EXHIBITS

from HEX hearing

CASE #: DC12006-00055

CASE NAME: Amazing Grace RPD

Attach a copy of this form to the top of packet of the exhibits & place exhibits in case file.

ARE THERE ANY BOARD EXHIBITS? ___ **YES** X **NO**

LOCATION OF BOARDS:

If there are any board exhibits, attach another copy of this form to boards for identification purposes.

EXHIBITS

APPLICANT	STAFF
#1 MCP 3/28/07	#1
#2 Vegetation/Wetland Map	#2
#3 Aerial photo.	#3
#4 Caldwell Resume	#4
#5 Lee Plan 1994 EAR	#5
#6	#6
#7	#7
#8	#8
#9	#9
#10	#10

OTHER EXHIBITS

NAME	NAME
#1	#1
#2	#2
#3	#3
#4	#4
#5	#5

STEPHANIE CALDWELL, P.E.

Project Engineer
Barraco and Associates, Inc.

EDUCATION

University of Florida
Bachelor of Science
Civil Engineering 1995

PROFESSIONAL REGISTRATION

Florida Professional Engineer
#56103, July 2000

Stephanie Caldwell joined Barraco and Associates as a Professional Engineer in February, 2006. Prior to joining Barraco and Associates, Stephanie lived in Jacksonville, Florida, where a majority of her experience is concentrated. Her experience includes a wide array of projects: residential (both single family and multifamily subdivisions), commercial (retail, medical, and general office), industrial (distribution centers), institutional (schools), recreational (golf courses), and roadway design. While working on these varying projects, her responsibilities and duties typically included permitting through state and local governmental agencies, site layout, drainage design, utility design, coordination with clients and contractors, construction observation services, and project certification.

PREVIOUS PROJECT EXPERIENCE:

Fleming Island Plantation Stormwater Master Planning
Orange Park, Florida

Designed and permitted overall stormwater model for a 1600-acre parcel located in northeast Florida. This property contains a mixture of residential, commercial, and recreational area. Further experience includes the detailed design of various residential parcels within this community.

Hammock Dunes Carino la Mer
Palm Coast, Florida

Project manager responsible for design and permitting of 67 oceanfront lots on US-1 in Flagler County. Project included coordination with FDEP for construction seaward of the Coastal Construction Control Line and included detailed design of finished floor criteria due to the project's proximity to the Atlantic Ocean.

Target Store T-1294
St. Augustine, Florida

Project manager for the design and permitting of a 125,000 square foot Target retail store and its associated site improvements. Project comprised of the consolidation of 17 individual parcels of land and entailed significant permitting effort.

Hammock Dunes Creek Course
Palm Coast, Florida

Project manager for design and permitting of golf course in Flagler County that incorporated wildlife crossings and substantial wetland preserve areas. Duties included surface water management design, coordination with golf course architect on detailed grading, permitting through state and local agencies, and certification of construction completion.

APPLICANT'S EXHIBIT # 4
CPD06-00055

LEE COUNTY
PLANNING DIVISION

3014 A

LEE PLAN
EVALUATION & APPRAISAL REPORT

Volume 1 of 2

ADOPTED BY THE
LEE COUNTY
BOARD OF COUNTY COMMISSIONERS

JULY 7, 1994

LEE COUNTY
PLANNING DIVISION

EXHIBIT H

FUTURE LAND USE ELEMENT EAR

GROUNDWATER RESOURCE PROTECTION STUDY

PREPARED BY HENIGAR & RAY, INC.
JULY 28, 1993

LEE COUNTY

GROUND WATER RESOURCE PROTECTION STUDY

Prepared For:

LEE COUNTY BOARD OF COUNTY COMMISSIONERS

July 28, 1993

Prepared By:

Henigar & Ray, INC.

640 East Highway 44
Crystal River, Florida 34429

Table of Contents

APPENDIXES PAGE NO.

I. INTRODUCTION

This ground water resource protection study has been prepared for Lee County in order to address the following issues:

1. Whether the current maximum densities and intensities in the density reduction ground water resources (DRGR) land use category are necessary to protect existing and future Lee County sources of potable water.

2. If densities and/or intensities may be increased in any or all of the DRGR land use category; if so, where and in what manner, may this be accomplished.

3. What new land development standards or regulations, if any, are necessary to permit increases in density and/or intensity if it is determined that such increases may occur.

The study considers only the protection of ground water and recharge areas and is not a comprehensive approach that addresses all factors affecting density/intensity decisions.

A comprehensive review of the existing data pertaining to the hydrogeological characteristics of the DRGR area was accomplished. Only existing data were used to analyze the hydrogeologic characteristics of the main water bearing aquifers identified in Lee County.

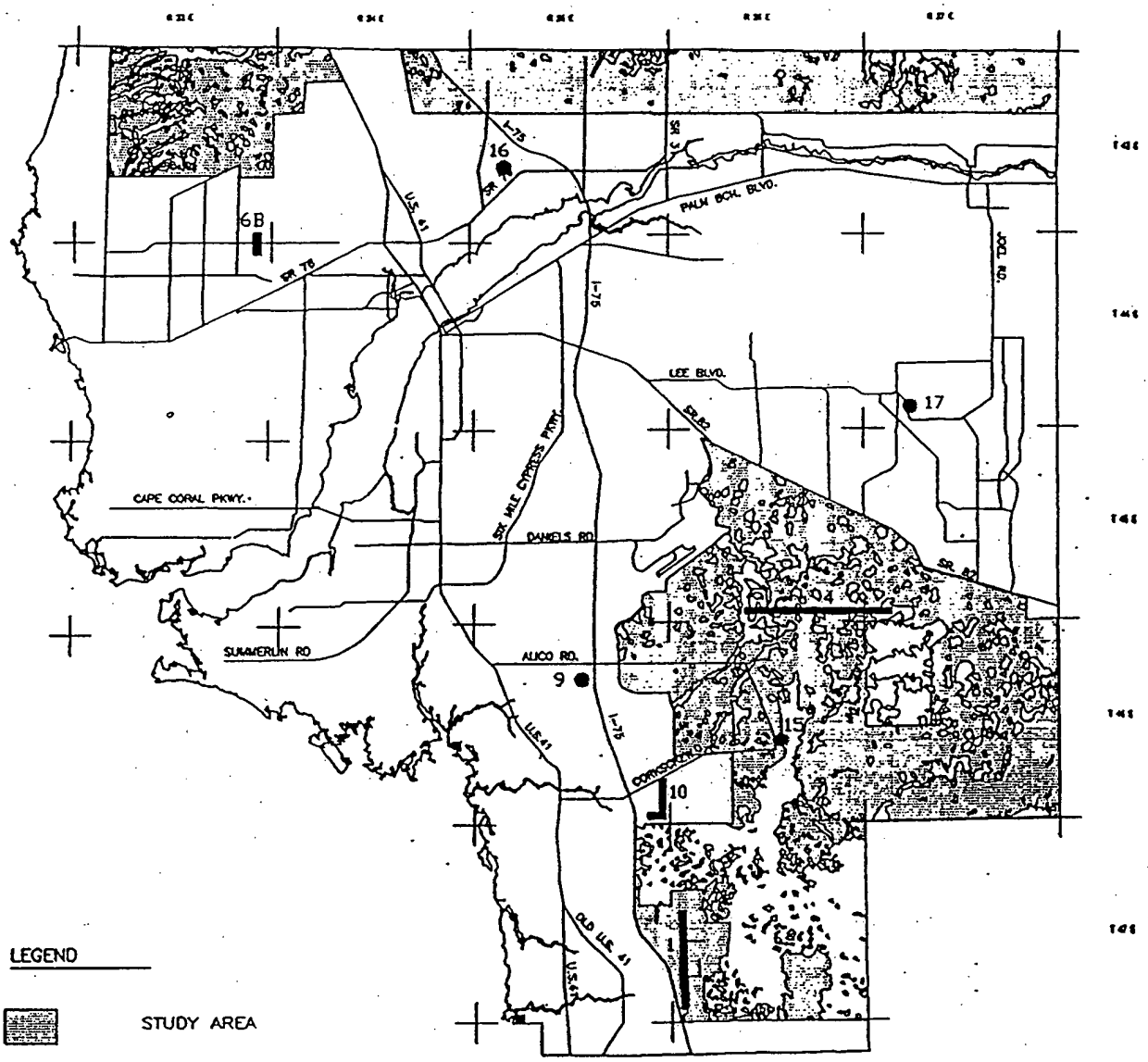
It should be noted that the analysis of the hydrogeologic characteristics of the main freshwater aquifers within the DRGR did not include an evaluation of the future water supply needs of the County nor did it include an evaluation of the most feasible sources to

satisfy these needs. Rather, this study was limited only to the identification of hydrogeologic characteristics that would be desirable when developing a water supply. As a result, the economics of developing a particular area as a water supply has not been considered in the evaluation performed for this study. The Lee County Regional Water Supply Authority (LCRWSA) is currently performing a study to evaluate future water supply needs and to identify the actual or plausible sources to satisfy these needs.

Four scenarios are developed and analyzed for potential impacts on growth management principals. Two scenarios were developed to present the extremes, the status quo scenario and the provision of a higher density throughout the DRGR land use category. Two other scenarios are based on a McHargian (McHarg, Ian L., Design With Nature, 1969) type analysis referencing only ground water issues. The McHargian analysis has been used as an effective tool for developing environmental strategies for about twenty years. It employs a mapping and overlay system to evaluate all data necessary to arrive at supportable decisions. In addition, physical and regulatory methods minimizing impacts of increased intensity of use are provided.

II. GROUND WATER RESOURCE EVALUATION

This section of the report describes the evaluation of the ground water resources in the Density Reduction/Ground Water Resource (DRGR) areas in the Lee County Master Plan. The area currently designated DRGR by the County is shown on Plate II-1. A description of the principle aquifers identified for future potable water supply is followed by the criteria for evaluating and ranking areas within the DRGR areas. The results of the evaluation conclude this section of the report.



LEGEND

STUDY AREA

REFERENCE #	UTILITY-LOCATION	NUMBER OF PRODUCTION WELLS/AQUIFER
1.	BONITA SPRINGS - WEST TERRY	16 LT
4.	FLORIDA CITIES - GREEN MEADOWS	14 WT, 13 SS
6B.	FLORIDA CITIES - NORTH CAPE CORAL	3 WT, 1 SS
9.	GULF UTILITIES - SAN CARLOS	4 WT
10.	GULF UTILITIES - CORKSCREW	14 WT, 1 SS
15.	LEE COUNTY - CORKSCREW	5 WT, 17 WT/SS, 1 SS
16.	LEE COUNTY - NORTH COUNTY	1 SS, 1 MH
17.	SSU/LEHIGH UTILITIES	10 SS

NOTE: LT = LOWER TAMIAMI
SS = SANDSTONE
WT = WATER TABLE

N

SCALE
0 5 MILES

SOURCE: LCRWSA, 1993

Henigar & Ray, INC.
Atlanta Testing & Engineering

STUDY AREA & WELLFIELD LOCATIONS

Lee County – Groundwater Resource Protection Study

PLATE NO. II-1

A. Past Studies

Numerous studies have been performed to identify and evaluate the hydrogeologic conditions and ground water resources in Lee County. The results of the following evaluation rely almost completely on the information developed from these reports. No field investigation has been performed for this study. A listing of the reports reviewed for this study is presented in Appendix A, References, at the end of this report. Information from the following reports was utilized extensively in the evaluation of the County's ground water resources:

Draft Final Report, 20-Year Water Master Plan for Lee County, prepared by Engineering-Science, dated September 1991.

Draft, Lower West Coast Water Supply Plan, prepared by the South Florida Water Management District, dated January 1992.

A Three-Dimensional Finite Difference Ground Water Flow Model of Lee County, Florida, prepared by R.F. Bower, K. M. Adams, and J.I.Restrepo, South Florida Water Management District Technical Publication 90-01, dated January 1990.

Final Report, Wellfield Protection Zone Modeling, Lee County, Florida, prepared by Camp Dresser & McKee, Inc., dated November 1987.

Lee County Water Resources Management Project, prepared by James M. Montgomery, Consulting Engineers, Inc., dated October 5, 1988

Draft Report, Hydraulic Model of Shallow and Intermediate Aquifer Systems in Lee County, Florida, Volume I, prepared by Camp, Dresser, McKee, Inc. and

ViroGroup/Missimer Division, for the Lee County Regional Water Supply Authority, dated March 1993.

The 1988 report prepared by James M. Montgomery, Consulting Engineers (JMM) presented the results of a comprehensive collection and validation of hydrogeologic characteristics of the primary aquifers within Lee County. The data presented in this report were utilized by the South Florida Water Management District (SFWMD) to develop a three-dimensional ground water flow model of Lee County. A description of this work is presented in the 1990 SFWMD report by R.F. Bower and others referenced above. Currently, the Lee County Regional Water Supply Authority (LCRWSA) is preparing a Master Water Supply Plan for Lee County. In preparing this plan, the ground water flow model developed by SFWMD was updated utilizing additional data that had become available since the JMM and SFWMD reports. This updating more than doubled the number of data points for the hydraulic parameters of the aquifers modelled and increased the number of data points for aquifer thickness by approximately 80 percent. As a result the 1993 draft report prepared by Camp, Dresser, McKee and ViroGroup/Missimer Division for the LCRWSA and other information provided by the LCRWSA was used most extensively in the resource evaluation due to the timeliness and completeness of the data it contained.

B. Description of Aquifers

Three principal aquifers were evaluated in this study. These aquifers were: the water table aquifer and the lower Tamiami aquifer of the Shallow Aquifer System; and, the sandstone aquifer of the Intermediate Aquifer System. These aquifers currently are used to supply significant quantities of potable water in the County. Furthermore, these aquifers all exist within some part of the designated DRGR area in the Lee County Master Plan. The mid-Hawthorn aquifer also serves as a source of water within Lee County but on a limited basis.

In general, this aquifer is capable of producing only small quantities of water and is not considered as a source of water to meet future fresh water supply demands. Furthermore, the aquifer is capable of producing only a small quantity of lesser quality water in the DRGR area, especially when compared to the sandstone aquifer and the Shallow Aquifer System. As a result, it was not included in this study.

The mid-Hawthorn aquifer formerly provided water for the City of Cape Coral and the greater Pine Island water utility. However, its limited water-producing characteristics made it an unreliable source. Both utilities have been forced to develop other sources, using the mid-Hawthorn wells for backup supply only. Today, the greatest use of the mid-Hawthorn is for domestic irrigation in Cape Coral and the area southwest of Fort Myers. It is also used for domestic individual supply in those areas of Cape Coral not served by city water and for small water utilities north of the Caloosahatchee River. Elsewhere the aquifer is used only occasionally for agricultural irrigation.

Draft Lower West Coast Water Supply Plan, SFWMD, 1992

Similarly, the Floridan Aquifer System was not considered in this study. The Floridan Aquifer System within Lee County yields non-potable water unless subjected to desalination treatment. Furthermore, upward ground water gradients in the uppermost aquifer in this system (the lower Hawthorn aquifer) indicates that recharge does not occur from overlying aquifers in Lee County (JMM, 1988). As a result, the Floridan Aquifer System was not included because it is not a source of potable fresh water and changes in land use densities would not affect the recharge of this aquifer.

The surficial aquifer system is subdivided into two aquifers: the water table aquifer; and the lower Tamiami aquifer (Plate II-2). In Lee County, the thickness of the water table aquifer generally varies from 20 to 40 feet and is comprised generally of fine and medium-grained quartz sands. In the southern portion of Lee County, a limestone member forms a permeable zone in the Tamiami Formation. In the extreme southern and southeastern portions of the County, thin beds of clay separate the water table aquifer from the permeable limestone formation. In this area, the water in the limestone formation exhibits characteristics of a semi-confined aquifer which comprises the lower

The surficial aquifer occurs within sediments of the Tamiami Formation and the Undifferentiated deposits. The Tamiami Formation is composed principally of sandy biogenic limestones, while the Undifferentiated deposits consist of quartz sand, shell beds and calcareous clays occasionally interbedded with thin seams of limestones. The base of the surficial aquifer is formed by the clayey dolosilts at the top of the Hawthorn Formation.

SFWMD Technical Publication 82-1

AGE (Million Years)	SERIES	STRATIGRAPHIC UNITS	HYDROGEOLOGIC UNITS	
.1	Recent	Undifferentiated Deposits	Surficial Aquifer System	Water Table Aquifer
1	Pleistocene			
13	Pliocene			
		Tamiami Formation		Confining Beds
				Lower Tamiami Aquifer
	Miocene	Hawthorn Formation	Intermediate Aquifer System	Upper Hawthorn Confining Zone
				Sandstone Aquifer
				Mid-Hawthorn Confining Zone
				Mid-Hawthorn Aquifer
				Lower Hawthorn Confining Zone
25		Tampa Limestone	Floridan Aquifer System	Lower Hawthorn Aquifer/Tampa Producing Zone
	Oligocene	Suwanee Limestone		Confining Beds
				Suwanee Aquifer
36	Upper Eocene	Ocala Group		
	Middle Eocene	Avon Park Limestone		Deeper Eocene Aquifer
		Lake City		

SOURCE: SFWMD, 1992

Henigar & Ray, Inc.
Atlanta Testing & Engineering

GENERALIZED HYDROSTRATIGRAPHIC CROSS-SECTION

Lee County – Groundwater Resource Protection Study

PLATE NO. II-2

FLU EAR Exhibit H Page 10 of 95

Tamiami aquifer. The lower Tamiami aquifer increases in thickness toward the south, reaching a thickness of 80 to 100 feet at the Lee County line. The clay semi-confining bed pinches out northeast of Bonita Springs and the lower Tamiami aquifer becomes unconfined. Where this occurs, the lower Tamiami is considered part of the water table aquifer. Due to this occurrence, the thickness of the water table aquifer exceeds 100 feet in southeastern Lee County.

Direct infiltration of precipitation is considered the major source of recharge to the water table aquifer (CDM, 1987). As a result, most of Lee County is considered to be a recharge area for the water table aquifer (JMM, 1988). The major source of natural water loss from the water table aquifer is evapotranspiration (CDM, 1987). Leakage through the confining bed is a major source of recharge to the lower Tamiami aquifer. Recharge also occurs due to horizontal flow from the water table aquifer where the confining bed begins (JMM, 1988).

The Sandstone aquifer underlies the upper Hawthorn confining unit under all of eastern Lee County and is comprised of sandy limestones, sandstones, sandy dolomites and calcareous sands confined above and below by clayey dolosilts (SFWMD, 1982). The Sandstone aquifer ranges in thickness from 20 feet in the vicinity of Fort Myers to greater than 150 feet in the east-central portion of the County. The aquifer essentially pinches out in the vicinity of Cape Coral which is accompanied by an increase in clay that reduces the permeability of the unit (USGS, 1986).

Recharge to the sandstone aquifer occurs through leakage from the overlying surficial aquifer system. In addition, subsurface inflow occurs mainly along the northeastern County boundary. Outflows from the aquifer include pumpage and upward leakage to the Surficial Aquifer System in the area adjacent to the Caloosahatchee River (CDM, 1987).

As noted above, these three aquifers have been identified in numerous planning documents as the primary sources of potable water supplies and for irrigation purposes. The location of existing public supply wellfields within or adjacent to the DRGR are shown on Plate II-1. The number of wells and the aquifer from which withdrawals occur are also shown on Plate II-1. While the South Florida Water Management District (SFWMD) recommends the development of the Floridan Aquifer System as a primary source of potable water supplies (SFWMD, 1992), this aquifer system was not included in this study because the naturally occurring quality of this water is generally non-potable in Lee County and would require significant treatment to render it potable.

C. Resource Evaluation

This section describes the criteria used to evaluate the ground water resources in the DRGR area. In addition, it presents the results of this evaluation and provides a qualitative "ranking" of the water resources in the DRGR areas.

The evaluation of the ground water resources in the DRGR area was based on the policy tatement for DRGR designation. It should be ıted that areas designated DRGR should ıvide "substantial recharge" to "aquifers most ıble for future wellfield development". s designated as DRGR do not have to be cterized as "prime recharge areas" as defined by Chapter 373 Florida Statutes (F.S.), ling to a letter from Patricia Walker, SFWMD to William Spikowski, dated August 0.

> The Density Reduction/Ground Water Resource areas include 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.
>
> Policy 1.4.3 of the "Lee Plan", 1992

As identified in Section II.B, the Shallow Aquifer System and the sandstone aquifer of the Intermediate Aquifer System have been identified as the aquifers considered to be the most favorable for the development of future potable wellfields (JMM, 1988) (based on the hydrogeologic characteristics of the aquifer).

1. Evaluation Criteria

Two criteria were utilized in evaluating the ground water resources in the DRGR area: the ability of the area to provide recharge to the aquifers identified as most favorable for the development of future water resources; and, the ability of the aquifers within or adjacent to the DRGR to provide water (through evaluation of the hydrogeologic characteristics of each aquifer). These two criteria also correspond to the definition of DRGR-designated areas under the Lee Plan. After the study began, a third criterion was identified for consideration when evaluating the Surficial Aquifer System. This third criterion was the potential for ground water contamination.

