsequent slow release of these stored floodwaters during the dry season, and habitat for wildlife. Destruction of wetlands in the County is recognized as a contributing factor in declining environmental quality. Wetlands in Lee County are depicted in <i>Appendix A</i>.</p>



The freshwater resources of Lee County are subjected to intense management, primarily for flood control purposes. A system of weirs, levees and canals dots the landscape and moves water quickly from land surfaces and the groundwater table into ponds, lakes, streams, rivers and bays. This rapid conveyance of water has proved to be a double edged sword in Lee County – while it helps to protect the population from flooding (usually), it does not allow for adequate filtering of pollutants through natural processes, nor does it promote storage of water for utilization in the dry months of the year. In addition, in some parts of the County, the manipulation of flows has led to lower levels of aquifer recharge, harmful discharges of fresh water into our coastal waters, and, when flows are withheld, harmful salinity levels in estuarine systems. Freshwater resources are depicted in *Appendix A*.

*Water Quality and Non-Point Source Pollution*

While there are areas in Lee County where waters are not impaired, non-point source pollution, primarily stormwater runoff, has contributed significantly to the impairment of many surface waters in Lee County. Segments of all of the major tributaries to Estero Bay are listed as “impaired” by the DEP, meaning that they do not meet their designated beneficial uses. We anticipate that water body segments in the Caloosahatchee Basin will be designated as “impaired” when the DEP verifies its list for that area. Nutrients, dissolved oxygen, fecal coliform, and copper are the most common suspected pollutants in the water bodies. Impaired and potentially impaired waters are depicted in *Appendix A*.

Only the Surficial and Intermediate Aquifer Systems are used for domestic groundwater supply in Lee County. The Surficial Aquifer System is susceptible to anthropogenic contamination because of its proximity to the land surface. Lack of confinement, high recharge, and relatively high permeability and a high water table all increase the potential for contamination. Concerns exist about yield and recharge of the Intermediate Aquifer since it recharges from above and below, and the conditions of both recharge areas have been changing due to demand impacts upon them. The lower aquifer (various components of the Floridan Aquifer) is mineralized. It is a source of raw water for the desalination systems of Cape Coral and Sanibel, and the Lee County Utility Department also has wells within the lower aquifer.

*Habitat/Wildlife:* First agriculture, and then urbanization, displaced native species as a normal component of settlement. With the change in the County’s economic base and the implementation by Federal, State, County and city government of laws to protect species from becoming extinct, earlier views of land and resource management have changed.



Lee County is doing its part to protect natural resources, and proposes to do more. Initial efforts include the Southern Bald Eagle Management Plan and various habitat protection and restoration efforts including species survey requirements that go beyond State requirements, species management plan requirements, native indigenous preservation requirements, the Conservation 20/20 program and incorporation of green infrastructure into the surface water management system. However, habitat and listed species management goes beyond any local effort.

While the U.S. Fish and Wildlife Service has identified fifteen species of plants and animals in Lee County that are Federally listed as endangered, there are many more species whose populations are being monitored through Federal, State, regional and local efforts due to concerns that they may be in decline.

Habitat destruction and fragmentation have contributed to the loss of diversity and the decline in population of many native species in Lee County in both upland and wetland areas. The introduction of invasive non-native species has also contributed to the decline in native species as the exotics compete for available resources.

The report, *Closing the Gaps in Florida's Wildlife Habitat Conservation System*, published in 1994 by the Florida Game and Fresh Water Fish Commission, identifies Strategic Habitat Conservation Areas that should be conserved in order to maintain components of the State's biological diversity. By means of a computerized Geographic Information System, distribution maps depicting selected species of wildlife, threatened species of plants, and rare plant communities have been created. The maps in *Closing the Gaps*, when used in conjunction with maps in the Environmental Impact Statement on Southwest Florida growth, and others provided by State and Federal agencies, provide valuable information that can be used to identify and prioritize habitat needs in Lee County. Examples of these maps are included in *Appendix A*.

In response to a call for a systematic approach to manage resources for protection and restoration, and to capitalize upon mitigation efforts associated with the permitting needs of public infrastructure, a multi-agency task team convened in December of 2003 at the Southwest Florida Regional Planning Council at the request of the BoCC. The task team is identified in *Appendix I*.

Members of the task team identified private and publicly owned parcels that could be candidate projects for preservation, restoration, or mitigation programs. The aggregate of these parcels is depicted in *Appendix A*. A description of each parcels' suitability for public preservation, restoration, or mitigation efforts, along with a coarse estimate of the costs for the described efforts are provided as a one-time snapshot in *Appendix B*.

The listing also includes existing private and public mitigation, restoration, and some preservation projects. Use of existing lands and programs may meet short term permitting needs. The continued use of



		<p>private and public partnerships for adding lands to meet mitigation and restoration needs is expected to be a major component of the implementation of the Mitigation Plan. This baseline map and series of descriptions are presented for agency review as the vehicle for the physical expression of the Mitigation Plan's implementation. Public parcels depicted on the map commonly have deficiencies that need remediation. Private parcels depicted on the map are not required by the mitigation planning process to be mitigation sites. Appearance on the map does, however, reflect current environmental conditions of the land that are notable at the mapping scale. Their inclusion for mapping purposes demonstrates the systematic review of Lee County restoration needs and mitigation and preservation opportunities.</p> <p>The projects identified as candidates for preservation, restoration or mitigation through the Mitigation Plan are summarized in <i>Table Three</i> below. Most projects address more than one issue and many include some acreage that does not have to be acquired or restored, thus the figures in the table do not add up across rows or down columns.</p>
8	25	<p><i>Part VII: Review and Updating of the Mitigation Plan Annual Update</i></p> <p>The Mitigation Plan has been designed to be reviewed and updated on an annual basis. It will continually evolve and be influenced by the development of new or improved management techniques; increased coordination with other regional programs and conservation organizations; and changes in Federal, State and local regulations. As preparations for the new CIP begin each year, Lee County and its partners in both the public and private sectors should gather to assess the accomplishments that have resulted from implementation of the Mitigation Plan. The basis for this discussion will be a report that tracks the cumulative progress of acquisition and restoration activities undertaken to offset for the impacts of growth each year. Lee County and its partners will also assess the status of other efforts aimed at the restoration and protection of natural resources in the region (the Comprehensive Everglades Restoration Plan, Total Maximum Daily Loads Program, etc.) to determine how they affect and can be incorporated into the Mitigation Plan. Finally, the County will use existing monitoring programs, along with any necessary amendments, to establish progress in achieving overall restoration goals.</p> <p><i>Monitoring for Water Quality and Hydrology</i></p> <p>County Monitoring programs currently encompass water quality and hydrology. The lead County agency for monitoring is the Division of Natural Resources. Within the County as a whole, water quality monitoring stations are maintained by Lee County, the SFWMD, DEP, the City of Cape Coral, and a number of private entities. These stations monitor for a number of water quality indicators. Current monitoring stations are depicted in <i>Appendix A</i>. Common water quality indicators for nutrients, clarity, salinity, and so forth are identified in <i>Table Nine</i>. Data</p>



		<p>from these stations will be used to assess success in water quality programs, and to guide changes in mitigation and restoration activities on an annual basis. <i>Table Nine: Common Water Quality Indicators</i></p> <p>County Monitoring Programs for hydrology include canal and streamflow and groundwater/aquifer levels. Hydrologic flow and water level monitoring are provided by a number of entities, including Lee County itself, the SFWMD, the United States Geologic Survey, and a variety of public utilities and private water users. These stations commonly document stormwater discharge and flow of water bodies to ensure that flow levels are not exceeded. Current stage recording stations are depicted in <i>Appendix A</i>. They also document changes in groundwater levels and, to a certain degree, their change in mineralization. By monitoring these stations and conducting an annual assessment, Lee County will evaluate whether the goals of maintaining and improving groundwater storage and stabilization and recovery from saltwater intrusion are being met. A comparable level of analysis will come from the review of fire hazard areas, a side effect of drainage efforts that are too successful.</p> <p><i>Priority Review</i></p> <p>Restoration and protection priorities should be evaluated and affirmed or revised. Each map that is a part of the Mitigation Plan should be updated to reflect changes that occur over time in Lee County, and the map series should be expanded to include pertinent data from all permitting agencies and be placed in an accessible location on-line to maximize its usefulness to scientists, planners, reviewers and resource managers.</p> <p>From the review process, the Mitigation Plan databases can be updated, cooperative agreements can be affirmed and/or renegotiated and the planning and implementation processes can continue to advance. Lee County may either facilitate the annual review and update of the Mitigation Plan or contract with a consulting firm or agency such as the Southwest Florida Regional Planning Council for this work. Updates to maps may be performed in a similar manner.</p>
9	27	<p><i>Part VIII: Structure for Implementing the Plan</i></p> <p>Implementation of the Plan requires several steps which are proposed herein:</p> <p>A. Lee Plan Implementation</p> <p>Amend the Lee Plan, with <i>Lee County Department of Community Development</i> as the Lead Agency. (2005) The Lee Plan is Lee County's policy blue print for guiding development and redevelopment. Various elements of the Lee Plan will need to be amended to state that the Mitigation Plan is the County's environmental quality investment plan that will guild its expenditures for hydrology, water quality, and habitat. The Mitigation Plan itself will then become a supporting document to the Lee Plan. This approach follows the MPO model. The Lee Plan should explicitly identify in the Intergovernmental Coordination Element the</p>



		<p>other public agencies discussed below as partners. The Mitigation Plan should be stated in the Lee Plan to be a guide for the following County agencies and programs:</p> <p><i>Department of Transportation.</i> Pre-identify suitable sites for offsite mitigation.</p> <p><i>Division of Natural Resources:</i> Pre-identify suitable sites to initiate water quality and hydrology remediation, and mitigation for stormwater, navigation, and beach projects.</p> <p><i>Department of Utilities:</i> In conjunction with the Groundwater Resources assessment to be completed late 2004, (which will subsequently be used to update the Mitigation Plan), sites will be identified for hydrology mitigation for any projects with groundwater impacts.</p> <p><i>Department of Parks and Recreation:</i> Preliminary identification of candidate sites to link with the open space trails, greenways, and blueways master strategy being developed (and subsequently amended into the Lee Plan.) Identification of sites suitable for exotics removal, wherein it is a permit concern. Identification of watersheds for soils management evaluation priority.</p> <p><i>Division of County Lands:</i> Preliminary identification of candidate sites for preservation under Conservation 20/20, which would only be furthered if owners are willing sellers. Preliminary identification of candidate sites for the other County agencies' mitigation and remediation needs.</p> <p><i>Division of Animal Services:</i> Should a County role be required, identification of sites for exotic animal control.</p> <p><i>Airport Authority:</i> Preliminary identification of candidate sites for offsite remediation or mitigation.</p> <p><b>B. Mitigation Banks and Bank Designation</b></p> <p>Agencies in their permit programs have accepted mitigation banks. These are locations that have been assessed to achieve a certain "volume" of incremental benefit if restored. There is no requirement that properties be restored to natural conditions under existing uses (nor should there be, barring a public health, safety or welfare finding). Consequently, mitigated "banks" have been established to meet a market demand for lands that want to change uses and lose "grandfather" protection since the public health, safety and welfare declaration has been made for air, land and water resources for new uses. Many of these banks are privately owned and operated. Others are publicly owned, established in part for a bank purpose.</p> <p>The Lee County BoCC will identify and annually update those public and private "banks" in Lee County. The "banks" identified are those considered qualified to meet some part of Lee County's mitigation credit needs. Current mitigation "banks" in public and private management are depicted in <i>Appendix A</i> .</p>
10	App	<i>Appendix A</i>

A	<p><b>Map Series One</b></p> <p><b>Base System - Natural Hydrology</b></p> <p><i>Map 1A: Historic Flow Ways in DR/GR Areas &amp; Rivers/Streams Throughout Lee County</i></p> <p><i>Map 2A: 100 Year Flood Plain</i></p> <p><i>Map 3A: Soil Types</i></p> <p><i>Map 4A: Topography</i></p> <p><b>Base System - Current</b></p> <p><i>Map 5A: Wet Season Water Table</i></p> <p><i>Map 6A: Watersheds</i></p> <p><i>Map 7A: Wetlands</i></p> <p><i>Map 8A: Species Occurrence as Documented by the U.S. Fish and Wildlife Service</i></p> <p><i>Map 9A: Strategic Habitat Conservation Areas</i></p> <p><b>Base System - Impaired</b></p> <p><i>Map 10A: Impaired and Potentially Impaired Waters</i></p> <p><i>Map 11A: Fire Hazard Areas</i></p> <p><i>Map 12A: Biodiversity Hotspots</i></p> <p><b>Base System – Manmade/Existing Land Use (general boundaries of man altered system)</b></p> <p><i>Map 13A: Year 2000 Land Use</i></p> <p><i>Map 14A: Public Lands, Conservation Lands and Conservation Easements</i></p> <p><i>Map 15A: Transportation Network</i></p> <p><i>Map 16A: Utility Map</i></p> <p><i>Map 17A: Mitigation “Banks”</i></p> <p><b>Map Series Two</b></p> <p><b>Future</b></p> <p><i>Map 1B: Wetlands Buildout</i></p> <p><i>Map 2B: Water Storage Buildout</i></p> <p><i>Map 3B: Habitats Buildout</i></p> <p><i>Map 4B: Long Range Transportation Plan 2020 Needs Assessment Mitigation</i></p> <p><i>Map 5B: Proposed Mitigation/Restoration/Preservation Sites</i></p> <p><b>Map Series Three</b></p> <p><b>Capital Improvements Program</b></p> <p><i>Map 1C: Transportation</i></p> <p><i>Map 2C: Utilities</i></p> <p><i>Map 3C: Stormwater</i></p> <p><i>Map 4C: Parks and Recreation</i></p> <p><i>Map 5C: Long Range Transportation Plan 2020 Financially Feasible</i></p> <p><i>Map 6C: Lee County Monitor Wells</i></p> <p><i>Map 7C: Lee County Stage Recorders</i></p>
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		<p><i>Map Series Four</i>  <b>Environmental Justice Considerations</b>  <i>Map 1D: Minority percentage by Block Group</i>  <i>Map 2D: Average Income by Census Tract</i>  <i>Map 3D: Neighborhood Districts</i></p>
11	App C	<p><i>Appendix C: Contributory Agency and Regional Initiatives</i>  <i>Comprehensive Everglades Restoration Plan (CERP)</i>  <b>The CERP provides a framework and guide to restore, protect, and preserve the water resources of central and southern Florida.</b> It covers 16 counties, including Lee, over an 18,000-square-mile area, and centers on an update of the Central &amp; Southern Florida (C&amp;SF) Project. The C&amp;SF Project provides water supply, flood protection, water management and other benefits to south Florida. For close to 50 years, the C&amp;SF Project has performed its authorized functions well. However, the project has had unintended adverse effects on the unique and diverse environment that constitutes south Florida ecosystems. The Water Resources Development Acts in 1992 and 1996 provided the U.S. Army Corps of Engineers with the authority to re-evaluate the performance and impacts of the C&amp;SF Project and to recommend improvements and or modifications to the project in order to restore the south Florida ecosystem and to provide for other water resource needs. <b>The resulting CERP was designed to capture, store and redistribute fresh water previously lost to tide and to regulate the quality, quantity, timing and distribution of water flows.</b> It was approved in the Water Resources Development Act of 2000 and includes more than 60 elements, will take more than 30 years to construct, and will cost an estimated \$7.8 billion. Development of the CERP was led by the U.S. Army Corps of Engineers and the South Florida Water Management District. Many other federal, state, tribal and local agencies were active partners in developing the CERP and that partnership will continue through its implementation. The major components of the CERP are:</p> <ul style="list-style-type: none"> <li>* Surface Water Storage Reservoirs</li> <li>* Water Preserve Areas</li> <li>* Improved Water Deliveries to the Estuaries</li> <li>* Underground Water Storage</li> <li>* Improved Water Deliveries to the Everglades</li> <li>* Treatment Wetlands</li> <li>* Removal of Barriers to Sheetflow</li> <li>* Reuse of Wastewater</li> <li>* Storage of Water in Existing Quarries</li> <li>* Pilot Projects</li> <li>* Additional Feasibility Studies</li> <li>* Improved Water Conservation</li> <li>* Management of Lake Okeechobee as an Ecological Resource</li> </ul>



Several CERP projects that do not fall within the boundaries of Lee County will nonetheless have a significant influence on the function of natural systems here. The C-43 Basin Storage Reservoir and Aquifer Storage and Recover (ASR), Caloosahatchee River (C-43) Basin Aquifer Storage and Recovery Pilot Project, and Environmental Water Supply Deliveries to the Caloosahatchee Estuary will all effect water resources and natural systems functions in Lee County.

*Southwest Florida Feasibility Study*

The Southwest Florida Feasibility Study (SFSS) is one of the additional Feasibility Studies included in the CERP. The SFSS Issues Paper is located in the Appendix. The SFSS has been undertaken because primary water quality and hydrologic data do not exist for much of the region. This lack of information, assessments and monitoring data is a fundamental gap and greatly hinders long-term resource management opportunities. The SFSS offers the opportunity to plan for proper infrastructure before or in conjunction with development. It will result in a plan for Southwest Florida that includes ecosystem and marine/estuary restoration and protection, environmental quality, flood protection, water supply and other water-related purposes. It will provide a framework to address the health of aquatic ecosystems; water flows; water supply; wildlife, biological diversity and natural habitat; the region's economic viability; and property rights. The study is also investigating non-structural alternatives and has been designed to maximize regional benefits through multi-purpose land use; ensure consistency with local planning initiatives; improve water quality; and protect Big Cypress National Preserve.

The ecological, hydrologic, and water quality modeling and assessment tools and the maps being developed through the SFSS will be useful in evaluating the impacts of projects proposed in the Master Mitigation Plan.

*Environmental Impact Statement (EIS) on Improving the Regulatory Process in Southwest Florida*

The EIS was undertaken in 1998 to improve the U.S. Army Corps of Engineers' reviews of permit applications in the region under Section 404 of the Clean Water Act. The Final EIS document, which was issued in 2000, disclosed the potential cumulative effects on a wide variety of issues as a result of five alternative predictions of future conditions. Each future depicts what the landscape may or may not look like in 20+/- years as a result of many individual decisions by the Corps, landowners, Counties and others. The EIS also compares the cumulative environmental and other effects resulting from each future for a wide variety of issues. This enables the Corps staff to better understand the context of the individual project impacts within the whole cumulative impact. The Record of Decision for the EIS was issued in August of 2003.



*Water Supply Plans*

The Lower West Coast Water Supply Plan (LWC Plan) is one of four long-term, comprehensive regional water supply plans that have been developed by the SFWMD. The 2000 LWC Plan includes all of Lee County. The expected growth of this will create additional water demands for potable and irrigation water. Agriculture (primarily citrus and sugarcane located outside of Lee County but still within the bounds of the LWC Plan) is projected to increase by ten percent to approximately 260,000 acres. Meeting water demands while addressing the water needs of the environment makes development of proactive water supply strategies imperative to the economic and environmental sustainability of the area. The SFWMD is responsible for water resource development to facilitate development of source options at the local level; while, local governments, water users, and water utilities are responsible for water supply development.

The LWC Plan documents existing and future (2020) agricultural and urban water demands; develops strategies to meet these needs, while providing adequate water to support the needs of the environment; identifies specific geographical areas that have water resource problems that are critical or are anticipated to become critical by the year 2020 and identifies preventative measures, including water resource development projects, water supply development projects, and operational and regulatory strategies; establishes a framework around which future water use decisions in the planning region can take place; identifies areas where collection of resource data and technical studies are necessary; and, implements the plan recommendations through regulatory, research, planning, construction, operational, land management and acquisition actions.

The LWC Plan is updated every five years, and is used by local governments, water users, and utilities to modify and update their local comprehensive plans, ordinances, and individual or utility plans. The Caloosahatchee Water Management Plan (CWMP), a separate but complementary planning effort to the LWC Plan, evaluated water supply in the northeastern portion of the LWC region in the Caloosahatchee River Basin. The CWMP determined the projected surface water needs of the Caloosahatchee River Basin and Estuary can be met based on recommended developments of water management and storage infrastructure that effectively captures and stores surface water flows in the Basin. The CWMP concluded that existing surface water supplies from the Caloosahatchee River are inadequate to meet existing as well as future demands, including the needs of the environment. The Caloosahatchee is heavily relied on for agricultural water supply and to a much lesser extent, potable water supply. Surface water availability is essentially a function of climate and storage; there are excess amounts during the wet summer months, and at times, insufficient supplies during



the dry winter months. This problem of timing is particularly illustrated by the impacts of freshwater discharges to the Caloosahatchee Estuary. Excessive discharges decrease the salinity of the estuary that contribute to the loss of estuarine productivity. Insufficient freshwater discharges increase the salinity to essentially saltwater impacting freshwater grasses. A minimum flow and level is being established for the Caloosahatchee River and Estuary.

*Total Maximum Daily Load (TMDL) Program*

Section 303(d) of the Clean Water Act (CWA) requires states to submit lists of surface waters that do not meet applicable water quality standards (impaired waters) after implementation of technology-based effluent limitations, and establish TMDLs for these waters on a prioritized schedule. TMDLs establish the maximum amount of a pollutant that a water body can assimilate without causing exceedances of water quality standards. As such, development of TMDLs is an important step toward restoring our waters to their designated uses. In order to achieve the water quality benefits intended by the CWA, it is critical that TMDLs, once developed, be implemented as soon as possible.

Chapter 99-223, Laws of Florida, sets forth the process by which the 303(d) list is refined through more detailed water quality assessments. It also establishes the means for adopting TMDLs, allocating pollutant loadings among contributing sources, and implementing pollution reduction strategies.

Implementation of TMDLs refers to any combination of regulatory, non-regulatory, or incentive based actions that attain the necessary reduction in pollutant loading. Non-regulatory or incentive-based actions may include development and implementation of Best Management Practices (BMPs), pollution prevention activities, and habitat preservation or restoration. Regulatory actions may include issuance or revision of wastewater, stormwater, or environmental resource permits to include permit conditions consistent with the TMDL. These permit conditions may be numeric effluent limitations or, for technology-based programs, requirements to use a combination of structural and non-structural BMPs needed to achieve the necessary pollutant load reduction.

The Florida Department of Environmental Protection (DEP) is charged with administering the TMDL program in our State. The DEP is taking a comprehensive approach to protecting water quality involving basin-wide assessments and the application of a full range of regulatory and non-regulatory strategies to reduce pollution. Two basins cover Lee County, the Everglades West Coast Basin and the Caloosahatchee Basin. All of the major tributaries to Estero Bay were found to be impaired during the first round of assessments, and efforts are now underway to address the impairments through a partnership of entities that includes private



		<p>developers, local governments, regulatory agencies, environmental organizations, citizens groups and others. The members of this partnership hope to reduce pollutant loading to acceptable levels through voluntary efforts so that regulatory action can be avoided. The water in the Caloosahatchee basin are now being assessed.</p> <p><i>Charlotte Harbor National Estuary Program (CHNEP)</i>  The CHNEP is a partnership of citizens, elected officials, resource managers and commercial and recreational resource users who are working to protect the greater Charlotte Harbor estuarine system by improving the water quality and ecological integrity of the 4,400 square mile watershed. The partnership works as an advocate for the estuarine system by building consensus that is based upon sound science.</p> <p>In 1995, Governor Lawton Chiles, on behalf of the State of Florida and in cooperation with the Southwest Florida Regional Planning Council, Mote Marine Laboratory and the Southwest Florida Water Management District Surface Water Improvement Management program, submitted an application to the U.S. Environmental Protection Agency (EPA) to designate the estuarine system around Charlotte Harbor as an “estuary of national significance.” The application was accepted, and the CHNEP was created.</p> <p>From 1996 through 2000, more than 200 individuals representing organizations interested in preserving the Charlotte Harbor estuarine system used a cooperative decision making process to identify resource management concerns. They developed a 20-year Comprehensive Conservation and Management Plan (CCMP) that identifies the priority issues within the CHNEP and the actions which need to be taken to address them. The acceptance of the CCMP by the State of Florida and the EPA in 2001 marked the beginning of action to protect and restore the estuary and its watershed. Action is underway to address the following priority issues:</p> <p><b>Hydrologic Alterations:</b> Adverse changes to amounts, locations, and timing of freshwater flows, the hydrologic function of floodplain systems, and natural river flows.</p> <p><b>Water Quality Degradation:</b> Including, but not limited to, pollution from agricultural and urban runoff, point source discharges, septic tank system loadings, atmospheric deposition, and groundwater.</p> <p><b>Fish and Wildlife Habitat Loss:</b> Degradation and elimination of headwater streams and other habitats caused by development, conversion of natural shorelines, cumulative impacts of docks and boats, invasion of exotic species, and cumulative and future impacts.</p>
12	App E – p. 3	<p>Lastly, the Restudy (1999) also recognized that achieving WQ objectives will require efforts by a number of different agencies, some of which were potentially outside the scope of the Restudy; Section F.1 of</p>



		<p>Appendix H states:  <i>"Implementation of the Comprehensive Plan consistent with the Implementation Plan (see Section 10) will lead to improved water quality throughout the study area. However, achieving water quality objectives for ecological restoration in all water bodies within the study area depends on actions outside the scope of the Restudy. To fully achieve ecological restoration pollution loads must be identified and quantified within each of the study area regions, and load reduction and concentration targets for pollutants of concern must be established. Concurrent with or prior to the proposed operation of proposed components of the Comprehensive Plan, water quality remediation programs for degraded and/or designated use-impaired water bodies must be implemented by the responsible agencies in order to fully achieve ecological restoration objectives."</i></p> <p>To this end, the Comprehensive Integrated Water Quality Feasibility Study (CIWQFS) was authorized and tasked with developing a comprehensive WQ plan that would integrate CERP projects with other federal, state and local government programs. One of the specific goals of that study is to establish pollutant load reduction targets in regions where such targets have not already been developed, including certain basins within the SWFFS area (for details, see the purpose statement for CIWQFS).</p>
13	p. 5	<p><b>PERFORMANCE MEASURES</b></p> <p>To assess the degree of success in meeting these objectives, the SWFFS WQ Sub-team has developed two sets of performance measures: 1) assessment measures and, 2) evaluation measures. Assessment performance measures are used to measure real responses as a basis for tracking how well the plan is meeting its goals. Evaluation performance measures are used to predict the performance of a given alternative. This document focuses on the rationale for selecting evaluation measures and provides the process for developing tiered WQ targets or goals to satisfy the stated objectives. Evaluation measures will be used in the comparison of alternatives and selection of the recommended plan. Because evaluation measures will be used to forecast future conditions, and in some instances hind-cast past conditions, the use of these measures will be constrained by the availability of modeling tools, including data (<b>this point cannot be over-emphasized</b>). The level of modeling for this effort will be determined at a future date, but may range from spreadsheet models to physically based dynamic models. In some cases, it may be necessary to rely on best professional judgment to qualitatively assess alternative performance relative to the criteria (see Uncertainty section).</p>



		<p><b>Parameters</b></p> <p>Both sets of performance measures were developed through a process of public Sub-team meetings. In developing the list of parameters, the Sub-team considered both Tier 25 of the Recover Water Quality Team's draft comprehensive WQ monitoring plan (Table 1), and the Charlotte Harbor National Estuary Program (CHNEP) list of core analytes (Table 2). This information combined with technical comments from Sub-team members and results of previous assessments within the study boundary (FDEP 2002a and b; USACOE 2000) lead to the preliminary assessment measures presented in Table 3. The parameter list and performance measures are scientifically based and the result of applying research findings, literature information, and best professional judgment. The list is provisional pending completion of ongoing research and, more importantly, review of the preferred data set. It is the Sub-team's intent that both assessment and evaluation measures also consider atmospheric loading. In developing evaluation measures, preliminary emphasis was placed on trophic state variables (i.e., causal variables and response variables) to predict the degree of nutrient overenrichment in both the receiving waterbody and the "waters to be restored".</p> <p><b>[NOTE: The pages following page 5 in Appendix E contain tables listing the analytes and water quality indicators of interest.]</b></p>
14	p.11	<p>Along similar lines, stressor and attribute-based performance measure NE12 (summarized in draft RECOVER-WQT documents) has the following restoration expectation: <i>“limit [nutrient] loads so that estuaries support normal algal, seagrass, and benthic communities, and achieve TMDL targets in those estuaries classified as “verified impaired” per Florida’s Impaired Waters Rule, and/or restoration targets of degraded waters as developed by the Comprehensive Integrated Water Quality Feasibility Study, and/or Florida’s numerical nutrient standards for estuarine waters as they are promulgated.”</i></p> <p>The SWFFS WQ Sub-team shares these expectations and recommends that reduction in annual loads of P and N be included as an evaluation measure. The IRL-South Feasibility Study based their load reduction targets on pollutant load reduction goals (PLRGs) developed under the Indian River Lagoon (IRL) Surface Water Improvement and Management Plan (SWIM). In the SWFFS area, Lower Charlotte Harbor may receive SWIM designation in the near-term. However, SWIM plans have not, as yet, been developed for any water body within the Study area, nor have total maximum daily loads (TMDLs) been established. FDEP is currently conducting a loading and abatement assessment for the C-43 basin. Load reduction targets may follow from that initiative. If those targets are deemed appropriate by the Sub-Team, a recommendation could be made for their adoption by the SWFFS. Another tool that could potentially be utilized in setting load reduction</p>



		<p>targets, this time for Estero Bay, is the Estero Water Quality model (DHL Inc., under contract to Lee County). The Sub-team is presently reviewing other regional plans and studies for similar tools to establish load reduction targets (e.g., Estero Bay Watershed Assessment, Naples Bay Initiative, FDEP study in tidal Caloosahatchee during the 1970s, which included water quality based effluent limitations, WQBEL, etc.). Nevertheless, for the reasons discussed above, the Sub-team will request that the SWFFS area be given priority by the CIWQFS.</p>
15	App J – p. 1	<p><i>Appendix J: Addressing the Lee County Comprehensive Plan</i> The Lee County Master Mitigation Plan is consistent with the following Goals and Objectives of the Lee County Comprehensive Plan. Implementation of the Lee County Master Mitigation Plan will foster progress toward these Goals and Objectives.</p> <p><b>FUTURE LAND USE ELEMENT</b> <i>GOAL 1: FUTURE LAND USE MAP.</i> 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 in order to protect natural and man-made resources, provide essential services in a cost-effective manner, and discourage urban sprawl. (Amended by Ordinance No. 94-30)</p> <p>OBJECTIVE 1.4: NON-URBAN AREAS. Designate on the Future Land Use Map categories for those areas not anticipated for urban development at this time.</p> <p>OBJECTIVE 1.5: WETLANDS. Designate on the Future Land Use Map those lands that are identified as Wetlands in accordance with F.S. 373.019(17) through the use of the unified state delineation methodology described in FAC Chapter 17-340, as ratified and amended in F.S. 373.4211. (Amended by Ordinance No. 94-30)</p> <p>GOAL 2: GROWTH MANAGEMENT. To provide for an economically feasible plan which coordinates the location and timing of new development with the provision of infrastructure by government agencies, private utilities, and other sources.</p> <p>OBJECTIVE 2.1: DEVELOPMENT LOCATION. Contiguous and compact growth patterns will be promoted through the rezoning process to contain urban sprawl, minimize energy costs, conserve land, water, and natural resources, minimize the cost of services, prevent development patterns where large tracts of land are by-passed in favor of development more distant from services and existing communities. (Amended by Ordinance No. 94-30, 00-22)</p>

		<p>OBJECTIVE 2.3: PUBLIC PROVISION OF INFRASTRUCTURE. The Capital Improvements Program will give the highest priority to the planning, programming, and construction of urban services and facilities in the existing developed areas where facilities are inadequate. Next priority will be given to service expansions in existing developed areas, followed by further expansion into other portions of the Future Urban Areas. Sufficient land will be identified and protected for utility facilities that will be necessary to support the proposed level of development. Other infrastructure planning priorities are contained in Policy 23.2.4 and Policy 70.1.1. (Amended by Ordinance No. 94-30, 00-22)</p> <p>OBJECTIVE 2.4: FUTURE LAND USE MAP AMENDMENTS. Regularly examine the Future Land Use Map in light of new information and changed conditions, and make necessary modifications.</p> <p>GOAL 10: NATURAL RESOURCE EXTRACTION. To protect areas containing identified natural resources from incompatible urban development, while insuring that natural resource extraction operations minimize or eliminate adverse effects on surrounding land use and natural resources. (Amended by Ordinance No. 02-02)</p>
16	p.2	<p>GOAL 16: PRIVATE RECREATIONAL FACILITIES IN THE DR/GR. To ensure that the development of Private Recreational Facilities in the DR/GR areas is compatible with the intent of this Future Land Use category, including recharge to aquifers, development of future wellfields and the reduction of density. (Added by Ordinance No. 99-16)</p> <p>OBJECTIVE 16.1: To ensure that Private Recreation Facilities are located in the most appropriate areas within the DR/GR future land use category. (Added by Ordinance No. 99-16)</p> <p>OBJECTIVE 16.2: GROWTH MANAGEMENT. Development of Private Recreation Facilities in the DR/GR areas must be consistent with the growth management principles and practices as provided in the following policies. (Added by Ordinance No. 99-16)</p> <p>OBJECTIVE 16.3: GENERAL DEVELOPMENT REGULATIONS. The protection of water quality, quantity, natural resources, and compatibility will be addressed by additional development controls that regulate the permitted uses, parcel size, density, intensity and design of Private Recreational Facilities. (Added by Ordinance No. 99-16)</p> <p>OBJECTIVE 16.4: WATER QUALITY, QUANTITY, AND SURFACE WATER RESOURCES. Private Recreational Facilities must be located, designed and operated in such a way that they will not degrade the ambient surface or groundwater quality. These facilities must be located, designed and operated in such a way that they will not adversely impact</p>



		<p>the County's existing and future water supply. The location, design and operation of Private Recreational Facilities must maintain or improve the storage and distribution of surface water resources. (Added by Ordinance No. 99-16)</p> <p>OBJECTIVE 16.5: WILDLIFE. The location, design and operation of Private Recreational Facilities will incorporate preservation and/or management activities that restrict the unnecessary loss of wildlife habitat or impact on protected species, species of special concern, threatened or endangered species. (Added by Ordinance No. 99-16)</p> <p>OBJECTIVE 16.6: NATURAL RESOURCES. Private Recreational Facilities must be located, designed and operated to minimize environmental impacts, and where appropriate, protect, enhance and manage natural resources such as flowways, waterways, wetlands, natural water bodies, and indigenous uplands. (Added by Ordinance No. 99-16)</p> <p>OBJECTIVE 16.8: GOLF COURSE PERFORMANCE STANDARDS. The location, design and operation of golf courses located within Private Recreational Facilities will minimize their impacts on natural resources, and incorporate Best Management Practices. A maximum of ten (10) 18-hole golf courses, for a total of 180 golf holes, will be permitted in the next 10 years. (Added by Ordinance No. 99-16)</p>
17	p.7	<p>PLANNING ON A WATERSHED BASIS. To protect or improve the quality of receiving waters and surrounding natural areas and the functions of natural groundwater aquifer recharge areas while also providing flood protection for existing and future development.</p> <p>OBJECTIVE 40.1: COUNTY-WIDE PROGRAM. Lee County will continue its efforts in developing a surface water management program that is multi-objective in scope and is geographically based on basin boundaries. (Amended by Ordinance No. 94-30, 00-22)</p> <p>OBJECTIVE 40.2: BASIN PROGRAM. Promote water management permitting on a basin-wide basis, as opposed to the current individual-site approach used by Lee County and the South Florida Water Management District, through pilot or demonstration programs in two or more basins by 1996. (Amended by Ordinance No. 94-30)</p> <p>OBJECTIVE 40.3: LEVEL-OF-SERVICE STANDARDS. Revise by 1996 the surface water management level-of-service standards for basins and sub-basins identified in the Surface Water Management Master Plan. These future service standards can only be finalized upon the completion of the basin studies and will be based upon providing a defined level of</p>

		<p>flood protection, balanced with the protection of natural flow ways and associated wetland systems. (Amended by Ordinance No. 94-30)</p> <p>OBJECTIVE 40.4: CRITICAL AREAS. The Six Mile Cypress Basin (as defined in Chapter 10 of the Land Development Code) and the Density Reduction/ Groundwater Resource land use category are both identified as "critical areas for surface water management." The county will maintain existing regulations to protect the unique environmental and water resource values of these areas. (Amended by Ordinance No. 94-30, 00-22)</p> <p>OBJECTIVE 40.5: INCORPORATION OF GREEN INFRASTRUCTURE INTO THE SURFACE WATER MANAGEMENT SYSTEM. The long-term benefits of incorporating green infrastructure as part of the surface water management system include improved water quality, improved air quality, improved water recharge/ infiltration, water storage, wildlife habitat, recreational opportunities, and visual relief within the urban environment. (Added by Ordinance No. 03-06).</p>
18	p. 8	<p>GOAL 43: GROUNDWATER. To protect the county's groundwater supplies from those activities having the potential for depleting or degrading those supplies.</p> <p>OBJECTIVE 43.1: WELLFIELD PROTECTION. The county will maintain a wellfield protection ordinance to provide regulations protecting the quality of water flowing into potable water wellfields. (Amended by Ordinance No. 94-30, 00-22)</p> <p>OBJECTIVE 43.2: POTABLE GROUNDWATER. Base all future development and use of groundwater resources on determinations of the safe yield of the aquifer system(s) in order not to impair the native groundwater quality or create other environmental damage. Criteria for safe-yield determinations will be determined by the SFWMD, the agency charged with permitting these activities. (Amended by Ordinance No. 94-30, 00-22)</p> <p>OBJECTIVE 43.2: POTABLE GROUNDWATER. Base all future development and use of groundwater resources on determinations of the safe yield of the aquifer system(s) in order not to impair the native groundwater quality or create other environmental damage. Criteria for safe-yield determinations will be determined by the SFWMD, the agency charged with permitting these activities. (Amended by Ordinance No. 94-30, 00-22)</p>
19	p. 10	GOAL 77: RESOURCE PROTECTION. To manage the county's



wetland and upland ecosystems so as to maintain and enhance native habitats, floral and faunal species diversity, water quality, and natural surface water characteristics.