It should be noted that the evaluation of the second criteria, the ability of the aquifers within the DRGR to provide water, was based solely on the hydrogeologic characteristics of the aquifer materials. As noted in Section I, no evaluation was conducted pertaining to the ability of these aquifers to satisfy projected demand, nor were the economics of developing these aquifers expressly considered. This work is currently being performed by the LCRWSA. It is our understanding that preliminary identification of future water supply sites is currently underway by the LCRWSA.

a. **Recharge** - In an area with little topographic relief, such as that found in Lee County, discharge areas from the water table aquifer are apparent in the form of lakes, streams, rivers and the Gulf of Mexico. Essentially all the remaining

portion of the County is considered a recharge area for the water table aquifer. To evaluate whether any particular portion of the DRGR area was better suited for recharging the shallow water table aquifer, the characteristics of the surficial soils within the DRGR, as classified and characterized by the U.S. Department of Agriculture, Soil Conservation Service (SCS), were reviewed (SCS, 1984). The characteristics of importance were soil permeability, soil stratigraphy, and depth to seasonal high ground water level.

In general, all of the soils in the area classified DRGR consisted of deep sandy soils with a seasonally high ground water level within 1 foot of ground surface (generally occurring between June and February of any year). No soils characteristics were identified from the SCS information that indicated any areas of surficial soils within the DRGR that could have significantly greater rates of recharge, such as deeper ground water levels or a greater thickness of more sandy soils. The review of the soils data indicated that, in general, the western portion of the northern DRGR area contains a higher proportion of soils that contained slightly higher percentages of silt and/or clay. It is probable that these soils will have a lower vertical permeability than some of the other soil types. Overall, however, it was concluded that the recharge characteristics of the surficial aquifer throughout the DRGR were essentially the same.

Both the sandstone and the lower Tamiami aquifers are considered to be semi-confined aquifers. The major factors determining recharge to these aquifers are the vertical component of ground water flow, and the "leakance" of the confining beds. If the head of the aquifer system overlying the confined aquifer is greater than the potentiometric surface of the confined aquifer, then the vertical component of ground water flow between the aquifers will be

downward and the overlying aquifer will provide recharge to the underlying aquifer. Conversely, if the vertical flow component is upward, then the lower aquifer is discharging to the upper aquifer.

The report prepared by James M. Montgomery (JMM, 1988) identified recharge areas based on a detailed six step overlay process which included other indicators of recharge such as water quality and confining bed thickness. The results of this work indicate that the entire area in which the lower Tamiami aquifer exists is a recharge area. The confining bed is thin and leakance values are high. In addition, the lower Tamiami aquifer is recharged via horizontal flow along the northern extent of the aquifer where the confining bed pinches out and the lower Tamiami becomes part of the water table aquifer.

The JMM report also indicates that, within the southeastern portion of the County designated DRGR, the potentiometric head in the water table aquifer is greater than that in the sandstone aquifer. Thus, the sandstone aquifer is recharged by the water table aquifer in this area. Furthermore, the central portion of this DRGR area is considered to have increased recharge due to the pumping of existing water supply wellfields. Pumping of water from the sandstone aquifer at the Green Meadows and Lee County Corkscrew wellfields reduces the potentiometric head in the sandstone aquifer further increasing the vertical gradient between the sandstone and water table aquifers, thus increasing the potential for recharge to occur. In general, the leakance values in the northern portion of the southeastern DRGR area are high.

For evaluation of recharge for the sandstone and lower Tamiami aquifers, a leakance value of greater than 10^{-3} gallons per day per cubic foot (gpd/cf) was considered to be high. Leakance values of less than 10^{-5} gpd/cf were considered to be low. Values in between were considered to be moderate.

b. **Water Supply Potential** - Two criteria were utilized to evaluate the water supply potential of the aquifers in the DRGR areas. These criteria are the transmissivity of the aquifer, or its ability to transmit water through the aquifer media, and the water quality of the aquifer. In addition to these two criteria, a third factor, the aquifer thickness, entered into the evaluation of the water table aquifer at the lower values of transmissivity considered in this study.

In general, the quality of the water in all three aquifers is good in the DRGR area located in the southeast portion of the County. Water quality deterioration as a result of saltwater intrusion due to pumping of the existing Bonita Bay and Bonita Springs wellfields has been reported in the past. However, the remaining areas within this DRGR designated areas available for wellfield development have good water quality. Similarly, the portions of the sandstone aquifer that meet the transmissivity criterion have good water quality, as does the water table aquifer.

Less water quality information is available for the area designated DRGR in the northern portion of the County. The data presented in the JMM Report indicates that the water in the water table aquifer is of potable quality. However, chloride concentrations in the sandstone aquifer exceed drinking water standards.

For purposes of the resource evaluation, transmissivities of greater than 100,000 gallons per day per foot (gpd/ft) are considered to be most desirable for the development of future water supplies in the water table aquifer and the lower Tamiami aquifer. Values below 50,000 gpd/ft are considered to be least desirable for development of a major water supply due to increased drawdown effects. In addition, a thickness criteria was identified for the water table aquifer in areas where the transmissivity was less than 100,000 gpd/ft but greater than 50,000 gpd/ft. This criterion was developed to ensure protection of the aquifer from overpumping. This depth criterion was established using the assumptions and procedures contained in Appendix B. Based on this analysis, the water table aquifer must have an aquifer thickness of greater than 25 feet in areas where the transmissivity is greater than 50,000 gpd/ft but less than 100,000 gpd/ft.

The transmissivity criterion for the sandstone aquifer was set at somewhat lower values due to the fact that wells established in this aquifer can accommodate much greater drawdowns in the potentiometric head than can the shallow surficial aquifer with respect to pump settings. In addition, only very small areas of the sandstone aquifer have a transmissivity of greater than 100,000 gpd/ft. For the sandstone aquifer, a transmissivity of greater than 50,000 gpd/ft was chosen to be most desirable for development of a wellfield. A transmissivity of less than 20,000 gpd/ft was considered to be undesirable. The lower limit of transmissivity was selected based on the lowest transmissivity found in any of the wellfields currently withdrawing water from this aquifer.

c. **Contamination Potential** - The ground water contamination potential for the Surficial Aquifer System was evaluated using DRASTIC indices. DRASTIC is a methodology developed by the National Water Well Association for the U. S. Environmental Protection Agency in order to systematically evaluate the

ground water pollution potential throughout the country. Seven factors that affect the ground water pollution potential are utilized to delineate areas of common pollution potential into "DRASTIC polygons". These factors are:

Depth to water
net Recharge
Aquifer media
Soil media
Topography or ground surface slope
Impact of the vadose (unsaturated) zone
hydraulic Conductivity of the aquifer.

The parameters are rated and mathematically combined to produce a relative index (the DRASTIC index). The higher the DRASTIC index, the more susceptible an area is to ground water contamination. It should be noted that the DRASTIC index value is useful for comparing the relative contamination potential from one area to another, but it is not designed to determine whether or not ground water pollution *will* occur.

The SFWMD has developed DRASTIC indices for the Surficial Aquifer and the Floridan Aquifer Systems within the SFWMD including Lee County (SFWMD, 1990). This mapping was performed using existing published information whenever possible.

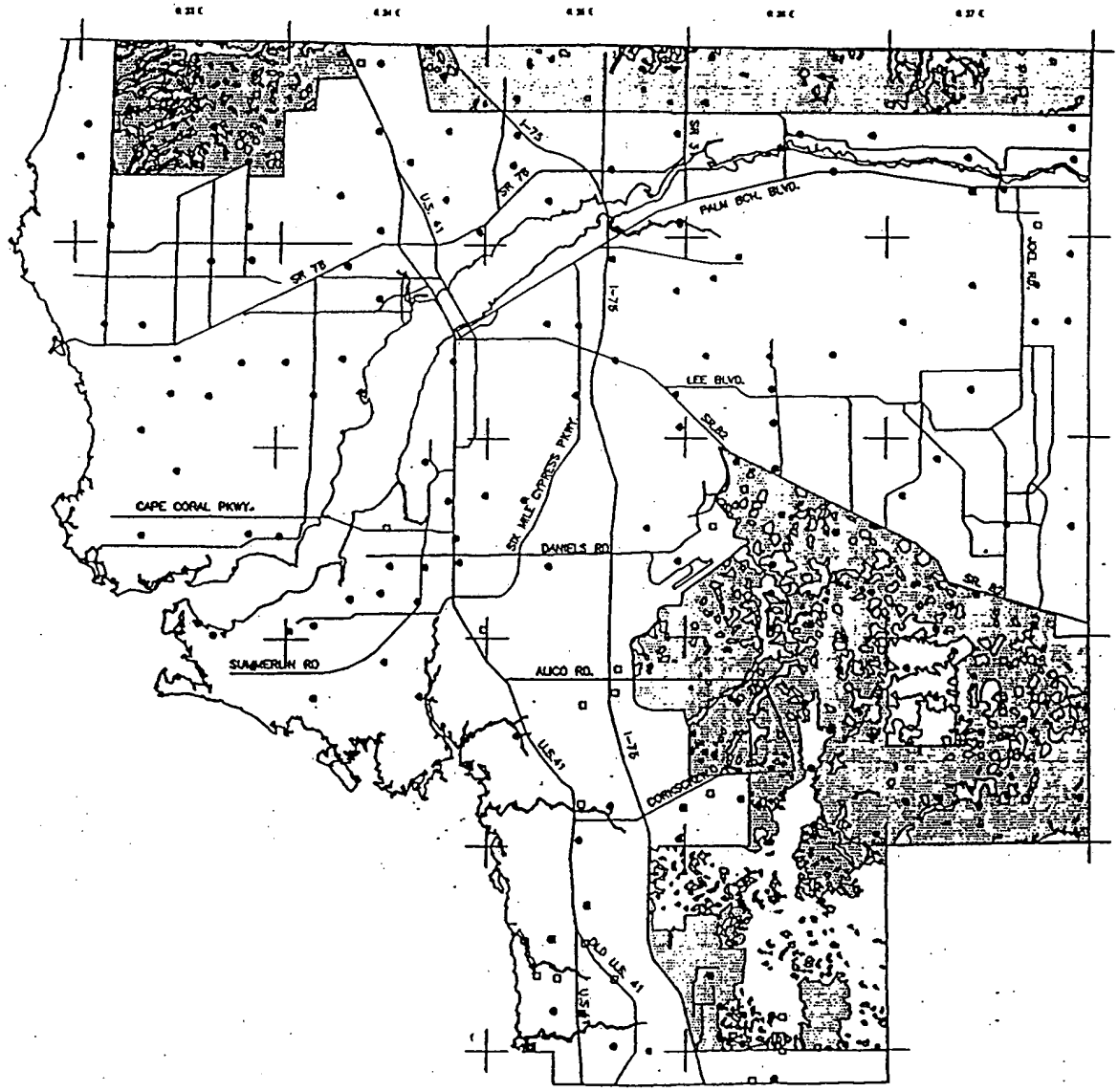
2. Results

Using the criteria discussed above, maps have been prepared for the area designated DRGR showing the evaluation criteria for the selected aquifers. As noted in Section II.C.1.a., recharge to the water table aquifer within the areas designated DRGR is essentially the same and no delineation of zones of differing recharge potential were

identified. Also, as noted in Section II.A., the current work being performed by the LCRWSA was relied upon heavily to delineate areas according to the evaluation criteria because this work represents the most recent and thorough compilation of hydrogeologic data for the County. It should be realized that the delineation of the various contour lines presented on the maps developed for this study are based on point locations where the specific data has been measured. Thus, more certainty can be assigned to areas where a higher number of data points exist.

Plates II-3, II-4, and II-5 identify the data points for the water table aquifer, the lower Tamiami aquifer and the Sandstone aquifer, respectively, that have been used by the LCRWSA in developing their model for use in their Master Plan development (LCRWSA, 1993). These and many other data points have been thoroughly reviewed for accuracy. Only those that could be validated by the LCRWSA were chosen for use in characterizing the County's hydrogeologic conditions.

In general, the data points used to identify characteristics for all three aquifers have a good areal distribution within and adjacent to the DRGR area in the southeastern portion of the County. However, few data points exist for the water table and Sandstone aquifers in the northernmost portion of the County. As a result, a lower level of confidence can be assigned to the interpolation of values between the known data points. This lower level of confidence does not invalidate the results of this study, rather, reviewers of the maps presented herein should recognize that the lines delineating the various evaluation criteria may change when additional data becomes available.



LEGEND

- WELL LOCATION – AQUIFER THICKNESS DATA POINT
- WELL LOCATION – AQUIFER TRANSMISSIVITY DATA POINT
- WELL LOCATION – AQUIFER THICKNESS AND TRANSMISSIVITY DATA POINT

STUDY AREA

N

SCALE

0 5 MILES

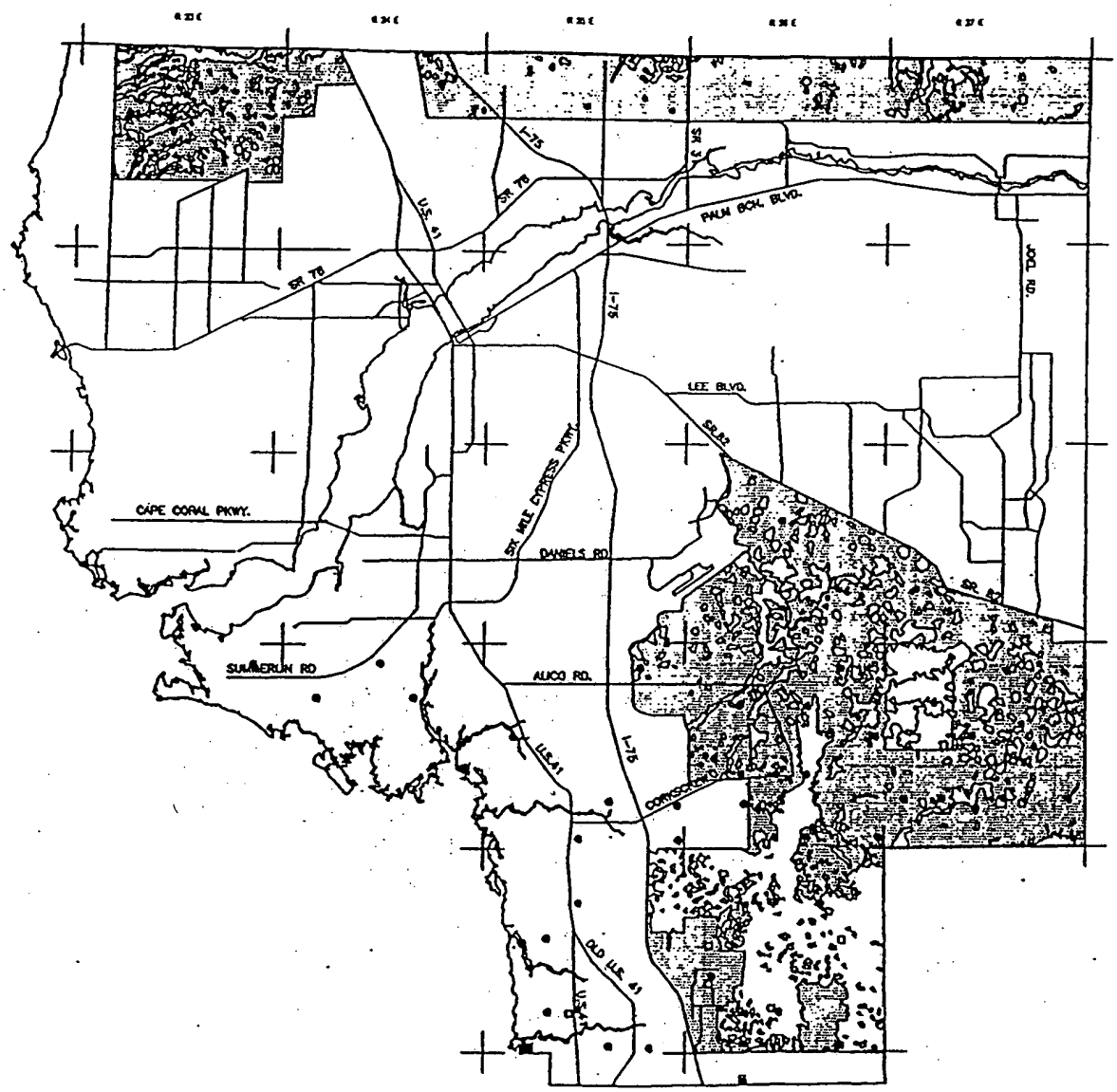
SOURCE: LCRWSA, 1993

Henigar & Ray, INC.
Atlanta Testing & Engineering

WATER TABLE AQUIFER DATA POINTS

Lee County – Groundwater Resource Protection Study

PLATE NO. II-3



LEGEND

- • WELL LOCATION – AQUIFER THICKNESS DATA POINT
- ▫ WELL LOCATION – AQUIFER TRANSMISSIVITY DATA POINT
- ▪ WELL LOCATION – AQUIFER THICKNESS AND TRANSMISSIVITY DATA POINT

STUDY AREA

N

SCALE

0 5 MILES

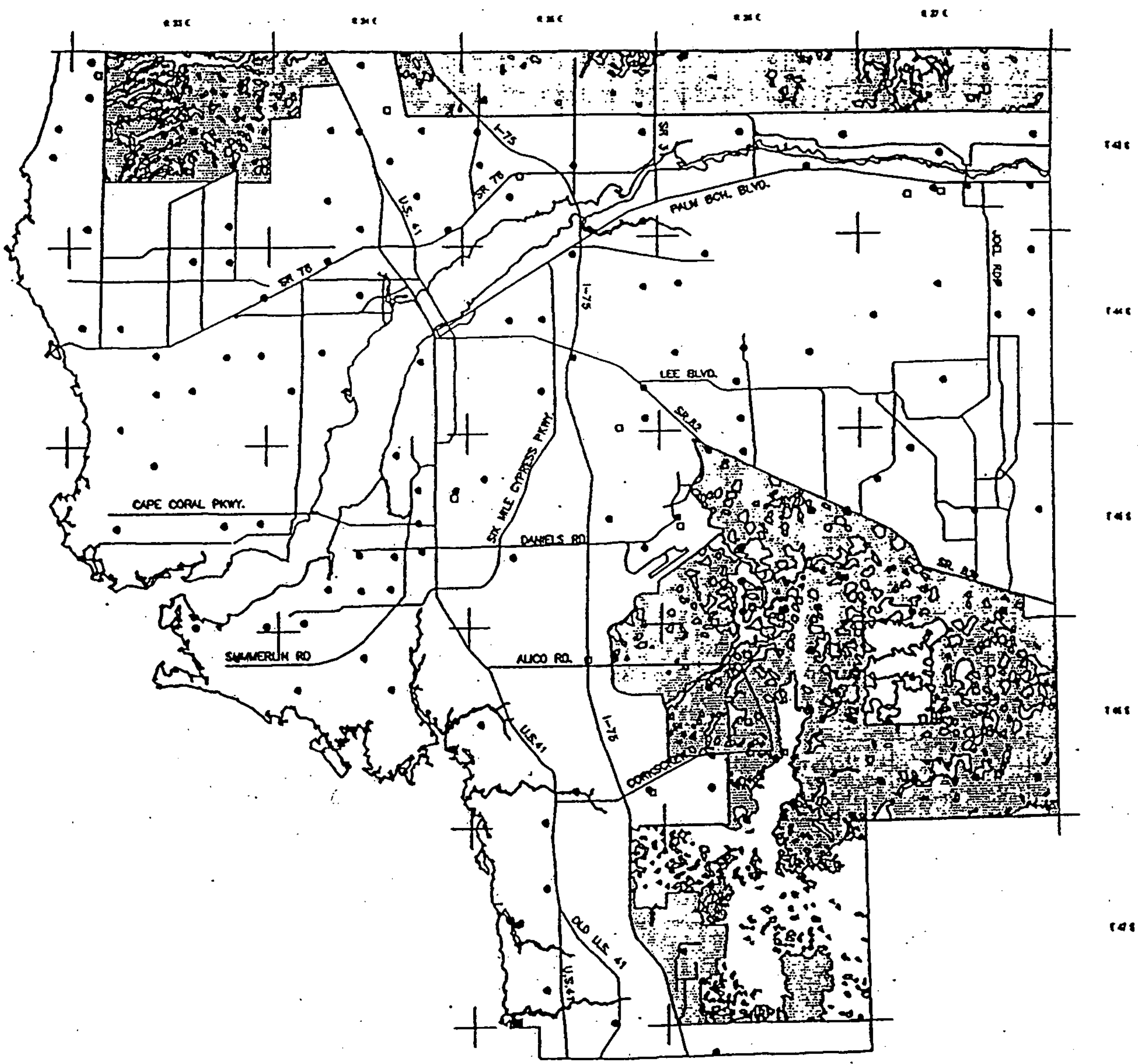
SOURCE: LCRWSA, 1993

Henigar & Ray, INC.
Atlanta Testing & Engineering

LOWER TAMIAMI AQUIFER DATA POINTS

Lee County – Groundwater Resource Protection Study

PLATE NO. II-4



LEGEND

- • WELL LOCATION – AQUIFER THICKNESS DATA POINT
- ▫ WELL LOCATION – AQUIFER TRANSMISSIVITY DATA POINT
- ▪ WELL LOCATION – AQUIFER THICKNESS AND TRANSMISSIVITY DATA POINT
- ▒ STUDY AREA

N

SCALE
0 5 MILES

SOURCE: LCRWSA, 1993

Henigar & Ray, INC.

Atlanta Testing & Engineering

SANDSTONE AQUIFER DATA POINTS

Lee County – Groundwater Resource Protection Study

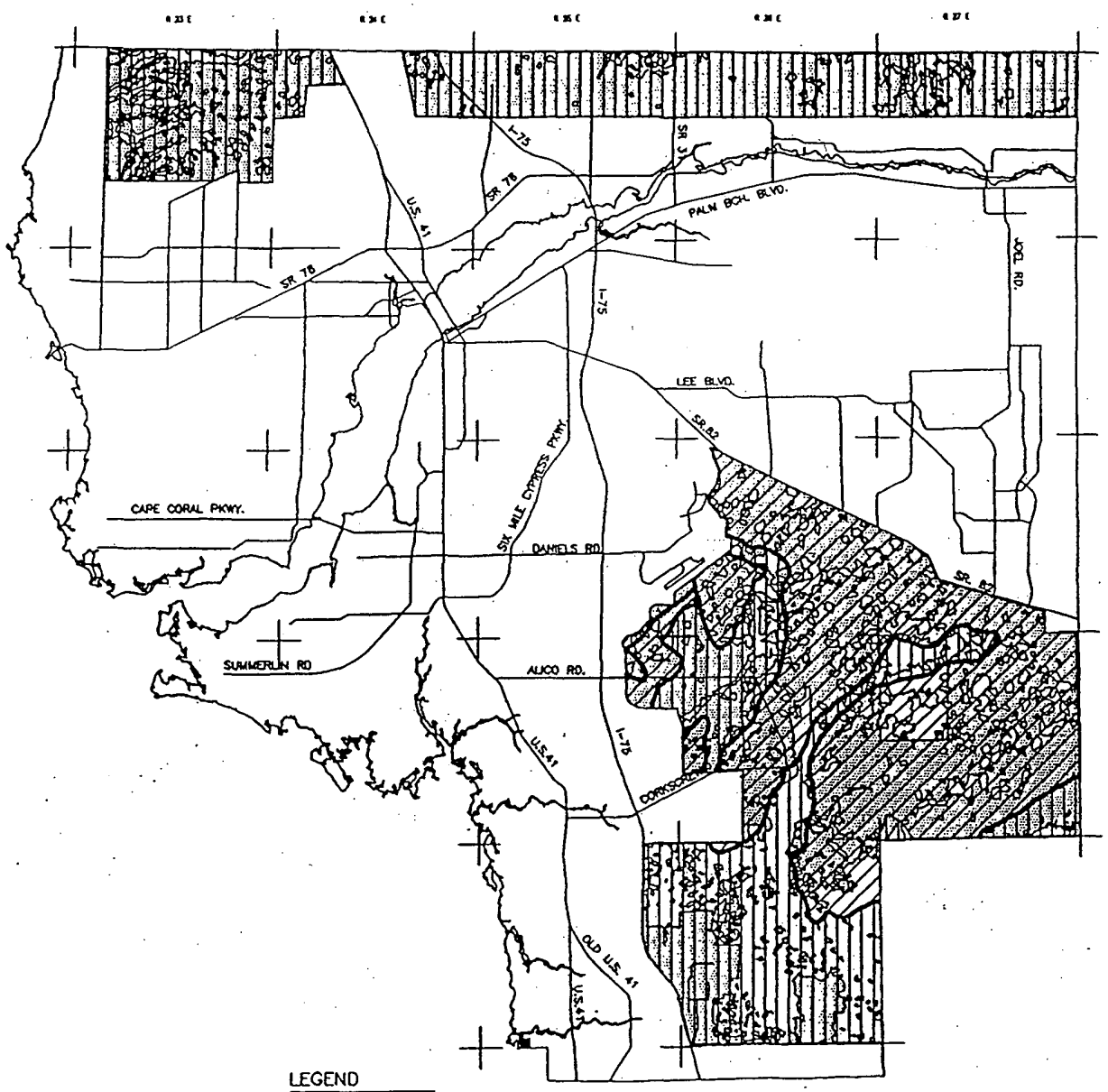
PLATE NO. II-5

The maps that have been developed to present the results of the aquifer evaluation criteria are as follows:

- ≈ Plate II-6 Water Table Aquifer DRASTIC Contamination Potential
- ≈ Plate II-7 Transmissivity of Water Table Aquifer
- ≈ Plate II-8 Transmissivity of Lower Tamiami Aquifer
- ≈ Plate II-9 Recharge Area for Lower Tamiami Aquifer
- ≈ Plate II-10 Transmissivity of Sandstone Aquifer
- ≈ Plate II-11 Recharge Areas for Sandstone Aquifer

Each of the areas identified on these plates was assigned a numerical ranking depending on the range in which each aquifer parameter fell with respect to the criterion established above. A breakdown of the ranking values is presented in Table II-1. All of the maps were then overlaid on one another and the numerical rankings were summed for each numerically-different area within the DRGR designated areas. (In developing the ranking values, it was assumed that the water quality in the Sandstone aquifer was potable due to the lack of data currently available.)

An inspection of the final rankings revealed that areas of the DRGR where geologic features attributed to all three aquifers were present had the highest numerical rankings (Plate II-12). In areas where features of two of the aquifer systems exist, the maximum ranking value that could be achieved would be twelve (resulting from a ranking value of three for each of the two factors for each of the two aquifers). A minimum ranking value would be eight or above (resulting from a ranking value of two for each of the two factors for each of the two aquifers). However, the DRGR areas in the southeastern portion of the County that were ranked less than eight were within the area that had transmissivity values in the water table aquifer well within the criterion selected to be desirable for future water supply development. Since the water table aquifer has been identified as a major source to meet future water supply needs, an alternative ranking process was considered.



LEGEND

- 200–226 (DRASTIC INDEX RANGE)
- 180–199 (DRASTIC INDEX RANGE)
- 160–179 (DRASTIC INDEX RANGE)
- 140–159 (DRASTIC INDEX RANGE)
- 120–139 (DRASTIC INDEX RANGE)
- STUDY AREA

N

SCALE 0 5 MILES

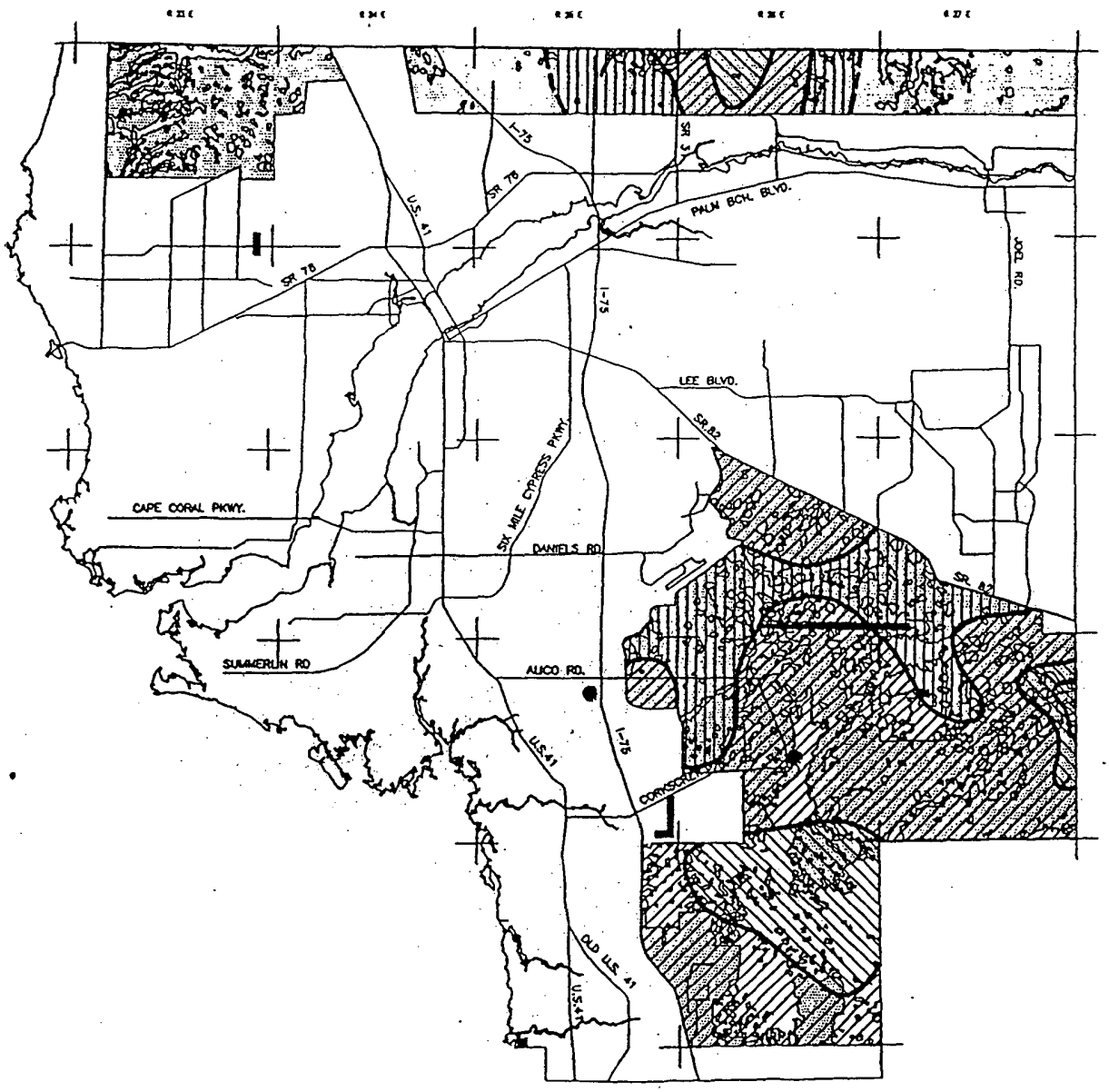
SOURCE: LCRWSA, 1993

Henigar & Ray, INC.
Atlanta Testing & Engineering

WATER TABLE AQUIFER
DRASTIC CONTAMINATION POTENTIAL

Lee County – Groundwater Resource Protection Study

PLATE NO. II-6



LEGEND

100000 — TRANSMISSIVITY (gpd/ft) CONTOUR

TRANSMISSIVITY GREATER THAN 50000 (gpd/ft) AND AQUIFER THICKNESS GREATER THAN 25 FEET

TRANSMISSIVITY GREATER THAN 100000 (gpd/ft)

TRANSMISSIVITY GREATER THAN 500000 (gpd/ft)

EXISTING PUBLIC WATER SUPPLY WELLFIELDS WITHDRAWING FROM WATER TABLE AQUIFER

STUDY AREA

N

SCALE

0 5 MILES

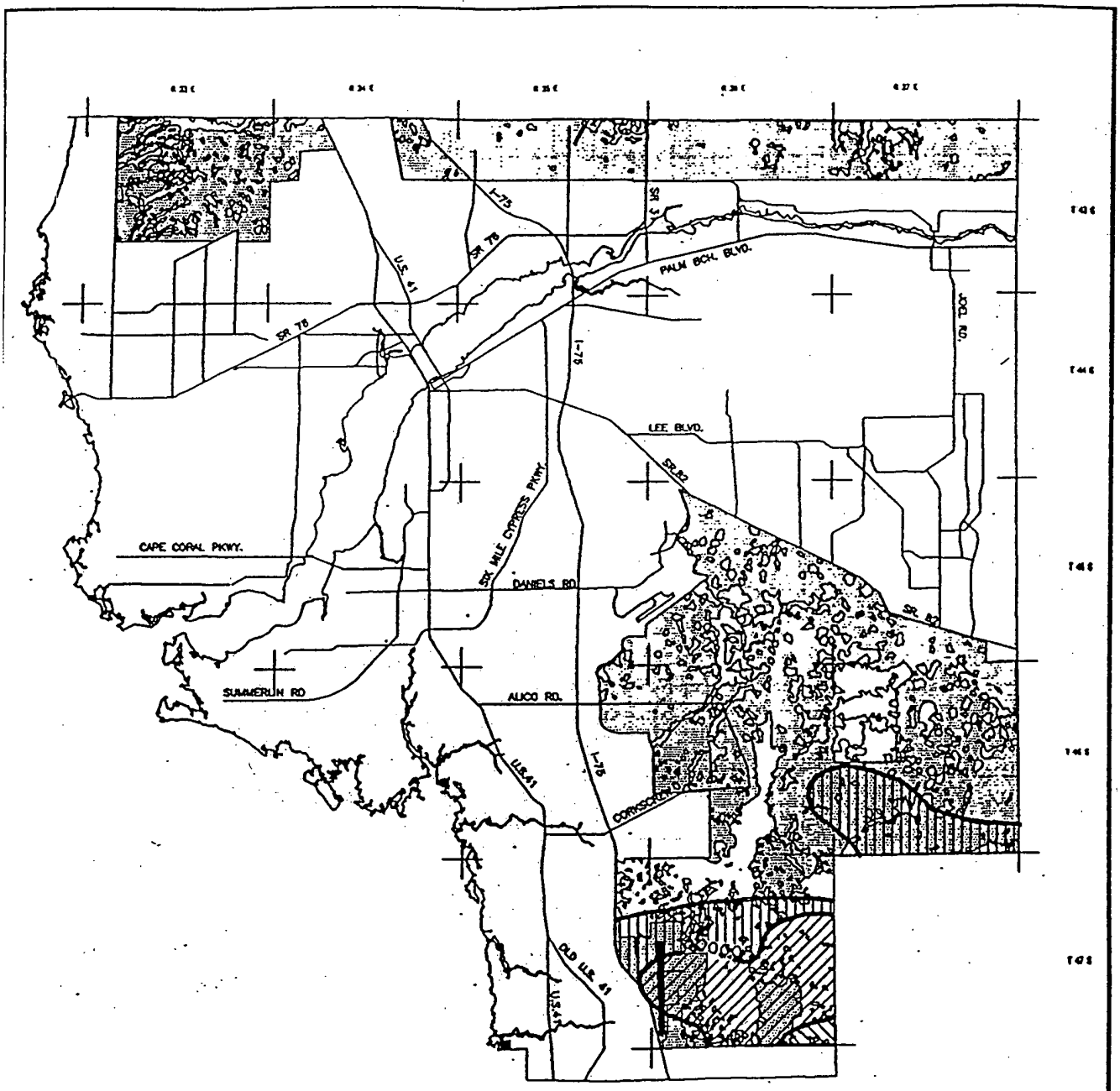
SOURCE: LCRWSA, 1993

Henigar & Ray, INC.
Atlanta Testing & Engineering

TRANSMISSIVITY OF WATER TABLE AQUIFER

Lee County – Groundwater Resource Protection Study

PLATE NO. II-7



LEGEND

100000 — TRANSMISSIVITY (gpd/ft) CONTOUR

TRANSMISSIVITY GREATER THAN 50000 (gpd/ft)

TRANSMISSIVITY GREATER THAN 100000 (gpd/ft)

TRANSMISSIVITY GREATER THAN 500000 (gpd/ft)

EXISTING PUBLIC WATER SUPPLY WELLFIELDS WITHDRAWING FROM LOWER TAMIAMI AQUIFER

STUDY AREA

N

SCALE

0 5 MILES

SOURCE: LCRWSA, 1993

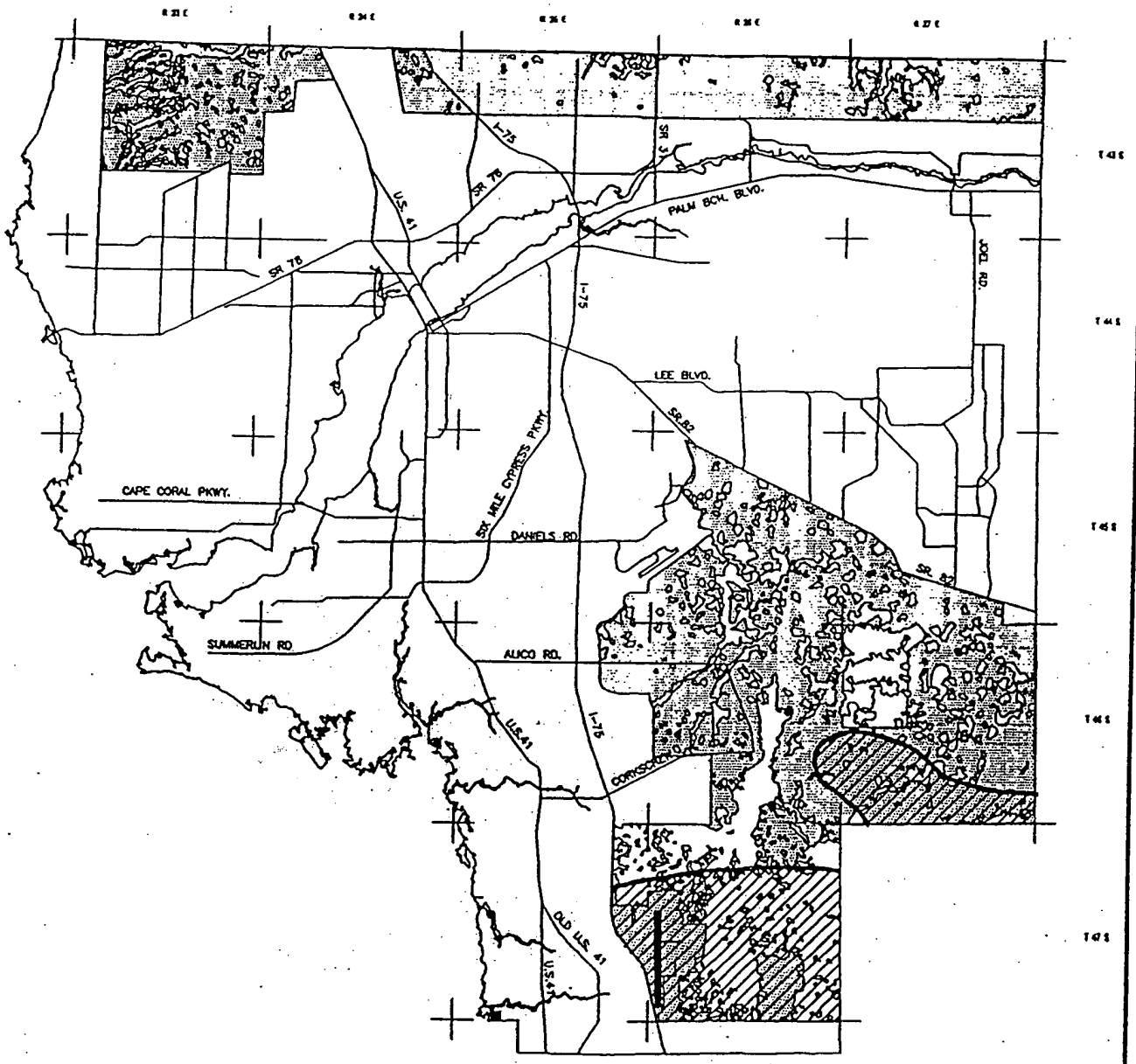
Henigar & Ray, INC.
Atlanta Testing & Engineering