OBJECTIVE 77.1: RESOURCE MANAGEMENT PLAN. The county will continue to implement a resource management program that ensures the long-term protection and enhancement of the natural upland and wetland habitats through the retention of interconnected, functioning, and maintainable hydroecological systems where the remaining wetlands and uplands function as a productive unit resembling the original landscape. (Amended by Ordinance No. 94-30, 00-22)

OBJECTIVE 77.2: PLANT COMMUNITIES. Lee County will maintain and routinely update an inventory of natural plant communities and will protect at various suitable locations remnant tracts of all important and representative natural plant communities occurring within Lee County. (Amended by Ordinance No. 94-30)

OBJECTIVE 77.3: WILDLIFE. Maintain and enhance the fish and wildlife diversity and distribution within Lee County for the benefit of a balanced ecological system. (Amended by Ordinance No. 94-30)

OBJECTIVE 77.4: ENDANGERED AND THREATENED SPECIES IN GENERAL. Lee County will continue to protect habitats of endangered and threatened species and species of special concern in order to maintain or enhance existing population numbers and distributions of listed species.

OBJECTIVE 77.6: SOUTHERN BALD EAGLES. The county will continue to monitor Southern bald eagle nesting activity and offer incentives to conserve buffer areas around Southern bald eagle nests. (Amended by Ordinance No. 98- 09)

OBJECTIVE 77.7: WEST INDIAN MANATEES. Minimize injuries and mortality of manatees to maintain the existing population by encouraging the adoption by the state of Florida and local governments of regulations to protect the West Indian Manatee in the Caloosahatchee and elsewhere in Lee County. By 1998, manatee protection plans will be prepared for other waters of Lee County also frequented by manatees. (Amended by Ordinance No. 94-30, 98-09)

OBJECTIVE 77.8: GOPHER TORTOISES. The county will protect gopher tortoises through the enforcement of the protected species regulations and by operating and maintaining, in coordination with the Florida Game and Fresh Water Fish Commission, the Hickey Creek Mitigation Park. (Amended by Ordinance No. 94-30)



		<p>OBJECTIVE 77.9: RED-COCKADED WOODPECKER. County staff will coordinate with the Florida Game and Fresh Water Fish Commission to determine on a case-by-case basis the appropriate mitigation for the protection of the redcockaded woodpecker's habitat. Mitigation may include on-site preservation, onsite mitigation, off-site mitigation, and associated habitat management. (Amended by Ordinance No. 94-30)</p> <p>OBJECTIVE 77.10: WOODSTORK. Lee County will maintain regulatory measures to protect the wood stork's feeding and roosting areas and habitat. (Amended by Ordinance No. 94-30, 00-22)</p> <p>OBJECTIVE 77.11: FLORIDA PANTHER AND BLACK BEAR. County staff will develop measures to protect the Florida panther and black bear through greenbelt and acquisition strategies. (Amended by Ordinance No. 92-48, 00-22)</p>
20	p. 11	<p>GOAL 78: ESTUARINE WATER QUALITY. To manage estuarine ecosystems so as to maintain or improve water quality and wildlife diversity; to reduce or maintain current pollution loading and system imbalances in order to conserve estuarine productivity; and to provide the best use of estuarine areas. (Amended by Ordinance No. 94-30)</p> <p>OBJECTIVE 78.1: Establish baseline conditions in all estuarine systems, including pollutant and freshwater loadings by 2000, and maintain an ongoing water quality monitoring program. Maintain communication with other local, state, and federal estuarine water quality studies to ensure that the latest data and recommendations are available. (Amended by Ordinance No. 94-30)</p> <p>OBJECTIVE 78.2: WATERSHED MANAGEMENT PLANS. By 1996, establish procedures for reviewing all new upland development in terms of its impacts on estuarine systems. Prepare estuarine watershed management plans which maximize stormwater retention and treatment, with priority to the Estero Bay watershed. (Amended by Ordinance No. 94-30)</p>
21	p. 12	<p>GOAL 84: WETLANDS. To maintain and enforce a regulatory program for development in wetlands that is cost-effective, complements federal and state permitting processes, and protects the fragile ecological characteristics of wetland systems. (Amended by Ordinance No. 94-30)</p> <p>OBJECTIVE 84.1: The natural functions of wetlands and wetland systems will be protected and conserved through the enforcement of the county's wetland protection regulations and the goals, objectives, and</p>

		<p>policies in this plan. "Wetlands" include all of those lands, whether shown on the Future Land Use Map or not, that are identified as wetlands in accordance with F.S. 373.019(17) through the use of the unified state delineation methodology described in FAC Chapter 17-340, as ratified and amended by F.S. 373.4211. (Amended by Ordinance No. 94-30, 00-22) Urban Community, Suburban, and Outlying Suburban areas may transfer densities to developable contiguous uplands under common ownership in accordance with Footnotes 9b and 9c of Table 1(a), Summary of Residential Densities. (Amended by Ordinance No. 94-30, 00-22)</p>
22	p. 12	<p>GOAL 87: WATER RESOURCES. To conserve, manage, and protect the natural hydrologic system of Lee County to insure continued water resource availability. (Amended by Ordinance No. 94-30)</p> <p>OBJECTIVE 87.1: WATER SUPPLIES. Insure water supplies of sufficient quantity and quality to meet the present and projected demands of all consumers and the environment, based on the capacity of the natural systems.</p>
23	p. 13	<p>GOAL 91: FISHERIES MANAGEMENT. To preserve the ecosystem that nourishes and shelters the commercial and sport fisheries in Lee County.</p> <p>OBJECTIVE 91.1: The county will continue monitoring for estuarine water quality to monitor the health and population of recreationally and commercially important fish and shellfish that depend on the estuaries. (Amended by Ordinance No. 00-22)</p>

**APPENDIX C**

**DR/GR ENVIRONMENTALLY SENSITIVE NATURAL RESOURCES  
AND  
ENVIRONMENTAL ISSUES IDENTIFIED IN  
LEE COUNTY COMPREHENSIVE PLAN**

## APPENDIX C

### DR/GR Environmentally Sensitive Natural Resources and Environmental Issues Identified in Lee County Comprehensive Plan – As Amended as of 2005

<b>Environmental Feature</b>	<b>Reference</b>
<b>Environmentally Sensitive Areas</b>	Policy 107.1.1, VII-5
<b>Vegetation and Wildlife</b>	
Vegetation communities	FLUCFCS codes Objective 104.1, VII-3; Policy 107.1.5, VII-6; Objective 107.2 VII-6
Environmentally sensitive coastal planning areas	Policy 113.1.5, VII-17
Wetlands	Objective 1.5, II-15; Policy 107.1.5, VII-6; Goal 114, V11-19
Wetland mitigation banks	Policy 1.4.6, II-14; Policy 114.1.2.5 VII-20
Issues: invasive/exotic species	Policy 16.3.7.5, II-52; Policy 16.6.1, II-55; Policy 107.2.9, VII-7

<b>Important Native Plant Communities</b>	Objective 107.2, VII-6
Rare and unique uplands	Policy 104.1.1, VII-3; Policy 107.1.1.b, VII-5
Native vegetation communities	Objective 104.1, VII-3; Policy 107.1.5, VII-6; Objective 107.2 VII-6
Coastal and interior hammocks	Policy 107.2.6, VII-7
Rare and unique habitats <ul style="list-style-type: none"> <li>- Mangroves</li> <li>- Cypress heads</li> </ul>	Policy 107.2.12, VII-7; Policy 16.4.6
Biodiversity "hot spots"	Policy 16.1.1.4, II-50

<b>Important Wildlife Habitat</b>	Objective 107.3, VII-7
Native Wildlife Habitat	Objective 107.3, VII-7
Migratory bird wintering areas	Objective 107.3, VII-7
Critical Habitat for Listed Species – endangered, threatened, species of special concern	Policy 107.1.5, VII-6; Objective 107.4, VII-8
Florida panther	Objective 107.11, VII-11
Wood stork	Objective 107.10, VII-10
Fish/fishery resources	Objective 107.12, VII-11
Bears	Objective 107.11, VII-11
Red-cockaded woodpecker	Objective 107.9, VII-10
Gopher tortoise	Objective 107.8, VII-10
Southern bald eagle	Objective 107.6, VII-9
Manatee	Objective 107.7, VII-9
Others	As may be identified in related planning and regulatory documents



<b>Important Plant Habitats</b>	Objective 107.2 VII-6
Endangered plant species habitat	Objective 107.4, VII-8

<b>Important Water Resources</b>	Policy 117.7.1, VII-21
Natural waterways/water bodies	Policy 107.1.4.b, VII-5; Policy 107.1.6, VII-6; Policy 117.1.1, VII-21
Riparian Areas/Riparian Systems	Policy 117.1.1, VII-21
Flow-ways existing and historic	Policy 107.1.6, VII-6
Sloughs	Policy 107.1.6, VII-6
Storm and flood hazard areas	Policy 107.1.1.b, VII-5
Natural lakes	Policy 107.1.6, VII-6
Estero Bay Estuary	Policy 108.1.1, VII-12; Objective 108.2, VII-13
Aquatic preserves/Outstanding Florida Waters Estero Bay	Policy 108.1.1, VII-12; Objective 108.2, VII-13
Aquifers	Policy 107.1.6, VII-6
Aquifer recharge areas	Policy 1.4.5, II-13
Watersheds	Policy 107.1.6, VII-6
Drainage basins	Policy 117.1.5, VII-22
Floodplains	Policy 107.1.6, VII-6
Wellfield protection areas	Policy 115.1.6, VII-21
Wellfields	Policy 115.1.6, VII-21
Water quality	Objective 16.3, II-51; Objective 108.1, VII-12; Goal 115 VII-20; Policy 117.1.1, VII-21
Surface water	Objective 115.1, VII-20
Groundwater	Policy 115.1.1, VII-20
Impaired areas	Policy 115.1.1, VII-20
Federal 303d classification	Objective 115.1 VII-20
State water classifications	Objective 115.1, VII-20
Water quantity/water supply (existing and projected water budget)	Objective 117.1, VII-21
Issue: Flooding	Policy 16.4.6, II-54; Policy 107.1.1, VII-5

<b>Greenway/Blueways</b>	Objective 107.1, VII-5
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<b>Conservation Lands Under Public Ownership – e.g. CARL, CREW, SOR, 2020 Conservation Program, community based land trusts</b>	Policy 1.4.6, II-14; Policy 107.1.4 d, f, VII-6
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<b>Proposed Acquisition Lands</b>	
CARL, CREW, SOR, 2020 Conservation Program	Policy 16.1.1, II-49
Florida Communities Trust	Policy 107.1.4 d, VII-6
Airport mitigation lands	Policy 1.7.11, II-18

<b>Mining Resources</b>	Goal 10, II-37
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**APPENDIX D**

**SUMMARIES OF SELECTED LEE COUNTY DR/GR DOCUMENTS**

## Lee Comprehensive Plan Update

Item	Description	Sect / Page	Information from Report
1	Document Title		The Lee Plan 2005 Codification As Amended through December 2005
2	Author		Lee County
3	Date		December 2005
4	Sponsoring agency / publisher		Lee County, Southwest Florida, Department of Community Development, Division of Planning
5	Purpose of study or document		N/A
6	Relevance to DR/GR lands in southeast Lee County		See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C
7	Summary of report content		REVIEWED FOR THE BACKGROUND INFORMATION INCLUDED IN APPENDICES B AND C OF THIS REPORT
7 a.	General information and overall content		N/A
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		N/A
7 c.	Useful maps and overlays		N/A
7 d.	Relevant results and conclusions		N/A
8	Summary of report strengths and weaknesses		N/A
8 a.	Evaluation of study approach and conduct		N/A

8 c.	Extent to which report is “up to date”		N/A
8 d.	Completeness / data gaps / remaining information needs		N/A
	Relationship to, and consistency with, other studies / reports		N/A



## Lee County Groundwater Resource and Mining Study

Item	Description	Sect / Page	Information from Report
1	Document Title	Cover/pg 1	Lee County Groundwater Resource and Mining Study - Draft for Peer Review (also reviewed: Peer Review Comment Response to the June 2005 Draft of the Lee County Groundwater Resource and Mining Study, August 2006)
2	Author	Cover/pg 2	Greg F. Rawl, PG, Michael Voorhees, PhD, PE
3	Date	Cover/pg 1	June 2005
4	Sponsoring agency / publisher	Cover/pg 1	Lee County CN-03-16
5	Purpose of study or document	<p>II - Scope of Work/ pg 1 (for Items 1 - 4)</p> <p>Item 5: last sentence in Section III, Background</p>	<p>1) Groundwater: first phase of process to evaluate/assess groundwater resources.</p> <p>2) Mining: evaluate/assess the location and quality of mineral resources, current capacity of approved mining activities, future need for mining material, effects of mining on water resources and water budget.</p> <p>3) Mapping: map surface water flow ways for all of Lee County to aid in review of sensitive environmental areas.</p> <p>4) Provide Background information that will be used for the next phase(s) of the study that will assess the resource in a planning and land use context.</p> <p>5) Future Land Use Decisions/Groundwater Model: use an existing database model (Viewlog) to create a new groundwater model to be used/integrated into the future land use decision-making process.</p> <ul style="list-style-type: none"> <li>• Asses the distribution of recharge and develop a detailed groundwater budget for the county.</li> <li>• Determine the impact of projected 2025 public water supply pumpage.</li> <li>• Estimate the groundwater flow to tide; including the Caloosahatchee and coastlines.</li> </ul>

			<ul style="list-style-type: none"> <li>Estimate effects of mining on the county groundwater.</li> </ul>
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C )	All	<p>High Relevance: report covers all of Lee County, but the emphasis is on the southern DR/GR lands.</p> <p>"The goal of this study is to develop a sound, scientifically-based platform from which to base future land use decisions, in particular those decisions related to the DR/GR land use classification, as well as mining activities." (Section II, page 1, paragraph 1).</p>
7	Summary of report content		
7a	General information and overall content	<p>III and IV</p> <p>V</p> <p>VI</p>	<ul style="list-style-type: none"> <li>Description of DR/GR designation and regulatory background information: Department of Community Affairs Governance, Groundwater Rules and Regulations, Mining Rules and Regulations and Lee County Master Mitigation Plan.</li> <li>Overview of topography, pre-existing/current land use conditions (just a narrative, no facts or numbers), watershed map, portion of a flow ways map– (1)Hydrologic alteration (Cape Coral – fresh/salt water interface &amp; Lehigh Acres - lower water table in a high recharge area). (2)Major watersheds, wetlands, outstanding waters, flow ways – updated in this study.</li> <li>Description of the geology/hydrogeology of Lee County and the database used to construct hydrogeologic conceptual and numerical model, maps and cross sections showing hydrogeologic units and properties. Used Viewlog (EarthFX) and 1,080 wells from a previous WRS report and 629 new wells from other sources for aquifer/aquitard elevation/thickness &amp; EarthFX hydrogeologic parameter database (hydraulic conductivity and leakance). Description of the three main aquifers in the area: Surficial, Intermediate and Floridan.</li> </ul>

		VII	<ul style="list-style-type: none"> <li>• Description of water levels and numerical groundwater model.</li> <li>• Groundwater Elevation database, using 550 wells, was created for the calibration of the groundwater model and to evaluate boundary conditions (wet - median of May 1996-2003 &amp; dry - median of October 1996-2003 for Surficial Aquifer: Holocene/Pliocene &amp; Ochopee and Intermediate: Sandstone &amp; Mid-Hawthorn aquifers) – Conclusion: Historical groundwater elevation decline.</li> <li>• Groundwater Flow Model – MODFLOW 2000:       <ol style="list-style-type: none"> <li>(1) Model discretization: 564 rows x 480 columns, 500 ft x 500 ft. &amp; 5 aquifers.</li> <li>(2) Recharge: Rainfall was evaluated using PRISM model (Daly2004). (<a href="http://www.ocs.oregonstate.edu/prism/index.phtml">http://www.ocs.oregonstate.edu/prism/index.phtml</a>) and Land Cover using SFWMD Feasibility Study geographical information systems Year 2000 coverage; evapotranspiration &amp; net recharge dry/wet.</li> <li>(3) Mine borrow pits were determined from the 2002 Aerial Photo &amp; mine penetration from the mine database; pits were modeled as ponds with high storage &amp; hydraulic conductivity.</li> <li>(4) Canals were modeled as drains. Aquifer penetration and conductance was computed based on the SFWMD Southwest Florida Feasibility Study canal geographical information systems data</li> <li>(5) Public and industrial pumpage is based on SFWMD permits, actual pumpage and utilities data. A future 2025 scenario was run. Aquifer Storage and Recovery were also included.</li> <li>(6) Model boundary conditions: constant head</li> <li>(7) Optimization - MODFLOW 2000 modified Gauss-Newton optimization method for boundary conditions, hydraulic conductivity, storage and leakage &amp; global optimization (Floudas 2001) for net recharge.</li> <li>(8) Calibration Statistics – Residuals 0 to 11 feet - Needs to include</li> </ol> </li> </ul>
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			<p>room mean square error.</p> <p>(9) Transient calibration (1/2000 to 1/2002) – wet/dry graphs.</p> <p>(10) Groundwater fluxes and contours</p> <p>(11) Groundwater flow to tide: Northern Gulf Coast, Southern Gulf Coast, Caloosahatchee River mouth and inland.</p> <p>(12) Canal drawdown impact</p> <p>(13) Water budget</p> <p>(14) 2025 simulation with projected flows, pumping, dry season = 53% of annual total and wet season 45% of annual total.</p> <p>(15) Conclusions and recommendations</p> <ul style="list-style-type: none"> <li>- extensive use of SFWMD, United States Geological Survey &amp; NOAA data</li> <li>- detailed MODFLOW model for Lee County</li> <li>- calibrated model</li> </ul> <p>• Description of mining practices, existing and potential mines, possible demand for rock, possible quantities of rock available.</p> <ul style="list-style-type: none"> <li>- rock mined in southwest Florida is an economically important commodity;</li> <li>- 9 mines operating in Lee County in 2004;</li> <li>- rock material is removed above the water table, and then below the water table; materials removed below the water table are allowed to drain so much of the excavated water is returned to the aquifer;</li> <li>- most of the inventoried borrow pits in Lee County were never permitted;</li> <li>- in all 329 excavations were inventoried that encompassed 5,544 acres (1.1 % of the entire county);</li> <li>- potential mineable materials were estimated using the Viewlog database; estimates within the DR/GR only were 29,050 acres, 892 million cubic yards of overburden, and</li> </ul>
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		VIII	<p>2,676 million cubic yards of rock</p> <ul style="list-style-type: none"> <li>- annual sale of rock materials mined in Lee County are estimated to range from \$40 million to \$80 million (and these could be underestimates;</li> <li>- Section F, page 85 presents a “Mining Impact Analysis”, but this is largely a conceptual discussion with essentially no calculations or quantitative analyses of the potential impacts</li> </ul> <ul style="list-style-type: none"> <li>• The report (p. 88) states that, because of the complex geology of the aquifers, the wellfield protection zones that have been used since 1989 to regulate land uses in the vicinity of Lee County potable well fields may no longer be valid.</li> </ul> <ul style="list-style-type: none"> <li>• The first half of the Groundwater Conclusions is more of a summary of the report than actual conclusions; other conclusions in this section include: <ul style="list-style-type: none"> <li>- “Net recharge to the water table is affected by a number of factors, anthropogenic factors such as irrigation increase net recharge, however in most cases this is artificial because of on-site groundwater withdrawals to facilitate the irrigation”</li> <li>- Regional net recharge to the water table is most significant in southeastern Lee County;</li> <li>- Mining-related recharge losses are no more significant than losses from lakes, reservoirs, wetlands and melaleuca;</li> <li>- Major water level declines in the Sandstone and Mid-Hawthorne aquifers have occurred in the last 10 to 15 years;</li> <li>- Surface water drainage features (e.g. canals) have significantly impacted groundwater levels in many areas of Lee County.</li> </ul> </li> <li>• The mining conclusions states that mining can have both positive and negative effects on the water resources of Lee County, but does not elaborate.</li> </ul>
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		IX	<ul style="list-style-type: none"> <li>The report contains recommendations for future or additional work hydrologic data collection work, and recommendations for mine design and mining regulation. It does not contain recommendations for land use decisions.</li> </ul>
7 b	Specific relevant data (e.g. water quality sampling for	VI	<ul style="list-style-type: none"> <li>Geologic cross-sections (A-A' to F-F' with G-G' missing).</li> <li>Aquifer properties – hydraulic conductivity and leakance (only</li> </ul>

**Groundwater Resource and Mining**

	specific dates, water level data, etc.)	VII	<p>interpolated contours not actual values).</p> <ul style="list-style-type: none"> <li>• Water-level elevation contours, surface elevation maps for the different aquifers, changes in the water level elevations for the different aquifers, recharge maps and tables.</li> <li>• Pumping rates – current and projected in 2025 (Table VII -1 through 2).</li> <li>• Hydrogeologic property multipliers – multipliers used to change the data from Viewlog to the calibrated model parameter values (Table VII-4 through 6).</li> <li>• Projected Recharge (Table VII-11).</li> <li>• Modeled water budgets (Tables VII-15 through 17). Additional information is needed in the water budget to calculate mass balance for the model; it is difficult to calculate with these tables.</li> <li>• Former, existing and potential mine locations.</li> </ul>
7 c	Useful maps and overlays		<ul style="list-style-type: none"> <li>• Flow ways map - only a portion of a flow ways map is included in report, would have to obtain full map from another source.</li> <li>• Existing and potential mine locations.</li> <li>• Net annual recharge to water table map - would have to be created from the information in the report or obtained from another source; however the data may not be defensible and therefore this map may not be useful.</li> <li>• Generalized geologic and hydrologic units (Fig. VI-1). Along with site cross-sections (Figs VI-14 through 21) show the geology.</li> </ul>

			<ul style="list-style-type: none"> <li>• 2-D maps with aquifer thickness.</li> <li>• 2-D hydrogeologic property maps – hydraulic conductivity &amp; leakance (Figs VI-22 through 35). Control data points used to interpolate the distribution of the hydrogeologic properties are not indicated.</li> <li>• Groundwater elevation contour maps (Figs VII-1 through 8).</li> </ul>
7 d	Relevant results and conclusions	VII, IX, X	<p>The report's conclusions are summarized under item 7a above.</p> <p>One of the primary conclusions is that recharge is related to land cover (e.g., urban, agricultural, open water). The report concludes that a significant amount of Lee County recharge is occurring on DR/GR lands, and offers the following recommendations:</p> <ol style="list-style-type: none"> <li>1. Add more monitoring wells to the DR/GR lands.</li> <li>2. Upgrade monitoring wells that go dry in the dry season.</li> <li>3. Further study of roles that land use and impervious surfaces play on the hydrologic system.</li> <li>4. More geologic logs to determine a better understanding of the lithology.</li> <li>5. Lee County should continue to optimize its water storage for groundwater recharge purposes.</li> </ol>
8	Summary of report strengths and weaknesses		<p>Strengths:</p> <ul style="list-style-type: none"> <li>• Good compilation of a lot of hydrogeologic data for the county.</li> <li>• Maps of recharge showing importance of DR/GR lands as a groundwater resource.</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>• The report in its current form and in the absence of other information may not form an adequate basis for future land use decisions because there are no evaluations, analyses, conclusions or recommendations regarding the potential impacts (positive or negative) that future land use within DR/GR could have on the groundwater resources.</li> </ul>

			<ul style="list-style-type: none"> <li>• Recharge is quantified based on land cover, but the logic behind the recharge rates may be flawed or confusing. For example, the highest recharge rates are assigned to agricultural land, where "...anthropogenic factors such as irrigation increase net recharge, however in most cases this is artificial because of on-site groundwater withdrawals to facilitate the irrigation." (Section IX, Conclusions, bullet item 6). A clear distinction should be made between recharge at the land surface and net recharge to the aquifer.</li> <li>• Well locations and information from wells used for the report are unclear.</li> <li>• The database used to build the conceptual and numerical hydrogeologic models has not undergone a QA/QC process and therefore the quality of the models could be questioned.</li> <li>• The reference section is incomplete. For example, there are no citations for the database used and the citation for the PRISM model is incorrect (the citation is for data generated by the model, but not the model itself).</li> <li>• Much of the modeling is dependent upon rainfall information developed by the PRISM model. However, it is unclear whether the authors used data generated by the author of the PRISM model or generated from their own PRISM model evaluations. Better description of recharge determination - specifically how recharge was determined for each land use; description and justification for using Restrepo et al., 1992. Recharge is a key point to the report and needs to be described in detail.</li> <li>• Graphs of water levels vs. time are not completely discussed. For example, the discussion of Figure VII-9 examines only an apparent downward trend in water levels. However, there are periods of stable water levels and periods of increasing water levels shown on that graph that are not discussed. The interpretations of water level trends may be biased toward a focus on decreasing water level trends.</li> <li>• It is unclear if the report has examined all of the water table aquifer</li> </ul>
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			<p>hydrographs and the trends that those hydrographs may show.</p> <ul style="list-style-type: none"> <li>• Missing CSM and optimization results: mainly the information regarding the sensitivity to the recharge and the mass balance.</li> <li>• The report contains numerous modeling maps but no detailed information for the discrete points used for interpolation and discussions.</li> <li>• Does not discuss existing regional or Lee County ground water models (e.g. Bower, Adams, and Restrepo, 1990), how well this model compares with those existing models.</li> <li>• Problems with mass balance as calculated from Tables VII-15 through 17.</li> <li>• Hydraulic conductivity, leakance and storage maps should show control points (locations; values) for data are that were used to determine maps; figures of typical semi-variograms would be helpful because plots (VI-22 through 35) show indication that Kriging was performed outside of the range - circles around assumed data points and average values (sill) elsewhere. These plots could be made more defensible by providing a detailed explanation of the method (i.e. data point locations and a plot or table of semi-variogram values).</li> </ul>
8 a	Evaluation of study approach and conduct		<ul style="list-style-type: none"> <li>• Data QA/QC methods are not described, data evaluations seem incomplete (e.g., interpretations of hydrographs), citations are possibly inaccurate or missing, and the evaluations of recharge are possibly confusing.</li> <li>• Additionally, the report, in and of itself, does not meet its goal of developing "...a sound, scientifically-based platform from which to base future land use decisions, in particular those decisions related to the DR/GR land use classification...", although it may be one step in that process.</li> </ul>
8 b	Extent to which report is "up to date"		<ul style="list-style-type: none"> <li>• The report appears to be reasonably up to date (i.e., the most recent data are no older than 2 to 3 years old), and a sufficient historical data range appears to have been used. Current data evaluation and models</li> </ul>

			are utilized.
8 c	Completeness / data gaps / remaining information needs		<ul style="list-style-type: none"> <li>• The report is incomplete since it does not achieve its stated goal.</li> <li>• Many of the figures could benefit from consistent color schemes so that evaluations of the data presented can be more easily made.</li> <li>• Data QA/QC needs to be performed.</li> <li>• A re-evaluation of recharge rates is required in the agriculture land cover areas to account for the effects of irrigation by on-site wells (and possible re-working of the computer model).</li> <li>• Presentation and evaluation of additional hydrographs would be beneficial to better describe the trends in water levels in the water-table aquifer. There may be hydrographs that show stable or increasing trends, but these are not presented or discussed. This would permit an evaluation of whether the report may be biased toward emphasizing declining trends.</li> <li>• This document does not consider the effects of mining on the range of ecological resources that exist within the DR/GR such as wildlife and important habitats.</li> </ul>
8 d	Relationship to, and consistency with, other studies / reports		<ul style="list-style-type: none"> <li>• This could be considered a complementary report to the Bonita Springs DR/GR report.</li> </ul>
8 e	Addition comments, concerns, or requests		<p>A number of items would facilitate a more in-depth review of the groundwater model presented in this report, including:</p> <ul style="list-style-type: none"> <li>• A concise description and diagram of the Hydrogeologic Conceptual Site Model (CSM) for this portion of Lee County.</li> <li>• 2-D map depicting model boundary conditions.</li> <li>• Description of the model generated plots, or tables with actual measured values (hydro-stratigraphy) and map/table with the model layers. Maps/Tables with the values of the discrete points used for interpolations.</li> <li>• Sensitivity analysis results of the model for input parameters such as hydraulic conductivity and recharge, both in terms of calibration and</li> </ul>

			<p>model mass balance.</p> <ul style="list-style-type: none"><li>• Description of what was optimized and perhaps a plot of change in parameters with iteration and residuals in the optimization.</li><li>• Electronic model input and output files for a more complete review.</li></ul>
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## Lee County Master Mitigation Plan (LMMP)

Item	Description	Sect / Page	Information from Report
1	Document Title		Lee County Master Mitigation Plan (LMMP) (Environmental Quality Investment and Growth Mitigation Strategic Plan)
2	Author		Lee County
3	Date		August 9, 2004
4	Sponsoring agency / publisher		Lee County, Southwest Florida Regional Planning Council
5	Purpose of study or document		
6	Relevance to DR/GR lands in southeast Lee County		See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendices B and C
7	Summary of report content		REVIEWED FOR THE BACKGROUND INFORMATION INCLUDED IN APPENDICES B AND C OF THIS REPORT
7 a.	General information and overall content		N/A
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		N/A
7 c.	Useful maps and overlays		N/A
7 d.	Relevant results and conclusions		N/A
8	Summary of report strengths and weaknesses		N/A
8 a.	Evaluation of study approach and conduct		N/A

8 b.	Extent to which report is “up to date”		N/A
8 c.	Completeness / data gaps / remaining information needs		N/A
8 d.	Relationship to, and consistency with, other studies / reports		N/A



## Lee County Water Resources Management Project

Item	Description	Sect / Page	Information from Report
1	Document Title	Cover	Lee County Water Resources Management Project
2	Author	Cover	James M. Montgomery, Consulting Engineers, Inc. Lake Worth, FL 33461
3	Date	Cover	October 5, 1988
4	Sponsoring agency / publisher	Cover	Lee County Board of County Commissioners
5	Purpose of study or document	Summary and Conclusions pg 1	"...examine future water demands and the potential water availability within the county. ...[the report contains] recommendations for land use and water resources strategies which assure wetlands protection, and the availability, quality, and potential safe yield of water for the future."
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C.)	All	<b>High Relevance:</b> the report covers all of Lee County.
7	Summary of report content		
7 a.	General information and overall content	All	Identification and mapping of the upper aquifers in Lee County. Determination of water budgets, aquifer storage and safe yields. Identification of aquifer recharge areas and potential well fields. Strategies for the protection of groundwater resources and wetlands. Water use projections and conservation strategies.
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data,	Chapter 2 Chapter 3 Chapter 4	Identification and mapping of aquifer units. Safe yield criteria, recharge areas, water budgets for the aquifers. Identification of potential new water supply areas, quantification of aquifer

	etc.)		storage.
7 c.	Useful maps and overlays		<p>Maps showing aquifer storage (the importance here is that the DR/GR contains significant amounts of groundwater storage for the county): Figures 4-5, 4-7, 4-9, 4-11, 4-13, 4-15, 4-17, 4-19, 4-21.</p> <p>Maps showing groundwater flow (the importance here is the possible maintenance of fresh water flows to the estuaries): Figures 4-50 - 4-51.</p> <p>Plate 11: shows thick portions of Water Table Aquifer are within the DR/GR.</p> <p>Plate 15: shows thick portions of Tamiami Aquifer are within the DR/GR.</p> <p>Plate 19: shows thick portions of Sandstone Aquifer are within the DR/GR.</p> <p>Plate 23: shows thick portions of Mid-Hawthorn Aquifer are within the DR/GR.</p> <p>Plates 79, 80, 81: Recharge areas for the Water Table, Lower Tamiami, and Sandstone Aquifers (recharge occurs within the DR/GR).</p> <p>Plates 83, 84, 85: Potential wellfields (some of these areas may already be developed as wellfields).</p>
7 d.	Relevant results and conclusions		<p>Realistic quantification of aquifer recharge and storage and excellent criteria for the protection of the resources. There are a number of maps that show important groundwater resources that are within the DR/GR area.</p> <p>The potential development of water supplies near wetland resources must be evaluated on a case by case basis and through the use of computer modeling. Water resources should be actively managed with an awareness of aquifer storage during the wet and dry seasons. Water withdrawals could be possible near wetlands if properly managed.</p>
8	Summary of report strengths and weaknesses:		<p><b>Strengths:</b> Comprehensive compilation of hydrogeologic data for the county with well-described Quality Assurance/Quality Control procedures.</p> <p>From the report: "Well logs were obtained from the Fort Myers office of the U.S. Geological Survey, the Florida Geological Survey, the South Florida Water Management District and numerous consultant reports. Although there are extensive data for wells throughout Lee County, not all contain the detail and accuracy necessary for correlation purposes. Therefore, each well on file was evaluated for its reliability before it was used for correlation. The</p>

		<p>references used for evaluation of lithologic data are presented in Appendix B.</p> <p>Before any data were entered into the final Symphony database they were thoroughly checked for accuracy. With respect to the lithologic data, corrections were made regarding the reasonableness of lithologic definition, mathematical accuracy and typographical errors. A review of the initial hydrogeologic unit database developed by James M. Montgomery, Consulting Engineers, Inc. (JMM) was made by a review team consisting of JMM, South Florida Water Management District and Lee County personnel.</p> <p>The initial database consisted of lithologic picks from 256 wells to define the hydrogeologic framework. These data were submitted to the South Florida Water Management District and Lee County staffs for review which resulted in the deletion of 60 wells and the introduction of 18 additional wells for a total of 214 wells."</p> <p>Also from the report: "253 water level/water quality wells were considered for the data base. Of these, 14 were rejected because the data indicate that they are screened in more than one aquifer and 11 were rejected because the well construction data were incomplete, leaving a total of 217 wells. Of these, 13 did not have the data to indicate that they were screened in only a single aquifer, but based on experience and recommendation by South Florida Water Management District personnel they were included. Two wells had no water level or water quality data, 30 had no water level data, ten had no wet season water level data, one had no dry season water level data and seven had no water quality data. A complete summation of the Water Level/Water Quality wells is shown in Table 2-1 and rejected wells along with the reasons for rejection are presented in Appendix C."</p> <p>Additional data Quality Assurance/Quality Control methods are described in Chapter 2 of the report.</p>
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		<p>Realistic and scientifically defensible conclusions, recommendations, and quantification of aquifer parameters (e.g., recharge). These conclusions include (from the report): "Ground water resource availability was evaluated on a qualitative basis by examining ground water storage, ground water recharge, well hydrograph declines, chloride increases in monitoring wells and sea level rise due to the greenhouse effect. Based on the amount of water in storage, the Water Table aquifer in conjunction with the Lower Tamiami aquifer and the Lower Hawthorn aquifer and possibly the Suwanee aquifer are the major potential sources of water supply to Lee County. Quantification of the amount of storage in both the Mid-Hawthorn and Sandstone aquifers also shows that these aquifers are more limited in the amount of water they contain. These two aquifers should be utilized primarily as sources of water for domestic (in-house) usage beyond the range of public water supply distribution systems or for small water supply systems. Future withdrawals from these aquifers should not involve irrigation uses. Water in storage is not entirely usable. Use of water from the Water Table aquifer is limited to a fraction of the water in storage by adverse impacts on wetlands and by the amount which is subject to recharge. The use of water in other aquifers is limited by factors including wetland impacts, impacts on other users, water quality degradation, recharge from lateral inflow and leakage and saltwater intrusion."</p> <p>Additional conclusions are presented in Chapter 4 of the report.</p> <p>Strategies are presented for the protection of groundwater and wetland resources and water conservation. From the report: "In summary, the strategy recommended for Lee County for recharge area protection is to protect both the quantity and quality of water undergoing recharge. Recharge quantity is protected primarily through existing regulatory programs which protect ground water usage, drainage, and wetlands. Existing water use regulatory programs will require development of "cumulative impact models" by the South Florida Water Management District to protect recharge areas."</p>
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			<p>Also from the report: "Wetlands can be protected in either of two ways: first, through regulation of development and, second, purchase of lands." Chapter 4 of the report provides additional details.</p> <p><b>Weaknesses:</b> some of the data are out of date.</p>
8 a.	Evaluation of study approach and conduct		This report is a scientifically defensible hydrogeologic evaluation/report. It also presents qualitative and quantitative aquifer parameters (e.g., aquifer storage).
8 b.	Extent to which report is "up to date"		<p>There has been about a 10 year period from the time this report was compiled to the present date. There have likely been a number of additional wells drilled and tested that could be incorporated into this report's data base. There is also another 10 years of rainfall and water level data that have been collected.</p> <p>Some of the water use projections may be outdated.</p>
8 c.	Completeness / data gaps / remaining information needs		Report is substantially complete with respect to hydrologic resources. However, this document does not consider the effects of mining on the range of ecological resources that exist within the DR/GR such as wildlife and important habitats.
8 d.	Relationship to, and consistency with, other studies / reports		This report could be viewed as the first of two phases, with the Rawl and Voorhees (2005) report being considered the second phase.



## Engineering Analysis for Properties Designated Within the City of Bonita Springs as “Density Reduction/Groundwater Resource”

Item	Description	Sect / Page	Information from Report
1	Document Title	Cover	Engineering Analysis for Properties Designated Within the City of Bonita Springs as "Density Reduction/Groundwater Resource" (DR/GR) - DRAFT
2	Author	Cover	Greg F. Rawl, P.G. R.M. Edenfield, P.E., Environmental Consulting and Technology, Inc. Paul Sebert, AICP, EMS Scientists Engineers Planners
3	Date	Cover	July 2005
4	Sponsoring agency / publisher	Cover	City of Bonita Springs, 9101 Bonita Beach Road, Bonita Springs FL, 34135
5	Purpose of study or document	Introduction	<p>"...in 2003 the City [of Bonita Springs] authorized a comprehensive study to asses the current land uses, groundwater resource, surface water resources and other natural resources within that portion of the City east of I-75 and north of Bonita Beach Road." (pg 3)</p> <p>"This report provides analysis of the existing land uses within the Study Area and specifically the basis of the most prominent category therein, the DR/GR designation, through the process of data collection, technical quantitative and qualitative analysis, and the development and evaluation of alternative land use scenarios. A comprehensive analysis of all of the factors will help guide the City with recommendations on future land use decisions. This report is the result of these analyses, and documents the findings." (pg 6)</p>
6	Relevance to DR/GR lands in southeast Lee County	All	High Relevance: The majority of the Study Area is within the DR/GR boundaries. The Study Area includes the southwest portion of the DR/GR. (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C)

7	Summary of report content	All	Description of existing land uses, geology, and hydrogeology. Presents several different land use scenarios and their potential impact on surface water quality.
7 a.	General information and overall content	Section I/p 2  Section II/ p 6	<p>Introduction – Gives a brief history of the DR/GR. Bonita Springs has recently allowed variances within the DR/GR for recreational use. The environmental issues sections within this document were coordinated informally (through meetings and presentations) with the Corkscrew Regional Ecosystem Watershed (CREW), the Conservancy of Southwest Florida, Estero Agency for Bay Management (ABM), the Florida Wildlife Federation, the Southwest Florida Watershed Council, and with the following government regulatory agencies that will have an influence on future regional issues: Lee County Natural Resources Division, South Florida Water Management District, and the Florida Department of Environmental Protection.</p> <p>Pre-development Condition of Study Area – The Study Area is entirely within the Estero Bay watershed, as is most of the DR/GR. The riverine systems within the Study Area are the Imperial River, Leitner Creek, and Spring Creek, all of which are tributaries of Estero Bay, a State of Florida Aquatic Preserve. Estero Bay and its watershed are also a part of the Charlotte Harbor National Estuary Program (NEP), a program Federally authorized by the US Environmental Protection Agency (EPA). These riverine systems historically transitioned into slough and marsh systems that were interspersed with upland areas that would periodically become inundated during high rainfall events when sheetflow was created.</p> <p>Existing Environmental Conditions of Study Area – Wetlands and other jurisdictional waters are identified and discussed. Boundaries are identified using Florida Land Use Cover and Forms Classification System (FLUCFCS) codes which are useful in terms of general types of wetlands present but are not sufficiently accurate to be used as jurisdictional wetland boundaries or for site-by-site wetland acreage or type determinations.</p>

		<p>Section III/ p 8</p> <p>Section IV/ p 31</p>	<p>A summary of regulatory issues, including a list of regulatory agencies and their roles in wetland regulation is provided (p. 11). Specific attention is given to the Florida Department of Environmental Protection-implemented Total Maximum Daily Loads Program. According to a Water Quality Assessment Report issued by Florida Department of Environmental Protection in 2003, waters within the Study Area have been designated as either impaired (total maximum daily loads will be developed) or as needing further monitoring to determine status. The Imperial River was identified as impaired for both Dissolved Oxygen and nutrients (total phosphorus and total nitrogen). Florida Department of Environmental Protection is projecting the development of a total maximum daily loads for dissolved oxygen, total nitrogen, and total phosphorus to be completed in 2007. As part of the total maximum daily loads process, the Estero Bay Nutrient Management Partnership has proposed a study of Best Management Procedures to improve the water quality of discharge into the Estero Bay. At the time this document was prepared, the SFWMD was also developing new rules regarding certain best management procedures and water treatment facilities within the Study Area and the larger southwest Florida Basin.</p> <p>A study of plant and animal species federally or state listed as endangered or threatened was also conducted. No specific locations of listed animal species sitings were documented during the field visit. Potential habitat for listed species and land uses were noted and used in preparation of Figures. Species listed as threatened, endangered, or of special concern by federal or state agencies and have the possibility of occurrence within the DR/GR area (based on potentially suitable habitat) are: Big cypress fox squirrel, Florida black bear, Florida panther, American alligator, Eastern indigo snake, gopher tortoise, gopher frog, Bachman's warbler (during migration - very low probability due to rarity of this species), bald eagle, black-crowned night heron, crested caracara (very low probability due to lack of contiguous</p>
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			<p>habitat), Florida sandhill crane (very low probability due to lack of contiguous habitat), Florida snail kite, Kirtland's warbler (during migration - very low probability due to rarity of this species), red-cockaded woodpecker, roseate spoonbill, snowy egret, tricolored heron, white ibis, and wood stork. The only listed plant species is the beautiful pawpaw, a low-growing shrub found only in open pine flatwoods that contain dwarf oak and wiregrass in the understory. Study methods included a review of existing literature, regulatory agency coordination, and field assessments, all conducted during a one-week survey in December 2003. The study was conducted at the level of providing planning information but does not provide the level of intensity that would be required for a presence/absence type survey.</p> <p>Existing Land Use – Natural lands and wetlands are not discussed in this section because they were covered in Sections I-III.</p>
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)	<p>Sections V, VI, VII</p> <p>V</p>	<ul style="list-style-type: none"> <li>• Geologic and hydrogeologic cross sections, maps showing water levels in the different aquifers, some water quality information presented.</li> <li>• Groundwater Flow Model – MODFLOW 2000: <ul style="list-style-type: none"> <li>(1) Model discretization: 564 rows x 480 columns, 500 ft x 500 ft. &amp; 5 aquifers.</li> <li>(2) Recharge: Rainfall was evaluated using PRISM model (Daly2004). (<a href="http://www.ocs.oregonstate.edu/prism/index.phtml">http://www.ocs.oregonstate.edu/prism/index.phtml</a>) and Land Cover using SFWMD Feasibility Study geographical information systems Year 2000 coverage → evapotranspiration &amp; Net Recharge dry/wet.</li> <li>(3) Mine borrow pits were determined from the 2002 Aerial Photo &amp; mine penetration from the mine database → Modeled as ponds with high storage &amp; hydraulic conductivity.</li> <li>(4) Canals were modeled as drains. Aquifer penetration and conductance was computed based on the SFWMD Southwest Florida</li> </ul> </li> </ul>

		IX	<p>Feasibility Study canal geographical information systems data</p> <p>(5) Public and industrial pumpage is based on SFWMD permits, actual pumpage and utilities data. Aquifer Storage and Recovery were also included.</p> <p>(6) Model boundary conditions: constant head</p> <p>(7) Optimization - MODFLOW 2000 modified Gauss-Newton optimization method for boundary conditions, hydraulic conductivity, storage and leakance &amp; global optimization (Floudas 2001) for net recharge.</p> <p>(8) Calibration Statistics – Residuals 0 to 11 feet - Needs to include room mean square error.</p> <p>(9) Transient calibration (1/2000 to 1/2002) – wet/dry graphs.</p> <p>(10) Groundwater fluxes and contours</p> <p>(11) Groundwater flow to tide: Northern Gulf Coast, Southern Gulf Coast, Caloosahatchee River mouth and inland.</p> <p>(12) Canal drawdown impact</p> <p>(13) Water budget.</p> <p>(14) Conclusions and recommendations</p> <ul style="list-style-type: none"> <li>- extensive use of SFWMD, United States Geological Survey &amp; NOAA data</li> <li>- detailed MODFLOW model for Lee County</li> <li>- calibrated model</li> </ul> <p>• XPSWMM model – The model was a modified version of the existing South Lee County Stormwater model. This model was acquired from its developer: Johnson Engineering, Inc.</p> <p>(1) This model incorporates the XPSWMM runoff block or module which “generates surface and subsurface runoff based on rainfall hyetographs, antecedent conditions, land use, soil characteristics and topography,” (pg 88).</p> <p>(2) This model incorporates the XPSWMM extran block which is a hydraulic flow routing model for open channel or closed conduit</p>
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			<p>systems,” (pg 88).</p> <p>(3) The National Resources Conservation Service Unit Hydrograph methodology was used to determine the rainfall/runoff relationship.</p> <p>(4) The authors modified the model with updated information.</p> <p>(5) Calibration was not conducted because calibration was conducted by Johnson Engineering, Inc in their development of the model.</p> <p>(6) The XPSWMM model was used to calculate water quality results.</p>
7 c.	Useful maps and overlays		<p>Maps are well done but contain only a small portion of the DR/GR. Probably maps from the Rawl Mining Study would be more useful to include as overlays.</p> <p>Figure 7- Composite Map of the Estero Bay Planning Unit – It would be helpful to see if a map like this could be prepared that shows the whole DR/GR.</p>
7 d.	Relevant results and conclusions	<p>Section III P 10</p>	<p>Overall: The use of best management practices for surface water management can lead to minimizing the potential impacts to surface water bodies, receiving waters (Estero Bay), and may improve recharge quality and quantity. Low density residential development appears to have the least impacts to the ecosystem.</p> <p>Specific comments:  The wetland and non-wetland surface water features identified within the Study Area include cypress dome and slough systems (FLUCFCS 621), cypress-pine-cabbage palm (FLUCFCS 624), open water (FLUCFCS 500), streams and waterways (FLUCFCS 510), and lakes (FLUCFCS 520). The wetlands appear to have “diminished functional value” based on the Wetlands Rapid Assessment Procedure. No follow-up information was included on how this assessment method was used or what numerical scores</p>

		<p>Section III P 18</p>	<p>were assigned to these wetlands. Hydrologic alterations such as ditch construction; tree harvesting; fire suppression; livestock grazing; and invasion by exotic species are listed as the main reasons for reduced quality of the wetlands. During field observations it was noted that most of the wetlands are hydrologically impaired due to residential development, agriculture, and surface mining. Existing vegetation is disturbed and invasive plant species are common throughout many of the wetlands within the study area. Based on these observations it was suggested that opportunities for ecosystem restoration projects exist in this area.</p> <p>Existing land uses are listed and discussed. Of interest from an ecological standpoint is the presence of pine flatwoods (FLUCFCS 411) and areas dominated by melaleuca (FLUCFS 424). Pine flatwoods, an upland vegetation community, in conjunction with other habitat types such as cypress-pine-cabbage palm wetlands, also identified within the Study Area, are a part of the historic landscape mosaic and are considered to be critically important to many species of wildlife. The authors do not discuss what might have existed historically within the melaleuca-infested portions of the project area. Melaleuca-infested uplands that were historically pine flatwoods present an opportunity for upland restoration or enhancement. Plant and animal species federally or state listed as threatened or endangered are identified in terms of possibility of occurrence based on potentially suitable habitat. Site-specific data were discussed for the Florida black bear and Florida panther. No black bear siting are reported within the study area. Text indicates no Florida Fish and Wildlife Conservation Commission-designated strategic habitat conservation area for the black bear within the study boundaries. This does not agree with Figure 8 A - Bear Location Map. It appears that the overlay for the Florida panther was used for this map rather than the Florida black bear data. Based on road kill data (1972-2000) and radio-collar telemetry data (1981-2001), three Florida panther sitings occurred within the project area between 1998 and 2002. An additional nine reports were made within one mile outside the project boundaries (and</p>
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			<p>within the DR/GR area). Figure 8-B shows that there is extensive Florida Fish and Wildlife Conservation Commission-designated strategic habitat conservation area within the study area and the DR/GR area. No information is provided regarding the date of the Florida Fish and Wildlife Conservation Commission-designated strategic habitat conservation area maps (Figures 8 A and 8 B). These are updated periodically and the most recent version should be used for any map overlays.</p>
		<p>Section III P 21</p>	<p>The authors recommend that extensive areas of impaired wetland habitat could be restored through such activities as re-establishment of appropriate hydrology through construction of ditch blocks and installation of additional culverts beneath roads, and enhancement of existing vegetation through the removal of exotic species, planting of native species, and reestablishment of natural fire regime.</p>
		<p>Section XI P 117</p>	<p>Recommendations – A discussion of reasoning and issues surrounding each recommendation is included. Those relevant to natural resource issues within the DR/GR are listed here:</p> <ul style="list-style-type: none"> <li>- #1 - The City of Bonita Springs should take a proactive role in the development of best management procedures for utilization within the watershed to improve water quality discharging into the Estero Bay.</li> <li>- # 3 – The City of Bonita Springs should adopt a numerical standard for nutrients and pollutants of concern.</li> <li>- #4 – The City of Bonita Springs should evaluate opportunities to implement water quality treatment systems within the DR/GR area to improve the quality of surface water discharges.</li> <li>- #10 – Require periodic updates of the Wellfield Protection Ordinance.</li> <li>- #11 – Allow for Individual Comprehensive Plan Amendments for DR/GR Land Use Category parcels upon demonstration by the applicant of compliance with proposed Comprehensive Plan policy</li> </ul>

			16.1.15. -
8	Summary of report strengths and weaknesses		<p>Strengths:</p> <ul style="list-style-type: none"> <li>• Appears to be a reasonably comprehensive record of current data.</li> <li>• Contains general overview of natural resources within the City of Bonita Springs.</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>• Limited in terms of geographical extent and detail provided regarding ecological issues.</li> <li>• Some references and citations are missing and conclusions are drawn from some of the missing references.</li> <li>• Recharge estimates may be flawed in that the estimates do not account for induced recharge around well fields and recycling of water on agricultural lands.</li> <li>• Appears to base conclusions and recommendations more on a common-sense approach to management of the DR/GR land (i.e., low density and the use of best management practices will decrease the potential impacts to the resources) than on in-depth quantitative evaluations and analyses.</li> </ul> <p>Groundwater Model</p> <ul style="list-style-type: none"> <li>• Missing conceptual site model and optimization results: mainly the information regarding the sensitivity to the recharge and the mass balance.</li> <li>• Does not discuss existing regional or Lee County ground water models (e.g. Bower, Adams, and Restrepo, 1990).</li> </ul> <p>XPSWMM Model</p> <ul style="list-style-type: none"> <li>• Does not appear that any checks were made on the calibration of the model. Could the author's recreate Johnson Environmental, Inc.'s</li> </ul>

			<p>results?</p> <ul style="list-style-type: none"> <li>No discussion of how modifications to the existent model changes results.</li> </ul>
8 a.	Evaluation of study approach and conduct		<p>Habitat enhancement and restoration suggestions are useful. The types of habitats within the Study Area have been impacted throughout the region and are of critical importance to a variety of plant and animal species. (See FWS Multi Species Recovery Plan, "Ecological Communities" section). Although creation of these habitat types has not been successful, restoration and enhancement of degraded habitat can work well at a cost well below that of many wetland creation projects.</p> <p>Wetland, existing land use, and wildlife information is presented at general landscape level and should not be used to determine the presence or absence of community types or wildlife or plant species on a given parcel of land. Field surveys and observations required for determinations on that scale are highly time and money intensive and are beyond the scope of this report. The discussion of plant and animal species is generally in agreement with other sources reviewed for the DR/GR study, but does not contain the level of detail found in other sources such as the 951 Environmental Reports and the State of Florida "Closing the Gaps" study.</p> <p>List of recommendations pertains mostly to water-quality and comprehensive plan land-use issues. The information presented in Section III lends itself to suggestions regarding mitigation and land preservation policies (some of which are suggested within this summary) but no follow-up in the form of specific recommendations in Section XI was included. Recommendation #11 - Individual Comprehensive Plan Amendments for DR/GR Land Use Category lacked discussion of possible impacts to existing environmental resources and water quality and how these might be addressed.</p> <p>In general the report provides accurate but sometimes incomplete information.</p>



8 b.	Extent to which report is “up to date”		<p>Hydrologic data are up to date (as of about 2005).</p> <p>Information regarding land cover and wildlife is changing constantly. For wildlife species, it is important to contact an agency such as the Florida Fish and Wildlife Conservation Commission (FWC) or the US Fish and Wildlife Service that maintains a database that is updated continually.</p>
8 c.	Completeness / data gaps / remaining information needs		<p>Overall:</p> <ul style="list-style-type: none"> <li>• Reasonably complete. No real data gaps, but additional studies are recommended.</li> </ul> <p>Groundwater model:</p> <ul style="list-style-type: none"> <li>• Modeled water budgets. Additional information is needed in the water budget to calculate mass balance for the model; it is difficult to calculate with these tables.</li> <li>• No plots or figures of properties used in the modeling: hydraulic conductivity, leakance, and storage.</li> <li>• This document does not consider the effects of mining on the range of ecological resources that exist within the DR/GR such as wildlife and important habitats.</li> </ul> <p>XPSWMM</p> <ul style="list-style-type: none"> <li>• Does not appear that any checks were made on the calibration of the model. Could the author’s recreate Johnson Environmental, Inc.’s results?</li> <li>• No discussion of how modifications to the existent model changes results.</li> <li>• No mass balance tables are reported or listed.</li> </ul>
8 d.	Relationship to, and consistency with, other studies / reports		Complimentary document to the Rawl groundwater resources and mining report.

## Estero Bay State of the Bay Report

Item	Description	Sect / Page	Information from Report
1	Document Title		Estero Bay State of the Bay Report
2	Author		The Estero Bay Agency for Bay Management
3	Date		January 2000
4	Sponsoring agency / publisher		Southwest Florida Regional Planning Council 4980 Bayline Drive, 4 <sup>th</sup> Floor North Fort Myers, FL 33917-3909 941-656-7720
5	Purpose of study or document		A summary of issues surrounding Estero Bay and its watershed, written with the intent of informing the general public on these issues
6	Relevance to DR/GR lands in southeast Lee County		The entire DR/GR is within the study area. Issues discussed are pertinent to DR/GR lands. (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C)
7	Summary of report content		
7 a.	General information and overall content	The Bay – An Overview  Florida’s First Aquatic Preserve P 12	Much of the document includes background and historical information regarding the Estero Bay watershed as a whole. Estero River, Halfway Creek, Spring Creek, Imperial River, Hendry Creek, and Mullock Creek (some of the water bodies that drain water from the DR/GR to the Estero Bay Aquatic preserve) are discussed in general terms (p 5). Land uses, including agriculture and mining, are summarized (p 11).  The changes over time in Florida’s stewardship ethic are discussed in terms of the creation of the Estero Bay and ongoing efforts to preserve the wetlands and other important habitats surrounding the Estero Bay.

		<p>Education: Who is Doing What? P 14</p> <p>Outdoor Activity on Estero Bay P 16</p> <p>Population P 19</p> <p>Water Quantity, Quality, and Timing P 21</p> <p>Wildlife and Habitat P 22</p>	<p>Includes a summary of public and privately run education programs within the Estero Bay watershed.</p> <p>Includes a discussion of the importance of the area in terms of human uses such as recreation, boating, fishing, and hunting.</p> <p>A discussion of projected population pressures that may exist in the area in the future up to the year 2020.</p> <p>Includes a good summary, in layman's terms, of hydrological alterations, such as increased development, wetland loss, water control structures, and draw down from agriculture, landscaping, and potable water within the area and their effect of the ecology and on human uses of the area such as tourism and agriculture. Surges in freshwater resulting from impacts to historic sheetflow are hard to predict due to wide variations in rainfall and result in degraded water quality, freshwater pulses into the estuary, and flooding. It is noted that water inflows to the Estero Bay from groundwater are unknown. Data collected by Estero Bay Marine Laboratory indicate that dissolved oxygen levels are often below the state standard of 4 mg/Liter in many locations within the area, including the Estero River. It is noted that inadequate data regarding hydroperiods have been collected to date.</p> <p>A good discussion of the variety of taxa found within the watershed, including discussion of non-listed species. Includes discussions of reptiles, amphibians and invertebrates that is often lacking in wildlife studies in</p>
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		<p>Issues of Special Concern P 30</p> <p>Management Initiatives: Groups and Organizations P 39</p>	<p>addition to a discussion of mammals, neotropical migrants, shore birds, and wading birds. The discussion of wide-ranging species, such as the Florida panther and the Florida black bear, is not as in-depth as some other sources but does give an overview of this issue that is very relevant to decisions regarding land use within the DR/GR.</p> <p>It is noted that very little information regarding freshwater and land invertebrates is available with the exception of mosquitoes, butterflies, damselflies, apple snails, and crayfish. Other invertebrates can be important in terms of providing food sources for many other taxa and in terms of providing information regarding long-term water quality conditions.</p> <p>Includes summaries of many issues relevant to the DR/GR area including Outstanding Florida Waters, environmentally sensitive lands (riverine systems, interior wetlands, rare habitats, uplands), state and federal listed wildlife species (including the Florida mastiff bat, an animal that may occur within the geographical area and habitat types found within the DR/GR but not often listed as a species of concern in discussions of wildlife within the area), exotic animals and plants, and the flooding events of the summer of 1995 (including mention of the South Lee County Watershed Study). Issues within this section are discussed in narrative form only.</p> <p>A discussion of public entities with direct or indirect management missions within the Estero Bay watershed. Agencies relevant to the DR/GR area include the South Florida Ecosystem Restoration Task Force, the Governor's Commission for a Sustainable South Florida, the Governor's Commission for the Everglades, Conservation 2020, Preservation 2000, Charlotte Harbor National Estuary Program, Florida Department of Environmental Protection Ecosystem Management Areas, Estero Bay Watershed Assessment, the Central and Southern Florida Flood Control District Restudy, and the U.S. Army Corps of Engineers Environmental Impact Study.</p>
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7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		No specific data are presented
7 c.	Useful maps and overlays		<p>Estero Bay Drainage Basin c. 1997 (from Lee County, Univ. of Florida, and FWC imagery) – shows basin boundaries, land uses. Best depiction of streams and rivers draining from the DR/GR.</p> <p>Estero Bay Watershed Land Conservation/Preservation Strategy Map (includes entire DR/GR area). Comprehensive list of sources that includes lands recommended for preservation. Could be useful if an updated version is available.</p>
7 d.	Relevant results and conclusions	Water Quantity, Quality and Timing P 22	Authors recommend that a watershed model including the parameters of cumulative effects of control structures in canals, rivers and creeks; wetland loss; projected land use; and water demand should be developed.
8	Summary of report strengths and weaknesses		<p>Good general overview of the Estero Bay Watershed.</p> <p>Often does not contain information on a level specific enough to be used directly for DR/GR issues.</p> <p>Listed Species section lacks a discussion of plant species.</p>
8 a.	Evaluation of study approach and conduct		
8 b.	Extent to which report is “up to date”		<p>General information regarding history and issues is timely.</p> <p>Principles of the Estero Bay Agency for Bay Management have been updated and are summarized in the 2004 update.</p>
8 c.	Completeness / data gaps / remaining information needs		Authors note need for more information regarding hydroperiods, groundwater influence, and freshwater invertebrate species.

### Estero Bay - State of the Bay



8 d.	Relationship to, and consistency with, other studies / reports		<p>General conceptual agreement between principles/recommendations between Estero Bay Agency and Charlotte Harbor National Estuary Program. The need for a better understanding and documentation of cumulative impacts and an overall water budget for the area are noted in other studies and reports.</p> <p>More complete list of wildlife taxa and species than included in many other reports. However, little detail is given to discussion of any particular species.</p>
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## Estero Bay State of the Bay Update

Item	Description	Sect / Page	Information from Report
1	Document Title		Estero Bay State of the Bay Update
2	Author		The Estero Bay Agency for Bay Management
3	Date		May 25, 2004
4	Sponsoring agency / publisher		Southwest Florida Regional Planning Council 4980 Bayline Drive, 4 <sup>th</sup> Floor North Fort Myers, FL 33917-3909 941-656-7720
5	Purpose of study or document		Provides an update to 2000 State of the Bay Report. To report on water quality status and trends and wildlife status and trends within the Estero Bay and associated watershed.
6	Relevance to DR/GR lands in southeast Lee County		The entire DR/GR is within the study area. Issues discussed are pertinent to DR/GR lands and receiving water bodies. ( See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C)
7	Summary of report content		
7 a.	General information and overall content	Introduction p 1  Water Quality p 7  Hydrology p 45	Summarizes revised Principles of the Estero Bay Agency on Bay Management (see Findings/Recommendations)  Discussion of water quality status and trends. (All trends and data mentioned in section 7a are discussed in section 7d.) All data are from Florida Department of Environmental Protection. No further information regarding data sources, locations, or quality control is provided.  Hydrology in terms of tributary flows is also presented. United States

## Estero Bay - State of the Bay Update

		Wildlife p 50 Social p 60	Geological Survey data from 1988-2000 are presented in graphical form. No statistical analyses are presented here, however, the data do appear to support the assertion that sharp peaks during rain events are becoming larger and more frequent.  Trends in wildlife utilization are discussed. Data sources are not listed. Other factors considered in this report were population (p 60), recreational uses (p 62), and building permits issued from 1992-2002 by Lee County (p 63).
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		Florida Department of Environmental Protection water quality data and wildlife trends data
7 c.	Useful maps and overlays	Water Quality p 8	Estero Verified 2002 303d. Includes South Florida Water Management District sub-basin boundaries. From Charlotte Harbor National Estuary Program, Southwest Florida Regional Planning Council, Florida Department of Environmental Protection, South Florida Water Management District. Based on 2001 data
7 d.	Relevant results and conclusions	Introduction p 1	From the Principles of the Estero Bay Agency on Bay Management, adopted May 13, 2002, only the ones most clearly applicable to a variety of DR/GR area issues are listed below): <ul style="list-style-type: none"> <li>- I.C. All rezoning requests will be critically evaluated to ensure protection of water quality, rare and unique habitats, listed wildlife, and ecosystem functions.</li> <li>- I.D. Variances from environmental regulations and deviations from development standards will be the exception, not the rule.</li> <li>- II – Uplands, Headwaters, and Isolated Wetlands (Section II - Uplands, Headwaters, and Isolated Wetlands, contains a 2-page list of recommendations, all of which are pertinent to the DR/GR area. They include recommendations regarding land management and acquisition, vegetation (mostly pertaining to planting of native vegetation, eradication of invasive vegetation, and the importance of</li> </ul>

## Estero Bay - State of the Bay Update

			isolated and seasonal wetlands), consideration to historic topography, including flow-ways, new construction guidelines, biological controls as preferred methods of mosquito control, incentives for ecologically sensitive agriculture, effects of urban areas on the Estero Bay watershed, and guidance for future roadways.)
		Water Quality p 7	Based upon the water quality information summarized on pp 7-39, and hydrology information summarized on pp 45-49, a list of findings and recommendations is presented. The following subset is particularly relevant to the DR/GR area; <ul style="list-style-type: none"> <li>- Dissolved oxygen is down and nutrients, specific conductivity, and turbidity are up in Estero Bay.</li> <li>- Current development standards are not working well, even in Outstanding Florida Waters.</li> <li>- Current development has lead to greater extremes in water quality, both in terms of higher, quicker flood peaks, and lower water levels during drought conditions.</li> <li>- 1 in 20 stations may falsely conclude a trend. Low dissolved oxygen can be present in an improving system. Inorganic nutrients are a better measure of health of a system than total nutrients.</li> <li>- Wildlife information presented on pp 50-57 revealed negative trends in number of red-cockaded woodpecker families and number of wading bird and brown pelican rookeries, extinction of the Florida scrub jay from the Estero Bay basin, positive trends in number of bald eagle nests from 1995-1999, and varying impacts to gopher tortoise habitat from 1999-2003.</li> </ul>
		Findings p 40	
		Discussion and Conclusions p 64	Discussion and Conclusions also includes the following findings: <ul style="list-style-type: none"> <li>- Increases in population and land conversion appear to have affected water quality, hydrology, and wildlife in Estero Bay and its watershed by altering the hydrology of tributary streams in ways that lead to</li> </ul>

### Estero Bay - State of the Bay Update

			<p>faster passage of water, resulting in increased floods and extended droughts; reducing catch of important indicator species, including mullet and blue crab; causing decreases in wildlife dependent upon interior habitats of the basin (including the DR/GR); and decreasing water quality within the Estero Bay and its tributaries, especially for dissolved oxygen, nutrients, and turbidity.</p> <ul style="list-style-type: none"> <li>- Florida Department of Environmental Protection water quality standards were not met in 2001 for the freshwater portion of Spring Creek for dissolved oxygen and the freshwater portion of Imperial River for fecal coliform. The majority of the DR/GR area is impaired for dissolved oxygen based on 2001 data. There is also an area in the southern part of the DR/GR that is impaired for chlorophyll-a and copper based on 2001 data. Each parameter is briefly discussed in terms of ecological significance and Florida Department of Environmental Protection state standards. Graphical results for each parameter measured over a period of 3-12 years are shown. Summaries are presented on a basin-wide basis and are therefore difficult to relate to the specific area within the DR/GR.</li> <li>- There is a need for a nutrient management partnership to address declines of these parameters.</li> <li>- Landscape-scale growth management and planning is crucial to maintaining clean water, natural hydrology, and fish and wildlife resources. The Lee County Master Mitigation Plan is identified as a good example of an integrated plan that addresses a variety of issues.</li> </ul>
8	Summary of report strengths and weaknesses		<p>Good discussion of trends (as summarized in section 7d) and status of many factors pertinent to DR/GR area, including recommendations regarding the findings.</p> <p>Often does not contain information on a level specific enough to be used directly for DR/GR issues.</p> <p>Listed Species section lacks a discussion of plant species.</p> <p>Information regarding data source, documentation, and quality control is</p>

**Estero Bay - State of the Bay Update**



			<p>often incomplete or lacking. This information is likely available but may not have been included in the report since it might not be helpful to target audience.</p> <p>Organization is somewhat hard to follow. Findings and recommendations sections are interspersed with results sections.</p>
8 a.	Evaluation of study approach and conduct		This study was designed as an overall review of status and trends for use by a lay person. Therefore, information regarding study approach and conduct are often not included.
8 b.	Extent to which report is “up to date”		Water quality and wildlife data should be updated to determine continuing trends. Subsequent State of the Bay reports are anticipated.
8 c.	Completeness / data gaps / remaining information needs		This report is intended as a broad overview of trends and therefore does not include information regarding all water quality, hydrology, or plant and animal issues relevant to the DR/GR. Water quality measurements and wildlife species reported here are a small subset of those that have been documented in the DR/GR area. The information reported here reflects an overall characterization of trends throughout the entire watershed rather than an attempt to catalog data specific to the DR/GR area.
8 d.	Relationship to, and consistency with, other studies / reports		Overall water quality, hydrology, and wildlife summaries appear to be in concurrence with other studies in terms of negative effects of increases in population and land conversion having negative effects on water quality, hydrology and wildlife utilization, as discussed in section 7d above. Water quality information is hard to compare because the data used are a subset of that discussed in other studies.