TRANSMISSIVITY OF LOWER TAMIAMI AQUIFER

Lee County – Groundwater Resource Protection Study

PLATE NO. II-8

FLU EAR Exhibit H Page 26 of 95



LEGEND

AREA OF RECHARGE

EXISTING PUBLIC WATER SUPPLY WELLFIELDS WITHDRAWING FROM LOWER TAMIAMI AQUIFER

STUDY AREA

N

SCALE

0 5 MILES

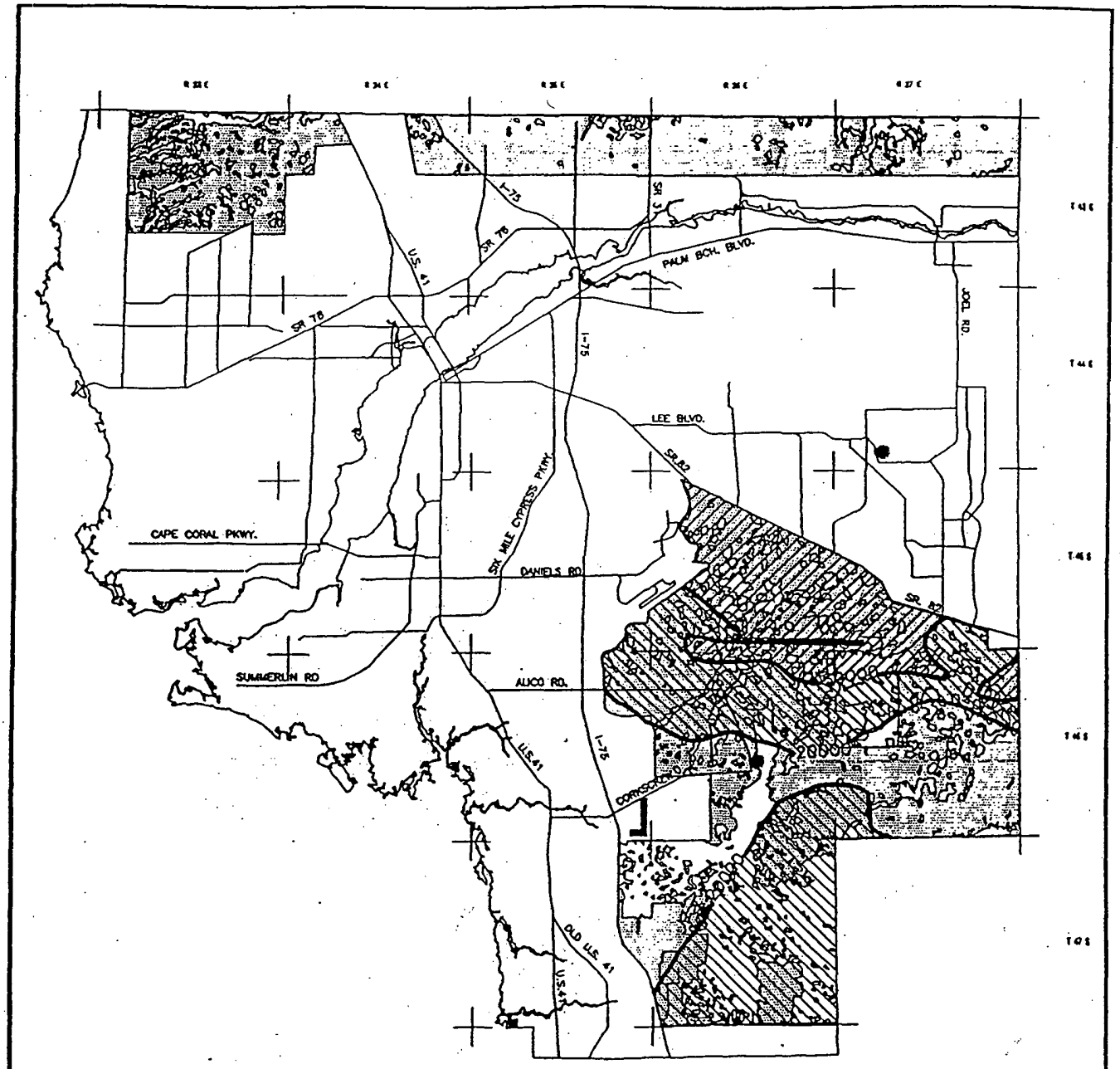
SOURCE: LCRWSA, 1993

Henigar & Ray, INC.
Atlanta Testing & Engineering

RECHARGE AREAS FOR LOWER TAMIAMI AQUIFER

Lee County – Groundwater Resource Protection Study

PLATE NO. II-9



LEGEND

50000 — TRANSMISSIVITY (gpd/ft) CONTOUR

TRANSMISSIVITY GREATER THAN 20000 (gpd/ft)

TRANSMISSIVITY GREATER THAN 50000 (gpd/ft)

EXISTING PUBLIC WATER SUPPLY WELLFIELDS WITHDRAWING FROM SANDSTONE AQUIFER

STUDY AREA

N

SCALE

0 5 MILES

SOURCE: LCRWSA, 1993

Henigar & Ray, INC.

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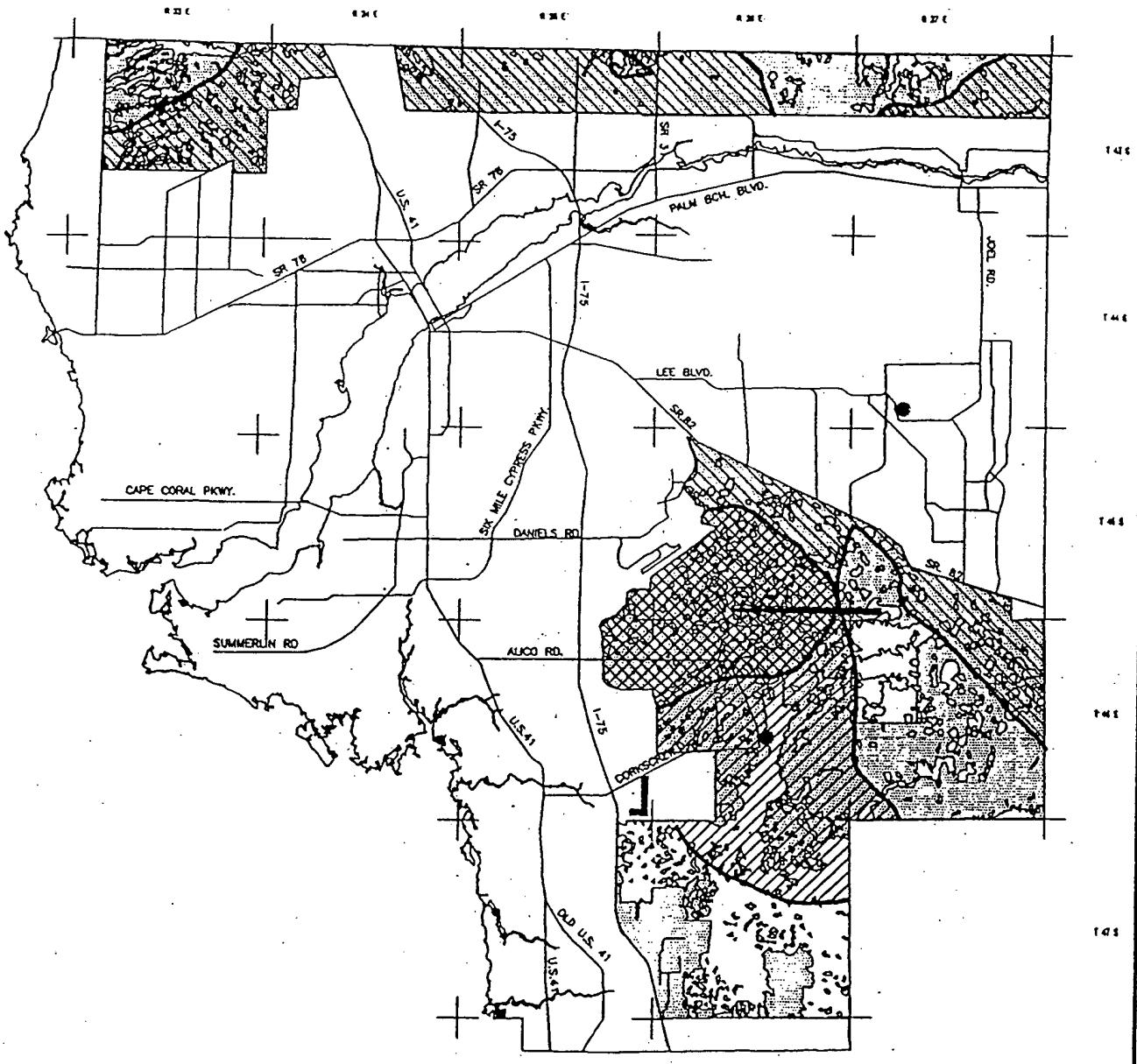
TRANSMISSIVITY OF SANDSTONE AQUIFER

Lee County – Groundwater Resource Protection Study

PLATE NO. 11-10

FLU EAR Exhibit H Page 28 of 95



LEGEND

AREA OF INCREASED RECHARGE DUE TO PUMPING (JMM, 1988)

LEAKANCE GREATER THAN 10^{-3} gpd/ft^3

EXISTING PUBLIC WATER SUPPLY WELLFIELDS WITHDRAWING FROM SANDSTONE AQUIFER

STUDY AREA

N

SCALE

0 5 MILES

SOURCE: JAMES M. MONTGOMERY, 1992

Henigar & Ray, INC.
Atlanta Testing & Engineering

RECHARGE AREAS FOR SANDSTONE AQUIFER

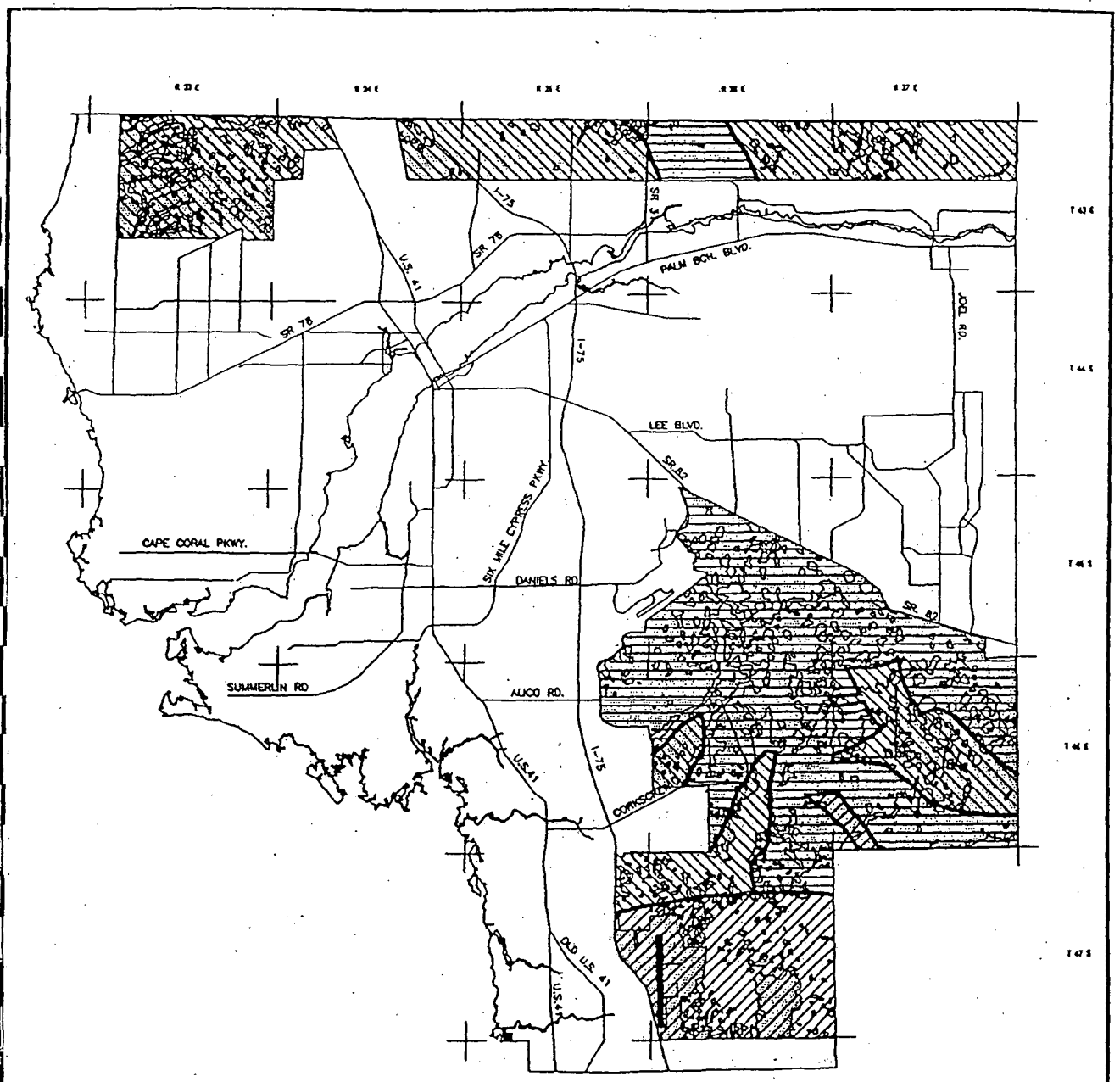
Lee County – Groundwater Resource Protection Study

PLATE NO. II-11

TABLE II-1
RANKING VALUES
HYDROGEOLOGIC CHARACTERISTICS
DRGR AREA

Aquifer	Factor	Rank
Water Table	Transmissivity (T)	
	T > 100,000	3
	50,000 gpd/ft < T < 100,000 gpd/ft	2
	T < 50,000 gpd/ft and Aquifer Thickness > 25 ft.	1
	Recharge	-[1]
	Contamination Potential	
	DRASTIC Index > 200	3
	180 < DRASTIC Index < 200	2
Lower Tamiami	Transmissivity (T)	
	T > 100,000 gpd/ft.	3
	50,000 gpd < T < 100,000 gpd/ft.	2
	T < 50,000 gpd/ft.	1
	Recharge	3[2]
Sandstone	Transmissivity (T)	
	T > 50,000 gpd/ft.	3
	20,000 gpd/ft. < T < 50,000 gpd/ft.	2
	T < 20,000	1
	Recharge	
	Leakance > 10^{-2} gpd/ft^3	3
	Area of increased recharge due to pumping	2
	Remaining Area	1

[1]No zonation for recharge was identified - entire DRGR area assumed to have same characteristic
[2]All of recharge area shown on Plate II has equal importance/meets minimum criteria for high recharge value



LEGEND

- NUMERICAL RANKING OF 8 OR LESS
- NUMERICAL RANKING OF 9 TO 12
- NUMERICAL RANKING OF GREATER THAN 12
- STUDY AREA

N

SCALE

0 5 MILES

Henigar & Ray, INC.
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NUMERICAL EVALUATION OF DRGR

Lee County – Groundwater Resource Protection Study

PLATE NO. II-12

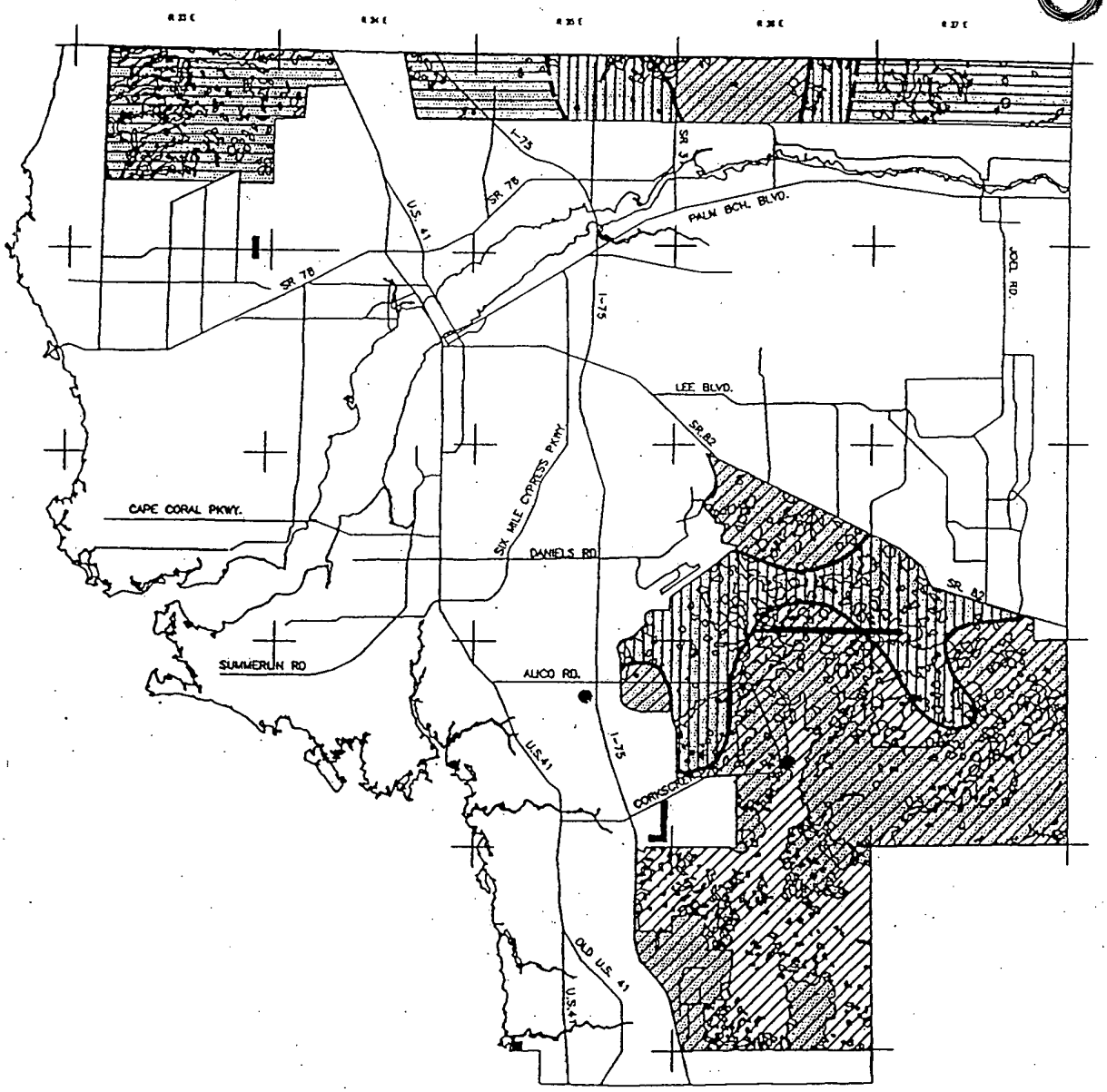
The alternative ranking criteria was based on a more qualitative ranking of the areas within the DRGR. This ranking was based on the following factors:

≈ The water table aquifer is capable of supplying sufficient quantities of fresh water to satisfy public water supply needs. Several major wellfields within or adjacent to the area designated DRGR currently withdraw water from this aquifer (Plate II-1). Furthermore, the water table aquifer has been targeted to provide some portion of the future water supply needs of the County (JMM, 1988, Engineering-Science, 1991, LCRWSA, 1993a).

≈ The ground water contamination potential for the water table aquifer is considered to be high within the DRGR area (Plate II-6). This high ranking results from the shallow depth to ground water, aquifer and soil media that do not attenuate contaminants readily (sandy soils), a flat topography, and high hydraulic conductivity (SFWMD, 1990).

Using these considerations, areas of the DRGR which were most desirable for development of the water table aquifer as a water supply were considered to have the highest ranking and thus deserving of the highest protection from a land use standpoint. This area was considered to be the area with transmissitives greater than 100,000 gpd/ft. and is shown on Plate II-13. This area also includes all of the recharge area for the lower Tamiami aquifer, the area of the lower Tamiami aquifer considered to be best suited for water supply development, much of the recharge area identified for the sandstone aquifer and portions of the sandstone aquifer considered most desirable for wellfield development.

For the purpose of this evaluation, the qualitative ranking was selected. If desired, the County could select a more conservative approach to the development scenarios contained in Section V using the numerical ranking. However, the qualitative ranking is believed to be appropriate based on the factors identified above.



LEGEND

AREA A – AREA DESERVING HIGHEST PROTECTION STANDARDS (WATER TABLE "T" GREATER THAN 100,000 gpd/ft)

AREA B – AREA CONSIDERED FOR INCREASED DEVELOPEMENT WITH STRINGENT BEST ENVIRONMENTAL MANAGEMENT PRACTICES

AREA C – AREA CONSIDERED TO HAVE LEAST POTENTIAL FOR WATER SUPPLY DEVELOPEMENT AND BEST POTENTIAL FOR INCREASED DEVELOPEMENT

EXISTING PUBLIC WATER SUPPLY WELLFIELDS WITHDRAWING FROM WATER TABLE AQUIFER

N

SCALE

0 5 MILES

Henigar & Ray, INC.
Atlanta Testing & Engineering

QUALITATIVE RANKING OF DRGR

Lee County – Groundwater Resource Protection Study

PLATE NO. II-13

3. Comments

The evaluation of the suitability of the three aquifers to serve as future water supply sources was based solely on the hydrogeologic characteristics of these aquifers. In actuality, numerous factors, both regulatory and economic, must be considered when selecting and evaluating future well field sites. The two major factors are:

≈ Can a Water Use Permit be obtained from the South Florida Water Management District to withdraw the desired volume of water?

≈ Is the development of the proposed water supply source the most economical source of supply?

In evaluating an application for a Water Use Permit, the SFWMD considers a large number of criteria including:

≈ The impact of drawdowns on wetlands

≈ The impact of drawdowns on existing legal uses of ground water

≈ The potential for water quality degradation due to sea water intrusion or saline water upcoming.

≈ The impact of drawdowns on other aquifers.