## Lower Charlotte Harbor Reconnaissance Report

Item	Description	Sect / Page	Information from Report
1	Document Title		Lower Charlotte Harbor Reconnaissance Report
2	Author		Charlotte Harbor National Estuary Program
3	Date		December 19, 2005
4	Sponsoring agency / publisher		Charlotte Harbor National Estuary Program 1926 Victoria Avenue Fort Myers, FL 33901 239-338-2556 <a href="http://www.charlotteharbornep.org">www.charlotteharbornep.org</a> and Stormwater Management Division South Florida Water Management District Fort Myers, FL 33091 <a href="http://www.sfwmd.gov">www.sfwmd.gov</a>
5	Purpose of study or document		To review and summarize existing information about the Lower Charlotte Harbor system in accordance with the Surface Water Improvement and Management (SWIM) program authorized by the State of Florida (F.S. 373.453). This document will be used by the SFWMD to develop the SWIM plan including a list of actions to be implemented to maintain and improve the water body.
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and		The study area is large in comparison with the DR/GR area and therefore conclusions regarding status and trends discuss basins as a whole rather than the DR/GR lands. The DR/GR is located mostly within the Estero Bay Basin. Some of the

## Lower Charlotte Harbor Reconnaissance

	Environmental Issues in Appendix C)		eastern portions of the DR/GR are located within the Trafford Basin. Based on data collected during the 1995 flooding of the area it was determined that the Trafford Basin flows west into Estero Bay depending on the amount of rainfall. Water quality and trends data are not presented for the Trafford Basin portion of the DR/GR lands within this report, however. Digitized maps in Section 4 – listed in “Maps and Overlays” – could be especially useful in further development of the Lee County Master Mitigation Plan
7	Summary of report content		
7 a.	General information and overall content	Section 1/p 1 Section 2/p 3  p 30  Section 3 p 31	<p>Introduction – describes the SWIM program</p> <p>Lower Charlotte Harbor Water Body System – Summary of basin boundaries, physiographic areas, and human history of the region. Includes a discussion of conditions that have led to the need for restoration. Major stressors relevant to DR/GR issues include altered hydrology; changes in water quality; habitat loss, alteration, and fragmentation; exotic plant and animal infestation; human use; and altered fire regime. Several conceptual models designed to illustrate these stressors (conditions that have led to the need for restoration) and the results of these stressors are presented.</p> <p>Also includes an in-depth summary of governmental agencies with jurisdiction within the study area. Table 6 is a list of implementation partners for the SWIM plan, including non-governmental organizations.</p> <p>Programmatic Context – Lists other coordinated restoration and projects being implemented within the study area. Programs relevant to the DR/GR area include: Comprehensive Everglades Restoration Plan, Southwest Florida Feasibility Study, Southwest Florida Restoration Coordination Team, Charlotte Harbor National Estuary Program, South Florida Multi-Species Recovery Plan, Southwest Florida Environmental Impact Statement, Aquatic Preserves Program, Outstanding Florida Waters, Charlotte Harbor Management Plan, Estero Bay Agency on Bay Management, Estero Bay and Watershed Assessment, South Lee County Watershed Plan, Lee County</p>

## Lower Charlotte Harbor Reconnaissance

			<p>Master Mitigation Plan, Southwest Florida Resource Conservation and Development Council, Inc. and the Corkscrew Regional Ecosystem Watershed Trust. A summary of the lead entity(ies), goals, and a Web site are included in each summary. Many of these programs have produced documentation that is also being reviewed as a part of the DR/GR study.</p>
		<p>Section 4 p 42</p>	<p>Geographic Analysis – Includes soil map, soil drainage characteristics, pre-development, current, and proposed land cover and land use, percentages of impervious cover, conservation lands, conservation easements, Strategic Habitat Conservation Areas, Florida Greenways and Trails conservation opportunities, and land identified for potential future acquisition.</p>
		<p>Section 5 p 61</p>	<p>Water Quality Status and Trends – Provides a summary of water quality monitoring being conducted by numerous agencies and volunteer organizations. Summaries include geographical locations of data, testing parameters, level to which data are comprehensive, and often associated Web sites. No discussion of quality control or data reliability are included. The most up-to-date compilation of existing testing is a study conducted in 2004 for the Southwest Florida Feasibility study completed by TetraTech with the assistance of Janicki Environmental, Inc, entitled “Compilation, Evaluation, and Archiving of Existing Water Quality Data for Southwest Florida.” A discussion of impaired waters and their classification is included. The Florida Department of Environmental Protection 303(d) list of impaired waters was approved by the EPA in 1998 and is based on “existing, readily available data or best professional judgment”. No further details regarding data source(s) for this list are provided. A Florida Department of Environmental Protection integrated assessment of categories is included. The majority of the DR/GR area is listed as Category 5 – Water quality standard not attained; water quality impaired and requires total maximum daily loads; verified list and 303(d) list.</p>

	p 73	A map depicting verified impairments (based on Florida Department of Environmental Protection list) shows much of the DR/GR area to be impaired for chlorophyll-a and dissolved oxygen.
	p 81-82	Trends based on the water quality summary conducted in 2004 by TetraTech are presented as maps of the study area. It is difficult to interpret the data for relevance within the DR/GR area due to the scale of the maps presented. However, it appears that negative trends for dissolved oxygen and biological oxygen demand and positive trends for total phosphorus may exist within the DR/GR. The authors do not discuss possible interpretations of these results. The 2004 report also identified data gaps. These are not discussed. National Pollutant Discharge Elimination System permits, brownfield data (a brownfield is an existing commercial or industrial site that has been abandoned or is underused due to public health and environmental hazards), and domestic and industrial wastewater generating facilities were identified as sources of pollution. All these sources but brownfields were identified within the DR/GR area.
	Section 6 p 90	Existing Hydrology and Hydraulics Plans – Includes summary of regional hydrologic and hydraulic studies. Most of these are presented in tabular form. A table of identified project needs within the study area is also included.  A list of recommendations for projects within the Estero Bay published by the Southwest Florida Watershed Council is provided at the end of Section 6.
	Section 7 p 106	Existing Management Actions – Includes summaries of some of the Everglades Restoration projects, Lee County and City of Bonita Springs capital improvement programs, and 2004 Restoration projects tracked by Charlotte Harbor National Estuary Program. Information regarding lands in stewardship and 2004 acquisition lands is also provided in tabular form.

## Lower Charlotte Harbor Reconnaissance



		Section 8 p 119	Water Resources Management Issues of Concern – This section is a summary of issues that need to be addressed within the study area. Research needs pertinent to the DR/GR area include study of assimilative capacities within each basin, establishment of minimum freshwater flows needed to maintain estuarine health, establishment of sub-regional water and nutrient budgets, and further study on the importance and ecology of ephemeral wetlands. Area-wide restoration needs are also included. Those relevant to the DR/GR area are listed in the Lee County Master Mitigation Plan.
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		Includes a summary of many existing water quality data sources.
7 c.	Useful maps and overlays		See below.
7 d.	Relevant results and conclusions		The Lower Charlotte Harbor is an area that has experienced widespread growth in recent years. This growth is projected to continue into the foreseeable future. The study area is also subject to many layers of government regulation. There are a number of existing programs currently being implemented by a variety of federal, state, regional, and local agencies and non-profit organizations within the study area to evaluate and manage the impacts of growth through research, planning, and regulatory measures. It is important that a concerted effort be made to coordinate these programs in order to maximize efficiency and reduce overlap. The DR/GR and the water bodies into which this area discharges have been listed by the Florida Department of Environmental Protection as an area where water quality standards are not attained
8	Summary of report strengths and weaknesses		Background information is extensive and provides good context in terms of regulatory and natural-resource issues.
8 a.	Evaluation of study approach and conduct		Information presented in Section 7 – Existing Management Actions – would be more useful in the form of a map of geographical extents of these projects. More information regarding which water quality data were used for the referenced summary studies would have made evaluation of these studies

## Lower Charlotte Harbor Reconnaissance

			more accurate.
8 b.	Extent to which report is “up to date”		Water Quality data are not up-to-date in terms of current trends.
8 c.	Completeness / data gaps / remaining information needs		Likely includes only a small subset of all water quality monitoring data for the DR/GR area. Water quality data were collected from a large geographical area and therefore did not include a focused attempt to document all water quality data and sampling stations within the DR/GR area and receiving tributaries. A small portion in the eastern part of the DR/GR is not represented in this report.
8 d.	Relationship to, and consistency with, other studies / reports		Consistent with other studies in terms of projected future growth, existence of water quality impairments within the Estero Bay basin, and general restoration needs.

### Maps and Figures

Page	Fig.	Title	DR/GR issues	Comments
42	Fig 19	Drainage Characteristics of Soils		For all maps within this document: Includes only Estero Bay Basin, not Trafford or West Caloosahatchee portions of DR/GR.
55	Fig 26	Lands in Conservation	Conservation Lands Under Public Ownership	Probably most up-to-date and comprehensive map in list of literature reviewed.
56	Fig. 27	Conservation Easements		Important in terms of linking protected land parcels.
58	Fig. 29	Florida Greenways and Trails Program Conservation/Ecological Opportunities	Greenways	
58	Fig. 30	Identified Lands for Potential Future Acquisition	Proposed Acquisition Lands	
68	Fig. 34	Florida Department of Environmental Protection Integrated Assessment	Impaired Areas	From Florida Department of Environmental Protection

69	Fig. 35	Designated Uses	State Water Classifications	From Florida Department of Environmental Protection
73	Fig. 39	Estero Verified Impairments	Impaired Areas	From Florida Department of Environmental Protection
81	Fig. 43	Dissolved Oxygen and Bio-Chemical Oxygen Demand Trends	Water Quality	From TetraTech/Janicki Env't. Inc. June 2004 Report
81	Fig. 44	Turbidity and Total Suspended Solids Trends	Water Quality	From TetraTech/Janicki Env't. Inc. June 2004 Report
82	Fig. 45	Nutrient Trends	Water Quality	From TetraTech/Janicki Env't. Inc. June 2004 Report
84	Fig. 46	Known Outfalls (NDPES permits)	Water Quality	From Lee County, Charlotte Harbor National Estuary Program, and U.S. Census Bureau
86	Fig. 48	Wastewater Generating Facilities National Pollutant Discharge Elimination System Status	Water Quality	From Florida Department of Environmental Protection, Charlotte Harbor NEP, and U.S. Census Bureau
86	Fig. 49	Domestic Wastewater Generating Facilities	Water Quality	From Florida Department of Environmental Protection, Charlotte Harbor National Estuary Program, and U.S. Census Bureau

## Lower Charlotte Harbor Reconnaissance

## Water Quality Data Analysis and Report for the Charlotte Harbor National Estuary

Item	Description	Sect / Page	Information from Report
1	Document Title	Cover	Water Quality Data Analysis And Report For The Charlotte Harbor National Estuary Program
2	Author	Cover	David Wade Anthony Janicki Susan Janicki Michele Winowitch Janicki Environmental, Inc. 1155 Eden Isle Drive NE St. Petersburg, FL 33704
3	Date	Cover	August 27, 2003
4	Sponsoring agency / publisher	Cover	Charlotte Harbor National Estuary Program 4980 Bayline Drive, 4 <sup>th</sup> Floor North Fort Myers, FL 33917 239-995-1777 <a href="http://www.chnep.org/info/wq/water_quality_data_analysis.htm">http://www.chnep.org/info/wq/water_quality_data_analysis.htm</a>
5	Purpose of study or document	1.0 (1-2)	The document was to provide information needed to : <ul style="list-style-type: none"> <li>- Prioritize areas of the estuary for improvements</li> <li>- Identify conditions that threaten habitats or provide opportunities for habitat enhancement</li> <li>- Identify water quality responses to sources of pollution in support of source reduction efforts</li> <li>- Identify impacts to freshwater inflows and salinity regimes</li> <li>- Provide background scientific results for incorporation into public education materials</li> </ul>

		1.0 (1-2)	<p>- Provide a statistical framework for future monitoring of the effectiveness of management actions</p> <p>Specifically the project was to:</p> <ol style="list-style-type: none"> <li>1. Compile initial data sets for surface and groundwater quality, hydrology, and rainfall</li> <li>2. Survey regional experts to identify potential data sources that were not captured in Objective 1</li> <li>3. Review the data and identify the datasets that meet the project criteria for availability, documentation of metadata, and quality control</li> <li>4. Prepare a summary of the datasets that meet the project criteria and will be used in the analysis of water quality status and trends</li> <li>5. Conduct analyses of temporal water quality variations (changes and trends) in the study area</li> <li>6. Conduct analyses of existing water quality conditions in the study area</li> </ol> <p>Prepare a final report summarizing the project results.</p>
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C)		<p>Most of the DR/GR area is within the study area. The easternmost part of the DR/GR is not within the Estero Bay basin and is not included in this report. The study area is relatively large compared to the DR/GR area. Very few sampling stations are within the DR/GR. More sampling stations were located along the tributary creeks into which the DR/GR lands drain. However, these creeks are located at the southernmost part of the study area and are not as well-represented as many of the other water bodies.</p>
7	Summary of report content		<p>NOTE: Ann Ertman reviewed sections 1, 2.4, 6, 7; supplemental data collection and quality control information; Andrew Miller &amp; Gregory Nelson reviewed relevant portions (i.e., Estero Bay information) of Chapters 1, 2, 6, 7.</p>
7 a.	General information and overall content	Technical Mem. Section 3.0,	<p>A separate technical memorandum dated April 24, 2002 includes a summary of data sources and requirements. These requirements included availability in electronic format, sufficient metadata including a description of collection</p>

		Attachments A, B, C	<p>techniques, quantification limits, and sample locations, and sufficient data to be compatible with statistical techniques (e.g. has sufficient time span of data collection). Data from SFWMD, Florida Department of Environmental Protection 305b program, Lee County, Fisheries Independent Monitoring Program, and Charlotte Harbor Fisheries Volunteer Monitoring Network were used.</p> <p>This memorandum also includes reasons for selecting the Kendall-Tau statistical methods.</p>
		Ch 1	Introduction, project scope.
		Introduction 1-5	<p>A list of water quality parameters is included in Table 1. Parameters that have not met state standards within the DR/GR and receiving water bodies include dissolved oxygen and nutrients (measured for this study in the form of chlorophyll-a, total nitrogen, total Kjeldahl nitrogen, total nitrate and nitrite nitrogen, orthophosphate, and total Phosphorus).</p> <p>Copper is one parameter identified as an impairment within the DR/GR area that is not included in this study.</p>
		Ch 2	"This methods section describes the methods used to analyze the data with respect to rainfall trends, stream flow trends, groundwater quality spatial trends and status, and surface water quality trends and status."
		Chapter 2 (2-2)	<p>Presents the methods used to analyze the collected data.</p> <p>Rainfall statistical analysis – used the Kendal Tau approach on precipitation data. Throughout the study, when calculating the Kendal Tau statistic, software from the EPA laboratory in the Corvallis, Oregon was used. The specific process for evaluating rainfall:</p> <ol style="list-style-type: none"> <li>1) Plot a time series of the raw data</li> <li>2) The time series is averaged to monthly values</li> <li>3) Correlation is determined to months prior up to 15 months</li> <li>4) Determination of whether seasonality exists.</li> <li>5) Autocorrelation</li> </ol>



			<ul style="list-style-type: none"> <li>a) Remove seasonal trends</li> <li>b) Check to see if there is correlation with the 1 and 2 month lags</li> <li>6) Compile results in a table.</li> </ul>
		(2-7 through 2-9)	<ul style="list-style-type: none"> <li>- Stream Flow Trend Methods – 32 Indexes of Hydrologic Alterations are calculated. Trends are determined by; <ul style="list-style-type: none"> <li>1) Indexes of Hydrologic Alterations values are calculated for each year for each gage.</li> <li>2) Trend tests are conducted for each Indexes of Hydrologic Alterations metric and for each gage. Indexes of Hydrologic Alterations statistics were not tested for trends because less than 20 years of Indexes of Hydrologic Alterations data were available.</li> <li>3) Indexes of Hydrologic Alterations parameters are tested for trends and compiled by gage into summary tables.</li> </ul> </li> </ul>
		(2-10)	<ul style="list-style-type: none"> <li>- Flow Duration Curves were constructed for each gage and compared across three relevant periods of record: <ul style="list-style-type: none"> <li>1) Stream flow gage period of record</li> <li>2) Water quality trend analysis period of record</li> <li>3) Current status</li> </ul> </li> </ul>
		(2-11)	<ul style="list-style-type: none"> <li>- Groundwater quality methods were compared by aquifer and by parameter Indexes of Hydrologic Alterations. “The data were compared by ranking the basins according to drinking water exceedances, ranking the values, and preparing synoptic trend maps.” (2-11)</li> </ul>
		Sect 2-4, p. 2-12	Status and trend analysis for surface water data is described. Trends analyses were conducted for surface and bottom values separately using seasonal Kendall Tau methods. Status testing was based on data collected between 1996 and 2000. Trend testing was based on data

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			collected between 1998 and 2000. A minimum of 60 data points (e.g. 5 years of monthly data points) was required. Non-parametric tests were conducted if there were at least 30 points available. Example data tables and comparisons figures are included. These results were then compared to Florida Department of Environmental Protection water quality standards and EPA nutrient criteria.
		(2-16)	- Surface Water Quality Status Methods – existing nutrient concentrations were compared to predefined criteria to identify those portions of the study area that are in concordance with ecoregional nutrient criteria.
		Sect 3.0	Rainfall analysis
		Sect 4.0	Stream flow analysis
		Sect 5.0	Groundwater quality analysis
		Sect 6.0	Surface water quality analysis Surface Water Quality - summarizes results. Sections 6.6 – Estero River (p 6-23), 6.8 – Imperial River (p 6-25), 6.9 – Spring Creek (p 6-26), and probably 6.7 - Hendry Creek (p. 6-24) are the sections relevant to the DR/GR area. These water bodies drain water from the DR/GR into Estero Bay.
		Section 6.6 Page 6-23	Several stations within the Estero River were found to have significant trends in worsening water quality. These trends included increasing nitrate + nitrite, orthophosphate, and turbidity, and declining dissolved oxygen. Stations within this basin were ranked among the lowest with respect to dissolved oxygen values. Conditions were ranked as relatively good for chlorophyll-a, total suspended solids, and turbidity compared to other basins within the study area. These stations had frequent exceedances of dissolved oxygen, fecal

## Water Quality Data Analysis

			<p>coliform, and ammonia standards. When compared to the Florida Department of Environmental Protection Impaired Water Rule, this basin was found to be acceptable in terms of fecal coliform and annual chlorophyll-a conditions but unacceptable in terms of dissolved oxygen and ammonia conditions.</p> <p>In comparison to EPA draft nutrient criteria, stations within the Estero River basin were found to exceed criteria for chlorophyll-a, nitrogen, and phosphorus.</p>
		<p>Section 6.8 P 6-25</p>	<p>Several stations within the Imperial River were found to have significant trends in worsening water quality. These trends included total suspended solids and turbidity, and declining dissolved oxygen. Stations within this basin were ranked among the highest with respect to nitrite + nitrate and fecal coliform values and the lowest with respect to dissolved oxygen values. Conditions were ranked as relatively good for chlorophyll-a, total suspended solids, and turbidity compared to other basins within the study area.</p> <p>These stations had frequent exceedances of dissolved oxygen, fecal coliform, and ammonia. When compared to the Florida Department of Environmental Protection Impaired Water Rule, this basin was found to be acceptable in terms of fecal coliform conditions but unacceptable in terms of dissolved oxygen, ammonia, and annual chlorophyll-a mean conditions.</p>
		<p>Section 6.9 P 6-26</p>	<p>Several stations within Spring Creek were found to have significant trends in worsening water quality. These trends included increasing orthophosphate, increasing turbidity, and decreasing dissolved oxygen. Turbidity was found to be increasing at one station. Stations within this basin were ranked among the lowest with respect to dissolved oxygen values but on a positive note were also ranked among the lowest for phosphorus, turbidity, ammonia, and total suspended solids.</p>

			<p>These stations had frequent exceedances of dissolved oxygen values. When compared to the Florida Department of Environmental Protection Impaired Water Rule, this basin was found to be acceptable in terms of fecal coliform and annual chlorophyll-a conditions but unacceptable in terms of dissolved oxygen and ammonia.</p> <p>In comparison to EPA draft nutrient criteria, stations within the Spring Creek basin were found to exceed criteria for all parameters except for turbidity.</p>
		<p>Section 6.7 P 6-24</p>	<p>Several stations within Hendry Creek were found to have significant trends in worsening water quality. These trends included increasing biochemical oxygen demand, fecal coliform, total suspended solids, turbidity, and decreasing dissolved oxygen. Stations within this basin were ranked high with respect to turbidity and total Kjeldahl nitrogen and low with respect to dissolved oxygen.</p> <p>These stations had frequent exceedances of dissolved oxygen values and fecal coliform standards. When compared to the Florida Department of Environmental Protection Impaired Water Rule, this basin was found to be unacceptable in terms of dissolved oxygen, ammonia, and annual chlorophyll-a conditions.</p> <p>In comparison to EPA draft nutrient criteria, stations within the Hendry Creek basin were found to exceed criteria for chlorophyll-a, nitrogen, and phosphorus.</p>
		<p>Section 7 P 7-3</p>	<p>Analysis of water quality data in relation to rainfall data indicate that water quality trends identified within this report have not been influenced greatly by short-term changes in rainfall.</p>

		P 7-5	<p>Results of this report can be used for the following:</p> <ul style="list-style-type: none"> <li>- To prioritize areas for improvement.</li> <li>- To be overlaid with potential restoration, protection and enhancement areas to identify parameters that might compromise project success or provide opportunities for further enhancement.</li> <li>- To prioritize source reduction efforts.</li> <li>- To identify local impacts to estuaries.</li> <li>- To provide background material for educational materials.</li> <li>- To provide a statistical framework for future monitoring of the effectiveness of management efforts.</li> </ul>
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)	Tech Memo	See Table 1-1, page 1-5, Attachment A, B, and C of April 24, 2002 Technical Memorandum
		Ch 6	Estero Bay tributaries show declining trends in water quality, especially for nutrients, dissolved oxygen, turbidity.
		Ch 7	"Many of the water quality changes in these areas were characterized as declining water quality. These results do not indicate directly that changes in stream flow were the primary reason for the changes in water quality, but the results do present a coincidence over the years of changes in stream flow timing and volume with changes in surface water quality. Other potential sources of surface water quality declines include increased pollutant loading from non-point sources in the watershed, point sources, and or atmospheric deposition."
7 c.	Useful maps and overlays		<ul style="list-style-type: none"> <li>- The results of the analysis are presented in appendices. The appendices are in PDF format on a CD which can be searched for any</li> </ul>

			<p>particular plot or table for a given basin, stream flow gage, aquifer, or for precipitation.</p> <ul style="list-style-type: none"> <li>- Figure 1-2 shows the study area.</li> <li>- Figure 4-2 shows the study area and is a basin reference map.</li> </ul> <p>Note - data are sparse within the southern DR/GR in many of the maps.</p>
		Technical Memorandum Attachment B	Charlotte Harbor Water Quality Study - DEP 305B Sampling Locations Estero Bay and Tributaries
		Fig 6-11	CHNEP Basins – Southern Coast – Surface – Specific Conductivity
		Fig 6-12	CHNEP Basins – Southern Coast – Bottom – Specific Conductivity
		Fig 6-14	CHNEP Basins – Southern Coast – Surface – Dissolved Oxygen
		Fig 6-15	CHNEP Basins – Southern Coast – Bottom – Dissolved Oxygen
		Fig 6-16	CHNEP Basins – Southern Coast – Surface – Biological Oxygen Demand
		Fig 6-17	CHNEP Basins – Southern Coast – Bottom – Biological Oxygen Demand
		Fig 6-20	CHNEP Basins – Southern Coast – Surface – Temperature
		Fig 6-21	CHNEP Basins – Southern Coast – Surface – Temperature
		Fig 6-23	CHNEP Basins – Southern Coast – Surface – Turbidity
		Fig 6-24	CHNEP Basins – Southern Coast – Surface – Turbidity
		Fig 6-32	CHNEP Basins – Southern Coast – Surface – chlorophyll-a (corrected)
		Fig 6-35	CHNEP Basins – Southern Coast – Surface – Nitrate + Nitrite
		Fig 6-36	CHNEP Basins – Southern Coast – Bottom – Nitrate + Nitrite
		Fig 6-39	CHNEP Basins – Southern Coast – Surface – Total Kjeldahl Nitrogen
		Fig 6-40	CHNEP Basins – Southern Coast – Bottom – Total Kjeldahl Nitrogen
		Fig 6-41	CHNEP Basins – Southern Coast – Surface – Total Nitrogen
		Fig 6-42	CHNEP Basins – Southern Coast – Bottom – Total Nitrogen
		Fig 6-45	CHNEP Basins – Southern Coast – Surface – Ammonia
		Fig 6-46	CHNEP Basins – Southern Coast – Bottom – Ammonia
		Fig 6-49	CHNEP Basins – Southern Coast – Surface – Total Phosphate
		Fig 6-50	CHNEP Basins – Southern Coast – Bottom – Total Phosphate

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		Fig 6-51	CHNEP Basins – Southern Coast – Surface – Orthophosphate
		Fig 6-52	CHNEP Basins – Southern Coast – Bottom – Orthophosphate
		Fig 6-55	CHNEP Basins – Southern Coast – Surface – Sulfate
		Fig 6-58	CHNEP Basins – Southern Coast – Surface – Chloride
		Fig 6-62	CHNEP Basins – Southern Coast – Surface – Fecal Coliform
7 d.	Relevant results and conclusions		Can overlay maps of water quality and land use to possibly guide land use decisions.
		Sect 7.0	<ul style="list-style-type: none"> <li>- There are significant trends toward increasing pollution in stream flow as seen in Kendal Tau testing of the data.</li> <li>- No trend in the rainfall data. Rainfall varied from year to year and was predictable throughout the year. Changes in water quality can not be attributed to changes in rainfall alone.</li> <li>- “With respect to regional changes in stream flow, the results indicate that many alterations to the hydrology have occurred in the tributaries of the Estero Bay watershed and Cape Coral peninsula, and the Upper Peace River.” (7-2) <ul style="list-style-type: none"> <li>o There were Indexes of Hydrologic Alterations stream flow changes observed in the Cape Coral peninsula area and in the Estero Bay watershed; these locations also showed declining water quality.</li> </ul> </li> <li>- There were not enough ground water samples to do large regional evaluations. There was however enough sampling to indicate problem areas – for instance the primary fluoride standard was frequently exceeded in the Floridan Aquifer in the Estero River portion of the Estero Bay basin, and in the Intermediate and Floridan Aquifers in the Matlacha Pass basin.</li> </ul>
8	Summary of report strengths and weaknesses		<p>Strengths: Good statistical evaluations of data.</p> <p>Weaknesses: In general - there may be a data bias in that most of the data may have been collected in areas that have been impacted.</p> <p>Specific to the DR/GR - there are very few groundwater and surface water</p>

			<p>data points within the southern DR/GR.</p> <p>Strengths:</p> <ul style="list-style-type: none"> <li>- The authors are concise in describing their methods.</li> <li>- The methods are straightforward.</li> <li>- The report is organized to present how the data was organized and analyzed without bogging the reader down with all of the figures.</li> <li>- The report fulfills its objective in providing a dataset of water quality data.</li> <li>- Authors use established methods in analyzing the data.</li> </ul> <p>Weaknesses:</p> <ul style="list-style-type: none"> <li>- The flow trend figures and precipitation figures in the appendices can be difficult to sort and search.</li> <li>- It is not apparent from the document how the database is/or will be updated and if and/or how the trends and statistics would be updated.</li> <li>- Because of the scope of the project, the number of data in the DR/GR may be limited. But the data available within and surrounding the DR/GR does show water quality changes.</li> </ul> <p>Well-documented study of water quality status and trends. Information regarding data selection was helpful and could be followed for additional reports.</p> <p>The scale of the project is very large compared to the DR/GR so it is sometimes difficult to determine status and trends from maps. Limited information in terms of sampling stations regarding the DR/GR area is available. Additional information regarding sampling stations within the DR/GR area does exist and could be used for a study regarding a smaller geographical area.</p>

8 a.	Evaluation of study approach and conduct		<p>Good approach, however this document falls short for data points within the DR/GR. The Montgomery and Johnson Engineering reports show many more data points.</p> <p>Given the scope of the project, probably a reasonable approach for evaluating trends within a large area.</p>
8 b.	Extent to which report is “up to date”		<p>This study and many other water quality summaries and reports are based on data that are dated in terms of analysis of current trends. The Charlotte Harbor National Estuary Program has obtained a grant from the Environmental Protection Agency to undertake a study entitled “Growth Management Regulation, Public Investment and Resource Implications for the Estero Bay Watershed – Southwest Lee County, Florida”. This Estero Bay watershed project will be a comprehensive study and evaluation of the decision framework utilized by government and private entities for development, permitting activity and public investment. A summary of a more up-to-date body of water quality data will be a part of this project. The final report is due to be published in August of 2007.</p>
8 c.	Completeness / data gaps / remaining information needs		<p>Additional information regarding sampling stations within the DR/GR area does exist and could be used for a study regarding a smaller geographical area.</p>
8 d.	Relationship to, and consistency with, other studies / reports		<p>This report has likely been used as a reference for data for other reports.</p> <p>It is hard to compare directly to other water quality studies because a different data set is used. However, in terms of overall watershed trends and status, is consistent with other reports reviewed for the DR/GR study.</p>

## How Much Is Enough? Landscape-Scale Conservation for the Florida Panther

Item	Description	Sect / Page	Information from Report
1	Document Title		How Much Is Enough? Landscape-Scale Conservation For The Florida Panther
2	Author		<ul style="list-style-type: none"> <li>- Randy Kautz (Florida Fish and Wildlife Conservation Commission), Robert Kawula (Florida Fish and Wildlife Conservation Commission), Thomas Hctor (Univ. of Florida), Jane Comiskey (Univ. of Tennessee), Deborah Jansen (Big Cypress National Preserve), Dawn Jennings (U.S. Fish and Wildlife Service), John Kasbohm (U.S. Fish and Wildlife Service), Frank Mazzotti (Ft. Lauderdale Research and Education Center), Roy McBride (No affiliation information given), Larry Richardson (U.S. Fish and Wildlife Service), and Karen Root (Bowling Green State University)</li> <li>- All members of Florida panther sub-team of the Multi-species Ecosystem Recovery and Implementation Team (MERIT), a committee appointed by the USFWS in Vero Beach.</li> </ul>
3	Date		2006
4	Sponsoring agency / publisher		Science Direct - Biological Conservation/ELSEVIER – www.elsevier.com
5	Purpose of study or document		To review and analyze existing information regarding Florida panther telemetry and habitat data to guide implementation of recovery actions for this species.
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental		All DR/GR lands are within the study area. The majority of the DR/GR is within the “primary zone” for Florida panthers. The DR/GR lands also contain “secondary” Florida panther habitat.

	Issues in Appendix C.)		
7	Summary of report content		
7 a.	General information and overall content	Section 2/p. 119	The authors used compositional and Euclidean distance analysis (two of many statistical techniques used to analyze data that include clustering and fragmentation issues) to identify regions of south Florida that are of value to support a self-sustaining population and create a model of important landscape components. The model was used in combination with radio telemetry data, home range overlaps, land use/land cover data, and satellite imagery.
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)	p. 129	Table 4 – Estimated number of panthers that could be supported by the Primary, Secondary, and Dispersal zones in South Florida by ownership.
7 c.	Useful maps and overlays	p. 120  p. 121  p. 124  p. 127  p. 128	<ul style="list-style-type: none"> <li>- Figure 1 - Study area and land cover (Water Management District aerial photography)</li> <li>- Figure 2 – Florida panther radio-telemetry data (Feb1981-March 2001).</li> <li>- Figure 3 – Least-cost paths most likely to be taken by Florida panthers dispersing out of south Florida. Based on analysis of impediments to Florida panther dispersal such as roadways.</li> <li>- Figure 4 – A model of landscape components significant to Florida panther conservation based on findings from Euclidean distance analyses.</li> <li>- Figure 5– Locations of Primary, Dispersal, and Secondary zones. Integrates information from Fig 4 into a connected landscape mosaic of cover types needed to support the Florida panther population.</li> </ul>

## Florida Panther Study

7 d.	Relevant results and conclusions	<p>Sections 3 and 4</p> <p>Section 3/p. 126</p> <p>Section 4/p. 127</p> <p>Section 4/p. 129</p> <p>Figure 5/p. 128</p>	<ul style="list-style-type: none"> <li>- The report confirmed previous findings of the importance of a large landscape mosaic, including forest patches, freshwater marsh, barren land, scrub, and open water to support a viable Florida panther population. Differing habitat types are important based on time of day, feeding, resting, and denning needs and can also change based on the age of an individual. Disturbed lands such as pastures and agricultural lands were also found to be present in the large landscapes that support Florida panthers.</li> <li>- Florida panther population appears to be increasing since early 1990.</li> <li>- The analyses showed that the smallest classes of forest patches were highest ranked within home ranges, contrary to previous studies indicating panthers avoid patches smaller than 500 hectares. Forest patches 2 hectares and up surrounded by 200 meters of non-urban buffers were found to be “significant landscape components”.</li> <li>- The majority of the Lee County DR/GR area is within the primary zone – identified as “essential to the long-term viability and survival of the Florida panther” or the secondary zone - areas that Florida panthers are not known to inhabit on a regular basis but which may be important to transient Florida panthers and have the potential to support an expanding population, especially if restoration/enhancement actions are implemented. The DR/GR also includes areas identified as “least-cost” paths most likely to be taken by Florida panthers dispersing out of South Florida. This dispersal could provide genetic intermixing between future sub-populations which could increase long-term species viability.</li> </ul>
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		<p>Section 4/p. 129 and Section 5/p. 131</p> <p>Section 1/p. 119</p> <p>Section 5/p. 131</p> <p>Section 1/p. 119</p>	<ul style="list-style-type: none"> <li>- The authors state that the existing habitats provide just enough space and habitat quality to support a Florida panther population that is “barely viable” –i.e. stable over the next 100 years as long as there is no habitat loss within this zone.</li> <li>- The first priority in terms of implementing the recovery of the Florida panther is to secure the existing South Florida population, including that found in the DR/GR area.</li> <li>- Recommend that assessments of potential impacts proposed within the Primary Zone should achieve no net loss of landscape function including reduction of aerial extent, degradation of habitat, further habitat fragmentation, or changes in land use moving along a gradient from natural conditions to pasture, to urban.</li> <li>- Habitat loss is identified as the greatest threat to the Florida panther.</li> </ul>
8	Summary of report strengths and weaknesses		<p>The study was conducted by a wide range of experts within the field, including public agencies and academia. Published in a peer-reviewed, scientific journal. Analysis includes standard statistical techniques. Authors point out parts that are backed up by existing data vs. more speculative parts. Actual panther locations are based on radio telemetry data. This type of data generally includes daytime locations of Florida panthers which can result in underestimation of territory and tends to be biased toward forested areas where Florida panthers are more likely to rest during the day.</p>

**Florida Panther Study**

8 a.	Evaluation of study approach and conduct		Use of telemetry data and Euclidean analysis are often used to study wildlife data. Telemetry data can be biased (see above), but overall conclusions regarding panther population are probably accurate.
8 b.	Extent to which report is “up to date”		Panther habitat maps have been revised as of February 2007. New maps are available from the US Fish and Wildlife Service Vero Beach office.
8 c.	Completeness / data gaps / remaining information needs		The model could be adjusted using existing infra-red observations of Florida panthers which include night observations.
8 d.	Relationship to, and consistency with, other studies / reports		This report is consistent with the other studies in terms of identifying important wildlife habitat and restoration/enhancement opportunities within the DR/GR lands, in terms of confirming the importance of a landscape-level habitat mosaic to wildlife, and in terms of identifying habitat loss as the greatest threat to the Florida panther. Primary and Secondary zones should be added to map overlays for the Lee County Master Mitigation Plan. Secondary zones represent potential restoration areas and Primary zones could be used for preservation in conjunction with restoration and/or enhancement of Secondary zones.

## Closing the Gaps in Florida's Wildlife Habitat Conservation System

Item	Description	Sect / Page	Information from Report
1	Document Title		Closing the Gaps in Florida's Wildlife Habitat Conservation System
2	Author		James Cox, Randy Kautz, Maureen MacLaughlin, and Terry Gilbert Florida Fish and Wildlife Conservation Commission (Formerly Florida Game and Fresh Water Fish Commission)
3	Date		1994
4	Sponsoring agency / publisher		Florida Fish and Wildlife Conservation Commission – Florida Marine Research Institute – Florida DEP
5	Purpose of study or document		<ul style="list-style-type: none"> <li>- To assess the habitat conservation needs and identify lands that must be preserved to meet the long-term habitat needs of Florida's flora and fauna using a focal species approach.</li> <li>- To identify areas important to several globally endangered species of plants and animals.</li> <li>- To identify regional areas of high biological diversity "hot spots".</li> <li>- To focus on-going land conservation efforts where they will provide the most protection to Florida's biodiversity.</li> <li>- To provide guidance to decision makers involved in public land acquisition, land use planning, development regulation, and other land conservation efforts.</li> </ul>
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental		The study area covers the entire state, including Lee County and the DR/GR lands. Data can be presented at a variety of scales, including county-level. Key issues addressed: vegetation communities, wetlands, invasive/exotic species, rare and unique uplands, native uplands, native vegetation communities, coastal and interior hammocks, rare and unique habitats,

	Issues in Appendix C.)		biodiversity “hot spots”, native wildlife habitat, migratory bird habitat, critical habitat for listed species, important plant habitats, endangered plant species habitat, conservation lands under public ownership.
7	Summary of report content		
7 a.	General information and overall content	<p>Section 1/p. 3</p> <p>Section 1.2/p. 4</p> <p>Section 2/p. 7</p>	<ul style="list-style-type: none"> <li>- Section 1 - Introduction - includes a good general discussion of the importance of biodiversity in terms of economic factors, public opinion, and factors not as easy to quantify such as aesthetics (Section 1.1). Includes a list of factors contributing to loss of biodiversity (Section 1.2). Habitat loss, fragmentation, and land management practices are all discussed as important factors.</li> <li>- Section 2 describes objectives and overview of the report – Authors identified a set of 44 focal species to serve as “indicator” species of biological diversity in Florida. Key species were chosen based on the criteria that habitat affinities for these species could be estimated using satellite imagery, home ranges of the species were large and might therefore benefit species with smaller home range requirements, the species had close ties to specific rare plant communities, and extensive occurrence information existed for the species. The authors acknowledge that these criteria for choosing focal species will not result in a list of perfect indicators for all species in all habitat communities in Florida. Rather, it is presented as a data-driven approach to quantify the habitat needs of a majority of Florida’s rare species and natural communities in a way that focuses efforts and efficiently uses the resources available to government agencies.</li> <li>- In addition to the focal species, information regarding rare plants, invertebrates, and natural communities was assembled and used to identify additional Strategic Habitat Conservation Areas (SHCAs) to add to the minimum conservation measures outlined for focal species.</li> </ul>

		Section 3/p. 11	<ul style="list-style-type: none"> <li>- Regional maps were developed to highlight additional areas of potential importance to expand upon the SHCAs.</li> <li>- Section 3 – Development of GIS data sets – Maps are based on Landsat data compared to aerial photography and helicopter “field surveys” conducted on 2.72 million acres statewide. Subsequent field reports indicate 80-90% accuracy.</li> </ul>
		Section 4/p. 19	<ul style="list-style-type: none"> <li>- Section 4 – Development of Information on Wildlife Species – provides details of how focal species were chosen. Detailed habitat maps were developed for each species through data documenting occurrences of focal species including Florida Natural Inventories (FNAI) data, Florida Fish and Wildlife Conservation Commission (FWC) data, and data collected by various researchers who specialize in the study of specific wildlife species (listed on p. 20). All data were entered in “point” format and Voronoi tessellation was used to determine where concentrations of these points occur. This technique is thought to be more objective and repeatable than less quantitative efforts to estimate clusters of points.</li> </ul>
		Section 5/p. 23	<ul style="list-style-type: none"> <li>- Section 5 – Assessing Population Viability – Discussion of reasons populations go extinct - primarily environmental variability and inbreeding depression. Some species, such as red-cockaded woodpeckers and fox squirrels, require multiple large populations (200-300) to assure long-term viability. Others, such as the Florida panther and black bear, require smaller populations (100-150). It is noted that these are based on estimations and no number or habitat size will “guarantee” population stability.</li> </ul>

### Closing the Gaps

		Section 6/p. 33	- Section 6 - Identification of Gaps in Florida's Wildlife Conservation Systems – General guidelines summarized in Section 5 are used to evaluate the effectiveness of existing conservation areas to provide adequate protection to Florida's rare species. Target was set at a minimum of 10 conservation areas with sufficient habitat to support a viable population. Section includes in-depth discussion of how this target was chosen. Due to incomplete information regarding population and distribution for many species, indirect estimations based on existing research were made. These are discussed in detail.
		Section 6.2/p. 35	- Evaluation criteria and potential habitat ranges for each focal species are also discussed in this section. Portions of the DR/GR area were identified as Strategic Habitat Conservation Areas (SHCAs - areas critically important to maintaining the core population of the species) for the Florida panther, the Florida black bear, the swallow-tailed kite, the Big Cypress fox squirrel, the snail kite, the limpkin, and 8 additional species of wading birds.
		Section 6.3 /p. 115	- An abbreviated gap analysis was performed for other components of Florida's biodiversity that could have been missed in the focal species analysis. These include areas supporting globally rare plant species, bat maternity areas, coastal communities, and 120 additional rare animal species (listed on Table 16, p. 122) to identify important conservation lands by overlaying potential habitat maps for individual species. These areas can then be compared to existing public lands to help show "hot spots" – areas important to the conservation of many species that are not currently within the system of public lands. A

## Closing the Gaps



			<p>detailed discussion of the theories involved is included in Section 6.3.4, p. 121. It appears Lee County contains numerous “hot spots,” including some that are important to 16-18 rare species of the 120 considered. It is difficult to determine the specific “hot spots” located within the DR/GR given the scale of the associated map included as part of the document. However, an up-to-date version of this map at a more useful scale can be obtained from the FWC.</p>
		Section 7/p. 137	<ul style="list-style-type: none"> <li>- Section 7- Closing the Gaps – includes a discussion of how information gathered and analyzed in the previous sections was combined to create a statewide composite map showing SHCAs for all species, species groups, and natural communities previously considered. This section is less relevant to areas on the scale of the DR/GR but does contain a discussion of other maps of natural resources.</li> </ul>
		Section 8/p. 147	<ul style="list-style-type: none"> <li>- Section 8 – Identifying Regional Hot Spots – This section is intended to provide guidance to local governments interested in expanding on the goals outlined in the previous sections. A good discussion of the importance of conserving locally valuable resources is provided on p. 147.</li> </ul>
		Section 8.1.7/p. 173	<ul style="list-style-type: none"> <li>- Section 8.1.7- Southwest Florida Region is the region in which the DR/GR is located. Much of the DR/GR contains hot spots of biological resources for 7 or more focal species. By comparison, other areas contain hot spots of biological resources for 3-4 or 5-6 focal species.</li> </ul>

**Closing the Gaps**

7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		Statewide distributions of a number of wildlife species and important habitats.
7 c.	Useful maps and overlays		Maps and overlays regarding species distributions, strategic habitat conservation areas, conservation areas, and hot spots of biological resources in the Southwest Florida Region can be obtained from the Florida Fish and Wildlife Conservation Commission. Use of the maps should include a commitment to periodically update these data layers as additional information becomes available.
7 d.	Relevant results and conclusions	<p>Section 7, p. 140 and throughout</p> <p>Section 8,/p. 147, Section 7</p> <p>Section 7/p. 140</p>	<ul style="list-style-type: none"> <li>- Existing conserved lands are not adequate to protect Florida's biodiversity.</li> <li>- Future land acquisitions should target key areas identified in studies. These areas are available in regional scale and are updated periodically. Agencies wishing to use this information should contact the FWC for most up-to-date information.</li> <li>- Authors recommend that land identified as high priority can be most effectively protected through acquisition or through conservation easements and land-use agreements. Although outright acquisition is considered to be the best way to assure protection, it is noted that the area needed to sustain the populations of Florida panther and black bear alone would consume all the funds currently available for land acquisition.</li> </ul>

		Section 7/p. 138	- Table 19, p. 138 is a summary of recommendations developed for each of the focal species.
		Section 2.6/p. 9 and throughout	- Authors stress that project maps are intended to guide land acquisition, land conservation, and land-use regulatory programs. These maps represent only a snapshot of Florida's conservation needs at one point in time and therefore should not be incorporated into law or rule as "no development" zones. Rather, they should be used as layers of information in making regulatory, land-acquisition/management, and planning decisions.
8	Summary of report strengths and weaknesses		- Overall useful discussion of many wildlife issues. Well-researched and documented way to focus scarce government resources in the area they are most needed (e.g. – prioritization of potential land acquisition parcels).. - Much of the wildlife occurrence data is based on individuals' reports of wildlife sightings. This biases results toward more populated areas where more observers are likely to be. - Many maps within the document are out-of-date. Individuals wanting to use any data layers reported within this document should contact FWC directly to obtain most up-to-date versions.
8 a.	Evaluation of study approach and conduct		Very good concept, well-researched from a variety of sources in wildlife management and conservation biology.
8 b.	Extent to which report is "up to date"		Follow up data collected for 76 additional listed species by James A. Cox and Randy S. Kautz (Florida Fish and Wildlife Conservation Commission) in 2000 indicates that despite a lack of sufficient data for many of the originally selected 44 focal species, the original approach worked fairly well in its attempts to identify important habitats for rare and declining species statewide. No new SHCAs were identified in this follow-up work. It was also determined that the original economic analyses contained in "Closing the Gaps" was still valid. However, when the "hot spots" (areas of habitat

## Closing the Gaps

			and resource overlap for multiple species) were reanalyzed using more precise distributional and habitat information, it was found that the results were very different from the overlay maps developed in 1994. This sensitivity to the type of underlying data sets could be especially problematic when comparison of gap maps produced by different states is attempted. (Cox, J.A., and R.S. Kautz, 2000. Habitat Conservation Needs of Rare and Imperiled Wildlife in Florida. Office of Environmental Services, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.)
8 c.	Completeness / data gaps / remaining information needs		Much of the information presented within this report is based on documented occurrence records. This reflects the most accurate level of information available at a statewide scale, but is not considered to be comprehensive in terms of determining presence or absence of a given species on a given parcel of land.
8 d.	Relationship to, and consistency with, other studies / reports		Consistent with other studies in terms of identifying habitat loss as a major threat to a wide variety of plant and animal species and in terms of stating existing land within public conservation is not adequate to protect many wildlife species.

## Southwest Florida Feasibility Study Scoping Meeting

Item	Description	Sect / Page	Information from Report
1	Document Title	Cover/p.1	Southwest Florida Feasibility Study - Charlotte, Collier, Glades, Hendry, Lee, & Monroe Counties, Florida - Feasibility Scoping Meeting Documentation
2	Author	Cover/p.1	US Army Corps of Engineer (Corps) – Jacksonville District – South Atlantic Division
3	Date	Cover/p.1	November 2005
4	Sponsoring agency / publisher	Cover/p.1	South Florida Water Management District (SFWMD)
5	Purpose of study or document	Study Background/p.1	<ul style="list-style-type: none"> <li>• Initiated in August 1999, as part of the Restudy reconnaissance and feasibility studies.</li> <li>• Has only a scoping phase (instead of another reconnaissance phase) to further identify water resources problems and opportunities, gather existing data, develop the scope and cost of the feasibility study, and execute a study cost-share agreement between the US Army Corps of Engineers and SFWMD.</li> <li>• Investigates water resources problems and opportunities in all or parts of Lee, Collier, Hendry, Glades, Charlotte, and Monroe counties.</li> <li>• Determines the feasibility of making structural, non-structural, and operational modifications and improvements in the region in the interest of environmental quality, water supply, and other purposes.</li> </ul>
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR	All	<ul style="list-style-type: none"> <li>• Report covers all of Lee County;</li> <li>• Report presents:                             <ol style="list-style-type: none"> <li>(1) The comprehensive regional plan of action to address the health of</li> </ol> </li> </ul>

	Environmentally Sensitive Resources and Environmental Issues in Appendix C.)		<p>aquatic and upland ecosystems; the quantity, quality, timing, and distribution of water flows; agricultural, environmental, and urban water supply; the sustainability of economic and natural resources; flood protection; fish and wildlife; biological diversity; and natural habitat.</p> <p>(2) <u>Selected models for hydrologic, water quality, salinity, and coastal mixing modeling purposes</u></p> <p>(3) <u>SWF species management measures</u></p> <p>Study covers a large area in comparison to the DR/GR lands so in terms of natural resources it can be difficult to evaluate the maps in terms of DR/GR area. For example, historic vegetation map is based on cell sizes of 20 acres.</p>
7	Summary of report content		
7 a	General information and overall content	<p>1</p> <p>2/p.7</p> <p>2/p.8</p>	<ul style="list-style-type: none"> <li>• Description of the study authority and of the study area</li> <li>• Must evaluate alternatives in the context of future conditions “without and with a plan” – i.e., conditions in the planning area, in 2050, if no federal action is taken versus conditions if alternative plans are implemented. Should not evaluate based on “Before-and-after” – i.e., should not compare conditions that exist now to the conditions expected to exist in the future after they have been changed by a plan.</li> <li>• The benefit/impact analyses conducted at local and system-wide scale. Regional models will be used to assess impacts to overall system, while sub-regional models were used to assess impacts to the project area.</li> <li>• Planning horizon extends from 2015, the base year, to 2050, the end point. The period of economic analysis will be 50 years, and will cover:</li> </ul>



		2/p. 9	<ul style="list-style-type: none"> <li>- Estuarine Resources – Changes in salinity, water quality degradation, and unnaturally high and low water flows due to increased impervious surfaces are identified as major factors degrading estuarine resources such as SAV and oyster reefs. It is noted that many estuarine flora and fauna are sensitive to these environmental stressors.</li> <li>- Water Quality – Existing/Proposed Water Quality Programs, Projects and Initiatives. Most important are: (1) State of Florida’s Total Maximum Daily Loads Program, (2) South Florida Water Management District’s Surface Water Improvement and Management (SWIM) Program, (3) CERP C-43 Basin Storage Reservoir, (4) revised Lake Okeechobee Regulation Schedule, (5) Lake Okeechobee Protection Program, and (6) new Lake Okeechobee and Estuarine Recovery (LOER) Plan.</li> </ul>
		2/p.22	<ul style="list-style-type: none"> <li>- Future Water Demands – <ol style="list-style-type: none"> <li>1. Water Demand Forecast Methodology - residential/non-residential scenarios – use IWR-Main Water Demand Management Suite computerized tool.</li> <li>2. Future Water Use Projections – six alternatives</li> </ol> </li> </ul>
		2/p.36	<ol style="list-style-type: none"> <li>3. Future Agricultural Water Supply – use Permit Allocation Method; AFSIRS (Agricultural Field Scale Irrigation Requirements Simulation) Modeling; MIKE SHE Modeling. The methodology and the results of each analysis are presented in the report.</li> </ol>
		2/p.41	<ul style="list-style-type: none"> <li>- Future Land Use: <ol style="list-style-type: none"> <li>1. Land use data from Florida Land Use, Cover and Forms Classification System (FLUCCS),</li> </ol> </li> </ul>

		<p>2.2.1/p. 64</p> <p>2/p.66-p.74</p>	<ol style="list-style-type: none"> <li>2. Public and conservation lands,</li> <li>3. Golf courses,</li> <li>4. County future plans (population density estimates for 2025 and 2050),</li> <li>5. Special areas,</li> <li>6. Agriculture,</li> <li>7. General Rules for Distributing Future Land Use,</li> <li>8. Estimation of 2025 and 2050 Land Use,</li> <li>9. Results of the Distribution of Future Land Use (Lee County – p.41).</li> </ol> <p>– Pre-Development Conditions: vegetation – based on Natural Soils Landscape Position map (South Florida Water Management District 2001) corrected using historical aeriels and personal communication with individuals having long-term knowledge of the area. Final map is based on approx. 20 acre cell size – relatively large-scale in terms of DR/GR area.</p> <ul style="list-style-type: none"> <li>▪ Public Concerns – As part of the CERP goal to understand public concerns, a series of public workshops was conducted early in the planning process. Numerous public concerns relevant to the DR/GR lands were identified.</li> <li>• Water Shed Problems Matrices – Problems include increasing urbanization, land conversion, water quality degradation, habitat loss and fragmentation, hydrologic alterations, suppression of natural fire regimes, increased flooding/drought cycles, and invasion by exotic plant and animals. The conclusion is that under current conditions, historic functions of the area cannot be maintained. If no preventive measures are taken, the system will continue to decline. In addition, current degraded ecological</li> </ul>
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		<p>2/p. 74 -</p> <p>2/p. 81</p> <p>2/p.82</p> <p>2/p. 84</p> <p>3/ p. 88 &amp;</p> <p>3/p. 94</p>	<ul style="list-style-type: none"> <li>• The Tidal Caloosahatchee watershed, the Freshwater Caloosahatchee watershed, The Estero Bay watershed and The Big Cypress watershed &amp; details. Conclusions summarized in list form.</li> <li>• Restoration Opportunities: Restore and improve wildlife habitat; Improve water quality; Improve timing of water quantities; Reestablish seasonal water level fluctuation patterns. Numerous opportunities are identified within DR/GR lands.</li> <li>• Planning goals and objectives: Restore ecological values (including habitat heterogeneity, surface and ground water resources, and hydrologic linkages), maintain economic values and social well-being (including water supply, water quality, and flood control).</li> <li>• Plan Evaluation Strategy – Describes screening criteria used to rank management measures in terms of regional goals.</li> <li>• Formulation and Evaluation of Preliminary Plans: (1) More natural flows to the coast (i.e. aquifer storage and recovery (ASRs)); (2) Major freshwater wetlands / altered hydrology of freshwater wetlands and water bodies in Southwest Florida; (3) Sensitive lands (including landscape-level habitat integrity); (4) Watershed control (hydrating soil/raising water table); (5) Stormwater treatment; (6) Groundwater extraction; (7) Estuary; (8) Education – Best Management Practices; (9) Land use management – zoning,</li> </ul>
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			<p>Ecolab for in-stream processes in each of the four sub-regions.</p> <ul style="list-style-type: none"> <li>- The spreadsheet model to be used by the Southwest Florida Feasibility Study will be similar to the work done by Janicki Environmental, Inc. for the Florida Department of Environmental Protection report titled "Pollutant Loading and Abatement Analysis for the C-43 Basin", November 2002. The model uses a runoff coefficient based on land use and soils along with rainfall to determine loading rates for various constituents of interest including Total nitrogen (TN) and total phosphorus (TP). Attributes associated with land use needed to compute the loading rates include runoff coefficients and event mean concentrations (EMC).</li>   <li>- The Watershed Management Model (WMM) was developed by Camp Dresser and McKee for the US Environmental Protection Agency to serve as a watershed water quality loading model to estimate seasonal and annual pollutant loads from non-point sources.</li>   <li>- <u>Salinity and coastal mixing</u> for the Caloosahatchee Estuary and Estero Bay areas will be modeled using the CH3D hydrodynamic model developed by Dr. Peter Sheng.</li> <li>- Flow data from the MIKE SHE models will be used as inflow into the <u>hydrodynamic model</u>.</li> <li>- The modeling process will be considered final when flow and stage data (from the hydrologic models for inland habitat units) and salinity values (from the hydrodynamic model for coastal habitat units) will be used in the ecological models developed by Natural Systems Group, Frank Mazotti and Leonard</li> </ul>
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		3/p.143	<p>Pearlstine.</p> <ul style="list-style-type: none"> <li>- A related effort will be used for alternative screening using the Stella software. A much less complex model than the MIKE SHE models, <u>Stella is a water balance model</u> which will incorporate flow data from the hydrologic models to develop a screening tool capable of quick calculations. The model will be used to check viability of storage and water conveyance options during the initial screening process.</li> </ul>
		VI/p.163  Appendix A/ p.168	<ul style="list-style-type: none"> <li>• Results from the modeling efforts will be used for an HGM based analysis for upland hydrologic benefits as well as coastal and estuarine benefits.</li> <li>• Results of the MIKE SHE runs will be post processed through an automated Performance Measure (PM) generator to produce graphics for inland hydrologic PM's and flows to the coast.</li> <li>• Automation also exists to generate salinity grids in the coastal regions from the CH3D output.</li> <li>• The ecological models will produce GIS based maps showing coverage areas for upland and coastal plant and animal species.</li> </ul> <ul style="list-style-type: none"> <li>• Compliance Memoranda for In-Progress Review (IPR) Guidance.</li> <li>• Southwest Florida Feasibility Study Listed Species Management Measures.</li> </ul>
7 b	Specific relevant data (e.g. water quality sampling for	2/p.16	<ul style="list-style-type: none"> <li>• Table with land use-specific runoff coefficients (RCs) and event</li> </ul>



specific dates, water level data, etc.)	2/p.17	mean concentrations (EMCs) for specific land use types (Table 2).
	2/p.18-19	<ul style="list-style-type: none"> <li>• Table ranking of typical Total Nitrogen (TN) and Total Phosphorus (TP) loads in pounds/acre per year (Table 3).</li> <li>• Table of estimated annual runoff volumes, existing and future loads of total nitrogen and total phosphorus, change in total nitrogen and total phosphorus loads by basin and land use (Tables, 4, 5, 6 and 7).</li> </ul>
	2/p.25-26	<ul style="list-style-type: none"> <li>• Table with present/future water withdrawals for each county (Table 8 and 9)</li> </ul>
	2/p.44	<ul style="list-style-type: none"> <li>• Summary table of selected land use categories for 2000, 2025 and 2050 (Table 28)</li> </ul>
	2/p.95	<ul style="list-style-type: none"> <li>• Description of unnatural flows (Table 36)</li> </ul>
	2/p.99	<ul style="list-style-type: none"> <li>• Altered hydrology of freshwater wetlands and water bodies in Southwest Florida (Table 37)</li> </ul>
	2/p.124	<ul style="list-style-type: none"> <li>• Lee County Regional Restoration Coordination Team (RRCT) Database (Table 39) – Project title, justification and description – For example: <u>Agripartners</u> – Six square mile property, east of I-75, opposite the Brooks and is headwaters for Halfway Creek and habitat for Florida panther, wood stork, Eastern indigo snake (confirmed), black bear, Big Cypress fox squirrel, and all other listed wading birds –</li> <li>• Exotic removal / replant natives • Removal of hydrologic</li> </ul>

		3/p.145 VI/p.160	<p>alterations, including unculverted power line road • Restoration of three borrow pits paralleling I-75.</p> <ul style="list-style-type: none"> <li>• Model Type and Application (Table 40)</li> <li>• List of Future Milestones/Completion Dates</li> </ul>
7 c	Useful maps and overlays	<p>I/p.6</p> <p>2/p.41</p> <p>2/p.83</p> <p>3/p.91</p> <p>3/p92</p> <p>3/p97</p> <p>3/p107</p> <p>3/p142</p>	<ul style="list-style-type: none"> <li>• Southwest Florida Feasibility Study study area boundary (Figure 1)</li> <li>• Lee County Future Land Use (Figure 5)</li> <li>• Potential Restoration Sites in Study Area (Figure 10) (could be helpful overlay for Lee County Master Mitigation Plan).</li> <li>• Species Richness (Figure 11) – Check with Florida Fish and Wildlife Conservation Commission (FWC) for updates</li> <li>• Biodiversity Hotspots (Figure 12) - Check with Florida Fish and Wildlife Conservation Commission for updates</li> <li>• Unnatural Flows to the Coast (Figure 13)</li> <li>• Southwest Florida Feasibility Study Restoration Projects – Phase I (Figure 14) (could be helpful overlay for Lee County Master Mitigation Plan).</li> <li>• Interactions between the hydrologic models and general applications (Figure 15)</li> </ul>
7 d	Relevant results and conclusions	2	<ul style="list-style-type: none"> <li>• Plan to review impacts of restoration projects – goals and objectives</li> </ul>

		3  Appendix A  3/p. 107	<ul style="list-style-type: none"> <li>• Detailed description of the models used to review alternative plans for restoration – feasibility studies</li> <li>• Detailed description of the SWF species management measures</li> <li>• Based on ranking of management measures, the DR/GR lands contain many potential restoration projects that rank “highest” in terms of benefits to environmental resources.</li> </ul>
7 e	Findings/ Recommendations		<ul style="list-style-type: none"> <li>• This report can be used as a model to plan DR/GR area changes, because it describes the steps and the methodologies necessary to quantify changes in an ecological system.</li> </ul>
8	Summary of report strengths and weaknesses		<ul style="list-style-type: none"> <li>• Overall useful discussion of water resources problems and opportunities in all or parts of Lee, Collier, Hendry, Glades, Charlotte, and Monroe counties.</li> <li>• Well-researched and documented way to determine the feasibility of making structural, non-structural, and operational modifications and improvements in the region in the interest of environmental quality, water supply, and other purposes.</li> <li>• Maps maybe out-of-date, since they are updated periodically. Individuals wanting to use any data layers reported within this document should contact South Florida Water Management District directly to obtain the most up-to-date versions.</li> </ul>
8 a	Evaluation of study approach and conduct		<ul style="list-style-type: none"> <li>• Good planning tool with modeling details and species management measures for specific counties</li> <li>• Good compilation of models, input data and expected results.</li> <li>• Includes measures of extent to which management tools contribute to landscape integrity.</li> <li>• Conducted on a regional scale, therefore better tool in terms of tracking landscape-scale changes and cumulative impacts than for</li> </ul>

8 b	Extent to which report is “up to date”		<ul style="list-style-type: none"> <li>• The report is up to date (i.e., the most recent data are no older than 2 to 3 years old), and a sufficient historical data range appears to have been used. Current data evaluation and models are utilized.</li> <li>▪ “Hot spot” GIS coverage based on Florida Fish and Wildlife Conservation Commission “Closing the Gaps” study (1994) is used as a scoring criterion for prioritization of projects. These maps are being updated continually and the most up-to-date versions should be obtained directly from Florida Fish and Wildlife Conservation Commission for future rankings.</li> <li>○ It is noted that assumptions must be made in terms of future land use and water use information. As more information becomes available the models could be updated to provide more accurate forecasts.</li> </ul>
8 c	Completeness / data gaps / remaining information needs		<ul style="list-style-type: none"> <li>• The report is complete and achieves its stated goal.</li> <li>• A more complete review of the modeling analyses described in this report would require the input/output files for each analysis of interest.</li> </ul>
8 d	Relationship to, and consistency with, other studies / reports		<ul style="list-style-type: none"> <li>• This study summarizes restoration plans and the methodologies to achieve them and evaluate their implications. It may overlap information in other CERP reports.</li> <li>• The Southwest Florida Feasibility Study Listed Species Measures uses as source the South Florida Multi-Species Recovery Plan and Florida Fish and Wildlife Conservation Commission guidelines, Federally Listed Species, Species Level and Habitat Level Recovery Actions.</li> <li>• Due to differences in terminology, it is difficult to compare hydrologic information (hydroperiod and inundation ranges) of ecological communities reported in this study to that reported in the South Lee County Watershed Plan. They appear to be relatively comparable, although deviations in terms of maximum or minimum</li> </ul>

			<p>hydroperiod and inundation depths vary somewhat.</p> <ul style="list-style-type: none"><li>• Identifies similar public concerns and regional watershed problems noted in the Estero Bay State of the Bay Report and the Lower Charlotte Harbor Reconnaissance Report. Conclusions regarding lack of maintainability of a range of ecological functions are also in agreement with other reports/documents.</li></ul>
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## Caloosahatchee Estuary and Charlotte Harbor Conceptual Model

Item	Description	Sect / Page	Information from Report
1	Document Title	Cover/p.1	Caloosahatchee Estuary and Charlotte Harbor Conceptual Model
2	Author	Cover/p.1	Tomma Barnes, South Florida Water Management District Mark Salvato, U.S. Fish & Wildlife Service
3	Date	Cover/p.1	May 22, 2006
4	Sponsoring agency / publisher		South Florida Water Management District (SFWMD)
5	Purpose of study or document	B. Introduction/ p.1	<ul style="list-style-type: none"> <li>Describe study area to understand how this system responds to stressors in order to be able to provide a basis for well-informed management decisions.</li> </ul>
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C)	All	<ul style="list-style-type: none"> <li>Report covers Caloosahatchee River watershed, which includes portion of Lee County.</li> <li>Descriptive. Useful as literature review (11 pages of references)</li> </ul>
7	Summary of report content		
7 a	General information and overall content	B/p.1  C/p.2	<ul style="list-style-type: none"> <li>Description of the study area</li> <li><u>External Drivers.</u> <ul style="list-style-type: none"> <li>Water Management (WM) – WM practices have resulted in habitat alterations, causing large fluctuations in the volume, timing and frequency of freshwater inflow to the estuary and on the ecology of the system through salinity zonation. (Salinity zonation represents a natural characteristic of a water body which is used to divide the estuarine and inshore coastal waters. Salinity zonation based on the NOAA National Estuarine Inventory</li> </ul> </li> </ul>



			<p>classifies the water bodies in: Tidal Fresh Zone (0-0.5), Mixing Zone (0.5-25) and Seawater Zone (&gt;25). Salinity zones are interpolated using annual average values over the water column for each sampling station.)</p> <ul style="list-style-type: none"> <li>○ Natural Phenomenon – sea level rise</li> <li>○ Growth and Development – C-43 canal</li> </ul>
		C/p.3	<ul style="list-style-type: none"> <li>• <u>Ecological Stressors</u> (1) Altered hydrology &amp; freshwater flow (2) Habitat alteration and loss (3) Changes in water quality &amp; increased sediment contaminants and (4) Boating and fishing pressure.</li> </ul>
		D/p.4	<ul style="list-style-type: none"> <li>• <u>Ecological attributes identified as indicators of biological/ecological stress:</u> (1) Submerged aquatic vegetation community structure, and function, (Number, diversity, dispersion, and their impact on ecological conditions.) (2) Oyster bar community structure, and function, (3) Mesohaline benthic community structure and function, (4) Fisheries community structure and function, (5) Manatee demographics, (6) Shoreline community structure and function, (7) Algal blooms community structure &amp; function, (8) Wading birds community structure &amp; function.</li> </ul>
		E/p.8	<ul style="list-style-type: none"> <li>• <u>Ecological Effects</u> (1) Loss of shoreline habitat and function, (2) Altered salinity regime, (3) Increased manatee mortality, (4) Decrease of submerged aquatic vegetation, (5) Increased nutrients &amp; contaminants, (6) Changes in sediment, (7) Decrease of fish populations.</li> </ul>
		F/p.13	<ul style="list-style-type: none"> <li>• <u>Research Questions</u> (1) Relationship of water management practices to estuarine protection and restoration. (2) Relationship of manatee</li> </ul>

**Caloosahatchee Conceptual Model**

		<p>G/p.13</p> <p>H/p.14</p>	<p>mortality to red tide (3) Relationship of blue crab fishery to temperature, salinity and other water quality parameters. (4) Relationship of mollusk populations and fish recruitment to submerged aquatic vegetation and salinity. (5) Relationship of current and historical submerged aquatic vegetation coverage to potential distribution.</p> <ul style="list-style-type: none"> <li>• <u>Hydrological Performance Measures</u> – Reader is directed to an addendum of the Southwest Florida Feasibility Study</li> <li>• <u>Ecological Performance Measures</u> <ol style="list-style-type: none"> <li>1. <u>Submerged aquatic vegetation structure and function</u> – needs to be increased by achieving proper salinity range</li> <li>2. <u>Oyster bar, community structure and function</u> – needs to be increased by achieving proper salinity range (see Salinity Envelope under Hydrologic Performance Measures).</li> <li>3. <u>Mesohaline benthic community structure and function</u> – needs to be increased by achieving proper salinity ranges for these freshwater species of clam.</li> <li>4. <u>Fisheries community structure and function</u> - The target is to restore assemblages with abundance, taxonomic composition (Pertaining to, or involving, taxonomy, or the laws and principles of classification; classificatory), diversity and representation of life stages characteristic of targeted salinity regimes for each estuary.</li> <li>5. <u>Manatee demographics</u> – achieved by maintaining and enhancing current habitat and foraging areas for manatees in the estuaries and canals to promote species recovery.</li> <li>6. <u>Algal Blooms Community Structure &amp; Function</u> – The performance measures are algal bloom frequency, duration, identity, concentration and negative effects.</li> </ol> </li> </ul>
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		H/p.15	<p>7. <u>Wading Bird Community Structure &amp; Function</u> –The performance measures for are wading bird foraging and nesting surveys.</p> <ul style="list-style-type: none"> <li>• <u>Baseline Conditions and Drivers for Water Quality in the Caloosahatchee Estuary and Lower Charlotte Harbor</u> – Water Quality Assessments (Table 1 – p.20 – 1998-2003 models summaries - 2003 Tetra Tech, Inc. results are missing).</li> <li>• Florida Department of Environmental Protection classified three water bodies in the Caloosahatchee Estuary and Lower Charlotte Harbor as potentially impaired based on chlorophyll-a, dissolved oxygen (dissolved oxygen), fecal coliform, copper, lead, and or biology.</li> </ul>
		I/p.21	<ul style="list-style-type: none"> <li>• <u>Linkage Between Water Quality and Attributes</u> -_This section examines how deviations, from a defined baseline, in the chemical and physical parameters measuring water quality, stress the ecological system by affecting the health and distribution of the indicators that describe the system’s attributes.</li> </ul>
		p. 37	<ul style="list-style-type: none"> <li>• <u>Southwest Florida Feasibility Study - Caloosahatchee Estuary Hydrologic Evaluation Performance Measures</u> – Presents S-79, Shell Point, and San Carlos Bay <u>Freshwater Inflow limitations to maintain salinity in the targeted ranges.</u></li> </ul>
7 b	Specific relevant data (e.g. water quality sampling for specific dates, water level data,	I/p.20	<ul style="list-style-type: none"> <li>• Summary of findings of water quality assessments in the Caloosahatchee Estuary, San Carlos Bay, Pine Island Sound and Matlacha Pass (Table 1).</li> </ul>

	etc.)		
7 c	Useful maps and overlays	I/p.6	<ul style="list-style-type: none"> <li>No map of the study area is included in this document.</li> </ul>
7 d	Relevant results and conclusions		<ul style="list-style-type: none"> <li>Presents inflow limitations in the C-45 canal to maintain salinity within required levels for ecological restoration.</li> </ul>
7 e	Findings/ Recommendations		<ul style="list-style-type: none"> <li>Add a map of the Conceptual Ecological Model area.</li> <li>Revise Table 1 to either delete last column or populate it with the missing information.</li> </ul>
8	Summary of report strengths and weaknesses		
8 a	Evaluation of study approach and conduct		<ul style="list-style-type: none"> <li>Good descriptive document for Caloosahatchee Estuary</li> <li>Good summary of the flow restrictions to the Caloosahatchee Estuary with the purpose of restoring the salinity along its longitudinal axis required to support naturally occurring conditions for estuarine biota (estuarine biota is the total collection of organisms of an estuary) by using the following methods: (1) reduction of wet season high flow from the watershed, capturing and storing this water, and then releasing it during the dry season in a more environmentally sensitive and beneficial manner to estuarine resources, and (2) reducing discharges from Lake Okeechobee to the Caloosahatchee Estuary.</li> </ul>
8 b	Extent to which report is “up to date”		<ul style="list-style-type: none"> <li>The report is up to date (i.e., the most recent data are no older than 2 to 3 years old), and a sufficient historical data range appears to have been used. Current data evaluation and models are utilized.</li> </ul>
8 c	Completeness / data gaps / remaining information needs		<ul style="list-style-type: none"> <li>The report is complete and achieves its stated goal.</li> <li>Missing a map of the conceptual model area.</li> <li>Missing 2003 Tetra Tech, Inc. results (Table 1 – p.20)</li> </ul>
8 d	Relationship to, and consistency with, other studies / reports		<ul style="list-style-type: none"> <li>This study summarizes numerous existent documents to describe and evaluate the ecological problems and presents the summary form of the Caloosahatchee Estuary and Charlotte Harbor Conceptual Ecological Model.</li> </ul>

## Big Cypress Basin Conceptual Ecological Model

Item	Description	Sect / Page	Information from Report
1	Document Title	Cover/p.1	Big Cypress Basin Conceptual Ecological Model
2	Author	Cover/p.1	Art Roybal, U.S. Fish and Wildlife Service
3	Date	Cover/p.1	May 22, 2006
4	Sponsoring agency / publisher		South Florida Water Management District (SFWMD)
5	Purpose of study or document	2. Introduction/ p.1	<ul style="list-style-type: none"> <li>Describe study area to understand how this system responds to stressors in order to be able to provide a basis for well-informed management decisions.</li> </ul>
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C)	All	<ul style="list-style-type: none"> <li>Report covers Big Cypress region, which includes a portion of Lee County.</li> <li>Descriptive. Useful as literature review (5 pages of references)</li> </ul>
7	Summary of report content		
7 a	General information and overall content	2/p.1  3/p.2	<ul style="list-style-type: none"> <li>Description of the study area – comparable to the freshwater Everglades in terms of natural community diversity, although the Big Cypress communities are primarily forested and tend to form more of a mosaic.</li> <li><u>External Drivers and Ecological Stressors</u> <ul style="list-style-type: none"> <li>Development for agricultural and residential use.</li> <li>Changes in land use associated with agricultural and residential development not only cause habitat loss on the affected lands, but fragmentation of the habitat mosaic</li> </ul> </li> </ul>

		3/p.4	<ul style="list-style-type: none"> <li>• Water Quality – Baseline Conditions <ul style="list-style-type: none"> <li>○ Florida Department of Environmental Protection indicates that three water bodies influencing water quality within the Big Cypress Swamp are potentially impaired for dissolved oxygen, fish consumption (for mercury), cadmium, and copper in the Tamiami Trail; dissolved oxygen and nutrients in the L28 Interceptor, and dissolved oxygen in the L28 Gap.</li> </ul> </li> </ul>
		3/p.4	<ul style="list-style-type: none"> <li>• Water Quality of Site Specific Areas within the Big Cypress Basin – L28 Drainage, Barron River Canal, Lake Trafford, and Southern Golden Gate Estates.</li> </ul>
		4/p.5	<ul style="list-style-type: none"> <li>• <u>Ecological attributes identified as indicators of biological/ecological stress</u> - Attributes are the biological indicators or components of natural systems, which are representative of the overall ecological conditions of the system. Attributes typically are populations, species, guilds, communities or processes. Attributes (also known as indicators or endpoints) are selected to represent the known or hypothesized effects of the stressors (e.g., numbers of nesting wading birds), and the elements of the systems that have important human values (e.g., endangered species, sports fishing). For the Big Cypress region they are: (1) Vegetation community gradients and habitat mosaic (vegetation community gradients represents vegetation spatial distribution changes from a zone to another. Habitat mosaic represents areas where many species live and grow, in a scattered pattern.), (2) Breeding birds (including red-cockaded woodpecker), (3) Aquatic fauna, (4) Wood stork &amp; wading birds, (5) Florida panther and prey.</li> </ul>
		5/p.12	<ul style="list-style-type: none"> <li>• <u>Ecological Effects</u> - Ecological effects are the biological responses caused by the stressors. They are critical linkages between stressors and attributes. For the Big Cypress region they are:</li> </ul>