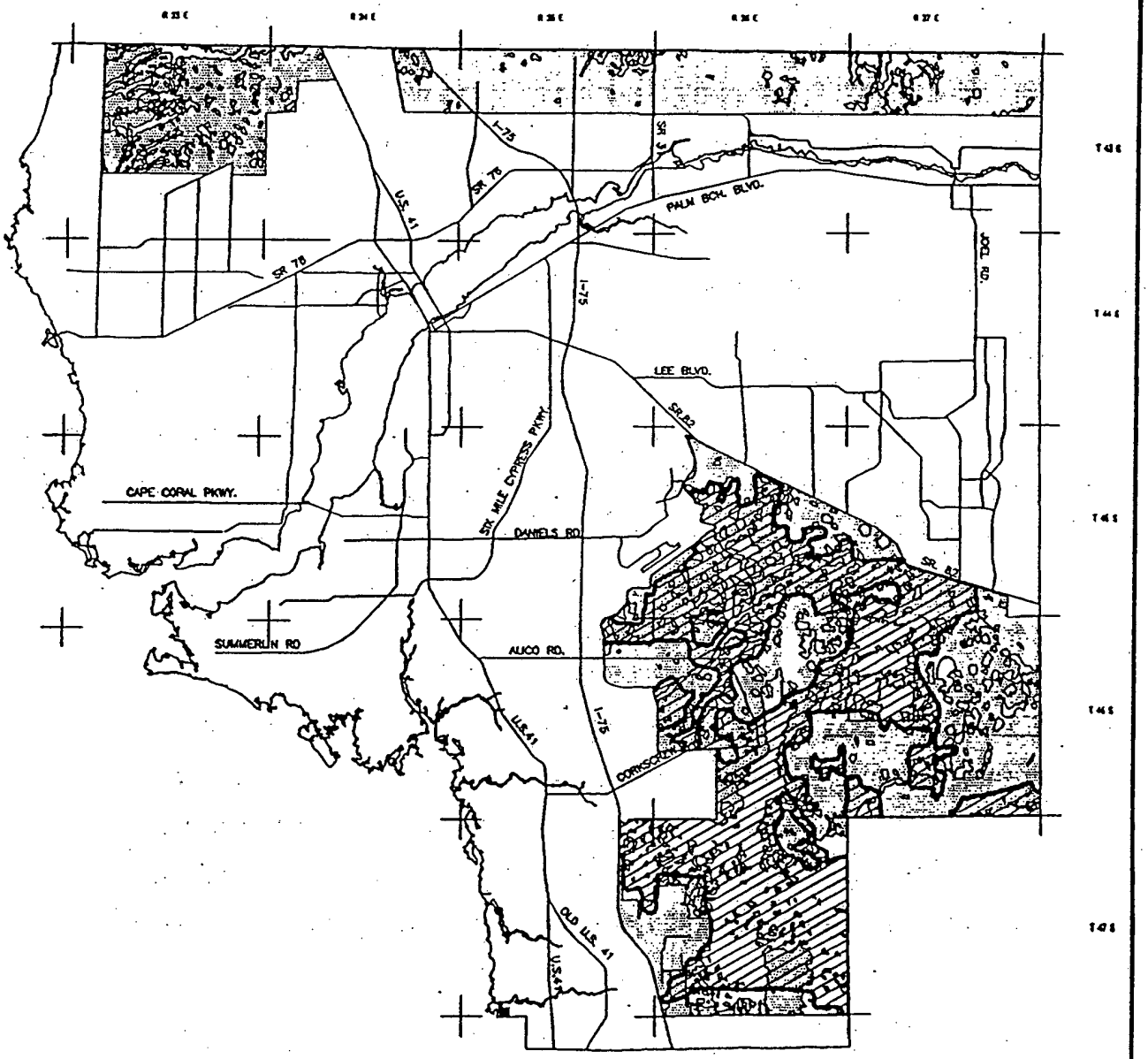
Evaluation of these criteria require the use of site-specific data for the area under consideration, such as distance from wetlands and existing users, pumping rates and schedules, aquifer characteristics and other factors, and is beyond the scope of this

study. However, it has been noted that wetland impacts will most likely be of foremost concern in the development of the water table aquifer as a water supply source because much of the interior of Lee County where good potential wellfield locations are found contain areas of wetlands (JMM, 1988).

The importance of minimizing impacts to wetland areas is exemplified by the future designation of areas of Outstanding Natural Systems (ONS) by the SFWMD. The protection of areas to be designated ONS from impacts caused by development within or adjacent to ONS areas will be given a high priority by the SFWMD. The process of designating ONS areas is currently underway. Although final ONS areas have not been approved by the SFWMD, the area proposed for ONS designation is shown on Plate II-14 and encompasses much of the area designated DRGR in the southeastern portion of Lee County. (The final proposed area to be designated ONS north of the Caloosahatchee River was not available in time for inclusion in this report.) Recent conversations with SFWMD staff indicate that the District may initiate rulemaking on this concept within the next 2 years (see Appendix E).

III. PROTECTION ISSUES

Review of the available studies and reports (see Appendix A) indicates that the water table, the lower Tamiami and the sandstone aquifers have the highest potential for developing potable water wellfields to meet the future water supply needs of Lee County. For this



LEGEND

STUDY AREA

OUTSTANDING NATURAL SYSTEMS

N

SCALE

0 5 MILES

SOURCE: LCRWSA, 1993

Henigar & Ray, INC.

Atlanta Testing & Engineering

PRELIMINARY DESIGNATION OUTSTANDING NATURAL SYSTEMS

Lee County – Groundwater Resource Protection Study

PLATE NO. II-14

reason it has been assumed, for the purpose of this study, that areas designated as Density Reduction/Ground water Recharge (DRGR) on the Lee County Future Land Use Map have been targeted as areas in Lee County requiring the most significant amount of ground water aquifer recharge protection.

One way to protect the ground water resource is to reduce, to the greatest extent possible, the development opportunity in the DRGR. This is the option presently in place by policy of the Lee Plan. Protection of ground water resources has three principal aspects of concern: those associated with the availability of recharge to the aquifer; those associated with drawdown due to excessive pumping; and, those that could degrade the quality of the ground water. The theory behind reduced development opportunity, as implied in the DRGR designation; is that all three concerns are appropriately and effectively addressed. However, as discussed below under the agricultural and mining uses, this is not necessarily the case.

A. Availability of Water to Recharge the Aquifer

In Lee County, the quantity of water available for replenishment of the water table aquifer depends on the relative amounts of rainfall, runoff and evapotranspiration. Without proper management systems the increase in impervious surface which accompanies urbanization may reduce the amount of water infiltrating into the ground and increase runoff. When the runoff from urbanized areas is collected and disposed of by poorly designed stormwater systems, or increases discharges to natural streams, the amount of water available for ground water recharge is reduced. In Florida, the reduction in recharge is offset to some degree by current development regulations that require the collection and storage of stormwater runoff in detention basins, grassed swales and other management methods. The impact of this reduction in recharge is difficult to quantify; therefore, any strategy that increases impervious surface needs to be cautiously approached.

The amount of surface area that can be paved in ground water recharge areas without reducing the net recharge to the ground water is a function of many variables. These variables include rainfall, depth to water table, depth to potentiometric surface of the aquifer, evaporation from paved areas, evapotranspiration from unpaved areas, runoff, the paving pattern, and leakage through confining beds (Tibbals, C.H., 1978). Tibbals in his 1978 study developed a model relating increased development to reductions in ground water recharge.

> "sufficient water is available to increase the net recharge rate if: 1) the rejected water from the paved area is uniformly placed in the non-artesian aquifer; 2) the water table rises and is maintained no higher than within two feet of land surface; 3) the estimates of rainfall runoff, evapotranspiration, depth to potentiometric surface of the artesian aquifer and depth to water table are as estimated (in Tibbal's Model); and 4) no net increase in runoff rate occurs after paving."
>
> Tibbals C.H.

The report states that "although the geohydrologic settings used in the calculations for the examples are somewhat typical of those in the four types of recharge areas, the results of the conceptual model applied in the examples cannot be used in a 'broadbrush' fashion to generalize or categorize the fractional amount of paving that can occur in a given type of recharge area".

The conclusion one can draw from this study and other sources (see also Missimer, 1991) is that runoff from impervious surfaces can be captured in a stormwater management system and introduced into the ground water aquifer at much the same rate or at a rate greater than would occur on the site in its natural vegetative state. This means that great care in analysis and design should be taken for stormwater management systems to ensure that not only is the quality of the water appropriately preserved but also that the quantity of the water returning to the ground water supply is maintained.

B. Drawdown

Drawdown rates can facilitate the downward and horizontal movement of nutrients, chemicals and other pollutants impacting water quality in the ground water. Water losses

from excessive pumping will eventually upset the water balance and begin to locally (and perhaps regionally in the case of large areas of cumulative impact) deplete the storage capacity of the aquifer. It is, therefore, important to maintain water balance and storage in the aquifer.

In Lee County, the responsibility for authorizing the consumptive uses of water lies with the South Florida Water Management District (SFWMD). The Water Use Permit (WUP) process requires the user to provide justification for increases in pumping rates and should include water balance analysis, evaluation of impacts on surrounding water users, establishing the reasonable and beneficial use of the withdrawal and mitigation of potential environmental impacts.

C. Quality of Ground water

Ground water, particularly unconfined ground water, is susceptible to contamination from a variety of development activities including improper disposal of wastes, accidental or undiscovered spills, leaks or other discharges, and improperly constructed or poorly designed stormwater management systems. Once ground water is contaminated, a considerable amount of time and expense will be required to return it to its original condition. Ground water is subject to contamination from stormwater runoff since treatment or percolation through soils may not remove all the pollutants. Studies have determined that ground water, in some areas, is being contaminated by pollutants, such as pesticides and fertilizers, that appear to be infiltrating through the surface soil. These studies are inconclusive as to the source and pathways of the pollutants but that does not lessen the need to be aware of the issue.

Some jurisdictions have instituted requirements that increase the stormwater retention quantity to insure an equal or greater amount of post development recharge percolation into the ground water. Examples of increased stormwater retention requirements are the Wekiva

River Basin standards in Seminole and Lake Counties and the Florida Department of Environmental Protection's (formally FDER) Outstanding Florida Waters standards. The downside of such a strategy is that the increased runoff of contaminants associated with development (pesticides from lawns, oils and metals from impervious surfaces) will be concentrated in greater amounts in a retention facility, one purpose of which is to recharge the ground water. Depending on soil types and depth to water table, these contaminants could find their way into the ground water unless appropriate surface level filtering, pre-treatment and facility maintenance are required. Any regulations promulgated to increase retention areas for the purpose of increasing ground water recharge should prescribe best environmental management practices (BEMP) that maintain vegetative and porous land cover and include on-site storage systems. The use of grassed swales, vegetative buffers and infiltration basins not only promotes recharge, but also attenuates and filters runoff.

Furthermore, increased residential development may often be accompanied by commercial development that can result in additional potential pollution sources. These additional potential pollution sources include fuel storage tanks and dispensing facilities at retail sales facilities, use of solvents in cleaning, small manufacturing and dry-cleaning facilities and the use and transport of wastes, raw materials and products that when discharged (spilled, leaked, dripped), become a source of pollutants.

D. Agricultural Uses

For the purpose of this analysis, agricultural activities in the DRGR land use category are considered appropriate based on previous land use decisions for the DRGR category. However, for purposes of comparison and understanding of the existing potential for adverse ground water impacts due to agricultural uses of the land, the following discussion is deemed appropriate and necessary by the authors of this analysis.

Agricultural land uses are generally considered to be low intensity, passive and benign as

to impacts on ground water. In fact, the Lee Plan permits unlimited agricultural uses in the DRGR land use category. However, if improperly managed, agricultural activities, including livestock and plant crop activities, have the potential to adversely impact the quality and quantity of ground water.

Nutrients in runoff from agricultural areas (considered non-point sources of pollution) have been linked to the presence of nitrates in drinking water. Nitrates ingested through drinking water have been suggested as a cause of methemoglobinemia or " blue baby syndrome". Chemicals such as ethylene dibromide (EDB), a carcinogenic pesticide used on crops and citrus groves, have reportedly contaminated over 1300 water supply wells in Florida (DeHan, R.S., 1990). Nitrates, allegedly from over fertilization, especially in citrus producing regions, have been documented in the water supplies of various counties being monitored by the Department of Agriculture and DER (Florida Environments, [a Newsjournal] April, 1993).

Irrigation of crops is by far the largest consumptive use of ground water in Florida, withdrawing approximately 4 billion gallons per day in 1990, statewide. Therefore, the primary issues to be considered on DRGR lands used for agricultural purposes are: uses of chemicals such as pesticides and fertilizers; wastewater from concentrated animal feed lots and rearing operations; and, water quantity issues associated with irrigation and land modifications which alter the natural recharge functions of the land.

IV. PROTECTION APPROACHES

There are two basic regulatory methods or approaches to protect ground water resources. One approach to regulation (land use zoning controls) attempts to control the land use activities based on the sensitivity of the area. For example, wellhead protection ordinances

typically prohibit or control specific land use activities within a certain radius from the well. Lee County's Wellfield Protection Ordinance does this. Another example of land use zoning controls is to prohibit general land use categories that are known to involve activities that may create ground water problems and/or limit the density and intensity of the development allowed in a sensitive ground water protection area. Lee County also does this through its DRGR land use policy.

Another protection approach regulates the design and control of sources of potential contamination or impact to the ground water resource (Best Environmental Management Practices). The statewide underground and aboveground storage tank regulations (17-761 and 17-762 F.A.C.) are examples of Best Environmental Management Practices (BEMP). Protection zones 3 and 4 of the Lee County Wellfield Protection Ordinance provide a form of BEMP under subsection 6.02.

Ground water recharge area protection generally combines both approaches - - land use/zoning control and Best Environmental Management Practices requirements. However, providing effective and certain protection of the ground water through BEMP's can be very costly for developers. A comprehensive water quality monitoring program necessary to ensure that BEMP's are, in fact, protecting the County's water supply may be costly to the County. Dade County realized that the implementation of the appropriate measures and monitoring would be costly to the public as well as severely limit development. It, therefore, decided that in the east Everglades area of Dade County, to be straight-forward and only impose stringent land use density and intensity controls (*Martin, Jeffe, and Frank DeNovo,* page 154).

V. SCENARIOS FOR DEVELOPMENT IN THE DENSITY REDUCTION/GROUND WATER RECHARGE LAND USE CATEGORY

Based upon the previous scientific foundation established in the research phase of this study and the planning regulatory approaches discussed above, the following four (4) development scenarios have been identified. Other scenarios obviously exist, however, these four appeared to provide the widest range of alternative analysis. The four scenarios are, for the purpose of identification, labeled (1) Status Quo, (2) Increased Density, (3) Selective Density Increases, and (4) Population Constant. As discussed in the Introduction of this document, it should be remembered and is emphasized here that sound growth management planning principles take into account many other aspects of the impacts of growth besides ground water. Proper planning requires a comprehensive approach to issues analysis and considers other equations such as compatibility, levels of public service, sprawl, population projections, analysis of community needs issues, and surface water issues to name a few. Ground water is only one of the issues and the following scenarios only evaluate potential land use designation possibilities based on this one issue. These scenarios are not suggested as the potential final land use designations, for the areas defined, but rather for discussion purposes based on ground water protection scenarios.

Furthermore, each scenario uses the term "density" as a representation of not only dwelling unit density (dwelling units/acre) but also as a general indicator of other intensity factors. The reader should assume that as density increases more non-residential uses will be necessary to support increasing populations and that it is not the intent of these scenarios to limit development to residential alone.

A. Scenario 1 - Status Quo

The Status Quo scenario is provided to test the existing Future Land Use Map designations. It is assumed that the present wellfield protection standards will remain in effect and no new BEMP provisions will be put in place.

B. Scenario 2 - Increased Density

The Increased Density scenario is suggested as a means to provide a foundation from which the other alternatives may be compared. In this scenario a density of one unit per acre is applied throughout the DRGR land use designation. It is assumed that the wellfield protection standards will remain in place as presently ordained. Other protection standards beyond existing development and zoning requirements presently in existence in Lee County are to be applied. The appropriate zoning districts would be the AG-2 Residential Single Family District and the RPD, Residential Planned Development District (limited to a maximum density of 1 unit per acre).

C. Scenario 3 - Selective Density Increases

Scenario 3 provides for selective increases in density based solely on the need to protect the ground water supply established in Section II or the hydrologic capacity of the land. The DRGR land use areas are further divided into sub-areas, each having different density/intensity limits. Based on the previous analysis of ground water studies, the DRGR land use geographical area was divided into categories of urban development suitability based only on the need to protect the ground water sources of Lee Counties potable water supply (see Plate II-13).

Area A, the most unsuitable for development within the DRGR, is that area underlain with the water table aquifer with a transmissivity value greater than 100,000 gpd/ft, as described in Section IIC. This area is deemed the most unsuitable for urban/suburban type development because it has the highest potential for development of the water table aquifer for future water supply needs (due to its transmissivity); contains the primary recharge area for the water table aquifer, the Lower Tamiami aquifer and portions of the Sandstone aquifer; and, contains all the area with the highest wellfield development potential in the

Lower Tamiami aquifer and portions of the Sandstone aquifer.

Area B is that area within the DRGR area that, unlike Area A, does not have as high a wellfield development potential within the water table aquifer. While the potential for wellfield development is not as great, the area has approximately the same potential for recharge of the water table aquifer. Area B does contain much of the area favorable for development of the sandstone aquifer as a future water source and much of Area B lies within the better recharge area for the sandstone aquifer. However, because of the lower development potential of the water table aquifer, this area, from a ground water perspective, is considered more suitable for urban/suburban development than Area A.

The final area in this scenario is Area C. Area C is the most suitable, from a ground water protection viewpoint, for urban /suburban type development. Based on available data, the hydrogeologic conditions in this area, located along the northern County boundary, are generally much less desirable for development of the water table and sandstone aquifers as a future water supply. Areas identified as Area C will yield only small quantities of water from either aquifer. The lower Tamiami aquifer does not exist in this area. There is not as great a potential for adverse impact on ground water supplies by development, given that standard and accepted design principles of development are followed. It should be noted that this area of the County has not previously been studied as thoroughly as the southeastern portion of the County. It , therefore, does not have as much data for analysis and collection and analysis of additional data could change the hydrogeologic picture of the area.

In this study Scenario 3 uses the following distribution of land use designations with the designated design standards and use prohibitions (see Plate II-13).

AREA A - 1 du/10 acres (present land use configuration)

AREA B - 1 du/acre with post development performance standards 1, 2, 4, 5, 6 and 7 below

AREA C - 1 du/acre with no post development standards beyond existing standards

The following are post-development performance standards which may be applied:

1. Site retention and percolation of the first three inches of the run-off generated in a 100 year storm. (The SFWMD is developing Best Management Practices for "Outstanding Natural Systems" that are located in the same general area as the DRGR in southeast Lee County. After the SFWMD research is concluded in 18-24 months, it may be appropriate to utilize retention/detention standards recommended in their study.) (See Appendix D for other standards.)

2. Underground storage of hazardous materials is not permitted. Above ground storage shall use Best Environmental Protection Management Practice design and operation standards (see Appendix C).

3. No storage of hazardous materials.

4. No septic systems at densities greater than 1 dwelling unit per net acre.

5. Sanitary sewer systems shall use BEMP structural design and operation standards for collection and treatment facilities that assure no leakage of effluent. Disposal methods shall be located and managed to assure proper treatment prior to reaching the ground water (see Appendix D).