## Big Cypress Conceptual Model



		<p>p. 15</p>	<ul style="list-style-type: none"> <li>- <u>For Vegetation Community Gradients and Habitat Mosaic:</u> (1) Relationship of vegetation to reduced hydrologic regime, (2) Relationship of vegetation to habitat loss and fragmentation, (3) Relationship of vegetation to exotic plant invasion, (4) Relationship of vegetation to exotic hog impacts, (5) Relationship of vegetation to fire, (6) Relationship of vegetation to nutrient inputs.</li> <li>- <u>For Wetland Aquatic Fauna:</u> (1) Relationship of aquatic fauna populations to habitat loss, (2) Relationship of marsh fish populations to hydroperiod, (3) Relationship of marsh fish populations to exotic fishes, (4) Macroinvertebrate and herpetofauna populations: controlling variables and functional importance (5) Relationship of the health of aquatic fauna to environmental contaminants.</li> <li>- <u>For Wood Stork &amp; Wading Birds:</u> (1) Relationship of wood stork nesting to density, size structure and seasonal concentration of marsh fish populations</li> <li>- <u>For Florida Panther:</u> (1) Relationship of Florida panther population to habitat loss and fragmentation and (2) Relationship of Florida panther health to bioaccumulation of environmental contaminants.</li> </ul> <p><u>Florida Panther</u> Discusses relationship of Florida panther population to habitat loss and fragmentation. States with a high level of certainty that it is well established that habitat loss and fragmentation are among the most important threats to persistence of Florida panthers (Maehr 1990; Maehr et al. 2002)</p> <p>Discusses relationship of Florida panther to bioaccumulation of environmental contaminants. States with a moderate level of certainty that there are a number of reasons for concern about contaminants and their potential effects on the</p>
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			<p>persistence of the Florida panther, not the least of which is the small population. Furthermore, part of the Florida panther population lives near the lower end of the Everglades hydrologic system, which is subject to pollution from urban, suburban, industrial, and agricultural land uses. Finally, as a top predator, the panther may be subject to bioaccumulation of toxins.</p>
		6/p.15	<ul style="list-style-type: none"> <li>• <u>Research Questions</u> (1) Relationship of wetland aquatic fauna populations to hydroperiod and water depth. (2) Plant community alterations associated with inflows of drainage water with high mineral content. (3) feral hog impacts on plant communities. (4) Relationship of Florida panther health to bioaccumulation of environmental contaminants.</li> </ul>
		7/p.16	<ul style="list-style-type: none"> <li>• <u>Hydrologic Performance Measures</u> – requires establishment of hydrologic targets that define the desired characteristics of a site’s hydrologic regime, and then the development of hydrologic performance measures to evaluate the current status of the site relative to the targets. Hydrologic targets will be based on conditions predicted by the Natural System Model (NSM) being developed by the Southwest Florida Feasibility Study. Southwest Florida Feasibility Study has developed a set of seven hydrologic performance measures of which six are applicable to the Big Cypress Basin region and include the following: <ul style="list-style-type: none"> <li>• Duration of uninterrupted inundation</li> <li>• Number of dry events</li> <li>• Hydroperiods</li> <li>• Duration of water level deviation</li> <li>• Seasonal amplitude and interannual variability of water levels</li> <li>• Water levels and timing</li> </ul> </li> </ul>

## Big Cypress Conceptual Model

		8/p.18	<ul style="list-style-type: none"> <li>• <u>Ecological Performance Measures</u> – Ecological performance measures were developed based primarily on attributes identified in the Big Cypress Conceptual Ecological Model. Some attributes were not included because there was not a clear relationship to restoration actions (i.e., black bear presence, distribution, and relative abundance, red-cockaded woodpecker nesting success, or panther habitat)</li> </ul>
		9/p.18	<ul style="list-style-type: none"> <li>• <u>Water Quality Performance Measures</u> - The Southwest Florida Feasibility Study Water Quality Sub-team has developed two sets of performance measures:             <ol style="list-style-type: none"> <li>1. Evaluation measures (Table 1 – p.19): Dissolved oxygen, salinity (PSU), turbidity, photosynthetically active radiation (PAR)/color, chlorophyll-a (Chl-a), total nitrogen, dissolved inorganic nitrogen (DIN), soluble reactive phosphorus (SRP), total phosphorus (TP).</li> <li>2. Assessment measures (Table 2 – p.20): Dissolved oxygen, specific conductance, turbidity/ total suspended solids / color, photosynthetically active radiation (PAR) / secchi disc depth, chlorophyll-a (Chl a), total nitrogen / ammonia nitrogen / total kjeldahl nitrogen / nitrate / nitrite / dissolved inorganic nitrogen, total phosphorus/ orthophosphate/soluble reactive phosphorus, chloride, sulfate, silica, pesticides and trace metals.</li> </ol> </li> </ul>
		10/p.21	<ul style="list-style-type: none"> <li>• Model Diagram</li> </ul>

7 b	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		<ul style="list-style-type: none"> <li>Water quality evaluation and assessment constituent information (Tables 1 and 2).</li> </ul>
7 c	Useful maps and overlays		<ul style="list-style-type: none"> <li>No map of the study area is included in this document.</li> </ul>
7 d	Relevant results and conclusions		<ul style="list-style-type: none"> <li>Panther habitat was not included in the model as an attribute.</li> </ul>
7 e	Findings/ Recommendations		<ul style="list-style-type: none"> <li>Add a map of the Conceptual Ecological Model area.</li> <li>Add Conceptual Ecological Model results.</li> </ul>
8	Summary of report strengths and weaknesses		
8 a	Evaluation of study approach and conduct		<ul style="list-style-type: none"> <li>Good descriptive document for Big Cypress region</li> <li>Good summary of the constituents to be included for evaluation measures and assessment measures.</li> </ul>
8 b	Extent to which report is “up to date”		<ul style="list-style-type: none"> <li>The report is up to date (i.e., the most recent data are no older than 2 to 3 years old), and a sufficient historical data appears to have been used.</li> <li>Current data evaluation and models are utilized.</li> </ul>
8 c	Completeness / data gaps / remaining information needs		<ul style="list-style-type: none"> <li>The report is complete and achieves its stated goal to create a Conceptual Ecological Model to study.</li> <li>Missing a map of the conceptual model area.</li> </ul>
8 d	Relationship to, and consistency with, other studies / reports		<ul style="list-style-type: none"> <li>This study summarizes numerous existent documents to describe and evaluate the ecological problems.</li> </ul>

## Big Cypress Conceptual Model

## Southwest Florida Feasibility Study Scoping Letter

Item	Description	Sect / Page	Information from Report
1	Document Title		Southwest Florida Feasibility Study Scoping Letter
2	Author		Marie G. Burns Chief, Environmental Branch
3	Date		April 27, 2006
4	Sponsoring agency / publisher		Department of the Army Jacksonville District Corps of Engineers P.O. Box 4970 Jacksonville, FL 32232-0019
5	Purpose of study or document		To announce the initiation of the U.S. Army Corps of Engineers Southwest Florida Study and to meet one of the requirements of NEPA to request public input to help the Corps formulate a plan for the Feasibility Study and to identify resources and impacts to those resources by the project.
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C)		The Southwest Florida Feasibility Study study area covers approximately 4,300 square miles including all of Lee County (including DR/GR lands east of Interstate 75), as well as other nearby counties.
7	Summary of report content		
7 a.	General information and overall content		This open letter from the Army Corps is to inform the public that the Jacksonville District has initiated a Feasibility Study (FS) to address water resource problems in Southwest Florida, under the local sponsorship of the South Florida Water Management District. The objective of the study is to develop a comprehensive regional plan for addressing water resource problems and opportunities. The study will develop and evaluate alternative plans and recommendations for structural, non-structural, and operational

			<p>modifications and improvements in the region. The study will compile information on and consider a wide variety of environmental factors and issues including:</p> <ul style="list-style-type: none"> <li>- restoration of estuarine, aquatic, wetland and upland ecosystems;</li> <li>- water flows;</li> <li>- future agricultural, environmental, and urban water demand and supply; socio-economic resources; aquifer recharge;</li> <li>- conversion of public conservation lands to water storage areas;</li> <li>- water quality;</li> <li>- impacts to the estuaries;</li> <li>- flood protection;</li> <li>- land acquisition;</li> <li>- fish and wildlife resources;</li> <li>- impacts to protected species;</li> <li>- cultural resources;</li> <li>- fragmentation and/or loss of habitat;</li> <li>- and other impacts identified as the study progresses.</li> </ul>
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		NA
7 c.	Useful maps and overlays		Map attached to memo showing the Southwest Florida Feasibility Study area.
7 d.	Relevant results and conclusions		NA
8	Summary of report strengths and weaknesses		NA
8 a.	Evaluation of study approach and conduct		NA
8 b.	Extent to which report is “up to date”		NA
8 c.	Completeness / data gaps / remaining information needs		NA

8 d.	Relationship to, and consistency with, other studies / reports		This letter announces the initiation of the U.S. Army Corps of Engineers Southwest Florida Feasibility Study, which represents a more recent and more localized phase (with respect to Lee County DR/GR lands) of the study described in the 1999 South Florida Feasibility Study report.
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## Southwest Florida Feasibility Study Component Location Map

Item	Description	Sect / Page	Information from Report
1	Document Title		Southwest Florida Feasibility Study Component Location Map
2	Author		US Army Corps of Engineers
3	Date		September 19, 2006
4	Sponsoring agency / publisher		Department of the Army Jacksonville District Corps of Engineers P.O. Box 4970 Jacksonville, FL 32232-0019
5	Purpose of study or document		Depict locations of Southwest Florida Feasibility Study components
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C )		The Southwest Florida Feasibility Study study area covers approximately 4,300 square miles including all of Lee County (including DR/GR lands east of Interstate 75), as well as other nearby counties. Yellow areas on this map show the location of Southwest Florida Feasibility Study components within the DR/GR lands of southeast Lee County.
7	Summary of report content		
7 a.	General information and overall content		Map showing location of Southwest Florida Feasibility Study components in southwest Florida including Lee County.
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		NA
7 c.	Useful maps and overlays		This map is useful in depicting the location and geographic interrelationships of the planned components of the Southwest Florida Feasibility Study.
7 d.	Relevant results and conclusions		NA
8	Summary of report strengths		NA

	and weaknesses		
8 a.	Evaluation of study approach and conduct		NA
8 b.	Extent to which report is “up to date”		NA
8 c.	Completeness / data gaps / remaining information needs		NA
8 d.	Relationship to, and consistency with, other studies / reports		This map accompanies other Southwest Florida Feasibility Study documents that describe the FS study area and components.

## Comprehensive Everglades Restoration Plan (CERP)

Item	Description	Sect / Page	Information from Report
1	Document Title	Cover	Comprehensive Everglades Restoration Plan (CERP) System-wide Performance Measures
2	Author	Cover	CERP
3	Date	Cover	March 16, 2006
4	Sponsoring agency / publisher		Central And South Florida Project
5	Purpose of study or document	Executive Summary (ES-p.1)  1.0 (p.1-1)	This report identifies and documents the specific set of system-wide performance measures developed by the RECOVER technical teams to date, and reviews the processes for developing and revising performance measures. The report also describes the application of performance measures in CERP planning and some of the uncertainty associated with that application.
6	Relevance to DR/GR lands in southeast Lee County		Covers Caloosahatchee Basin (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C )
7	Summary of report content		
7 a.	General information and overall content	1.0 (p.1-1)  2.0 (p.2-1)  2.0 (p.2-2)	This document identifies and describes the system-wide CERP performance measures. These measures are to be scientifically based using the best science and practices available. It is intended to be a “living” document where the performance measures are updated as science and practice improves.  “Performance measures are planning tools used to determine the degree to which proposed alternative plans are likely to meet restoration objectives, or implemented plans have met restoration objectives.”  “These land use and water management practices over the past 100 years have resulted in either loss or extensive alteration of the defining

## Comprehensive Everglades Restoration Plan Performance Measures

			characteristics of South Florida's pre-drainage ecosystem.”
		3.0 (p.3-1)	<u>The performance measures were developed based on the Conceptual Ecological Model.</u> The Conceptual Ecological Model was developed based on <u>11 regional Conceptual Ecological Model</u> : Barnes 2005, Browder et al. 2005, Crigger et al. 2005, Davis et al. 2005a, 2005b, Duever 2005, Havens 2005, Ogden 2005, Rudnick et al. 2005, Sime 2005, VanArman et al. 2005.
		3.0 (p.3-1)	“These conceptual ecological models illustrate links among societal actions, environmental stressors and ecological responses, and provide a basis for developing and testing a set of causal hypotheses that best explain why natural systems in South Florida have been altered.”
		3.0 (p.3-1)	The <u>South Florida Conceptual Ecological Models</u> were evaluated to: <ul style="list-style-type: none"> <li>• Illustrate ecological links between physical, chemical and biological elements in specific physiographic regions of South Florida.</li> <li>• Develop a suite of causal hypotheses linking the most important hydrological, physical and chemical stressors with major ecological effects as a basis for predicting responses to restoration projects.</li> <li>• Create a set of measurable indicators of success as a basis for evaluating and assessing how well projects meet broad, policy-level goals that have been established for the regional restoration program.</li> </ul>
		3.0 (p.3-6)	The <u>performance measures were developed to meet the following criteria</u> : <ul style="list-style-type: none"> <li>• The performance measure should change as a direct result of a CERP implementation.</li> <li>• The performance measure should be part of an ecological conceptual model or have regulatory basis.</li> <li>• The performance measure should be a strong indicator of ecosystem health or the ecosystem should be very sensitive to it.</li> <li>• The performance measure indicator should either be an indicator of 1)</li> </ul>

**Comprehensive Everglades Restoration Plan  
Performance Measures**

		3.0 (p.3-3)	<p>an important ecological process (e.g., food webs, energy transfer), 2) an important ecological structure (e.g., fragmentation, compartmentalization, succession, disturbance, biodiversity), or 3) an indicator of major environmental change (e.g., hydrology, fire, water quality).</p> <ul style="list-style-type: none"> <li>• The performance measure indicator should be a regional indicator of CERP performance (versus a project-level measure).</li> <li>• The performance measure should provide information not provided by other performance measures being recommended for the physiographic region.</li> <li>• The performance measure indicator should be measurable or indirectly measured using surrogate indicators.</li> <li>• The performance measure should have a relatively strong degree of predictability. Changes in the performance measure resulting from CERP implementation should be easily distinguished from those contributed by other factors and a mechanism should be available to predict future performance for project planning purposes.</li> <li>• Consider if: (1) The species are state/federally listed threatened/endangered; (2) The species have high aesthetic value/public appreciation; (3) The species have an important recreational/commercial value</li> </ul> <p>Presents <u>guidelines</u> to complete performance measure Documentation Sheets</p> <ul style="list-style-type: none"> <li>• Title</li> <li>• Justification</li> <li>• Relationship to Conceptual Ecological Models and Adaptive Assessment Hypotheses</li> <li>• Restoration Expectation: (1) Predictive metric and target, which represent the desired restoration conditions obtained through modeling or other predictive methods; (2) Assessment parameter and target, which serve as the basis to assess responses monitored in the</li> </ul>
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**Comprehensive Everglades Restoration Plan  
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		3.0 (p.3-9)	<p>field in natural and human systems following CERP implementation.</p> <ul style="list-style-type: none"> <li>• Evaluation Application; (1) Evaluation protocol, which provides details regarding the predictive tool used to evaluate the performance measure, data, and additional post-processing methods; (2) Normalized performance output, which represent the numeric performance measure results, normalized and related to the desired restoration condition; (3) Model output; (4) Uncertainty.</li> <li>• Monitoring and Assessment Approach – specifies monitoring and assessment methods related to the performance measure indicator.</li> <li>• Future tool development needed to support performance measure</li> <li>• Additional notes</li> <li>• Information regarding working group members</li> <li>• Acceptance status.</li> <li>• References</li> </ul> <p>Presents the <u>review process ten steps</u> - performance measures will be periodically added and refined by RECOVER’s Evaluation and Assessment Teams, as necessary, to incorporate new scientific information and as additional tools become available.</p> <ul style="list-style-type: none"> <li>• Sub-team and module team revision and development of documentation sheet sections</li> <li>• Integration of documentation sheets</li> <li>• 45-day review</li> <li>• Review of comments received</li> <li>• Technical comments addressed</li> <li>• Performance measure working group addresses comments</li> <li>• 14-day review</li> <li>• Performance measure working group addresses comments</li> <li>• acceptance</li> <li>• Posting accepted documentation sheets</li> </ul>
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**Comprehensive Everglades Restoration Plan  
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		4.0 (p.4-1)	<p>Presents the <u>Simplified Conceptual Ecological Model</u> and performance measure Documentation Sheet</p> <ul style="list-style-type: none"> <li>• The overviews focus on simplified Conceptual Ecological Model, which only include those stressors and attributes that will be influenced by CERP implementation.</li> <li>• The regions expected to be affected by CERP implementation, presented in Figure 12, are, for the most part, smaller than those of the Conceptual Ecological Model presented in Figure 9</li> <li>• Simplified Conceptual Ecological Model were tailored to match the draft 2005 Assessment Strategy for the Monitoring and Assessment Plan (RECOVER 2005b)</li> <li>• The Total System presented here is derived from the Total System Conceptual Ecological Model manuscript recently published in Wetlands (Ogden et al. 2005b)</li> <li>• Performance measures have also been developed for <u>water supply and flood protection</u>, derived from Florida Statutes</li> </ul> <p>Each overview is followed by the performance measure documentation sheets for the physiographic region and for water supply and flood protection</p>
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)	2.0 (p.2-3)	<p>A major premise of the restoration of Southern Florida is that it can return to pre-drainage characteristics through changes to:</p> <ul style="list-style-type: none"> <li>• Regain lost storage capacity (quantity)</li> <li>• Restore water quality conditions (quality)</li> <li>• Improve timing and quantities of freshwater deliveries to estuaries (timing)</li> <li>• Restore more natural hydro patterns (distribution).</li> </ul>
7 c.	Useful maps and overlays		<p>Figure 9 - Satellite image of physiographic regions in South Florida with 11 specific regional conceptual ecological models which have been developed for South Florida.</p> <p>Figure 11 - Performance measure review process</p> <p>Figure 12 – Boundaries of CERP regional modules</p>

**Comprehensive Everglades Restoration Plan  
Performance Measures**



7 d.	Relevant results and conclusions		Important – methodology: application of performance measures in CERP planning Evaluation steps
8	Summary of report strengths and weaknesses		Conducted on a region wide scale, therefore better tool in terms of tracking landscape-scale changes and cumulative impacts than for review of specific parcels of land within the DR/GR area.
8 a.	Evaluation of study approach and conduct		Provides good conceptual framework for future research and monitoring within South Florida, including the DR/GR area.
8 b.	Extent to which report is “up to date”		The performance measures were developed based on the most up-to-date models available at the time. It is noted that this document will be updated “periodically” (the timeframe not specified) based on improvements in our basic understanding of the science.
8 c.	Completeness / data gaps / remaining information needs		Complete in terms of the stated goals.
8 d.	Relationship to, and consistency with, other studies / reports		Not directly comparable to many of the studies due to the large scale and conceptual nature of the study. Makes direct use of the Conceptual Ecological Models within the Southwest Florida Feasibility Study.

**Comprehensive Everglades Restoration Plan  
Performance Measures**

## Greater Everglades Wetlands CEM

Item	Description	Sect / Page	Information from Report
1	Document Title	4.3-p.1	Greater Everglades Wetlands CEM
2	Author		CERP
3	Date		March 16, 2006
4	Sponsoring agency / publisher		South Florida Water Management District (SFWMD)
5	Purpose of study or document		Report “performance measures” that will be used to track the effects of the CERP on the Northern Estuaries”
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C)		The study reports on wetlands near Lake Okeechobee, which could influence the DR/GR lands. Some of the performance measures pertain to wetlands within the DR/GR lands and could be used to develop a conceptual model for use within the DR/GR area.
7	Summary of report content		Description of the various conceptual ecological models (CEMs) used for Everglades Wetlands to improve certain aspects of the study area using performance measures (PMs).
7 a.	General information and overall content	4.3-p1	<p>This report describes the various CEMs used by the CERP to describe the Greater Everglades Wetlands. The ecological models are:</p> <ul style="list-style-type: none"> <li>• Integrated Hydrology and Water Quality</li> <li>• Coastal Transgression</li> <li>• Tidal Channel Characteristics</li> <li>• Coastal Salinity Gradients</li> <li>• Mangrove Forest Production, Organic Soil Accumulation, and Resilience</li> <li>• Ridge and Slough Landscape Dynamics</li> <li>• Plant Communities/Elevation Gradients</li> <li>• Predator-Prey Interactions of Wading Birds and Aquatic Fauna</li> </ul>

## Greater Everglades Wetlands Conceptual Ecological Model

			<p>Forage Base</p> <ul style="list-style-type: none"> <li>• Linkage of Periphyton to Higher Trophic Levels</li> <li>• Everglades Crocodylian Populations</li> </ul> <p>According to these conceptual models, CERP designed projects to improve certain aspects of the study area. These projects are evaluated using the PMs, as presented in Table 4.</p>
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)	4.3-p16	Table 4 – presents the 24 performance measures applicable to Greater Everglades Region.
7 c.	Useful maps and overlays	4.3-p.2	Figure 24 – presents the Boundary of Greater Everglades Wetlands within influence of CERP. This figure is useful since it shows this area in relation to the DR/GR lands.
7 d.	Relevant results and conclusions		<p>The conceptual models show the interaction of:</p> <ul style="list-style-type: none"> <li>• Direct rainfall as primary water source on Greater Everglades wetlands.</li> <li>• Disturbance events: hurricanes, fires freezes on coastal areas.</li> <li>• Sea level/freshwater flow on tidal channel characteristics.</li> <li>• Sheet flow on coastal salinity gradients.</li> <li>• Sea level/freshwater flow &amp; disturbance events: hurricanes, fires freezes on organic soil accumulation.</li> <li>• Sheet flow, eutrophication &amp; nutrients dynamics and exotic plants on ridge and slough landscape dynamics, and plant communities/elevation gradients.</li> <li>• Hydroperiod &amp; site nutrient state, drought severity, multi-year wet/dry cycles, dry season water level recession patterns and sub-lethal effects of toxins on predator-prey interactions.</li> <li>• Site nutrient state and hydroperiod &amp; water depth patterns on linkage of periphyton.</li> <li>• Canal habitat, water depth patterns, estuarine freshwater flow &amp; salinity and hydroperiod on everglades crocodylian population.</li> </ul>

## Greater Everglades Wetlands Conceptual Ecological Model

8	Summary of report strengths and weaknesses		<ul style="list-style-type: none"> <li>- Overall useful summary of the Conceptual Ecological Models for the Everglades.</li> <li>- Maps maybe out-of-date, since they are updated periodically. Individuals wanting to use any data layers reported within this document should contact SWFMD directly to obtain the most up-to-date versions.</li> </ul>
8 a.	Evaluation of study approach and conduct		<p>Appears to evaluate wetlands in terms of their contribution to overall landscape mosaic – important for most wetland systems.</p> <p>Possibly oversimplifies system to the extent that model robustness will be compromised.</p>
8 b.	Extent to which report is “up to date”		The conceptual models of this report are developed from recent, more detailed ecological models: Davis et al. 2005a, 2005b, Duever 2005, and Ogden 2005.
8 c.	Completeness / data gaps / remaining information needs		<ul style="list-style-type: none"> <li>• The report is complete and achieves its stated goal.</li> <li>• A more complete review of the modeling analyses described in this report would require the input/output files for each analysis of interest.</li> </ul>
8 d.	Relationship to, and consistency with, other studies / reports		The water quality data of this study, along with the data presented by Janicki Environmental, Inc. in their Aug. 27, 2003 report, can be compared to future studies for environmental assessment.



## Northern Estuaries Conceptual Model

Item	Description	Sect / Page	Information from Report
1	Document Title	4.2-1	Northern Estuaries Conceptual Model
2	Author		Comprehensive Everglades Restoration Plan (CERP)
3	Date		March 16, 2006
4	Sponsoring agency / publisher		South Florida Water Management District (SFWMD)
5	Purpose of study or document		Briefly describes the influence of water management practices on the northern estuaries within the CERP. Reports performance measures that will be used to track the effects of the CERP on the northern estuaries.
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C )		One of the northern estuaries (the Caloosahatchee Estuary) lies within Lee County and is alongside the DR/GR lands.
7	Summary of report content		
7 a.	General information and overall content		<ul style="list-style-type: none"> <li>• This report mentions briefly how water management practices affect: (1) oyster, (2) fish, (3) submerged aquatic vegetation, and (4) benthic infaunal communities.</li> <li>• “Water management practices cause significant volumes of fresh water over a short period of time to enter the estuaries resulting in a sudden drop in salinity,” (pg 4.2-3). The freshwater also carries large amounts of silt, clay and high organic content increasing muck. Water management practices affect the dissolved oxygen content of the estuaries. The change in salinity, development of “muck”, and high oxygen content negatively affect the oyster, fish, submerged aquatic vegetation, and benthic infaunal community.</li> <li>• CERP projects are designed to mitigate the effects of these “water</li> </ul>

			management practices” and performance measures are presented to measure how CERP projects mitigate said effects.
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		Table 3 presents 17 Northern Estuary performance measures
7 c.	Useful maps and overlays		Figure 18 – Boundary of Northern Estuaries within Influence of the CERP along the Gulf Coast. This figure shows the location of the Caloosahatchee Estuary and its proximity to DR/GR lands.
7 d.	Relevant results and conclusions		The change in salinity, development of “muck”, and high oxygen content negatively affect the oyster, fish, submerged aquatic vegetation, and benthic infaunal communities of the northern estuaries.
8	Summary of report strengths and weaknesses		
8 a.	Evaluation of study approach and conduct		This is a brief summary of results or conclusions, the data or the calculated “performance measures” are not presented.
8 b.	Extent to which report is “up to date”		The author cites recent studies that were used to develop this report. Studies: Barnes 2005, Crigger et al. 2005, Sime 2005, and Van Arman et al. 2005.
8 c.	Completeness / data gaps / remaining information needs		This is a brief summary of results or conclusions, the data or the calculated “performance measures” are not presented.
8 d.	Relationship to, and consistency with, other studies / reports		The water quality data of this study, along with the data presented by Janicki Environmental in their Aug. 27, 2003 report, can be compared to future studies for environmental assessment.



## NE-3 Caloosahatchee Estuary Salinity Envelope

Item	Description	Sect / Page	Information from Report
1	Document Title	1.0	NE-3 Caloosahatchee Estuary Salinity Envelope
2	Author		Comprehensive Everglades Restoration Plan (CERP)
3	Date	1.0	September 9, 2005
4	Sponsoring agency / publisher		N/A
5	Purpose of study or document		Describe the “performance measure” defined by the CERP for the Caloosahatchee Estuary or its salinity envelope.
6	Relevance to DR/GR lands in southeast Lee County		Proximity of the Caloosahatchee Estuary to DR/GR lands. (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C)
7	Summary of report content		
7 a.	General information and overall content		<p>The report suggests controlling the inflow of the Caloosahatchee river into the Caloosahatchee Estuary. Controlling the inflow would control the salinity of the estuary and improve the ecology of the estuary. There are large discharges of freshwater into the estuary. These influxes can lower the salinity to levels harmful to “valued ecosystem components” (VECs) like the tape grass or American oyster. If 75% of inflows are within the 450 to 800 cubic feet per second range, the VECs will feel less of an effect.</p> <p>Based on recent studies, the report hypothesizes that by controlling the salinity, an improvement in VECs will be seen in the estuary. The report proposes to test this through monitoring of the VECs</p>
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		N/A
7 c.	Useful maps and overlays		N/A

7 d.	Relevant results and conclusions		N/A
8	Summary of report strengths and weaknesses		Strengths: Report integrates recent studies into a hypothesis on how to improve the Caloosahatchee Estuary. Recommendations on how to monitor and evaluate the hypothesis are presented.  Weaknesses: No alternatives evaluated would meet the target salinity envelope for the study. What would it take to get to that level?
8 a.	Evaluation of study approach and conduct		N/A
8 b.	Extent to which report is “up to date”		The report cites other studies performed within the last 5-15 years. I think that the report is still highly applicable, but could be updated.
8 c.	Completeness / data gaps / remaining information needs		N/A
8 d.	Relationship to, and consistency with, other studies / reports		The water quality data of this study, along with the data presented by Janicki Environmental in their Aug. 27, 2003 report can be compared to future studies for environmental assessment.

## NE-7 Caloosahatchee Estuary Nutrient (Total Phosphorous and Total Nitrogen) Loading and Concentration

Item	Description	Sect / Page	Information from Report
1	Document Title	1	NE-7 Caloosahatchee Estuary Nutrient (Total Phosphorus And Total Nitrogen) Loading and Concentration
2	Author		Comprehensive Everglades Restoration Plan (CERP)
3	Date	1	September 9, 2005
4	Sponsoring agency / publisher		CERP
5	Purpose of study or document		Describe the “performance measure” defined by the CERP for the Caloosahatchee Estuary nutrient and concentration.
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C )		The DR/GR lands lie just east of this study and can be affected by the water quality changes in the estuary and by the changes made to the tributaries to the estuary made by CERP.
7	Summary of report content		
7 a.	General information and overall content	2.0	This document gives the justification for using total phosphorus and total nitrogen as a performance measure of the effectiveness of CERP projects to improve the Caloosahatchee Estuary. Evaluation was done to determine target values of the estuary for both total phosphorus and total nitrogen.
		4.0	It is expected that by establishing the CERP recommended inflow distribution and with lower discharge variability water quality can be improved.
		4.1	CERP’s target is the reduction of both total phosphorus and total nitrogen loading concentrations by 28% in order to maintain the estuary total

		5.1	phosphorus and total nitrogen concentrations near the “Natural Systems Model.” These target concentrations are 0.079 mg/l total phosphorus and 0.92 mg/l total nitrogen. Reported current conditions are 1.28 mg/l total nitrogen and 0.11 mg/l total phosphorus.  The target will be assessed by determining how close each concentration approaches its respective target.
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		N/A
7 c.	Useful maps and overlays		N/A
7 d.	Relevant results and conclusions		N/A
8	Summary of report strengths and weaknesses		N/A
8 a.	Evaluation of study approach and conduct		N/A
8 b.	Extent to which report is “up to date”		There are no data attached to the report showing how the CERP projects have influenced this performance measure.
8 c.	Completeness / data gaps / remaining information needs		See 8 b.
8 d.	Relationship to, and consistency with, other studies / reports		The water quality data of this study, along with the data presented by Janicki Environmental in their Aug. 27, 2003 report, can be compared to future studies for environmental assessment.

## South Florida Multi-Species Recovery Plan

Item	Description	Sect / Page	Information from Report
1	Document Title		South Florida Multi-Species Recovery Plan
2	Author		U.S. Fish and Wildlife Service
3	Date		1999
4	Sponsoring agency / publisher		U.S. Fish and Wildlife Service
5	Purpose of study or document		To provide a plan to aid in the recovery of 68 listed (i.e. endangered, threatened, or species of special concern) plant and animal species (including State of Florida listed species) through the landscape-level restoration of natural ecological communities throughout South Florida in ways that will optimize benefits to the greatest number of species. To define recovery criteria, develop actions needed to achieve recovery plans, and estimate costs of recovery implementation.
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C.)	Section 2/p. 2-6  Section 3	Study area is all of south Florida including Lee County. Most of the DR/GR lands are within the Caloosahatchee subregion as described on page 2-6. Key issues addressed are: vegetation communities, wetlands, invasive/exotic species, rare and unique uplands, native uplands, native vegetation communities, coastal and interior hammocks, rare and unique habitats, native wildlife habitat, migratory bird habitat, critical habitat for listed species, important plant habitats, endangered plant species habitat, conservation lands under public ownership.
7	Summary of report content		
7 a.	General information and overall content	Appendix A and B	- This study is based on input from a diverse team of government, conservation agency, industry, and academic members. Summaries of team members names and affiliations are provided in Appendices A and B.

	Section 1/p. 1-1	- Section 1 – Introduction – defines terms and objectives, lists variables used to develop recovery criteria and discusses the application of these criteria.
	Section 2/p. 2-2 and 2-6	- Section 2 – The South Florida Ecosystem – defines watersheds and subregions of South Florida. The majority of the DR/GR lies within the area defined in this study as the Caloosahatchee River subregion. A small part of the southeastern-most DR/GR also lies within the Big Cypress subregion.
	Table 1/p. 2- 12	- Includes a list of species of concern.
	p. 2-11	- Discusses the importance of the region to migratory birds in terms of breeding areas and migratory “stopover” areas.
	p. 2-15	- Discusses the importance of the region to wading bird populations.
	p. 2-17	- Includes a section regarding the importance of estuarine areas, including Estero Bay, to fisheries resources and the economic relevance of these resources to humans.
	p. 2-18	- Contains overview of South Florida economics and land use changes.
	p. 2-41, Appendix F, G	- Contains a good overview of existing federal, state, local, and private conservation efforts and conservation lands and restoration organizations and efforts within South Florida.
	Section 3/p. 3-1	- Section 3 – The Ecological Communities – Provides a

## South Florida Multi-Species Recovery Plan

			<p>community/ecosystem perspective for maintaining biodiversity. Community types relevant to the DR/GR area are mesic pine flatwoods, hydric pine flatwoods, pond swamps, seepage swamps, freshwater marshes/wet prairies, and possibly small areas of mesic temperate hammock and mangroves. These communities are discussed in terms of synonymy (including Florida Natural Area Inventory, Florida Land Use and Cover Classification System codes, and National Resources Conservation Service terminology), wildlife diversity, animals of special concern, vegetation composition, plants of special concern, ecology, soils, status and trends (including hydrologic alterations and water quality issues), susceptibility to exotic species, management issues, proposed restoration actions, and restoration techniques (if any are known). Both types of pine flatwoods appear to be most crucial to the highest variety of plant and animal species and also are some of the habitats least protected by existing law. Management and ecological issues relevant to most community types, including those occurring in the DR/GR, include the importance of protecting and maintaining large, intact, contiguous tracts of land as part of a landscape mosaic containing a variety of native habitats; the lack of adequate legal protection of lack of enforcement of existing protection laws; and the tendency for even small alterations in the landscape, such as deep ruts, tire tracks, any road or other linear structure above grade, etc. to have large potential to interrupt sheetflow and alter hydrology, therefore effecting vegetation structure, wildlife habitat, and susceptibility to exotic infestations. Even small hydrologic alterations were noted to have extensive effects on such wildlife taxa as wading birds, reptiles, amphibians, small mammals, and medium and large carnivores.</p> <p>- Section 3 lists other animal and plant species that are not among the 68 listed here yet are known to rely on the community types discussed in Section 3. It is difficult to determine if the plant species are found within the DR/GR or not.</p>
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		<p>p. 3-597</p> <p>Section 4/p. 4-1</p>	<ul style="list-style-type: none"> <li>- Although it may be difficult to integrate specific management requirements for each species into an overall land-use policy, the narrow foraging and habitat requirements of a variety of the species discussed makes it clear how even minor habitat and/or hydrologic alterations could have large impacts on many species of concern.</li> <li>- Section 3 also includes a brief discussion of the effects of water quality degradation on seagrass communities in estuarine habitat.</li> <li>- Section 4 – The Species – A compilation of 68 individual species accounts that summarize the biology, ecology, status, trends, management needs, and recovery needs of these species. Species which may be of concern to the DR/GR area summarized in this section are: Florida panther, bald eagle, Everglades snail kite, wood stork, red-cockaded woodpecker (possibly, although no known clusters are located within Lee County), and Eastern indigo snake, and possibly the beautiful pawpaw (a tree that occurs in pine flatwoods in Lee County, possibly not as far east as the DR/GR).</li> </ul>
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)	Section 4	<ul style="list-style-type: none"> <li>- Species-level habitat needs and ranges.</li> </ul>
7 c.	Useful maps and overlays	<p>p. 2-60</p> <p>p. 3-198</p>	<ul style="list-style-type: none"> <li>- Figure 9 – Existing Mitigation Service Areas (Federal) and Mitigation Banks in South Florida.</li> <li>- Figure 1 – The Distribution of Hydric and Mesic Pine Flatwoods in South Florida (from USGS-BRD 1996).</li> </ul>

		p. 3-481	- Figure 1 – The Distribution of Forested Pond Swamps in South Florida (from USGS-BRD 1996).
		p. 3-501	- Figure 1 – The Distribution of Seepage Swamps in South Florida (from USGS-BRD 1996).
7 d.	Relevant results and conclusions	Section 2/p. 2-25	- Found that many listed species are habitat-limited. For these species, limiting factors are similar and include upland and wetland habitat loss, fragmentation, and degradation resulting from urbanization and other land use conversions; wetland drainage and alteration of hydrology; invasion of exotic species; fire suppression; soil subsidence; and increased levels of contamination. These are all issues pertinent to land use decisions within the DR/GR area and are discussed in greater detail in Section 2 of this document (p. 2-25).
		Section 1/p.1-16	- Reduction in habitat quality and quantity threaten South Florida wildlife species more than any other factor. - For some species, including the Florida panther, recovery will require more suitable habitat than currently exists.
		Section 5/p. 5-1	- Section 5 – Implementation – Summarizes plans to form the Multi-Species/Ecosystem Recovery Implementation Team (MERIT) to coordinate implementation of the Multi-Species Recovery Plan. This will be accomplished through an adaptive management approach focusing on multi-agency coordination.
8	Summary of report strengths and weaknesses		Extensive information regarding habitats and listed species and the effects of current management practices on these species. Status and trends reported are based on Landsat data (a series of satellites deployed to collect data regarding natural resources; often used to determine vegetation cover) and are probably not useful for areas on the scale of the

			<p>DR/GR as presented in this report. Status and trends information is of limited use to determine presence/absence on a specific parcel of land (small-scale resolution). The maps show general locations where species might occur, but at large-scale resolution (county level).</p> <p>Some of the species distribution data is also not defined at a sufficient scale to determine relevancy to the DR/GR.</p>
8 a.	Evaluation of study approach and conduct		<p>Comprehensive information regarding a range of species and habitats. The section regarding ecological communities is especially useful to evaluating landscape-level importance of many DR/GR habitats.</p>
8 b.	Extent to which report is “up to date”		<p>Wildlife distribution and conservation needs for all species are constantly undergoing updates and revisions. For example, the Florida panther habitat map and recovery plan have been recently revised (February 2007) and is available from the Vero Beach U.S. Fish and Wildlife Service office (Paul Souza or Allen Webb 772-562-3909).</p>
8 c.	Completeness / data gaps / remaining information needs		<p>Complete information regarding wildlife is not practicable to obtain. The “Ecological Communities” section contains discussions of how reasonable predictions can be made regarding wildlife species likely to utilize a given habitat in a given geographical location when more specific wildlife information is not available. Additional information regarding the accuracy of vegetation community-type mapping (especially for pine flatwoods communities) and the extent of exotic vegetation infestation for the entire DR/GR area would be useful for making these predictions.</p> <p>The report also included information regarding topics for which there is little information throughout South Florida, including the DR/GR area. One example is the lack of information regarding invertebrates in terms of species present and how each species interacts with other species in each ecological community.</p>
8 d.	Relationship to, and consistency with, other studies / reports		<p>Agrees with other studies regarding projected population and land use and the need to manage land use changes proactively.</p> <p>Agrees with other studies regarding the limiting effects of habitat loss</p>

			(including wetlands and uplands), fragmentation of habitat, and degradation of water quality on a wide variety of plant and animal taxa.
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## County Road 951 Project Development and Environment Study Draft Endangered Species Biological Assessment

Item	Description	Sect / Page	Information from Report
1	Document Title		County Road 951 Project Development and Environment Study Draft Endangered Species Biological Assessment
2	Author		Quest Ecology, Inc. in association with Dyer, Riddle, Mills & Precourt, Inc.
3	Date		July 2006
4	Sponsoring agency / publisher		Lee County Department of Transportation
5	Purpose of study or document		<ul style="list-style-type: none"> <li>- To evaluate impacts of the proposed extension of County Road 951 on state and federally protected plant and animal species.</li> <li>- To aid in determining type, design, and location of the proposed extension.</li> <li>- To ensure the proposed actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of critical habitat to such species.</li> <li>- To document environmental conditions of the study area and evaluate the project's potential impact to affect species listed as endangered, threatened, or of special concern to the U.S. Fish and Wildlife Service or the Florida Fish and Wildlife Conservation Commission</li> </ul>
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C.)		The study area overlaps with the DR/GR. Contains southern portion of DR/GR lands.

7	Summary of report content		<ul style="list-style-type: none"> <li>- This document discusses impacts of two Alignment Alternatives – referred to as #3 and #4. Alignment Alternative #3 involves running the proposed extension to the west and adjacent to Route 75 north of Bonita Springs. Alignment Alternative #4 involves running the proposed extension further east along an existing power line easement in this area.</li> <li>- Started review with section 5 - Wildlife Habitat. Previous sections 1-3 provide project history and alternatives analyses not directly applicable to DR/GR study. Section 4 – Existing Environmental Characteristics includes land use information similar to that which is reviewed in conjunction with the draft wetlands report for this project.</li> </ul>
7 a.	General information and overall content	<p>Section 5.1/p. 5-1</p> <p>p. 5-2</p>	<ul style="list-style-type: none"> <li>- Section 5.1- Wildlife and Habitat – literature reviews, agency data base reviews, agency coordination, previous studies and field reviews of the study area, soil surveys and aerial photography were used to identify target species and habitat types within and adjacent to the study area. A list of all agencies and databases used is included in Section 5.5.1, p. 5-1. Based on the results of these initial surveys, a preliminary list of potentially occurring species and a proposed field survey methodology were developed. These preliminary findings were further refined based on coordination with U.S. Fish and Wildlife Service and Florida Fish and Wildlife Commission.</li> <li>- A list of species conceded as present based on existing information included American alligator, eastern indigo snake, Florida panther, and Florida black bear.</li> <li>- Field surveys were based on methods described by Florida Fish and Wildlife Commission and included meandering pedestrian transects, roadside observations, vehicular transects, and aerial surveys, depending on target habitat and species type. Survey periods included morning and evening hours. Further details are provided in</li> </ul>

			Section 5.2.2, p. 5-2.
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		Wildlife survey results, ground-truthed vegetation community information.
7 c.	Useful maps and overlays		Relevant maps and overlays consist of U.S. Fish and Wildlife Service and Florida Fish and Wildlife Commission data layers listed in other review items. (Strategic Habitat Conservation Areas and biodiversity "hot spots", discussed in "Closing the Gaps" report.)
7 d.	Relevant results and conclusions	<p>Section 6/p. 6-2</p> <p>p. 6-3</p> <p>p. 6-14</p> <p>Section 7/p. 7-1</p>	<ul style="list-style-type: none"> <li>- Table 6-1, p. 6-2 summarizes listed wildlife species potentially occurring within the study area.</li> <li>-</li> <li>- Table 6-2, p. 6-3 summarizes rare plant species potentially occurring within the study area.</li> <li>-</li> <li>- Section 6 - provides further information on selected plant and animal species.</li> <li>-</li> <li>- Section 7.0– Analysis of Wildlife Habitat Impacts. Includes a summary of direct impacts (in acres) to wetlands, undeveloped upland habitats, and primary Florida panther habitat. Secondary impacts (in acres) are quantified for Primary Florida panther habitat only, although the report does state that secondary impacts to wetlands and undeveloped upland habitats are unavoidable. These secondary impacts include fragmentation of habitat, exposure of wildlife to vehicle collisions, and potential obstruction of water flow, which can result in alteration of water quality and natural hydroperiods. Alternative 3 would result in more direct impacts to wetlands, uplands, and Primary Florida panther habitat. Alternative 4 would result in 1,300 more acres of secondary impacts to Primary Florida</li> </ul>



		<p>Section 7.3/p. 7-3</p>	<p>panther habitat, mostly due to habitat fragmentation and exposure to vehicle collisions.</p> <ul style="list-style-type: none"> <li>- Section 7.3 - Conceptual Mitigation – Mitigation requirements for impacts to wetlands and Florida panther habitat are discussed. Wetland impacts will be implemented through a combination of preservation, restoration, and enhancement as described in the Draft Lee County Master Mitigation Plan. Final amounts will be determined through coordination with the ACOE, U.S. Fish and Wildlife Service SFWMD, and Florida Fish and Wildlife Commission. The Uniform Wetland Assessment Methodology, a wetland assessment required under current state Environmental Resource Permitting rules, may be used to calculate amount of wetland mitigation to be implemented.</li> <li>- Mitigation for direct and secondary impact to Florida panther habitat will also be required. The U.S. Fish and Wildlife Service Panther Tool will be used to determine compensation need. This methodology consists of calculating functional units (FU) based on the acreage of proposed impact (A), multiplied by the habitat value (HV), multiplied by the base ratio (BR) of 2.5, then by the landscape multiplier (LM) of 1.0 (project in “primary” habitat, compensation in “primary” habitat). Based on this method and the proposed impacts determined for this study, an estimated 1,822 acres of preservation may be required for Alternative 3 and an estimated 3.847 acres of preservation may be required for Alternative 4. The final acreage will likely change somewhat based on the new Florida panther focus area map released by the U.S. Fish and Wildlife Service since this environmental assessment was conducted.</li> </ul>
		<p>Section 8/p. 8-1</p>	<ul style="list-style-type: none"> <li>- Section 8.0– Conclusions and Commitments – Includes all listed species observed on site during surveys – Big Cypress fox squirrels, wood storks, gopher tortoises, and American alligators, and includes a discussion of other species that might possibly occur on the site and</li> </ul>

			Section 5.2.2, p. 5-2.
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		Wildlife survey results, ground-truthed vegetation community information.
7 c.	Useful maps and overlays		Relevant maps and overlays consist of U.S. Fish and Wildlife Service and Florida Fish and Wildlife Commission data layers listed in other review items. (Strategic Habitat Conservation Areas and biodiversity "hot spots", discussed in "Closing the Gaps" report.)
7 d.	Relevant results and conclusions	<p>Section 6/p. 6-2</p> <p>p. 6-3</p> <p>p. 6-14</p> <p>Section 7/p. 7-1</p>	<ul style="list-style-type: none"> <li>- Table 6-1, p. 6-2 summarizes listed wildlife species potentially occurring within the study area.</li> <li>-</li> <li>- Table 6-2, p. 6-3 summarizes rare plant species potentially occurring within the study area.</li> <li>-</li> <li>- Section 6 - provides further information on selected plant and animal species.</li> <li>-</li> <li>- Section 7.0– Analysis of Wildlife Habitat Impacts. Includes a summary of direct impacts (in acres) to wetlands, undeveloped upland habitats, and primary Florida panther habitat. Secondary impacts (in acres) are quantified for Primary Florida panther habitat only, although the report does state that secondary impacts to wetlands and undeveloped upland habitats are unavoidable. These secondary impacts include fragmentation of habitat, exposure of wildlife to vehicle collisions, and potential obstruction of water flow, which can result in alteration of water quality and natural hydroperiods. Alternative 3 would result in more direct impacts to wetlands, uplands, and Primary Florida panther habitat. Alternative 4 would result in 1,300 more acres of secondary impacts to Primary Florida</li> </ul>

		<p>Section 7.3/p. 7-3</p> <p>Section 8/p. 8-1</p>	<p>panther habitat, mostly due to habitat fragmentation and exposure to vehicle collisions.</p> <ul style="list-style-type: none"> <li>- Section 7.3 -Conceptual Mitigation – Mitigation requirements for impacts to wetlands and Florida panther habitat are discussed. Wetland impacts will be implemented through a combination of preservation, restoration, and enhancement as described in the Draft Lee County Master Mitigation Plan. Final amounts will be determined through coordination with the ACOE, U.S. Fish and Wildlife Service SFWMD, and Florida Fish and Wildlife Commission. The Uniform Wetland Assessment Methodology, a wetland assessment required under current state Environmental Resource Permitting rules, may be used to calculate amount of wetland mitigation to be implemented.</li> <li>- Mitigation for direct and secondary impact to Florida panther habitat will also be required. The U.S. Fish and Wildlife Service Panther Tool will be used to determine compensation need. This methodology consists of calculating functional units (FU) based on the acreage of proposed impact (A), multiplied by the habitat value (HV), multiplied by the base ratio (BR) of 2.5, then by the landscape multiplier (LM) of 1.0 (project in “primary” habitat, compensation in “primary” habitat). Based on this method and the proposed impacts determined for this study, an estimated 1,822 acres of preservation may be required for Alternative 3 and an estimated 3.847 acres of preservation may be required for Alternative 4. The final acreage will likely change somewhat based on the new Florida panther focus area map released by the U.S. Fish and Wildlife Service since this environmental assessment was conducted.</li> <li>- Section 8.0– Conclusions and Commitments – Includes all listed species observed on site during surveys – Big Cypress fox squirrels, wood storks, gopher tortoises, and American alligators, and includes a discussion of other species that might possibly occur on the site and</li> </ul>
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			<p>potential impacts to wildlife observed or considered to be likely to occur.</p> <ul style="list-style-type: none"> <li>- No federally listed plant species were observed. State-listed plant species observed were cinnamon fern, royal fern, bromeliads, giant wild pine, stiff-leaved wild pine, and inflated wild pine.</li> <li>- Agency correspondence relevant to DR/GR issues includes mostly Florida Fish and Wildlife Commission and U.S. Fish and Wildlife Service comments pertaining to listed wildlife species. It is suggested that the following species should also be considered to be likely to occur within the study area: swallow-tail kite, American crocodile, burrowing owl, red-cockaded woodpecker, and Florida mastiff bat. It is also suggested that the list of plant species included in Table 6-2 could be refined to include only those plant species that are found within habitat types observed within the study area.</li> </ul>
8	Summary of report strengths and weaknesses		<ul style="list-style-type: none"> <li>- The Uniform Wetland Assessment Methodology and the U.S. Fish and Wildlife Service Panther Tool were both referenced as possible ways to calculate mitigation requirements. Few details regarding use of the Uniform Wetland Assessment Methodology were included.</li> <li>- There was no mention of a methodology for assessing impacts to the Estero Bay Aquatic preserve, although it was acknowledged that impacts to this system (which lies downstream from the study area) may occur.</li> <li>- Some portions of the report discuss Alternatives 2, 3, and 4. Other parts discuss only Alternatives 3 and 4. The study area maps include only two proposed alignments. It would be helpful to include all three alternatives in the study area maps and all sections of text or to delete reference to Alternative 2.</li> <li>- A summary of the Uniform Wetland Assessment Methodology and the U.S. Fish and Wildlife Service Panther Tool on the level of the summary of the Wetland Rapid Assessment Procedure discussed in the wetlands evaluation of the 951 study would have been helpful in</li> </ul>

			evaluation of this report.
8 a.	Evaluation of study approach and conduct		<ul style="list-style-type: none"> <li>- The field survey methods used for the study were based on extensive agency coordination (see Appendix B – Agency Correspondence), and are based on industry standards. The fact that so few listed species were observed, even among those “conceded as present” indicates that direct observation of wildlife species during the restricted amount of time available for a standard survey may be an unreliable measure of wildlife presence. A literature search and habitat evaluations were used to compile a “likelihood of occurrence” list in accordance with industry standard methods for supplementing wildlife survey information.</li> </ul>
8 b.	Extent to which report is “up to date”		Recent field surveys are up to date.
8 c.	Completeness / data gaps / remaining information needs		<ul style="list-style-type: none"> <li>- Wildlife surveys and ground-truthing of habitat types reported in this document could be helpful when evaluating future land-use planning and regulatory decisions. This information was collected within the area in which proposed impacts from realignment of SR 951 may occur. Small-scale information at the level that reported in this document is not available for the entire DR/GR area.</li> <li>- Based on correspondence with state and federal wildlife agencies, additional species, such as the Florida mastiff bat, could use more discussion. Potential listed plant species section could also be refined.</li> </ul>
8 d.	Relationship to, and consistency with, other studies / reports		<ul style="list-style-type: none"> <li>- Difficult to compare due to differing scales on which data collection was based. No apparent discrepancies.</li> <li>- It is interesting to note that the U.S. Fish and Wildlife Service letter to the Department of Transportation regarding technical assistance on the Florida panther cites Kautz et. al, - “How Much Is Enough? Landscape-scale Conservation for the Florida Panther,” also reviewed for the DR/GR project, as the sole source of literature supporting the</li> </ul>

			technical recommendations included in the letter.
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## County Road 951 Project Development and Environment Study – Draft Wetland Evaluation Report

Item	Description	Sect / Page	Information from Report
1	Document Title		County Road 951 Project Development and Environment Study - Draft Wetland Evaluation Report
2	Author		Dyer, Riddle, Mills & Precourt, Inc.
3	Date		July 2006
4	Sponsoring agency / publisher		Lee County Department of Transportation
5	Purpose of study or document		To evaluate impacts of the proposed extension of County Road 951 to wetlands. To aid in determining type, design, and location of the proposed extension.
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C.)		Proposed road alignments are partially within DR/GR lands. The project area extends into the southern portion of the DR/GR.
7	Summary of report content		<ul style="list-style-type: none"> <li>- This document discusses impacts of two Alignment Alternatives – referred to as #3 and #4. Alignment Alternative #3 involves running the proposed extension to the west and adjacent to Route 75 north of Bonita Springs. Alignment Alternative #4 involves running the proposed extension further east along an existing power line easement in this area.</li> <li>- Started review with section 4- Existing environmental characteristics. Previous sections provide project history and alternatives analyses not directly applicable to DR/GR study.</li> </ul>



7 a.	General information and overall content	Section 4/p. 12  p. 12  p. 17  p. 26  p. 30	<ul style="list-style-type: none"> <li>- Section 4.1 - Existing Land Use – identified in field and digitized over aerial photography of the study area using ArcGIS 8.3 and 9.1.</li> <li>- Section 4.1.1 Vegetative Communities - Described for the project area based on Florida Land Use, Cover and Forms Classification System codes.</li> <li>- Section 4.2 – Future land use – subsection of land use described in Lee County Comprehensive Plan. Also includes a list of existing DRI’s and brief mention of cumulative effects of these DRI’s on Florida panther habitat and the Estero Bay Aquatic Preserve.</li> <li>- Section 4.3 – Natural and Biological Features – includes a brief discussion of listed species (to be discussed in Endangered Species Biological Assessment (ESBA) review), soil data, and floodplains and drainage. Figure 4-6 includes more detailed information.</li> <li>- Section 5.1- Wetlands Study Methodology – National Resources Conservation Service soils maps, National Wetlands Inventory mapping, U.S. Geological Survey maps, and site-specific aerial photography were used for initial identifications of wetlands within the project area. These locations were further identified in the field using the methods described in the US Army Corps of Engineers 1987 wetland delineation manual and the Florida DEP and Water Management District method described in “The Florida Wetlands Delineation Manual”. A functional assessment using the Wetlands Rapid Assessment Procedure (WRAP) (SWFMD, 1999), a method designed to aid in compliance of mitigation sites in South Florida, was performed on each wetland. Sizes of each wetland were calculated using ArcGIS 9.1 from the wetland delineations. Wetlands were identified using Florida Land Use, Cover and Forms</li> </ul>
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			<p>Classification System codes and USFWS codes for each major South Florida Water Management District sub-basin. It is noted that the study area includes a mosaic of wetland and upland habitats. The vegetation composition is often indistinct and can vary on a scale that limits the ability to map specific boundaries between these communities. Table 5-1, p. 37 provides a summary of existing wetland communities and acreages by drainage sub-basin. Drainage sub-basins within the area that contains proposed alignment alternatives and are located within or partially within the DR/GR are Estero River, Imperial River West, Flint Pen, and Six Mile Cypress Slough.</p>
		p. 35	<ul style="list-style-type: none"> <li>- Section 5.2 – Existing Wetland Communities – Includes a list of those wetlands identified in 5.1 and a brief discussion of each community in terms of typical vegetation, contiguity, vegetative structural diversity, edge relationships, wildlife habitat value, hydrologic function, public use, and integrity.</li> </ul>
		p. 50	<ul style="list-style-type: none"> <li>- Section 5.3 – Wetland Rapid Assessment Procedure analysis – includes an overview of the method and a discussion of each parameter evaluated and calculates final wetland scores using this method. Appendix D includes Wetland Rapid Assessment Procedure field data sheets that are very helpful for study review. Table 5-2, p. 54, includes final Wetland Rapid Assessment Procedure scores by drainage sub-basin.</li> </ul>
		Appendix E	<ul style="list-style-type: none"> <li>- Appendix E, agency coordination, and Appendix F, advance notification includes some information relevant to the DR/GR but concerns mostly wildlife-related issues and will be discussed with ESBA</li> </ul>

7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)		Wetland delineation, Wetland Rapid Assessment Procedure assessment
7 c.	Useful maps and overlays		<ul style="list-style-type: none"> <li>- Figure 4-4 DR/GR Classification Map – in relation to Study Area and proposed alignments.</li> <li>- Figure 4-6: Drainage Map. Also includes existing waterways and flow-ways and proposed cross-drains and ponds.</li> <li>- Figure 5-1: Drainage Sub-basins within the Study Area (based on South Florida Water Management District data).</li> <li>- Figure 5-3: Wetland Location Map – based on aerial photography, National Resources Conservation Service data, National Wetlands Inventory data, and ground-truthing – includes wetlands Florida Land Use, Cover and Forms Classification System codes.</li> <li>- Figure 5-4: Wetland Rapid Assessment Procedure Location Map.</li> </ul>
7 d.	Relevant results and conclusions	<p>Section 5/p. 30</p> <p>Section 6/p. 55</p>	<ul style="list-style-type: none"> <li>- The study area consists of a mosaic of upland and wetland habitats including a variety of ecological communities.</li> <li>- Section 6.0 – Analysis of potential wetland impacts – construction of Alignment Alternative #3 will result in approximately 261.4 acres of direct wetlands impacts, construction of Alignment Alternative #4 will result in approximately 293.9 acres of direct wetland impacts. Direct impacts to each wetland type are reported by drainage sub-basin in Table 6-1, p. 56. An additional 32.4 acres of direct impacts associated with stormwater management facilities will result from either alternative.</li> <li>- The majority of the impacts for either alignment alternative are to “mixed forested deciduous/evergreen” - the canopy in this Florida Land Use, Cover and Forms Classification System type is a mixture of slash pine, cypress, and melaleuca. Alternative 3 involves 150.8</li> </ul>

			<p>acres of direct impact to this habitat type vs. 115.3 acres for Alternative 4. There is also a small difference in impacts to cypress wetlands between the alternatives – Alignment 4 involves 15.6 acres of direct impacts to this habitat type vs. 13.7 for Alternative 3. The other habitat type with large amounts of proposed direct impacts is “exotic wetland hardwood” – canopy of mostly melaleuca. Both alternatives would involve 126.3 acres of direct impacts to this wetland type.</p> <ul style="list-style-type: none"> <li>- A discussion of secondary and cumulative impacts is included but there is no discussion of quantification of these or if they will be greater for either alternative.</li> </ul>
8	Summary of report strengths and weaknesses		<ul style="list-style-type: none"> <li>- Extensive ground-truthing of land use, vegetation, extent and quality of wetlands, and habitat issues could be helpful when evaluating future land-use planning and regulatory decisions.</li> <li>- Figure 4-6: Drainage Map is referenced in the text of the document but not included in the List of Figures on p. iv.</li> <li>- It appears that some of the subject wetlands were assigned high numerical scores in comparison to the wetland descriptions included in the field notes. For example, wetland # 20 was given a score of 3 out of 3 for wetland canopy, but the canopy included 5% melaleuca in the canopy and strangler fig and Brazilian pepper (percentages not noted) in the subcanopy according to the notes section. The first descriptor in the Wetland Rapid Assessment Procedure for canopy/shrub layer to score a 3 is “no exotic species present”.</li> <li>- It would have been helpful to include information regarding the team conducting the Wetland Rapid Assessment Procedure in terms of background and training.</li> <li>- It would be helpful to include a summary of impacts to wetland function/value as well as a summary of wetland acreage impacts for each alternative.</li> </ul>

8 a.	Evaluation of study approach and conduct		<ul style="list-style-type: none"> <li>- Methods for identifying and delineating wetlands are consistent with industry standards and regulatory requirements. Wetland assessment methodology (Wetland Rapid Assessment Procedure) is a good way to evaluate many aspects of subject wetlands.</li> <li>- Wetland Rapid Assessment Procedure is not designed to measure the extent to which a given wetland parcel supports the larger landscape mosaic, an important natural resource consideration for all habitats within the DR/GR.</li> </ul>
8 b.	Extent to which report is “up to date”		The report is based upon recent field surveys and is up to date.
8 c.	Completeness / data gaps / remaining information needs		Covers only part of the DR/GR area.
8 d.	Relationship to, and consistency with, other studies / reports		Consistent with vegetation types reported in other studies. Accurate on a smaller scale than the other studies due to on-the-ground wetland delineations. Information presented in this report and in the biological assessment for the CR 951 extension are a good example of how different ecological resources must sometimes be balanced when making regulatory and land use decisions.

## South Lee County Watershed Plan

Item	Description	Sect / Page	Information from Report
1	Document Title	Cover	South Lee County Watershed Plan
2	Author	Cover	Johnson Engineering, Inc., Agnoli, Barber & Brundage, Inc., Boylan Environmental Consultants, Inc.
3	Date	Cover	July 1999
4	Sponsoring agency / publisher	Cover	South Florida Water Management District
5	Purpose of study or document	Exec Summary page E-2  page E-4	<p>Overall - To conduct a regional analysis of the watershed to quantify cumulative effects of the many small-scale hydrologic alterations that have occurred and are continuing to occur throughout the watershed.</p> <p>Phase II – To conduct a region-wide assessment of ecological effects of hydrologic alterations, including the following parameters: habitat type, hydrology, vegetation composition, wildlife utilization, and adjacent land uses.</p> <p>More specifically.</p> <ul style="list-style-type: none"> <li>• "Maintain or improve existing levels of flood protection in the developed and developing areas consistent with the Lee and Collier County Comprehensive Plans as well as State and Regional Growth Management Plans.</li> <li>• Restore historic surface water flow characteristics on conservation and public lands.</li> <li>• Improve water detention and aquifer recharge potential.</li> <li>• Reduce threats of saltwater intrusion.</li> <li>• Reduce the impact of excessive freshwater discharges on downstream estuaries.</li> </ul>

		Executive Summary and I-A.4-1	<ul style="list-style-type: none"> <li>• Provide basis for off-site mitigation opportunities.</li> <li>• Enhance natural system functions and values on publicly owned and conservation lands.</li> <li>• Coordinate with other regional studies (Estero Bay Project, Big Cypress Basin Watershed Plan)."</li> <li>• "This report identifies the improvements that can be made to protect the capacity of historic outfalls and includes the analysis of improvements to re-establish historic flows."</li> </ul> <p>Major Tasks Undertaken as Part of Study/Document:</p> <ul style="list-style-type: none"> <li>• Hydrologic/hydraulic model.</li> <li>• 1-foot contour topographic mapping of watershed.</li> <li>• Identification of entire watershed boundary.</li> <li>• Ecological assessment.</li> <li>• Evaluation of the overall water management system and its subsystems, their functions and operational constraints.</li> <li>• Presentation of alternatives to restore the watershed and outflows, including land purchases and projects.</li> </ul>
6	Relevance to DR/GR lands in southeast Lee County (See list of DR/GR Environmentally Sensitive Resources and Environmental Issues in Appendix C )	All	High relevance. The majority of the DR/GR is within the study area. Specific data are gathered only for the southern part of the DR/GR (Transects 1 and 2).
7	Summary of report content		<p>Phase I: Hydrologic/Hydraulic Model Development</p> <p>Phase II. Ecological Assessment</p> <p>Phase III: Problem Identification &amp; Plan Formulation and Amendments 1, 2, and 3</p>



7 a.	General information and overall content	Phase I-A	<p>Catalyst for study is the summer 1995 flooding in south Lee County. The study identifies the problems associated with "piecemeal" permitting, not integrating the potential effects of developments, and not recognizing the cumulative effects of developments on the entire resources of the watershed (e.g., ecological, groundwater, surface water runoff).          Prioritized list of lands for purchase and projects useful for the restoration of flow ways.          Good history and background of the flooding in 1995.          Good description of the factors that lead to the expanding of the size of the watershed and the effects of development on flow ways (e.g., restriction of outfalls, reduction or elimination of sheet flow through development, development on flood zones).          Integrated field observations from the 1995 flooding into the development of the model.</p>
		Phase I-B	<p>Good review of 12 previous watershed studies from 1956 to 1995 (although 6 of the 12 are Johnson Engineering reports).          Short review of 10 previous groundwater studies from 1981 to 1994.          Description of the aquifers within the study area.          Description of the changes to surface water flow.          Description of culverts and drainage structures.          Description of the need for and the development of a 1-foot topographic contour map.          Description of data collection activities for the study.          Description of the results of the flow ways and drainage basin maps and the necessity to expand the size of the drainage basin.</p>
		Phase I-C	<p>Model feasibility assessment.          Good summary of 13 previous water quality and (where applicable) surface</p>

		Phase I-D	<p>water modeling reports.</p> <p>Good description of model selection process, based on site-specific criteria (e.g., soil type, topographic relief, land cover) and model capabilities (e.g., compatibility with other models, surface and groundwater interaction, steady or unsteady state, single event or continuous events).</p> <p>Model development.</p> <p>Detailed description of building the model, including sources of data and calibration.</p>
		Phase I-E	<p>One page description of South Florida Water Management District staff training for model.</p>
		Section A P II-A	<p>Project orientation – provides a summary of hydrologic and ecological effects of development within the watershed. The flooding resulting from rains experienced in the summer of 1995 is an example of negative effects on human habitation resulting from watershed alterations.</p> <p>Background materials reviewed included: current and historic aerial photographs; future land use maps; site inspections; data and information gathered by the National Audubon Society Ecosystem Research Unit; and the Corkscrew H &amp; H Study Hydrological Assessment Report Prepared by Gee &amp; Jensen.</p> <p>Watershed goals are listed. Alternative analyses were reviewed with respect to consistency with these goals. Coordination with other ongoing regional studies will continue throughout the study.</p> <p>A summary of existing and proposed public lands in terms of vegetation cover is included. The following are within or partially within the DR/GR area – the Flint Pen Strand, Southwest Florida International Airport Mitigation and possibly sections of the Estero Buffer.</p> <p>Inspections on most of the lands listed are mentioned, but no details</p>

		<p>Section B P II-B</p>	<p>regarding dates, locations, or data gathered during these reviews is provided.</p> <p>Data Collection – the following data were reviewed and compiled – vegetation and land use cover mapping, hydrological information (as discussed in Task I-B), species distribution and habitat requirements, and soils mapping. The study authors elected to use the FLUCFCS land use cover for the model since it provides information most relevant to the model. The Florida Fish and Wildlife Conservation Commission (FWC) was the major source of information regarding species distribution. The criteria were chosen to provide parameters that can be incorporated into the hydrologic-hydraulic parameter estimation to be used for the alternatives analysis in the Southern Lee County Watershed Plan. The variables were used to assess the value of the community in a matrix with an organizational structure similar to that used in the Wetland Rapid Assessment Procedure (WRAP), a wetland assessment technique developed by the SFWMD to evaluate mitigation projects. The sub-basins are discussed in terms of dominant vegetation communities.</p> <p>Four transects were established to provide information regarding the relationship between hydrology and community type. Transects 1 and 2 are located within the DR/GR area.</p>
		<p>Section C P II-C</p>	<p>Criteria Development – a matrix was developed to include the following indicators of function of the ecological communities within the study area – type of community, vegetation composition, wildlife utilization, and hydrological regime. Much of the data is based on remote-sensing information. The major exception is the information regarding water elevations and hydroperiods for each vegetation community type which</p>

			<p>is based upon numerous on-the-ground inspections and transect data, summarized in Sections B and C. After a review of available information, the following parameters were chosen – habitat type, hydrology, vegetation composition, wildlife utilization, and adjacent land uses.</p> <p>Habitat type was based on FLUCFCS data that was further narrowed down to the following categories – forested wetland, forested upland, shrub wetland, non forested upland, non forested wetland, transitional forested wetland, transitional non-forested wetland, and developed lands. These categories were developed based on the hydrologic regime and are useful in terms of making data compatible with the hydrology parameter. However, they lose a lot of information in terms of importance of habitat types to plant and animal species of concern. This information is only partially captured in the vegetation composition parameter.</p> <p>Hydrology was based on extensive research conducted in the Corkscrew Swamp Sanctuary. The summary of how these data were used is a good example of specific water level and hydroperiod data that is lacking for many areas of the DR/GR. Transects 1 and 2 are located in the southern part of the DR/GR area.</p> <p>Vegetation composition was based on the extent of exotic plant species, the absence of native vegetation, and the extent to which lands are managed to maintain natural conditions. Sources for the mapping of these attributes are not included but it is stated that they are “very general”.</p> <p>Wildlife utilization – The data from the FWC used for this data layer was – Strategic Habitat Conservation Areas (SHCAs) for the Florida panther, Florida black bear, and snail kite, hot spots data for Lee, Collier, and Glades counties, and wildlife observations for Lee, Collier and Glades counties. Each grid cell can be evaluated in terms of presence of listed species and SHCAs. In addition to the limitations noted by the authors regarding up-to-date data, this method also has the drawback of being limited to mostly observation data for the majority of wildlife species.</p>
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			<p>This biases the data toward areas close to trails, roadways, and other areas that tend to have more observers than less frequently traveled areas.</p> <p>Adjacent land uses – A measure of the buffer area between developed areas and undeveloped lands. These distances were based on the center point of the developed area rather than the edge due to the large-scale nature of the projects.</p> <p>Part 2 includes a discussion of modeling techniques to accurately simulate rainfall and runoff regimes.</p> <p>Part 3 is a discussion of how to apply the study criteria to existing and proposed public conservation lands within the study area. It includes a summary of how a parcel of land within the study area can be assigned a score of 0 (very poor) to 3 (excellent) for each parameter described above. These numbers are used to develop a numerical matrix similar to the one designed by the SFWMD for the WRAP (described in Section B).</p>
7 a.	General information and overall content	Phase III-A, 1. p. 1-1	<p>The objective of the task described in this section was to develop a problem statement by evaluation of the overall water management system and its subsystems, their functions and operational constraints. The objective included the simulation of the hydraulic performance of the existing outfalls in the South Lee County Watershed including outfalls on the following reaches:</p> <ul style="list-style-type: none"> <li>- Estero River Basin north branch, south branch, and main branch;</li> <li>- Spring Creek;</li> <li>- Imperial River;</li> <li>- Cocohatchee Canal;</li> <li>- Corkscrew Canal; and</li> <li>- Camp Keais Strand.</li> </ul>
		p. 1-1	<p>South Lee County Watershed area encompasses the north branch of the Estero River (the northern limit of the watershed), extending to the northernmost reaches of the basins of Collier County on the south, with the eastern extent located in Hendry County. Elevation ranges from 3 to 5 feet</p>

			NGVD near the coast on the west to 40 feet NGVD at the eastern limit in Hendry County. Extremely flat slopes (0.035%) within the watershed result in long concentration times. Standing water is common throughout much of the watershed during the year. Development over the past several decades has altered the natural collection of sheetflow.
		Phase III-A, 2.	This section presents a hydraulic summary for the outfalls. With the exception of the Imperial River and the Cocohatchee Canal, the watershed outfalls do not exhibit flows close to their historic capacities.
		III-A, p. 3-1	In this section a general description is provided of conditions and deficiencies for many of the outfalls in the watershed.
		III-B, p. 1-1	This section identifies the improvements that can be made to the historic outfalls and includes the analysis of improvements to re-establish historic flows.
		III-B, p. 2-1	Three model scenarios were run to evaluate the Flow ways and Flow ways with Berm alternatives. A detailed description and hydraulic evaluation of the alternatives is included in the Appendix beginning on page A-27.
		III-B, p. 3-1	<p>This section provides an economic analysis and impact assessment of the alternative plans for outfall improvements. Interim alternative improvements are described for:</p> <ul style="list-style-type: none"> <li>- North Estero River</li> <li>- Estero River South Branch</li> <li>- Halfway Creek</li> <li>- Spring Creek</li> <li>- Imperial River</li> <li>- Cocohatchee Canal</li> <li>- Corkscrew Canal</li> <li>- Camp Keais Strand</li> </ul> <p>Cost analyses are also provided for a watershed storage berm system and an integrated regional flow ways and water resources berm.</p>
		III-B, p. 4-12	<p>Conclusions:</p> <ol style="list-style-type: none"> <li>1. The 1995 reconnaissance of the South Lee County area and</li> </ol>