6. Impervious surface ratio must not exceed 0.35 including roads and all other public facilities.

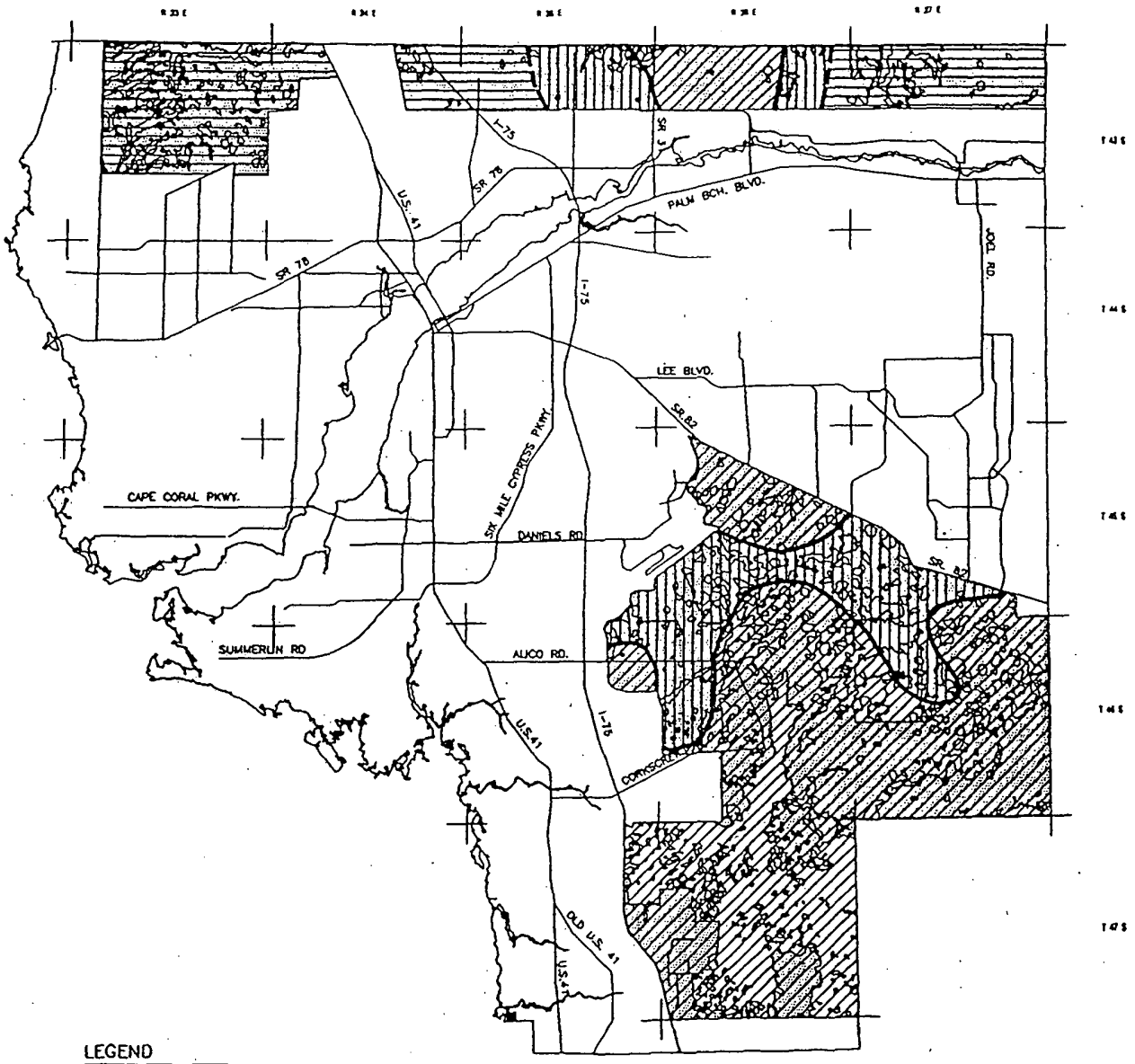
7. Current Potable Water Wellfield Protection standards will remain in place.

8. Applicable current Potable Water Wellfield Protection standards will be expanded to encompass the entire area.

D. Scenario 4 - Population Constant

Scenario 4 allocates the same geographical areas (A, B, & C) as Scenario 3 (see Plate V-1). However, Scenario 4 assigns density by allowing the redistribution of overall existing planned population accommodation potential through a Transfer of Development Rights (TDR) program. Area A which is least desirable for urban/suburban development and should require the greatest effort in regulatory ground water protection will only be allowed to develop at a density/intensity of 1 du/40 acres. Area A will, however, continue to have a 1 du/10 acres available for TDR. Area B will be allowed to develop at 1 du/acre but must acquire from a sending zone the necessary units to increase density from 1 du/10 acres to 1 du/acre. Area B will also require BEMP's specified in Scenario 3 when development exceeds 10 du/acres and for all non-residential development. Area C will be allowed to develop at 1 du/acre but will also be required to acquire increased development density of up to 1 du/acre from an assigned density of 1 du/5 acres. In Area C, this increase in density (from 1 du/5 acres to 1 du/acre) can be accomplished without any further BEMP standards than presently exist (ie: wellfield protection standards). The remainder of the undeveloped, unplatted County would be allowed to transfer out (sending zone) up to 25% of its development rights.

Sending zones are land use areas designated as having a surplus of development rights (density/intensity assigned exceeds allowable development density/intensity right) or areas where it is anticipated that development rights may not be fully used and, therefore, available for transfer. Receiving zones are land use areas designated as having assigned density/intensity rights that are less than the potential development density/intensity use if certain performance standards were applied to the development design and management.



LEGEND

- AREA A – SENDING ZONE – (ALLOWABLE DEVELOPMENT – 1 du/40 acres, ALLOWABLE TRANSFER RIGHTS – 1 du/10 acres)
- AREA B – RECEIVING ZONE AND INTERNALLY A SENDING AND RECEIVING ZONE (ALLOWABLE DEVELOPMENT – 1 du/acre, DESIGNATED DEVELOPMENT RIGHTS – 1 du/10 acres, BEMP'S REQUIRED)
- AREA C – RECEIVING ZONE AND INTERNALLY A SENDING AND RECEIVING ZONE (ALLOWABLE DEVELOPMENT – 1 du/acre, DESIGNATED DEVELOPMENT RIGHTS – 1 du/5 acres)
- SENDING ZONE – (THE REMAINDER OF THE UNDEVELOPED/UNPLATTED UNINCORPORATED COUNTY MAY TRANSFER OUT UP TO 25% OF ITS DEVELOPMENT RIGHTS)

N

SCALE 0 5 MILES

Henigar & Ray, INC.
Atlanta Testing & Engineering

TDR ZONES

Lee County – Groundwater Resource Protection Study

PLATE NO. V-1

E. Non-Residential Land Uses

In each of the above scenarios, population density is used as the intensity of use indicator. In other words, one would expect at a density of 1 unit per acre, to have non-residential/non-public uses of 1.5 to 6 percent based on Lee County Comprehensive Plan analysis. For purposes of the following analysis, it is assumed that 3% of the 1 unit/acre designations would be non-residential development and that transportation systems land use would not decrease the gross acreage density allowed. It is suggested that, should the County deem it appropriate to increase land use intensity in the DRGR area, only Residential Planned Development zoning be permitted in each of the above scenarios. For that matter, any other scenario developed by the County should be subject to special overlay standards that would apply ground water protection design and use prohibition requirements. These standards may best be applied and evaluated using a planned development approval process.

However, where the County may deem it appropriate in areas B and C in Scenario 3 and 4 to provide more intense non-residential development districts (ie: a commerce park or large shopping district), the BEMP's suggested in Scenario 3 should be applied.

F. A Word About BEMP

The term Best Environmental Management Practices used in this study is derived from Best Management Practices a term used to refer to a construction and ongoing operation technique that is believed to create a positive result. It represents state-of-the-art knowledge. BEMP is a Best Management Practice that is designed to create positive environmental protection with less consideration for the economics of construction or operation of an activity.

BEMP's are not without risk to the environment. Anytime potential ground water contaminants are introduced into an area regardless of the precautionary construction and operational practices provided, the risk of a ground water contamination incident increases. Certainly, increased intensity of development may be allowed throughout the DRGR area with increased BEMP's for protection. However, the potential risk increases as the intensity of development increases. Futhermore, the development process associated with growth can increase the amount of impervious surface and alter the natural topography, vegetation and runoff patterns, to the extent that the amount of recharge, and many of the recharge functions, may be reduced.

Obviously, the safest approach to assure protection of ground water is to limit development. The previous scenarios using BEMP's provided to varying degrees, "the limiting of development approach". The basic premise here is that less development in sensitive areas is the most effective means to reduce the risk of contamination and assure proper ground water recharge. The BEMP scenarios are suggested for limited areas of development where it has been postulated that additional risk can be tolerated due to the hydrogeologic characteristics of the water table aquifer.

VI. IMPACTS ON THE VIABILITY OF EXISTING COMPREHENSIVE PLAN

Land use should be coordinated with water resource use and water quality protection planning to form a comprehensive approach to ground water protection. The interrelationships between land use and ground water protection are numerous and complicated. In Lee County those interrelationships are compounded by several factors:

≈ The "hundreds of thousands of platted lots" that exist, many of which have been sold to individuals for future construction and the numerous large scale developments approved since the 1984 plan (The Lee Plan, Section B Support Document).

≈ The relative importance of the water table aquifer for potable water supply (Lee County Planning Division, Vol. 3 of 3., 1990 Amendments to the Plan, September, 1990. p.II-6).

≈ Recharge of the water table aquifer by precipitation in areas of the DRGR is not particularly large in that it is not a prime recharge area (recharge rate ≥ 8" / year) but, it is the primary source of water.

A. Analysis

Any net increase in density over the DRGR land use category will increase the availability of potential urban development opportunities and may provide opportunity for urban sprawl during the remaining 20 years of the plan. On the other hand properly conditioned development approvals could provide for compact new communities that are self sufficient and not in and of themselves "urban sprawl". The following analysis evaluates each of the three new alternatives as they relate to the viability of the Lee Plan.

Scenario 1 - Status Quo

The status quo scenario is a land use plan that has gained the approval of the Florida Department of Community Affairs. It is an acceptable growth management policy that, to the greatest extent practical given the large number of subdivided lots throughout Lee County, discourages scattered urban sprawl and protects the County's ground water source by prohibiting excessive use of the land. It does not, however, address the potential negative effects that increased agricultural activities may have on the ground water. While not within the purview of this study, agricultural uses may withdraw large quantities of ground water for irrigation purposes and may contribute to ground water contamination with fertilizers and pesticides. While very low densities may appear to be the best way to protect the potable ground water sources, the unrestricted increase of agricultural activities may actually contribute to the problem the County is trying to avoid. Further study of agricultural practices and their impact on ground water in Lee County is suggested.

Furthermore, the Lee Plan permits mineral or limerock extraction within the DRGR land use category. Because the principal aquifer for potable water supply in Lee County is the water table aquifer, can have an impact on the water table aquifer, especially if dewatering is performed. Removal of overlying material reduces attenuation of contaminants. Mining does not always create hazards, but it does increase the risk to aquifers from adjacent or succeeding activities.

Surface penetrations are particularly susceptible to contaminants carried in runoff, including agricultural chemicals, organic and mineral contaminants from industrial sites or urban area, and microbial pathogens from urban runoff.

Reclamation of surface excavations, by backfilling and avoiding ground water exposure, can minimize contamination from runoff on succeeding land uses. Landscape buffering, berming and runoff diversion, along with security fencing to prevent illegal dumping, may also be necessary. Succeeding land uses should be carefully evaluated for their ground water contamination potential. In much of the DRGR, mining may be an inappropriate activity depending on depth of mine, depth to ground water and proximity of urban and agricultural uses.

Scenario 2 - Increased Density

Increasing the density of the DRGR area to one unit per acre will increase the potential dwelling unit buildout capacity from 8,980 to 87,104 (assuming 3% of the land to be used for non-residential land uses). Based on the Lee Plan Evaluation and Appraisal Report (May 24, 1993) establishing an average household population (2.09 persons/unit), a potential buildout population increase over existing land use scenarios of 163,179 may be excepted.

The Florida Growth Management statutes specifically say that land use issues must be correlated with potable water protection and aquifer recharge protection. Rule 9J-5 requires that the plan policies and, therefore, land use distribution policy "discourage the proliferation of urban sprawl".

The potential population increase with this alternative does not appear to support the year 2020 population projections of the Lee Plan projections and may contribute to scattered urban sprawl.

The increase in residentially associated hazardous materials, other potential pollution sources, and the necessary support land uses to serve a population of this magnitude scattered over so large an area would increase the potential for environmental contamination of ground water deemed important as the potable water supply for Lee County. Even with the recommended construction and design standards, the risk of ground water contamination increases with increased development.

Scenario 3 - Selective Density Increases

Scenario 3 would provide a potential buildout increase of 37,238 dwelling units over the existing capacity of the DRGR. However, unlike Scenario 2, these units would be concentrated in areas of the DRGR that have slightly less value from a potable water ground water protection perspective.

Area A of Scenario 3 (see Plate II-13) has the highest potential for meeting existing and future water supply needs in Lee County and, therefore, should have the greatest protection from development. Area A remains at 1 unit/10 acres with a buildout potential of approximately 4,700 units and a buildout population of 9,821.

Area B is to be designated 1 unit/acre with the most restrictive of the post development ground water protection standards. The number of buildout units is estimated at 18,671 units with a buildout population of 39,023.

Area C, along the northern edge of the County except those areas designated as A and B, is also designated 1 unit/acre with no further restrictions than those that apply in the rural land use category. Buildout dwelling units would be approximately 22,848 with a buildout population of about 47,753.

The entire Scenario would, therefore, have a buildout population of 96,597 or about half the buildout capacity of Scenario 2 and an approximately 79,730 person increase over the existing population capacity of the DRGR.

Scenario 4 - Population Constant

Scenario 4 (see Plate V - 1) relies on a reallocation of the existing planned buildout capacity of the DRGR land use category. Area A, because it is considered to be the most in need of protection, would be re-designated at 1 unit per 40 acres development density retaining the 1 unit per 10 acres for Transfer of Development Rights (TDR). Area A would be a sending zone only, under the TDR scheme. Area A would then have 2,995 units to transfer out.

Area B would retain its 1 unit/10 acres designation but would be allowed to develop at 1 unit/acre with development rights transferred in. Area B would be a receiving zone and internally, a sending and receiving zone.

Area C would also be re-designated as 1 unit/5 acres designation but be allowed to develop at 1 unit/acre. It would be a receiving zone only for TDR's up to 1 unit/acre. No BEMP standards beyond those wellfield protection standards presently in effect in Lee County will be required.

Furthermore, the remainder of Lee County (those areas outside the present DRGR) that are undeveloped and unplatted and have no approved development plans will also be sending zones for up to 25% of their development capacity).

This Scenario produces no net increase in potential buildout population. There is, however, the potential for leapfrog/urban sprawl development if the TDR receiving zone is implemented completely over Areas B and C.

B. Transfer of Development Rights

As indicated in the introductory remarks to this section there are other options available should the County determine it appropriate to allow increases in density and intensity of use in areas of the present Density Reduction/Ground Water Resource land use category. While it was not the scope of this study to analyze the entire County in methods that could be used to balance land value with potential land use, transfer of development rights is an obvious countywide solution to some of the issues that have been expressed for the DRGR land use category. Scenario 4 explores one method of applying the TDR concept. Another example- - - all or some of the existing land use categories, except the DRGR, in the Future Land Use Element of the Lee County Comprehensive Plan could be reduced an appropriate amount (example from 6 units per acre to 4 units per acre for the Urban Community District). Each of those districts would then be designated a receiving zone for transfer of development rights and could upon purchasing appropriate number of development rights actually develop at greater units per acre (ie: 6 units/acre). However, greater units per acre would not be allowed by right, only upon acquisition of the necessary development rights.

Conversely, the DRGR area could be increased in density and designated a sending zone. Based on the suitability analysis done in scenarios 3 and 4, some areas could be only sending zones and some areas could be both receiving and sending zones as suggested in Scenario 4. The sending zones would have a designated density that would actually exceed the allowable development capacity of the property (example designated density: 1 unit per acre, development density allowed: 1 unit per 10 acres).

The theory behind the TDR concept is that the County would be creating a market for the sale of development rights with the major supplier of those rights to be purchased in the DRGR area. The demand would be created in the rest of the County for units to be purchased from the DRGR area in order for a development to approach its highest intensity right. A similar situation could be created with regard to floor area ratios for non-residential development in the DRGR with a concomitant decrease in floor area standards in the commercial designations in the remainder of the County.

The transfer of development rights approach has not been extremely successful in communities and counties that have not insured that there was a demand for the development rights and a supply available that could not otherwise be used. The Florida Keys is a good example of a workable TDR program where a supply of development rights has been created by density/intensity designations on lands that can not be developed and a TDR demand has been created by preventing a land owner from achieving the highest allowable development without purchasing the necessary rights from a property owner who could not otherwise use them. If the over-supply with creation of demand scenario is not established, its unlikely that the Transfer Development Rights program will be used to any real extent.

Another option is to apply the Transfer Development Rights program exclusively within the DRGR category with transfers taking place from the more critical ground water protection areas to the lesser critical ground water preservation areas. However, the supply and demand would be harder to balance and the County may wish to consider including the resource protection areas and transition zones as part of the transfer of development rights that would occur exclusively within those three categories (DRGR, Resource Protection, Transition).

C. Conclusions

The area designated on the Future Land Use Map as Density Reduction/Ground water Resource (DRGR) includes a large portion of the County that is underlain by aquifers suitable for producing large quantities of fresh water to satisfy the needs of the County. In general, the area designated DRGR includes:

≈ Nearly all of the area in which the water table aquifer has the greatest thickness within Lee County.

≈ A large portion of the area in which the water table aquifer has the highest transmissivity (and, thus, the ability to provide the greatest amount of water with the least amount of drawdown) within the County.

≈ Most of the recharge area for the lower Tamiami aquifer.

≈ Most of the area in which the lower Tamiami aquifer exists in Lee County.

≈ Much of the area in which the sandstone aquifer has the greatest transmissivity.

≈ Several of the existing municipal water supply well fields that currently exist in the County.

Considering the characteristics of the fresh water aquifers underlying the DRGR, the area designated DRGR appears to have been appropriately selected, with the possible exception of the area along the northern edge of the County.

With the exception of an area east of I-75, much of the area along the northern border is capable of producing only limited quantities of fresh water from the water table aquifer. Futhermore, the sandstone aquifers in the northern DRGR area has very low (less than 2,100 gpd/ft) transmissivities when composed to the east-central portion of the County and may or may not been of potable water quality. It must be noted in making this conclusion, however, that the data pertaining to the characteristics of the ground water resources in this area are much more sparse than the data available in the southern DRGR area.

It should also not be inferred that the area designated DRGR will fulfill all of the water supply needs of the County in the future. Limitations do exist in developing wellfields within the DRGR, most notably impacts of withdrawals on the extensive system of wetlands that are interspersed within the DRGR. In addition, the economics of developing wellfields in portions of the DRGR that are more distant from the demand may make the development of alternate sources of water that require additional treatment (such as water from the Floridan Aquifer System) more competitive (the cost of the treatment is offset by the cost of transmission).

From a water supply and quality standpoint, the density/intensity of proposed development within this area is more an issue of the degree of protection that the County desires to afford the aquifers within this area. If additional density/intensity is desired by the County, then every effort should be made to maintain recharge to the water table aquifer at a rate

equivalent or greater than that now occurring, and, Best Environmental Management Practices should be required to minimize the potential for contamination of the aquifers to the greatest extent possible. These criteria should be implemented to protect the quantity and quality of water for existing wellfields in the DRGR area in addition to future wellfield.

Of the four scenarios evaluated in the study, Scenario 3 offers increased development density/intensity while still protecting the ground water through maintenance of lower density/intensity standards in the most critical areas required to supply the water needs in the future and minimizes the risk through BEMP standards in the less critical areas.

Scenario 4 maintains the existing "Lee Plan" population potential and uses TDR's to realign density/intensity around the County. From a statutory and rule perspective this alternative may be the most acceptable to the State.

TDR's may be the appropriate method for providing increased land values to those lands that must bear the brunt of the water resource protection policy. With the TDR concept and sound BEMP policy, other alternatives may be explored that more appropriately meet the long term growth management and water resource protection needs of the County.

APPENDIX A

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APPENDIX B

Aquifer Thickness Considerations

Water Table Aquifer

AQUIFER THICKNESS CONSIDERATIONS
WATER TABLE AQUIFER

The aquifer characteristic, transmissivity, has been used as one of the factors used to evaluate the qualities of the water table aquifer suitable for water supply development. Transmissivity, or the ability of the aquifer to transmit water, is the product of the hydraulic conductivity and the aquifer thickness. In evaluating the suitability of an aquifer to provide water, consideration must be given to the aquifer thickness as the value of transmissivity decreases. As the value of transmissivity decreases, increased drawdown occurs for the same rate of withdrawal (pumping). As the drawdown increases, then additional criteria must be considered in evaluating alternate wellfield sites.

In developing the evaluation factors in which to identify areas suitable for wellfield development, various values of transmissivity have been chosen (Section II.C.). As the values of the transmissivity criterion were chosen, a minimum aquifer thickness was included in the criterion for the lowest value of transmissivity (50,000 gpd/ft) for the water table aquifer. To develop this depth criterion, the following assumptions were made:

≈ The transmissivity of the water table aquifer was 50,000 gpd/ft.

≈ The minimum pumping rate that would be used in developing a wellfield was 200 gallons per minute (gpm). This is based on a comparison of minimum pumping rates used at existing wellfields in Lee County (SFWMD, 1992).

≈ The maximum drawdown allowed within the aquifer was one-third of the aquifer saturated thickness. Using this criteria, pump intakes could be set at levels that would have sufficient submergence to accommodate declines in water levels due to natural conditions. This condition could be considered somewhat conservative. However, if greater drawdowns were allowed, then the minimum pumping rate could be increased if desired.

≈ A specific yield of 0.20 was assumed.

≈ The time of pumping was chosen to be 180 days. This timeframe was chosen to reflect pumping of the water table aquifer primarily during the "wet season" when ground water levels are typically the highest. It was assumed that pumping of deeper aquifers, such as the sandstone, or different water table well(s) would occur for the remainder of the time to minimize impacts caused by pumping on water table levels.

After selecting these assumptions, a computer program developed by Daniel K. Sunada at the Colorado State University named "Flow from Wells and Pits, Revision 2.0" was utilized to evaluate drawdowns in an unconfined aquifer. Utilizing the assumptions identified above, a drawdown of approximately 8 feet will occur at the pumping well (computer results for varying values of transmissivity and pumping rates are attached). If the maximum drawdown must be no more than one-third of the saturated thickness of the aquifer, then the aquifer must have a saturated thickness of at least 25 feet. This criterion was thus added to the criterion of the transmissivity equaling 50,000 gpd/ft.

Based on the available data, all of the area within the DRGR in which the transmissivity of the water table aquifer was greater than 50,000 gpd/ft but less than 100,000 gpd/ft had an aquifer thickness of 25 feet or greater.

DISCHARGE RATE	=	200 GPM
TRANSMISSIVITY	=	6700 SQ.FT/DAY
SPECIFIC YIELD	=	.2
BEGINNING TIME	=	180 DAYS
FINAL TIME	=	180 DAYS
TIME INCREMENT	=	180 DAYS
TIME OF CUT OFF	=	180 DAYS
EGINNING DISTANCE	=	0 FT
FINAL DISTANCE	=	8000 FT
ISTANCE INCREMENT	=	500 FT
TURATED THICKNESS	=	25 FT
ANGLE	=	0 DEGREES

TIME (DAYS)	DISTANCE (FT)	HEIGHT (FT)
%180	0	-7.827
%180	500	-1.831
%180	1000	-1.211
%180	1500	-0.863
%180	2000	-0.631
%180	2500	-0.465
%180	3000	-0.343
%180	3500	-0.252
%180	4000	-0.183
%180	4500	-0.132
%180	5000	-0.094
%180	5500	-0.067
%180	6000	-0.046
%180	6500	-0.032
%180	7000	-0.021
%180	7500	-0.014
%180	8000	-0.009

DISCHARGE RATE	=	200 GPM
TRANSMISSIVITY	=	10000 SQ.FT/DAY
SPECIFIC YIELD	=	.2
BEGINNING TIME	=	180 DAYS
FINAL TIME	=	180 DAYS
TIME INCREMENT	=	180 DAYS
TIME OF CUT OFF	=	180 DAYS
BEGINNING DISTANCE	=	0 FT
FINAL DISTANCE	=	8000 FT
DISTANCE INCREMENT	=	500 FT
SATURATED THICKNESS	=	25 FT
ANGLE	=	0 DEGREES

TIME (DAYS)	DISTANCE (FT)	HEIGHT (FT)
%180	0	-5.366
%180	500	-1.349
%180	1000	-0.930
%180	1500	-0.692
%180	2000	-0.530
%180	2500	-0.411
%180	3000	-0.320
%180	3500	-0.250
%180	1000	-0.194
%180	4500	-0.150
%180	5000	-0.116
%180	5500	-0.089
%180	6000	-0.067
%180	6500	-0.051
%180	7000	-0.038
%180	7500	-0.028
%180	8000	-0.020

DISCHARGE RATE = 350 GPM
TRANSMISSIVITY = 6700 SQ.FT/DAY
SPECIFIC YIELD = .2
BEGINNING TIME = 180 DAYS
FINAL TIME = 180 DAYS
TIME INCREMENT = 180 DAYS
TIME OF CUT OFF = 180 DAYS
BEGINNING DISTANCE = 0 FT
FINAL DISTANCE = 8000 FT
DISTANCE INCREMENT = 500 FT
SATURATED THICKNESS = 25 FT
ANGLE = 0 DEGREES

TIME (DAYS)	DISTANCE (FT)	HEIGHT (FT)
%180	0	-13.696
%180	500	-3.205
%180	1000	-2.119
%180	1500	-1.510
%180	2000	-1.104
%180	2500	-0.814
%180	3000	-0.600
%180	3500	-0.441
%180	4000	-0.321
%180	4500	-0.232
%180	5000	-0.165
%180	5500	-0.116
%180	6000	-0.081
%180	6500	-0.056
%180	7000	-0.037
%180	7500	-0.025
%180	8000	-0.016

DISCHARGE RATE = 350 GPM
TRANSMISSIVITY = 10000 SQ.FT/DAY
SPECIFIC YIELD = .2
BEGINNING TIME = 180 DAYS
FINAL TIME = 180 DAYS
TIME INCREMENT = 120 DAYS
TIME OF CUT OFF = 180 DAYS
BEGINNING DISTANCE = 0 FT
FINAL DISTANCE = 8000 FT
DISTANCE INCREMENT = 500 FT
SATURATED THICKNESS = 25 FT
ANGLE = 0 DEGREES

TIME (DAYS)	DISTANCE (FT)	HEIGHT (FT)
%180	0	-9.391
%180	500	-2.360
%180	1000	-1.627
%180	1500	-1.210
%180	2000	-0.927
%180	2500	-0.719
%180	3000	-0.560
%180	3500	-0.437
%180	4000	-0.340
%180	4500	-0.263
%180	5000	-0.203
%180	5500	-0.155
%180	6000	-0.118
%180	6500	-0.089
%180	7000	-0.066
%180	7500	-0.049
%180	8000	-0.036

APPENDIX C

Containment of Hazardous Materials Standards

CONTAINMENT OF HAZARDOUS MATERIALS

[COMMENT: An excellent source of regulatory provisions for Hazardous Material Management is Alachua County, Ordinance 91-6. This section provides a more simplified approach to regulatory containment design]

Primary and secondary levels of containment shall be required for all new storage facilities intended for the storage of hazardous materials which are liquids or solids at standard temperature and pressure (STP). Such facilities shall meet the following specifications:

1. All primary containment shall be product-tight.

2. Secondary Containment:

   a) All secondary containment shall be constructed of materials of sufficient thickness, density, and composition so as not to be structurally weakened as a result of contact with the discharged hazardous materials and so as to be capable of containing hazardous materials discharged from a primary container for a period of time equal to or longer than the maximum anticipated time sufficient to allow recovery of the discharged hazardous material.

   b) In the case of an installation with one primary container, the secondary containment shall be large enough to contain at least 110% of the volume of the primary container.

   c) In the case of an aboveground storage facility with multiple primary containers, the secondary container shall be large enough to contain 150% of the volume of the largest primary container placed in it, or 50% of the aggregate internal volume of all primary containers in the storage facility, whichever is greater.

d) In the case of an underground storage facility with multiple containers, the secondary container shall be large enough to contain 110% of the volume of the largest primary container placed in it, or 50% of the aggregate internal volume of all primary containers in the storage facility, whichever is greater.

e) If the storage facility is open to rainfall, then the secondary containment must be able to additionally accommodate the volume produced by a ten (10) inch rainfall in a twenty-four (24) hour period.

f) Single-walled containers do not fulfill the requirement of an underground storage tank providing both a primary and secondary containment. However, an underground storage tank with a primary container constructed with a double complete shell shall be deemed to have met the requirement for primary and secondary containment set forth in this section if the outer shell is constructed primarily of none-earthen materials, including, but not limited to concrete, steel, and plastic, which provides structural support; a leak detection system is located in the space between the shells; the system is capable of detecting the entry of hazardous substances from the inner container into the space; and the system is capable of detecting water intrusion into the space from the outer shell.

3. Overfill Protection

An approved means of overfill protection shall be required for any non-portable primary container.

4. Separation of Materials

Materials that in combination may cause a fire or explosion, or the production of a flammable, toxic, or poisonous gas, or the deterioration of a primary or secondary

container, shall be separated in both the primary and secondary containment so as to avoid intermixing.

5. Drainage System

Drainage of precipitation from within a storage facility containing hazardous materials which are liquids or solids at STP shall be controlled in a manner approved by the County so as to prevent hazardous materials from being discharged. No drainage system will be approved unless the flow of the drain can be controlled.

6. Professional Engineer Stamp

The County may require design submittals to bear the stamp of one or more professional engineers, registered with the State of Florida, attesting to, but not limited to such items as the following: structural sounds, compatibility of construction materials with contents, cathodic protection, and mechanical compatibility with the structural elements.

APPENDIX D

Model
Ground water Resource
Protection Requirements

PRIMARY AQUIFER RECHARGE AREA PROTECTION ZONE

The location of the Primary Aquifer Protection Overlay District is shown on the Future Land Use Plan Map as the Density Reduction/Ground water Resource District.

a. Permitted Use

1) All uses currently permitted under the County land development regulations and zoning map are permitted in the Primary Aquifer Recharge Overlay District subject to the provisions and restrictions of this section.

2) Not withstanding any other provisions herein, a non-conforming use within the Primary Aquifer Recharge Overlay district may be continued and maintained so long as it remains otherwise lawful. No such use shall be enlarged, altered, extended, or operated in any way, which increases its threat to ground water or otherwise contravenes the purpose and intent of this Article. As with other zoning (land use) districts, all provisions of Article *[name existing non-conformance provisions of the county land development code]* shall apply in the same manner to the provisions of the Primary Aquifer Recharge Overlay District.

b. Prohibited Uses and Activities

1) The discharge, land application or disposal of any hazardous material, toxic substance or radioactive material.

2) The production or processing of bulk quantities of any hazardous material or toxic substance.

3) The open storage of pesticides, herbicides, fungicides and artificial fertilizers.

4) Any form of underground injection of hazardous materials or toxic substances.

5) Underground or aboveground bulk storage facilities of hazardous materials.

6) Sanitary landfills, as defined by Chapter 17-7 F.A.C., solid waste disposal facilities and junkyards.

7) Single family houses using septic tanks on lots of less than [30,000] square feet or at a density of greater than [1] unit per acre.

8) a) Two family housing using septic tanks on lots of less than [45,000] square feet or at a density of greater than [1.5] units per acre.

b) All plans for two family houses using septic tanks require the approval of the County Health Department.

9) Multi-family houses using septic tanks are prohibited.

10) The use of septic system cleaners which contain toxic substances or hazardous materials.

11) The disposal of toxic substances or hazardous materials by means of discharge to a septic system.

12) Pipelines transporting hazardous materials.

c. Other Requirements

1) Petroleum Bulk Storage Facilities installed above ground require permits and are subject to compliance with those standards described in Appendix C above.

2) Bulk storage of toxic substances or hazardous materials installed above ground is subject to compliance with Appendix C above.

3) Sand and/or gravel mining and excavations are permitted in accordance with Section *[insert appropriate section(s) of County's existing codes]* of the county land development regulations except where on-site activities violate any provisions of these regulations.

Operations which commence on or after the effective date of these regulations shall install a minimum of one (1) ground water monitoring well in a direction upgradient from on-site activities and one (1) ground water monitoring well in a direction downgradient from on-site activities. The specific location of these ground water monitoring wells shall be determined by a professional geologist, hydrologist, engineer, or other qualified expert trained and experienced in hydrogeology.

Frequency of required water quality sampling from monitoring wells shall be determined on a site-specific basis.

Access to monitoring wells shall be provided to employees of the County Environmental Regulation Department for purposes of any additional water quality sampling deemed appropriate.

4) Vehicular servicing, including but not limited to, automotive repair stations, body shops and rustproofing operations, is allowed within the Aquifer Protection Zone provided that the following requirements are met:

a) Floor drains must be connected to holding tank or sanitary sewer equipped with an oil and grit separating tank. (Note: allowing expected wastewater from such facilities into sanitary sewers will contribute to treatment system upsets.)

b) Wastes collected in a holding tank must be disposed of through a licensed waste hauler.

c) Waste degreasing solvents must be stored in drums for disposal by a licensed waste hauler.

d) Waste oil must be stored in tanks or drums for disposal by a licensed waste hauler.

e) Storage facilities for tanks and/or drums require coated concrete floors and dikes to retain accidental spills or leaks; a permanent roof to protect tanks or drums and to prevent precipitation from entering dikes. Drums should be sealed, and tanks and drums must be located away from floor drains.

f) Large drip pans should be kept beneath drums which have spigots and are stored in horizontal position on racks.

g) Potentially contaminated scrap, including but not limited to scrap parts, batteries and used filters shall be stored in proper containers to prevent environmental release of contaminants.

5) a) Application of pesticides, herbicides, fungicides, or chemical fertilizers shall be performed in accordance with the recommendations and label of the manufacturer, and a record kept of applications by date, quantity, substance and acreage applied.

b) Property owners who enlist the services of a commercial pesticide, fungicide, or herbicide applicator shall ensure that the applicator is certified and licensed by the Florida Department of Environmental Regulation.

6) Conversion of a one family house using a septic tank to a two family house using a septic tank requires the approval of the County Health Department.

7) Site plans for all proposed industrial and commercial uses shall be accompanied by a detailed and complete description of the anticipated uses and their operation as per *the submission requirements* of the County Land Development Regulations.

8) Whenever there is a question as to the ground water contamination potential of a proposed use, the expert opinion of the United States Environmental Protection Agency (U.S. EPA), the Florida Department of Environmental Protection , and the State and County Health Departments may be requested.

9) Stormwater - in addition to stormwater management requirements (contained in the County's stormwater regulations) all new development in the Primary Recharge Protection area shall use an infiltration system only and retain on-site the first three inches of runoff from all impervious surfaces.

Discharges through natural or man-made conduits, such as wells and sinkholes, that allow direct contact with ground water are prohibited, except for residential stormwater discharging through wet retention/detention ponds.

10) Impervious surface standards - the impervious surface shall not exceed 35% of the development site.

11) Sanitary sewer mains shall comply with the following standards:

a) Residential land use - no gravity sanitary sewer shall have a exfiltration rate greater than twenty (20) gallons per inch pipe diameter per mile per day.

b) Non-residential land use - no gravity sanitary exfiltration rate greater than twenty (20) gallons per inch pipe diameter per mile per day.

c) Sanitary sewer force mains - All sanitary sewer force mains shall be constructed of either ductile iron or reinforced concrete pressure sewer pipe. No such ductile iron sanitary sewer force main shall, exfiltrate at a rate greater than the allowable leakage rate specified in American Water Works Association Standard C600-82 at a test pressure of one hundred (100) pounds per square inch. No such reinforced concrete pressure sanitary sewer force main shall exfiltrate at a rate greater than one-half (½) the allowable leakage rate specified for ductile iron pipe in American Water Works Association Standard C600-82 at a test pressure of one hundred (100) pounds per square inch.

APPENDIX E

Environmental Protection Strategies for the Lower West Coast Water Supply Plan

SFWMD, August 1992

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Environmental Protection Strategies for the Lower West Coast Water Supply Plan

Prepared by
South Florida Water Management District

August 25, 1992

EXECUTIVE SUMMARY

In an effort to develop environmental protection strategies for incorporation into the water supply plans, staff of the South Florida Water Management District (SFWMD) established interdisciplinary work groups to explore specific technical and policy aspects of the environmental water supply issue. Membership in these groups included environmentalists, hydrogeologists, planners, engineers and managers from the Planning, Research, Regulation, Water Resource Evaluation and Legal Departments. This paper summarizes the environmental protection strategies developed for the Lower West Coast Planning Area.

The District's policies seek to maintain a balance between the competing interests of environmental protection, flood control, drainage, water storage, and water supply in a manner which capitalizes upon the natural benefits of the environment. As a part of the regional water supply planning process, the District will develop criteria to protect and enhance the environment.

The Governing Board is required to establish minimum flows and levels for surface water systems and minimum water levels for ground water systems and may reserve water from allocation as may be required for the protection of fish, wildlife, and water resources (373.042 and 373.223, F.S.). This complex process will result in the development of criteria for defining the water needs of natural systems. The determination of environmental water supply needs will require applied research and long-term monitoring. These environmental water supply needs will be identified through the regional water supply planning process.

To that end, natural systems will be evaluated to identify those systems which will continue to receive the existing base level of protection (through the current regulatory criteria) and those which will receive an elevated level of protection. Systems that will receive an elevated level of protection are termed "Outstanding Natural Systems" (ONS). A methodology is being developed to identify ONS within the Lower West Coast Planning Area. The techniques to be applied to identify the ONS areas will be developed by District Staff and a sub-committee of the Lower West Coast Advisory Committee. A map which illustrates the ONS concept is shown in Figure 1.

The specific numeric criteria to protect ONS areas will not be included in the next draft of the Lower West Coast Water Supply Plan (LWCWSP), since wetlands research and monitoring studies must be performed to develop the specific regulatory criteria. Non-numeric resource protection criteria will be included in the LWCWSP for ONS designated areas. These criteria will provide the District with guidelines when issuing consumptive use permits and other implementing activities such as land acquisition and local comprehensive plan reviews. Eventually, in order to minimize localized impacts from man's activities, certain ONS areas may be enhanced through implementation activities such as master mitigation banking or land stewardship programs.

The next draft of the Lower West Coast Water Supply Plan will present a series of short term and long term strategies for identifying and implementing environmental protection criteria.

Preliminary minimum levels have been proposed for ground water systems (aquifers) in the study area. The purpose of the minimum levels is to prevent physical damage to the aquifer. These aquifer protection strategies are also described in this paper.

INTRODUCTION

The Draft LWCWSP projected drawdown levels for several aquifers through the year 2010, including the surficial aquifer. Drawdown projections for the surficial aquifer through the year 2010 indicated that some drawdown would occur under wetland systems within the region.

The LWCWSP Advisory Committee was presented with these preliminary results along with the plan's recommendation that no drawdown should occur under a wetland at the end of an average dry season. The Committee raised numerous questions about the identification of affected wetlands and the methodology used to determine the appropriateness of the "no drawdown under wetlands" recommendation, among others. This paper is an attempt by District staff to respond to the questions and concerns of the Advisory Committee regarding the environmental criteria in the LWCWSP.

The paper is divided into several major sections. Following the Introduction, a series of goals, objectives and policy statements is presented to provide an overall understanding of how environmental issues should be dealt with in the planning process. These also provide specific actions to be taken by the District, and other agencies or groups when appropriate, for addressing this important issue. The second section of the report identifies major environmental resources within southwest Florida. The methodology used to arrive at these areas as well as an attached conceptual map (Figure 1) depicting the areas is included in the report. The recommended approach for protecting these environmental resources is presented in the report's next section. This includes general criteria for protecting aquifers, and suggested possible implementation strategies. Finally, a section providing recommendations and future directions is presented as the last segment of the report.

GOALS, OBJECTIVES AND POLICY STATEMENTS

Protect Environmental and Water Resources

The SFWMD Water Supply Policy Document (Trost, *et al* 1991) outlines a directive to "Protect and enhance environmental resources while providing appropriate levels of service for drainage, flood control, water storage and water supply." The water supply planning process will identify environmental water supply needs through applied research, long term monitoring and modeling. The District, in this process will seek to accommodate the reasonable-beneficial uses for human needs (agriculture and urban) and the needs of the environment. The fact that a particular user's location is within an area where environmental water supply needs are significant may ultimately require users to diversify supply sources.

Surface Water Considerations

Drainage and flood control activities must be balanced with water supply interests in order to optimize each of these competing water resource elements. Balancing the inherent conflicts between these elements is a critical challenge of modern water resource management. A long term goal of the SFWMD is to more

fully integrate surface water management and water use permits, so that eventually, identical criteria would be utilized.

Establish Aquifer Protection Criteria

Reduction in water levels in aquifers can cause damage to the water resources through a variety of processes. The primary processes that would damage ground water resources in the south Florida hydrogeologic environment are:

1. Saline water intrusion. Reduction in ground water levels near surficial sources of saline water can cause lateral movement of saline water, resulting in displacement of fresh water. In many cases, this procedure is reversible and no long term damage to the water resources take place. However, in some instances, the saline water cannot be flushed out in a short period of time. In these cases, the ground water resource has been damaged in the sense that it can no longer be used as a source of fresh water.

2. Upconing of poor quality water. This situation is similar to saline water intrusion, except that the source of poor quality water is lower aquifers or producing zones, and the phenomenon can be more widespread as it is not limited to locations near a surficial source of saline water. The impacts to the ground water resources are similar to the impacts described for lateral intrusion.

3. Aquifer dewatering and compaction. In unconsolidated and partially consolidated aquifers and confining zones, the hydrostatic pressure of the water in the pore spaces helps to support the aquifer materials and the weight of the overburden. If pressure is removed through severe declines in water levels or aquifer dewatering, the aquifer matrix can compact and actually reduce the amount of pore spaces. This results in a permanent lowering in the aquifer's ability to store and transmit water. In consolidated aquifers, dewatering can result in air entering the aquifer, becoming trapped in the pore spaces resulting in a permanent reduction in the aquifer's ability to store and transmit water.

The District's Water Supply Policy Document offers three statements of policy that relate to ground water resource protection:

1. "The District will establish minimum flows and levels for natural surface and ground water systems. The implementation of these criteria will result in reserving from allocation that supply required to maintain healthy natural systems "(page 21, 3.a.ii).