			<p>subsequent modeling indicated that the watershed area (approx. 315 square miles) was much larger than originally presumed.</p> <ol style="list-style-type: none"> <li>2. The one –foot contour map in conjunction with 1995 reconnaissance indicates that contributing area to the Imperial River outflow is greater than 250 square miles in contrast with the previously assumed 86 square miles.</li> <li>3. The 1995 Bonita Springs flood was primarily the result of an accumulation of rainfall over a three-month period, rather than a peak stage resulting from a classic three-day design type event.</li> <li>4. The Corkscrew Swamp Sanctuary data can be calibrated to ecologic-hydrologic conditions throughout much of the South Lee County Watershed, with special relevance to the CREW public lands areas east of I-75.</li> <li>5. There appears to be no simple single concept to solve the Bonita Springs flooding; with the preferable approach being an integrated solution which utilizes a management component and – Regional Flow ways to restore historical flow.</li> </ol>
		III-B, p. 4-13	Presents numerous recommendations for future surface water management in South Lee County.
		III-b, p. 4-15	Presents a list of 13 Flow Way Restoration and Improvement projects completed, initiated or funded during the development of the South Lee County Watershed Plan.
		Amend 1	Amendment No. 1 basically enlarged the watershed boundary to the east incorporating an area centered around Immokalee-Lake Trafford.
		Amend 2	Provides additional characterization data for Camp Keais Strand, Corkscrew Swamp Area, Kehl Canal, and Halfway Creek.
		Amend 3	The rules of SFWMD require that the post-development for a project be equivalent to the pre-development runoff in rate, volume, and timing. The purpose of this study is to determine the effect on a project by requiring that an equivalent volume of water be stored in both the pre- and post-development conditions. This is in addition to the peak rate of the post-development condition not exceeding the pre-development runoff rate. Study



			sites include locations at West Bay Club Basin 9, Stoneybrook Basin 1, The Habitat, and Bay Landing.
7 b.	Specific relevant data (e.g. water quality sampling for specific dates, water level data, etc.)	Phase I-B  Phase I-C, pg I-C.1-1  pg I-C.3-1	Basin boundaries have been changed through development and man-induced activities (e.g., berms, ditches, roads, housing developments). Results of changes are a constriction of flow and re-routing of sheet flow (e.g., culverts under US 41 and I-75). An additional and significant result of the changes induced within the basin is that under high rainfall periods, the basin boundaries overlap and existing flow structures cannot handle the flow, resulting in flooding.  Agricultural areas east of I-75: "The agricultural areas have been ditched and provide higher runoff rates than those experienced prior to the agricultural development." This contradicts the Rawl reports which states that agricultural areas have higher recharge rates.  Good, specific information regarding conditions that led to the 1995 flooding. "Previous studies that are available address one watershed at a time. The goal of this study is to determine how these adjacent watersheds interact."
		Phase II	Hydrologic data – water level, hydroperiod.
7 c.	Useful maps and overlays	Section D P 1-8  Section D P 1-9	Baseline Conditions – Hydrologic Ranking – II-D p. 1-8 Shows results of the initial model run in terms of hydrology  Baseline Conditions – Ecological Assessment – II-D p. 1-9. (Summary of overall model results) shows results of the initial model run in terms of all parameters defined.
		III-B, p. 4-6	Map showing draft FEMA floodway and floodplain.
		III-B, p. 4-10	Regional Flow Ways, South Lee County Watershed Plan.
7 d.	Relevant results and		The general message of the report is sound - i.e., the drainage basin must be

	conclusions		<p>examined and managed as a whole and previous permitting efforts have been piecemeal, which has not accounted for the cumulative affects of changes to the drainage basin.</p> <p>Also, a modification of the drainage basin was presented and well-documented to include a larger area than previously thought.</p>
		Section D	<p>Maps in Section D provide graphical summaries of baseline conditions within the Study Area based on running the model using existing conditions. These baseline conditions can be used in alternative analyses and to track landscape-scale changes resulting from activities such as construction, land-use changes, and management/restoration implementation.</p> <p>Target hydrologic regimes were set for each habitat type.</p> <p>Alternatives were summarized and discussed at the end of Section D.</p>
8	Summary of report strengths and weaknesses		<p>Strengths: well written, well documented, a lot of references, very defensible document. On a conceptual basis, the findings in this report can be used to guide future development and restoration of the study area.</p> <p>Weaknesses: cannot be used as a site-specific guide for changes or modifications to the DR/GR. Some of the data are not up to date. This document may be useful in assessing landscape-scale changes to vegetation communities from proposed development projects.</p> <p>Information provided regarding hydrologic data for a variety of habitat types provides useful information regarding water levels and hydroperiods for the transect areas. The southern portion of the DR/GR is well-represented in these but not the northern or eastern sections.</p> <p>Small-scale variations in vegetation, habitat, and wildlife are not measured since the dominant coverage for a given cell is all that is included in the model. This was a reasonable approach given the scope of the study, but it means it may not be accurate for a given land parcel within the DR/GR area. The model does not appear to account for rare or endemic plant species nor plant species listed as threatened, endangered, or of special concern by state or federal agencies.</p>

8 a.	Evaluation of study approach and conduct		This is a scientifically defensible hydrogeologic evaluation/report. It also presents qualitative and quantitative data and recommendations for remediation. Overall approach is to study a large area on a general level to measure large-scale changes.
8 b.	Extent to which report is “up to date”		Data compilation and report preparation likely occurred almost 10 years prior to this review. There are likely additional data that can be incorporated into the models. The incorporation of recent data may likely be an ongoing project for the SFWMD.
			Much of the data used at the time the baseline model was run (e.g. – wildlife, exotic species cover) has likely changed significantly since 1999. The authors noted in many cases the data might not have been sufficiently current even at the time it was used in the model.
8 c.	Completeness / data gaps / remaining information needs		Report is substantially complete.  Additional ground-truthing in the northern portions of the study area would increase model robustness.
8 d.	Relationship to, and consistency with, other studies / reports		This report is part of the basis of the models used in the Rawl reports.  Could be useful to overlay model results with other data such as water quality data, known sources of pollutions, etc. reported in other studies to compare trends to land use.

**APPENDIX E**

**ENVIRONMENTAL FEATURES MAPS  
COMPILED FROM SELECTED DR/GR DOCUMENTS**



## APPENDIX E

### Environmental Features Maps Compiled from Selected DR/GR Documents

(NOTE: While all maps listed below contain information specific to Lee County DR/GR lands, highlighted maps are considered to be of higher priority in the event that a phased approach is taken to incorporating DR/GR-related maps into the Lee County Geographic Information System.)

Lee County, Florida - DR/GR Maps and Overlays					
No	Page	Fig. No	Title/Caption	Key Environmental Resources/Features	Comment
<b>1. Lee County Comprehensive Plan Update</b>					
					No maps to include
<b>2. Groundwater Resources and Mining Study</b>					
2-1	4	III-1	Lee Future Land Use Map	Shows the future land use in the DR/GR.	This figure may have been acquired from Lee County
2-2	19	V-4	Lee County Watersheds	Shows the different watersheds within the county.	This figure may have been acquired from Lee County
2-3			Viewlog database	For this report and the “Engineering Analysis for Properties Designated within the City of Bonita Springs as ‘Density Reduction/Groundwater Resource’ (DR/GR)” report a Viewlog database was utilized to create many of the figures in the report. Including past water level contours, and hydrostratigraphy. It would be advantageous for the County to acquire a copy of this database. It could be updated	

				and could be used to recreate any of the figures from these reports.	
2-4		VI-3	Location map of wells with lithologic data		
2-5		VI-4	Digital elevation model interpolated to 500ft grid		
2-6		VI-5	Contour map of Holocene thickness		
2-7		VI-6	Contour map of Pliocene thickness		
2-8		VI-9	Contour map of Ochopee thickness		
2-9		VI-11	Contour map of Peace River sandstone thickness		
2-10		VI-13	Contour map of Arcadia thickness		
2-11		VI-36	Location map of wells with water level data		
2-12	38	VII-19	Extent and location (domain) of Model Grid for Lee County		Depicts extent of model area in relation to DR/GR land features.
2-13		VII-24	Location of existing borrow pits		
2-14		VII-37	Net recharge to water table average annual season steady state		
<b>3. Lee Master Mitigation Plan (LMMP)</b>					
					No maps to include

**4. Water Resources Management Project**

4-1				<p>Maps showing aquifer storage (the importance here is that the DR/GR contains significant amounts of groundwater storage for the county): Figures 4-5, 4-7, 4-9, 4-11, 4-13, 4-15, 4-17, 4-19, 4-21.</p> <p>Maps showing groundwater flow (the importance here is the possible maintenance of fresh water flows to the estuaries): Figures 4-50 - 4-51.</p> <p>Plate 11: shows thick portions of Water Table Aquifer are within the DR/GR.</p> <p>Plate 15: shows thick portions of Tamiami Aquifer are within the DR/GR.</p> <p>Plate 19: shows thick portions of Sandstone Aquifer are within the DR/GR.</p> <p>Plate 23: shows thick portions of Mid-Hawthorn Aquifer are within the DR/GR.</p> <p>Plates 79, 80, 81: Recharge areas for the Water Table, Lower Tamiami, and Sandstone Aquifers (recharge occurs within the DR/GR).</p> <p>Plate 82: Recharge areas for Mid-Hawthorn aquifer</p> <p>Plates 83, 84, 85: Potential wellfields (some of these areas may already be developed as wellfields).</p>	
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5. Engineering Analysis for Properties Designated within the City of Bonita Springs as “Density Reduction/Groundwater Resource” (DR/GR)					
					No maps to include
6. Estero Bay: State of the Bay Report					
6-1			Estero Bay Watershed Land Conservation/Preservation Strategy Map	Conservation Lands, Proposed Acquisition Lands	The 2000 document includes the entire DR/GR area. Relatively comprehensive, the map was adopted in 1998 – not current.
6-2	8		Estero Verified 2002 303d	Water Quality, Impaired Areas, Federal 303d classification  These should be kept updated and could be overlaid with potential restoration, protection and enhancement areas to identify parameters that might compromise project success or provide opportunities for further enhancement.	The 2004 document includes SFWMD sub-basin boundaries from Charlotte Harbor NEP, Southwest Florida Regional Planning Council, Florida Department of Environmental Protection, SFWMD. Based on 2001 data

<b>7. Lower Charlotte Harbor Reconnaissance Report</b>					
7-1	42	Fig. 19	Drainage Characteristics of Soils		For all maps within this document: Includes only Estero Bay Basin, not Trafford or West Caloosahatchee portions of DR/GR.
7-2	55	Fig. 26	Lands in Conservation	Conservation Lands Under Public Ownership	Probably most up-to-date and comprehensive map in list of literature reviewed.
7-3	56	Fig. 27	Conservation Easements		Important in terms of linking protected land parcels.
7-4	58	Fig. 29	Florida Greenways and Trails Program Conservation/Ecological Opportunities	Greenways	
7-5	58	Fig. 30	Identified Lands for Potential Future Acquisition	Proposed Acquisition Lands	
7-6	68	Fig. 34	FDEP Integrated Assessment	Impaired Areas	From FDEP
7-7	69	Fig. 35	Designated Uses	State Water Classifications	From FDEP
7-8	73	Fig. 39	Estero Verified Impairments	Impaired Areas	From FDEP
7-9	81	Fig. 43	Dissolved Oxygen and Bio-Chemical Oxygen Demand Trends	Water Quality	From TetraTech/Janicki June 2004 report
7-10	81	Fig. 44	Turbidity and Total Suspended Solids Trends	Water Quality	From TetraTech/Janicki June 2004 report

7-11	82	Fig. 45	Nutrient Trends	Water Quality	From TetraTech/Janicki June 2004 report
7-12	84	Fig. 46	Known Outfalls (NDPES permits)	Water Quality	From Lee County, Charlotte Harbor NEP, and U.S. Census Bureau
7-13	86	Fig. 48	Wastewater Generating Facilities NPDES Status	Water Quality	From FDEP, Charlotte Harbor NEP, and U.S. Census Bureau
7-14	86	Fig. 49	Domestic Wastewater Generating Facilities	Water Quality	From FDEP, Charlotte Harbor NEP, and U.S. Census Bureau
7-15	88	Fig. 50	Petroleum Storage Tanks	Water Quality	From FDEP, Charlotte Harbor NEP, and U.S. Census Bureau
7-16	89	Fig. 51	Hazardous Waste Handlers	Water Quality	From FDEP, Charlotte Harbor NEP, and U.S. Census Bureau
7-17	90	Fig. 52	Identified Stormwater Plans	Water Quality	From Lee County, Charlotte Harbor NEP, and U.S. Census Bureau

<b>8. Water Quality Data Analysis and Report</b>					
8-1		Fig 6-11	CHNEP Basins – Southern Coast – Surface – Specific Conductivity	Water Quality (Trend)	For all Maps in Section 8 – shows trends in water quality parameter. Includes only Estero Bay Basin of DR/GR, some of eastern parts not included. Note - data are sparse within the southern DR/GR.
8-2		Fig 6-12	CHNEP Basins – Southern Coast – Bottom – Specific Conductivity	Water Quality (Trend)	
8-3		Fig 6-14	CHNEP Basins – Southern Coast – Surface – Dissolved Oxygen	Water Quality (Trend)	
8-4		Fig 6-15	CHNEP Basins – Southern Coast – Bottom – Dissolved Oxygen	Water Quality (Trend)	
8-5		Fig 6-16	CHNEP Basins – Southern Coast – Surface – Biological Oxygen Demand	Water Quality (Trend)	
8-6		Fig 6-17	CHNEP Basins – Southern Coast – Bottom – Biological Oxygen Demand	Water Quality (Trend)	
8-7		Fig 6-20	CHNEP Basins – Southern Coast – Surface – Temperature	Water Quality (Trend)	
8-8		Fig 6-21	CHNEP Basins – Southern Coast – Surface – Temperature	Water Quality (Trend)	
8-9		Fig 6-23	CHNEP Basins – Southern Coast – Surface – Turbidity	Water Quality (Trend)	
8-10		Fig 6-24	CHNEP Basins – Southern Coast –	Water Quality (Trend)	



			Surface – Turbidity		
8-11	Fig 6-32	CHNEP Basins – Southern Coast – Surface – Chlorophyll-a (corrected)	Water Quality (Trend)		
8-12	Fig 6-35	CHNEP Basins – Southern Coast – Surface – Nitrate + Nitrite	Water Quality (Trend)		
8-13	Fig 6-36	CHNEP Basins – Southern Coast – Bottom – Nitrate + Nitrite	Water Quality (Trend)		
8-14	Fig 6-39	CHNEP Basins – Southern Coast – Surface – Total Kjeldahl Nitrogen	Water Quality (Trend)		
8-15	Fig 6-40	CHNEP Basins – Southern Coast – Bottom – Total Kjeldahl Nitrogen	Water Quality (Trend)		
8-16	Fig 6-41	CHNEP Basins – Southern Coast – Surface – Total Nitrogen	Water Quality (Trend)		
8-17	Fig 6-42	CHNEP Basins – Southern Coast – Bottom – Total Nitrogen	Water Quality (Trend)		
8-18	Fig 6-45	CHNEP Basins – Southern Coast – Surface – Ammonia	Water Quality (Trend)		
8-19	Fig 6-46	CHNEP Basins – Southern Coast – Bottom – Ammonia	Water Quality (Trend)		
8-20	Fig 6-49	CHNEP Basins – Southern Coast – Surface – Total Phosphate	Water Quality (Trend)		
8-21	Fig 6-50	CHNEP Basins – Southern Coast – Bottom – Total Phosphate	Water Quality (Trend)		
8-22	Fig 6-51	CHNEP Basins – Southern Coast – Surface – Orthophosphate	Water Quality (Trend)		
8-23	Fig 6-52	CHNEP Basins – Southern Coast – Bottom – Orthophosphate	Water Quality (Trend)		
8-24	Fig 6-55	CHNEP Basins – Southern Coast – Surface – Sulfate	Water Quality (Trend)		
8-25	Fig 6-58	CHNEP Basins – Southern Coast –	Water Quality (Trend)		

			Surface – Chloride		
8-26		Fig 6-62	CHNEP Basins – Southern Coast – Surface – Fecal Coliform	Water Quality (Trend)	

<b>9. How much is enough? Landscape-scale conservation for the Florida panther</b>					
9-1	120	Fig. 1	Study area and land cover (WMD aerial photography).	Vegetation Communities, Wetlands, Rare and Unique Uplands, Native Uplands, Native Vegetation Communities	
9-2	121	Fig. 2	Florida panther radio-telemetry data (Feb1981-March 2001)	Listed Species	
9-3	124	Fig. 3	Least-cost paths most likely to be taken by Florida panthers dispersing out of south Florida. Based on analysis of impediments to Florida panther dispersal such as roadways.	Listed Species	
9-4	127	Fig. 4	A model of landscape components significant to Florida panther conservation based on findings from Euclidean distance analyses	Listed Species	
9-5	128	Fig. 5	Locations of Primary, Dispersal, and Secondary zones	Habitat for Listed Species	Integrates information from Fig. 4 into a connected landscape mosaic of cover types needed to support the Florida panther population. Contact Paul Souza or Allen Webb, USFWS,

					Vero Beach, 772-562-3909 for current habitat map.
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<b>10. Closing the Gaps in Florida's Wildlife Habitat Conservation System (Gaps Report)</b>					
10-1	53	Fig. 48	Potential black bear habitat in and around the Big Cypress National Preserve		
10-2	68	Fig. 65	Proposed strategic habitat conservation areas for the Florida panther		
10-3	123	Fig. 141	Overlay of coarse habitat distribution maps for 120 rare species		
			Information regarding species distributions, Strategic Habitat Conservation Areas, conservation areas, and Hot Spots of biological resources in the Southwest Florida Region. Can be obtained from the Florida Fish and Wildlife Conservation Commission.	Vegetation communities, wetlands, invasive/exotic species, rare and unique uplands, native uplands, native vegetation communities, coastal and interior hammocks, rare and unique habitats, biodiversity "hot spots", native wildlife habitat, migratory bird habitat, critical habitat for listed species, important plant habitats, endangered plant species habitat, conservation lands under public ownership	
10-4	172	170b	Strategic Habitat Conservation Areas	Habitat areas for species	
10-5	173	170c	Hotspots of biological resources	Habitat areas of multi-species diversity	
<b>11. Southwest Florida Feasibility Study</b>					
<b>11.1 Southwest Florida Feasibility Study- Feasibility Scoping Meeting Documentation</b>					
11.1-1		Fig. 1	SWFFS Study Area Boundary		
11.1-2		Fig. 5	Lee County Future Land Use		
11.		Fig. 8	Pre-Development Vegetation Map		



1-3					
11. 1-4		Fig. 9	Study Area Map Depicting the 4 Main Watersheds and the Overlaps Between Watersheds		
11. 1-5		Fig. 10	Potential Restoration Sites in Study Area		
11. 1-6		Fig. 11	Species Richness		
11. 1-7		Fig. 12	Biodiversity Hotspots		
11. 1-8		Fig. 13	Unnatural Flows to the Coast		
11. 1-9		Fig. 14	SWFFS Restoration Projects (Phase I)		
11. 1-10		Fig. 15	SWFFS Modeling Suite Connectivity		
<b>11.2 Southwest Florida Feasibility Study- Caloosahatchee Conceptual Model</b>					
					No maps to include
<b>11.3 Southwest Florida Feasibility Study- Big Cypress Conceptual Model</b>					
					No maps to include
<b>11.4 Southwest Florida Feasibility Study- April 2006 Scoping letter</b>					
					Map attached to memo showing the Southwest Florida Feasibility Study area

<b>11.5 Southwest Florida Feasibility Study- project component map</b>					
					This map is useful in depicting the location and geographic interrelationships of the planned components of the Southwest Florida Feasibility Study.
<b>11.6 Southwest Florida Feasibility Study- Comprehensive Everglades Restoration Plan System-wide Performance Measures</b>					
11.6-1	3-3	Fig. 9	Satellite image of physiographic regions in South Florida	This figure shows the 11 specific regional conceptual ecological models which have been developed for South Florida.	
11.6-2	3-12	Fig. 11	Performance measure review process		
11.6-3	4.0-1	Fig. 12	Boundaries of CERP regional modules		
<b>11.7 Southwest Florida Feasibility Study- Greater Everglades Wetlands Conceptual Ecological Model</b>					
11.7-1	4.3-2	Fig. 24		Presents the boundary of Greater Everglades Wetlands within influence of CERP.	This figure is useful because it shows this area in relation to the DR/GR lands.
<b>11.8 Southwest Florida Feasibility Study- Northern Estuaries Conceptual Model</b>					
11.8-1		Fig. 18	Boundary of Northern Estuaries within Influence of the CERP along the Gulf Coast.	This figure shows the location of the Caloosahatchee Estuary and its proximity to DR/GR lands.	

<b>11.9 Southwest Florida Feasibility Study- Caloosahatchee Estuary Salinity Envelope</b>					
					No maps to include
<b>11.10 Southwest Florida Feasibility Study- NE-7 Caloosahatchee Estuary Nutrient (TP and TN) Loading and Concentration</b>					
					No maps to include
<b>12. The South Florida Multi-species Recovery Plan</b>					
12-1	2-60	Fig. 9	Existing Mitigation Service Areas (Federal) and Mitigation Banks in South Florida	Existing conservation areas	Should be updated periodically. Does not include state mitigation service areas.
12-2	3-198	Fig. 1	The Distribution of Hydric and Mesic Pine Flatwoods in South Florida (from USGS-BRD 1996)	Vegetation communities, wetlands, rare and unique uplands, native uplands, native vegetation communities	
12-3	3-481	Fig. 1	The Distribution of Forested Pond Swamps in South Florida (from USGS-BRD 1996)	Wetland vegetation communities	
12-4	3-501	Fig. 1	3-501 – The Distribution of Forested Pond Swamps in South Florida (from USGS-BRD 1996)	Wetland vegetation communities	
<b>13. County Road 951 Project Development &amp; Environmental Study</b>					
13-1		Fig. 4-6	Drainage Map	Also includes existing waterways and flow-ways and proposed cross-drains and ponds.	In Wetlands Report. Southern part of DR/GR
13-2		Fig. 5-3	Wetland Location Map	Based on aerial photography, Natural Resources Conservation Service data, National Wetlands Inventory data, and	In Wetlands Report. Southern part of DR/GR

				ground-truthing – includes wetlands Florida Land Use, Cover and Forms Classification System codes.	

<b>14. South Lee County Watershed Plan</b>					
14-1	II-D 1-8		Baseline Conditions – Hydrologic Ranking		No directly useful maps.
14-2	II-D 1-9		Baseline Conditions – Ecological Assessment	Overall results of ecological assessment model	
<b>15. Other Sources of DR/GR-Related Spatial Information</b>					
15-1			Flow Ways Map		
15-2			Conservation 20/20 Map		

**APPENDIX F**

**INFORMATION SOURCE SUMMARY FOR DR/GR  
ENVIRONMENTALLY SENSITIVE NATURAL RESOURCES  
AND ENVIRONMENTAL ISSUES  
IDENTIFIED IN LEE COUNTY COMPREHENSIVE PLAN**

**APPENDIX F**

**Information Source Summary for**

**DR/GR  
Environmentally Sensitive Natural Resources  
and  
Environmental Issues Identified in  
Lee County Comprehensive Plan**

<u>Environmental Feature</u>	<u>Information Sources</u>
Environmentally Sensitive Areas	Addressed in Estero Bay State of the Bay Report (2000) (no maps).
<b>Vegetation and Wildlife</b>	
Vegetation communities	Addressed in 951 Report (for a portion of the DR/GR), Lower Charlotte Harbor Reconnaissance, Closing the Gaps (get most recent version from Florida Fish and Wildlife Conservation Commission), Bonita Springs Report (for a portion of the DR/GR), "How Much is Enough?" Florida panther study, and Estero Bay State of the Bay Report (2000 and 2004). Most maps are based on remote sensing data. Some verification through low-level helicopter flyovers or field surveys was conducted for the 951 Report, Bonita Springs Report, and "Closing the Gaps" report. This verification is important for the DR/GR area because pine flatwoods are easily misidentified as cypress forests when only remote sensing data are used. More field verification of vegetation communities for the DR/GR would be useful.
Environmentally sensitive coastal planning areas	Addressed in Estero Bay State of the Bay Report (2000) (no maps). Discussed in Water Quality/Data Analysis Report.
Wetlands	Addressed in 951 Report (for a portion of the DR/GR), Lower Charlotte Harbor Reconnaissance, Closing the Gaps (get most recent version from Florida Fish and Wildlife Conservation Commission), Bonita Springs Report (for a portion of the DR/GR), "How Much is Enough?" Florida panther study, Multi-species Recovery Plan, and Estero Bay State of the Bay Report (2000 and 2004). Most maps are based on remote sensing data. Some verification through low-level helicopter flyovers or field surveys was conducted for the 951 Report, Bonita Springs Report, and "Closing the Gaps" report. The 951 report is the only document that includes wetland boundaries



	delineated in accordance with state and federal rules. These boundaries are more accurate than those based upon remote sensing.
Wetland mitigation banks	Included on Fig. 26 of Lower Charlotte Harbor Reconnaissance – shown as “Lands in Conservation” – not called out specifically as mitigation banks. All mitigation banks within Lee County are included in the Florida Department of Environmental Protection ( <a href="http://www.dep.state/fl.us/water/wetlands/docs/mitigation/mitbanks.html">http://www.dep.state/fl.us/water/wetlands/docs/mitigation/mitbanks.html</a> ). Mitigation Service Areas for each mitigation bank are also included in map form.
Issues: invasive/exotic species	Addressed in narrative form in Bonita Springs document, Estero Bay State of the Bay Report (2000), Multi-species Recovery Plan, “Closing the Gaps” Report, and Lower Charlotte Harbor Reconnaissance. A more extensive vegetation survey and corresponding map showing areas that are infested with exotic plant species would be useful.

<b>Important Native Plant Communities</b>	Best narrative descriptions of the ecological importance of all native plant communities listed below are in the Multi-species Recovery Plan (Section 3) and the “Closing the Gaps” Report.
Rare and unique uplands	Addressed in 951 Report (for a portion of the DR/GR), Estero Bay State of the Bay Report (2000 and 2004), Lower Charlotte Harbor Reconnaissance, Closing the Gaps (get most recent version from Florida Fish and Wildlife Conservation Commission), Bonita Springs Report (for a portion of the DR/GR), “How Much is Enough?” Florida panther study, and the Multi-species Recovery Plan. Most maps are based on remote sensing data. Some verification through low-level helicopter flyovers or field surveys was conducted for the 951 Report, Bonita Springs Report, and “Closing the Gaps” report. Some verification through low-level helicopter flyovers or field surveys was conducted for the 951 Report, Bonita Springs Report, and “Closing the Gaps” report. This verification is important for the DR/GR area because pine flatwoods are easily misidentified as cypress forests when only remote sensing data are used. More field verification of vegetation communities for the DR/GR would be useful.
Native vegetation communities	Addressed in 951 Report (for a portion of the DR/GR), Estero Bay State of the Bay Report (2000 and 2004), Lower Charlotte Harbor

	Reconnaissance, Closing the Gaps (get most recent version from Florida Fish and Wildlife Conservation Commission), Bonita Springs Report (for a portion of the DR/GR), "How Much is Enough?" Florida panther study, and the Multi-species Recovery Plan. Most maps are based on remote sensing data. Some verification through low-level helicopter flyovers or field surveys was conducted for the 951 Report, Bonita Springs Report, and "Closing the Gaps" report. Some verification through low-level helicopter flyovers or field surveys was conducted for the 951 Report, Bonita Springs Report, and "Closing the Gaps" report.
Coastal and interior hammocks	Addressed in Multi-species Recovery Plan, "Closing the Gaps" Report, and the Estero Bay State of the Bay Report (2000 and 2004).
Rare and unique habitats <ul style="list-style-type: none"> <li>- Mangroves</li> <li>- Cypress heads</li> </ul>	Addressed in Multi-species Recovery Plan, "Closing the Gaps" Report, the Estero Bay State of the Bay Report (2000 and 2004), and Lower Charlotte Harbor Reconnaissance and Bonita Springs DR/GR Report.
Biodiversity "hot spots"	Addressed most fully in "Closing the Gaps" Report.

<b>Important Wildlife Habitat</b>	
Native Wildlife Habitat	Addressed in 951 Report (for a portion of the DR/GR), Estero Bay State of the Bay Report (2000 – narrative only), Lower Charlotte Harbor Reconnaissance, Closing the Gaps Report (get most recent version from Florida Fish and Wildlife Conservation Commission), Bonita Springs Report (for a portion of the DR/GR), "How Much is Enough?" Florida panther study, and the Multi-species Recovery Plan.
Migratory bird wintering areas	Addressed in narrative form in Multi-species Recovery Plan, "Closing the Gaps" Report, and the Estero Bay State of the Bay Report (2000)
Critical Habitat for Listed Species – endangered, threatened, species of special concern	<u>All species listed below</u> are addressed in the Multi-species Recovery Plan, "Closing the Gaps" Report, 951 Report (for a portion of the DR/GR), and the Estero Bay State of the Bay Report (2000 and 2004).
Florida panther	"How Much is Enough?" Florida panther study.
Wood stork	See "Critical Habitat for Listed Species" above.
Fish/fishery resources	See "Critical Habitat for Listed Species" above.
Bears	See "Critical Habitat for Listed Species" above.
Red-cockaded woodpecker	See "Critical Habitat for Listed Species" above.
Gopher tortoise	See "Critical Habitat for Listed Species" above.
Southern bald eagle	See "Critical Habitat for Listed Species" above.
Manatee	See "Critical Habitat for Listed Species" above.
Others	See "Critical Habitat for Listed Species" above.

<b>Important Plant Habitats</b>	
Endangered plant species habitat	Addressed in the Multi-species Recovery Plan, "Closing the Gaps" Report, 951 Report (for a portion of the DR/GR), and the Estero Bay State of the Bay Report (2000 and 2004) and Bonita Springs DR/GR Report. Florida Natural Areas Inventory Database includes additional information regarding endangered plant species.

<b>Important Water Resources</b>	
Natural waterways/water bodies	Discussed in Rawl Groundwater and Mining Report. Addressed in Estero Bay State of the Bay Report (2000 and 2004), Lower Charlotte Harbor Reconnaissance, Water Quality/Data Analysis Report and Bonita Springs DR/GR Report. Discussed in South Lee County Watershed Plan.
Riparian Areas/Riparian Systems	Narrative description included in the Estero Bay State of the Bay Report (2000), Many data points in the Water Quality/Data Analysis Report are located within these areas. Discussed in South Lee County Watershed Plan.
Flow-ways existing and historic	Discussed in Rawl Groundwater and Mining Report. Discussed in Bonita Springs DR/GR Report. Addressed briefly in Lower Charlotte Harbor Reconnaissance. Discussed in South Lee County Watershed Plan.
Sloughs	Discussed in Bonita Springs DR/GR Report. Addressed briefly in Lower Charlotte Harbor Reconnaissance. Discussed in South Lee County Watershed Plan.
Storm and flood hazard areas	Discussed in South Lee County Watershed Plan.
Natural lakes	Not specifically discussed.
Estero Bay Estuary	Discussed in Bonita Springs DR/GR Report. Addressed in Estero Bay State of the Bay Report (2000 and 2004), Lower Charlotte Harbor Reconnaissance, Water Quality/Data Analysis Report. Discussed in South Lee County Watershed Plan.
Aquatic preserves/Outstanding Florida Waters Estero Bay	Discussed in Bonita Springs DR/GR Report Addressed in Estero Bay State of the Bay Report (2000 and 2004), Lower Charlotte Harbor Reconnaissance, Water Quality/Data Analysis Report. Discussed in South Lee County Watershed Plan.
Aquifers	Discussed in Rawl Groundwater and Mining Report and the Montgomery Report. Addressed in Water Quality/Data Analysis Report. Discussed in Bonita Springs DR/GR Report.

Aquifer recharge areas	Discussed in Rawl Groundwater and Mining Report and the Montgomery Report. Addressed in Bonita Springs DR/GR Report.
Watersheds	Discussed in Rawl Groundwater and Mining Report and the Montgomery Report. Addressed in Estero Bay State of the Bay Report (2000), Water Quality/Data Analysis Report, Lower Charlotte Harbor Reconnaissance. Discussed in Bonita Springs DR/GR Report. Discussed in South Lee County Watershed Plan.
Drainage basins	Discussed in Rawl Groundwater and Mining Report and the Montgomery Report. Addressed in Estero Bay State of the Bay Report (2000), Water Quality/Data Analysis Report, Lower Charlotte Harbor Reconnaissance. Discussed in Bonita Springs DR/GR Report. Discussed in South Lee County Watershed Plan.
Floodplains	Discussed in South Lee County Watershed Plan and the Montgomery Report.
Wellfield protection areas	Discussed in Bonita Springs DR/GR Report.
Wellfields	Discussed in Rawl Groundwater and Mining Report and the Montgomery Report. Mentioned in Water Quality/Data Analysis Report. Discussed in Bonita Springs DR/GR Report.
Water quality	Discussed in Rawl Groundwater and Mining Report and the Montgomery Report. Addressed in Estero Bay State of the Bay Report (2000 and 2004), Water Quality/Data Analysis Report, Lower Charlotte Harbor Reconnaissance. Discussed in Bonita Springs DR/GR Report. Discussed in South Lee County Watershed Plan.
Surface water	Discussed in Rawl Groundwater and Mining Report and the Montgomery Report. Addressed in Estero Bay State of the Bay Report (2000 and 2004), Water Quality/Data Analysis Report, Lower Charlotte Harbor Reconnaissance. Discussed in Bonita Springs DR/GR Report. Discussed in South Lee County Watershed Plan.
Groundwater	Discussed in Rawl Groundwater and Mining Report and the Montgomery Report.. Addressed in Water Quality/Data Analysis Report. Discussed in Bonita Springs DR/GR Report.
Impaired areas	Addressed in Estero Bay State of the Bay Report (2000 and 2004), Water Quality/Data Analysis Report, Lower Charlotte Harbor Reconnaissance. Discussed in South Lee County Watershed Plan. Discussed in Bonita Springs DR/GR Report.
Federal 303d classification	Addressed in Estero Bay State of the Bay Report (2000 and 2004), Water Quality/Data Analysis Report, Lower Charlotte Harbor Reconnaissance.
State water classifications	Addressed in Estero Bay State of the Bay

	Report (2000 and 2004), Water Quality/Data Analysis Report, Lower Charlotte Harbor Reconnaissance. Discussed in Bonita Springs DR/GR Report.
Water quantity/water supply (existing and projected water budget)	Discussed in Rawl Groundwater and Mining Report and the Montgomery Report. Discussed conceptually in Estero Bay State of the Bay Report (2000 and 2004). No quantitative data regarding water budgets are included. Discussed in Bonita Springs DR/GR Report.
Issue: Flooding	Best discussion in SW Florida Feasibility Study, also included in Estero Bay State of the Bay Report (2000 and 2004). Addressed in Bonita Springs DR/GR Report. Discussed in South Lee County Watershed Plan.

<b>Greenway/Blueways</b>	Addressed in Lower Charlotte Harbor Reconnaissance Report (greenways only).
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<b>Conservation Lands Under Public Ownership</b> – e.g. CARL, CREW, SOR, 2020 Conservation Program, community based land trusts	Addressed in Lower Charlotte Harbor Reconnaissance Report, Multi-species Recovery Plan, and Estero Bay State of the Bay Report (2000). Discussed in Bonita Springs DR/GR Report. Discussed in South Lee County Watershed Plan.
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<b>Proposed Acquisition Lands</b>	In general, discussed in Bonita Springs DR/GR Report and South Lee County Watershed Plan.
CARL, CREW, SOR, 2020 Conservation Program	Addressed in Lower Charlotte Harbor Reconnaissance Report and Estero Bay State of the Bay Report (2000).
Florida Communities Trust	Mentioned in Lee Comprehensive Plan. Not specifically mentioned by name in other documents although acquisition and management of sensitive lands was discussed.
Airport mitigation lands	Addressed in narrative form only in the Multi-species Recovery Plan.

<b>Mining Resources</b>	Discussed in Rawl Groundwater and Mining Report. Mention of mining is made in Estero Bay State of the Bay Report (2000) and Lower Charlotte Harbor Reconnaissance Report as a land use category. No in-depth discussions mining resources nor of impact of mining activities on environmental resources.
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