2. "The District will prohibit practices which result in aquifer compaction and aquifer de-watering to preserve productivity and quality of water supply "(page 25, 4.d).

3. "The District will manage water withdrawals to minimize salt water intrusion, upconing of saline water (sic)" (page 31, 5.e).

The translation of these policies into actual water levels is a complicated process involving a large amount of analysis. Some preliminary minimum levels have been developed in the LWC Planning Area:

1. Maintaining one foot of positive head along the coast in the water table and lower Tamiami aquifers to prevent lateral intrusion.

2. Not allowing water levels to decline more than 60% of the distance between the top of the aquifer and its pre-development head to prevent compaction and dewatering. This level should be applied to the sandstone, mid-Hawthorn, and lower Tamiami aquifers. This level needs to be re-examined, levels based on actual physical properties of each aquifer need to be developed.

3. Not allowing water levels to drop more that five feet below pre-development water levels in the water table aquifer to prevent aquifer compaction.

4. Not allowing water levels to drop more than 25 feet below NGVD for the Floridan Aquifer System to prevent lateral intrusion and upconing.

All these minimum levels should be considered preliminary. Development of "improved" levels should be based on analysis of modeling, physical properties, and the determination of whether any damage to the resource or aquifer is permanent or temporary.

IDENTIFICATION OF ENVIRONMENTAL RESOURCES

Reasons for Classifying Environmental Resources

The LWC Planning Area contains a wide variety of natural resources, ranging from coastal barrier islands, mangrove forests, bays, beaches and estuaries to inland forested, shrub/scrub and herbaceous wetlands and uplands. Over the past 50 years, land clearing, filling, and lowering of the ground water table to accommodate residential and agricultural growth has destroyed many of the natural systems within the region. Several large scale developments (e.g., Lehigh Acres in Lee County and Golden Gate Estates in Collier County) have resulted in the ditching and draining of thousands of acres of the region's original wetland and upland habitat.

Other parts of the LWC Planning Area within Hendry County, western Glades County, eastern Charlotte and Lee Counties, and northern Collier County have been converted to citrus, crop land, or improved pasture. Conversion of native systems to urban and agricultural uses eliminates indigenous habitats and alters natural water levels and hydroperiods. Although the central and southern parts of the LWC Planning Area still have large tracts of undeveloped lands containing native ecosystems (e.g., Big Cypress National Preserve, Fakahatchee Strand, and Corkscrew Swamp), those native systems not currently preserved as public lands are becoming fragmented and are subject to local and regional development pressures.

To prevent further fragmentation and degradation from altered water regimes and dredge and fill activities, special regulatory protection must be established for the remaining large natural systems and corridors linking those systems. Although the District's current level of protection may be appropriate for some areas, more stringent protection standards will be necessary to preserve the functions and values

of these large natural systems. Therefore, it is proposed that two levels of protection be established for the remaining natural systems within the Lower West Coast Planning Area.

The two levels of protection proposed in this Plan are: 1) the "base" level that all wetlands would be subject to; and 2) an "elevated" level for those areas designated in this plan as "Outstanding Natural Systems" (ONS).

Identify Categories and Resources

The ONS will comprise a skeleton of natural systems to be preserved in essentially its present condition in order to maintain the ecological integrity of the region. Large areas that could be considered relatively pristine natural environment will be incorporated. In addition, substantial areas of valuable habitat that have been modified by human activity may also be included. In most cases the more impacted areas will represent extensions of, or corridors between, the more pristine sites. In some cases, areas substantially modified by man retain such important habitat value that they are considered ONS on their own merit.

The designation of ONS does not in any way lessen the importance of other areas, including wetlands. Some areas that are not designated as ONS lands have environmental values that also need to be protected. However, the management of these areas can be more flexible, with an emphasis on retaining overall environmental value, rather than the more restrictive (no impact) standard applied to ONS.

Methodology for Classifying Environmental Resources

A multidisciplinary group of Planning, Regulation and Research Department staff were selected to develop methodology for identifying ONS within the Lower West Coast Planning Area. A five step approach was developed to prepare a map that would identify the ONS areas. The five steps are briefly discussed below:

1. Data Search. A review of readily available resource maps of the LWC Planning Area revealed that the National Wetlands Inventory (NWI), "Charrette Map", and County Soil Survey maps provided the most pertinent resource information. Of the three maps, the "Charrette Map" was most representative of the ONS concept. The "Charrette Map" was produced by a group of 40 experts on January 24 and 25, 1992, to identify ecological resource areas. (A conceptual ONS map, based on the "Charrette Map", is attached as Figure 1.)

2. Develop Generalized ONS Map. The District will refine the Charrette Map based on interpretations of satellite imagery and high altitude aerial photography to develop a generalized ONS map of the LWC Planning Area. During this step, all large natural systems and corridors linking those systems will be delineated. Due to the scale of this mapping effort, boundaries will be general and should not be used to determine whether a specific parcel is "in" or "out". For example, agricultural/developed areas may exist within the delineated ONS areas and/or areas which should be considered ONS lands may lie outside this line.

3. Develop Evaluation Technique. To refine the generalized ONS map, an evaluation technique will be developed. For example, an evaluation matrix

similar to that used to select Save Our Rivers (SOR) projects or a checklist of ONS criteria may be employed. Regardless of the technique chosen, all lands that have been acquired or are targeted for acquisition with public funds for environmental preservation and/or restoration will automatically be designated ONS. All other natural areas will be reviewed using a chosen evaluation technique to determine which lands will receive the elevated level of protection as ONS lands and which lands will receive the base level of protection. A subcommittee of the Lower West Coast Advisory Committee will be formed to develop the ONS evaluation techniques. The Subcommittee will include representatives from the agricultural community, public utilities, private environmentalists, FDER, Big Cypress Basin and the District.

4. Conduct Evaluation. In order to objectively apply the chosen evaluation technique, collection of additional information may be required. These efforts may include ground truthing and stereoscopic photointerpretation; as well as, review of wildlife habitat information, soil maps, basin maps, District surface water permits, and endangered, threatened, endemic or regionally rare species data.

5. Prepare Final Map. Those areas selected as ONS through the chosen evaluation process will be delineated on the final ONS map which will be included in the LWCWSP.

Use Of Best Available Data

Best available data such as the sources listed in Appendix 1/ will be used throughout the ONS evaluation process. The Technical sources listed represent the most up-to-date information available for the mapping effort.

Further refinement of data

Development of the ONS map will be a dynamic process. Steps one and two will provide a generalized base map that will require considerable refinement. As information is obtained and reviewed during steps three and four, a more accurate ONS map will be generated. A final ONS map is scheduled for completion within six months.

SUGGESTED IMPLEMENTATION STRATEGIES

Integration of surface water permitting with Water Supply permitting :

TO BE ADDED LATER.

Off-site Master Mitigation Planning

Off-site Master Mitigation Planning may be an appropriate strategy for enhancing and restoring lands within the ONS boundary. Additionally, this concept may be applied to provide buffers to ONS areas. Mitigation required through the regulatory process for lands outside the ONS boundary may be conducted in these Off-site Master Mitigation Planning Areas.

Local Government Land Use Overlays

An accepted method of identifying environmentally sensitive areas is the use of overlays by local governments. The land use overlay technique designates environmentally sensitive areas using a pattern on the comprehensive plan future land use maps and/or zoning maps.

For example, Collier County's Comprehensive Plan Future Land Use Map incorporates a land use overlay designation entitled Areas of Environmental Concern (AEC). The AEC overlay designation identifies areas in the county that may contain unique environmental resources and, therefore, require special review prior to allowing any development. As a land use overlay, the AEC designation covers urban, commercial and industrial future land use designations. Therefore, special development review criteria associated with the AEC overlay applies to these other designations. Lee County has a similar overlay designation on their comprehensive plan entitled Aquifer Recharge Areas requiring special considerations prior to development approvals.

One possible implementation tool for the LWCWSP is to coordinate the designation and criteria of local land use overlays with the designation of ONS in the plan. This would ensure consistency of designated areas as well as any special criteria associated with the overlays.

Fee Simple

Fee simple ownership is the highest and most complete land ownership known in law. The individual claiming this type has absolute ownership of unlimited duration, subject to no conditions, limitations, or encumbrances.

Land acquisition under the Save Our Rivers (SOR) and Conservation and Recreation Lands (CARL) programs is usually fee simple. Under this type ownership, no restrictions are placed on the types of restoration or enhancement programs which may be proposed, or on land management activities.

While conservation easements can sometimes be purchased from a landowner, the price paid is normally very high, and typically 80% or more of the fee value.

USFWS and SCS Land Stewardship Program

The Wetland Reserve Program was authorized by the 1990 Food, Agriculture, Conservation, and Trade Act to be administered by the U.S.D.A, Soil Conservation Service. The goal of this program was to encourage restoration of wetlands on private lands and protect them through long-term easement. In addition, the U.S. Fish and Wildlife Service has implemented a nationwide Partners for Wildlife Program to provide technical assistance to private landowners. In the Southeastern Region, several hundred landowners have participated in the program, resulting in restoration of over 20,000 acres of wetlands since 1989. There are also similar land stewardship programs implemented through the Division of Forestry. These partnership programs to protect natural systems on private lands could be effectively used to protect ONS on large agricultural projects.

Ground Water Resources Protection Criteria

Development of strategies for protecting aquifers from physical damage caused by drawdown is envisioned to be a three-part process:

1. Identifying the critical water levels below which damage will occur,

2. Determining what level of service these water levels represent (i.e., what level of drought or development can be met without surpassing the critical levels), and the relationship between these levels and the levels resulting from permitted use, and

3. Determining management strategies and criteria, such as shifting new uses to alternative sources, management through water shortage declarations, or allowing water levels below critical levels if damage is reversible (i.e., no compaction will occur and saline water can be flushed out upon return to normal conditions).

The critical level for a given location will be a function of levels needed to prevent saltwater intrusion, upconing, aquifer compaction and dewatering. These levels may be superseded by levels needed to protect natural systems and existing users. Currently, these levels exist in conceptual form (one foot of head to prevent lateral intrusion, 60% of available pre-development drawdown, etc.). These levels need to be re-evaluated; ideally they will be physically based on the properties of the various aquifers.

The determination of the level of service (for some pre-determined planning horizon) able to be provided without exceeding the critical levels can be determined through modeling and optimization of withdrawals. Once the level of service is determined, it will serve as the basis for the implementation of strategies to protect the aquifers. For example, the critical level may represent the drawdown caused by withdrawals needed to meet demands in a 1-in-50 year drought. The District may permit to some other level, such as a 1-in-20 year drought. When water levels fall below the 1-in-20 year level, the District may implement management schemes (water use restrictions, etc.) to ensure that the critical level (1-in 50) is not exceeded. In severe drought events, the District may allow water levels to fall below the critical levels if damage is reversible. In some areas, the permit level may fall below the critical level. In these cases, other management strategies need to be implemented, such as shifting new uses to alternative sources or increasing the efficiency of existing uses through the permitting process.

SHORT AND LONG-TERM PLANNING EFFORTS

After several months of discussions with the LWCWSP Advisory Committee, District staff and other environmental experts in the state, it became apparent that it would be impossible to develop specific drawdown criteria for addressing environmental resources in the next draft of the plan. The issues are too complex to adequately address with quantitative measures within the next several months.

Instead of attempting to arrive at numeric environmental protection criteria that might not adequately protect the environment or that might infringe on private property rights, staff has developed a short-term and long-term approach for dealing with this complex issue. The short-term approach presents a series of interim, non-

numeric criteria and actions that can be identified in the next draft of the plan and which can be implemented over the following five years. This includes identifying specific non-numeric measures intended to offer some level of resource protection, particularly for ONS properties, while further studies of wetlands and other resources are being performed. In addition to non-numeric resource protection criteria, the short-term strategy will include the development of goals, objectives and strategies, as well as performing and implementing studies and programs. The short-term strategy will be described in the next revised edition of the LWCWSP intended for adoption in late 1992 or early 1993.

The long-term effort is designed to address the real problem of scientifically identifying and defending the environmental resources and appropriate management strategies. These results would be included in the amendments of the LWCWSP. Following is an outline briefly stating the tasks that would be performed in the two-staged approach.

Short-Term Efforts (1992 - 1997)

- Establish goals, objectives and strategies for dealing with environmentally sensitive areas.
- Identify two distinct types of environmentally sensitive areas (map): 1) Outstanding Natural Systems, and 2) all other non-regional systems.
- Identify potential future problem areas (areas where projected drawdown is under wetlands).
- Develop non-numeric resource protection guidelines for ONS areas which would help to insure that water resource related activities within or adjacent to ONS areas would not jeopardize the hydrologic cycle or plant and animal communities within such designated areas.
- Re-evaluate ground water resource protection criteria accounting for physical properties of the various aquifers.
- Revise the existing Basies of Review (Surface Water Management and Consumptive Use Permitting) criteria to include the statistical equivalent of the current environmental regulatory criteria (a maximum of one foot drawdown of the surficial aquifer under a wetland at the end of 90 days of no recharge).
- Identify and implement programs (studies and projects) required to document the relationship between drawdown of the surficial aquifer and impact to wetlands - research and monitoring to identify minimum flows and levels for wetlands and other environmental impacts such as saltwater intrusion.
- Identify and implement programs and studies for alternative sources and supplies:
  - ASR,
  - use of surficial resources (Caloosahatchee and Naples Bay),
  - emerging technologies (new types of desalination).
- Adopt LWCWSP.

Long-Term Efforts (1997 - 2010)

- Revise the LWCWSP to incorporate:
  - summary of results of studies and projects; identification of minimum flows and levels for wetlands from previous research and monitoring,
  - establishment of new specific criteria for impacts to wetlands,
  - recommendation of strategy for inclusion of new criteria into permitting and other implementation strategies,
  - new modeling of projected impacts (water shortages) using environmental criteria.
  - recommended surface water control elevations to maximize water supply, flood protection and allow development.
  - establish revised aquifer protection criteria based on the physical properties of the aquifer.
- Revise the Basis of Review for consumptive use permitting.
- Perform ongoing research and monitoring in the field of new criteria.

List of Figures

APPENDIX 1

Data Sources for Environmental Analysis

National Wetland Inventory Maps developed from stereoscopic analysis of high altitude aerial photographs (U.S. Dept. of Interior, Fish and Wildlife Service, 1988) and revised in 1991 by South Florida Water Management District staff.

Lee County Water Resource Mapping Program (SFWMD Internal Report, 1982) and Collier County Water Resource Mapping Program (District Internal Report, 1984)

The Charrette Map resulted from a workshop in January, 1991 sponsored by the Florida Audubon Society, Nature Conservancy and Florida Department of Natural Resources to identify ecological natural resource conservation areas to be considered for acquisition under the Preservation 2000 Act passed by the Florida Legislature in 1990.

Satellite Imagery. A satellite image of the Lower West Coast Planning Area was created using 1988-1989 Landsat scenes, which were merged together. The image was generalized to a pixel size of one acre each.

Florida Atlas of Breeding Sites for Herons and their Allies (Runde et al, 1991) was produced by the Florida Game and Fresh Water Fish Commission (FGFWFC) to document endangered wood stork and other wading bird breeding colonies throughout the state of Florida.

Caloosahatchee River land use maps were developed by South Florida Water Management District staff to analyze agricultural development in tributary sub-basins within the Caloosahatchee drainage system.

South Florida Water Management District Save Our Rivers 1992 5-year plan identifies natural systems that are being considered for acquisition.

Southwest Florida Water Management District 5-year plan identifies lands already acquired or being considered for acquisition in Charlotte County.

Information regarding Florida panther range and habitat requirements were provided by FGFWFC maps (1988) and the Florida Panther Recovery Plan.

Soil surveys of Collier, Charlotte, Hendry, Lee, and Monroe Counties (U.S.D.A. Soil Conservation Service, 1954, 1984, 1990, 1984, 1984).

Significant Wildlife Resource Areas of Florida (U.S. Dept. of Interior, Fish and Wildlife Service, 1981) provides information regarding areas of ecological interest and data on endangered flora and fauna.

EXHIBIT I

FUTURE LAND USE ELEMENT EAR

ANALYSIS OF GROUNDWATER RESOURCES CATEGORY

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I. Historical Background

A. Creation of the Category

The 1989 Lee Plan permitted residential development in all uplands located outside of the Future Urban areas at a maximum density of one unit per acre. This maximum density figure was challenged by DCA and several intervenors in the 1989 plan litigation because, among other things, it allegedly encouraged urban sprawl.

The 1989 Lee Plan amendment litigation was abated in October of that year, when all of the parties signed a settlement agreement. The agreement provided, inter alia, that Lee County would amend its Future Land Use Map to lower the maximum density in a "proposed new Water Resources category" to one unit per 10 acres. The new category was to be imposed on the following property:

1. Most non-urban land east of I-75, southwest of the new airport, and south of S.R. 82;

2. All non-urban land located north of Cape Coral between Burnt Store Road and U.S. 41; and

3. All non-urban land within an area lying east of U.S. 41 and bounded on the south by a line lying two miles south of the Charlotte County line and running parallel with it to the eastern boundary of Lee County.

Lee County complied with the settlement agreement and created a new Future Land Use Map category, named the Density Reduction/Groundwater Resource (DRGR) area, with a maximum density of one unit per 10 acres in 1990. The new category was used to redesignate the land described in the settlement agreement based on findings in four studies, most particularly the Lee County Water Resources Management Project prepared by James M. Montgomery, Consulting Engineers, Inc., which indicated that all of the DRGR areas had at least some potential for wellfield development. The analysis supporting the 1990 amendments indicated that reductions in densities were not the only means by which groundwater resources could be protected; in fact, it contained the following statements:

> "There is no universal consensus as to the proper type of land use controls which are needed to protect shallow groundwater resources... As more is learned about the techniques for protecting these areas, it is

possible that the restrictions against urban development can be modified...."

The new category was extremely unpopular with many of the affected land owners. A group of them, consisting of members of the Zemel family, filed both a petition for an administrative hearing and a complaint in Circuit Court, alleging that the redesignation of their property was unsupported by the data and constituted a taking without the payment of just compensation. The administrative proceeding concluded when DCA found that the map change was, in fact, amply supported by the studies that were available to the county at the time the amendment was adopted. This decision has been appealed to the First District Court of Appeals. The Circuit Court case has been tried, but the Judge has not yet issued a final order.

Several other owners of property in the DRGR have filed applications to redesignate their property based on testimony from engineers and hydrologists that their proposed developments would not endanger groundwater resources. Some of these applicants clearly anticipated that such testimony would be sufficient to persuade the Board to increase their densities. In fact, however, only two of these requests have been approved, one of which was initiated, in part, by the State of Florida, and the other of which is subject to ongoing litigation.

B. The Henigar & Ray Study

During the process of preparing its 1993 Evaluation and Appraisal Report (EAR), the county hired Henigar & Ray, Inc. to conduct a study to determine the maximum densities that could be permitted in the DRGR without jeopardizing existing and future water supplies. This study was intended to be the first step in a two step process; in the second stage, the county staff would be evaluating densities in the DRGR in relation to a wide variety of planning considerations, in addition to groundwater protection, including:

1. DCA's definition of urban sprawl;
2. Economic diversification;
3. Existing and projected service availability;
4. Ownership and development patterns;
5. Population accommodation capacity concerns;
6. Environmental limitations;

7. The land use classifications of adjoining properties; and

8. Affordable housing.

The Henigar & Ray study was completed on July 28, 1993 and was incorporated into the EAR. The salient features of the study were as follows:

1. The study divided the DRGR into three areas based on the transmissivity of the water table aquifer. Area "A" has the highest transmissivity and is, therefore, entitled to the greatest degree of protection; Area "B" also has potential for wellfield development, but has lower transmissivity values; and Area "C" has relatively little potential for wellfield development.

2. The study evaluated four different density scenarios, two of which were primarily intended to illustrate extreme positions. One of the remaining scenarios included density increases in Areas "B" and "C," partly through the use of TDRs.

3. The study suggested best environmental management practices to protect groundwater resources in Area "B."

4. Section VI.B of the study acknowledged that TDR programs could not work in the absence of proven demand for densities above the maximums that are otherwise permitted by the plan and an adequate supply of transferable development rights.

5. The study also emphasized the need to protect groundwater resources from incompatible agricultural and mining uses, both of which have always been permitted in the DRGR.

C. <u>The Lee County Regional Water Supply Authority Master Plan</u>

On January 27, 1994, the Lee County Regional Water Supply Authority, an entity consisting of representatives from the Lee County Commission and the city councils of Fort Myers, Cape Coral, and Sanibel, conceptually approved the Lee County Regional Water Supply Authority Master Plan. The Master Plan analyzes the potable water needs for Lee County in 10-year increments through the year 2030 and makes recommendations as to the size and location of future wellfields. Map 1, which is reproduced from the study, shows the locations of these wellfields.

MAP 1A

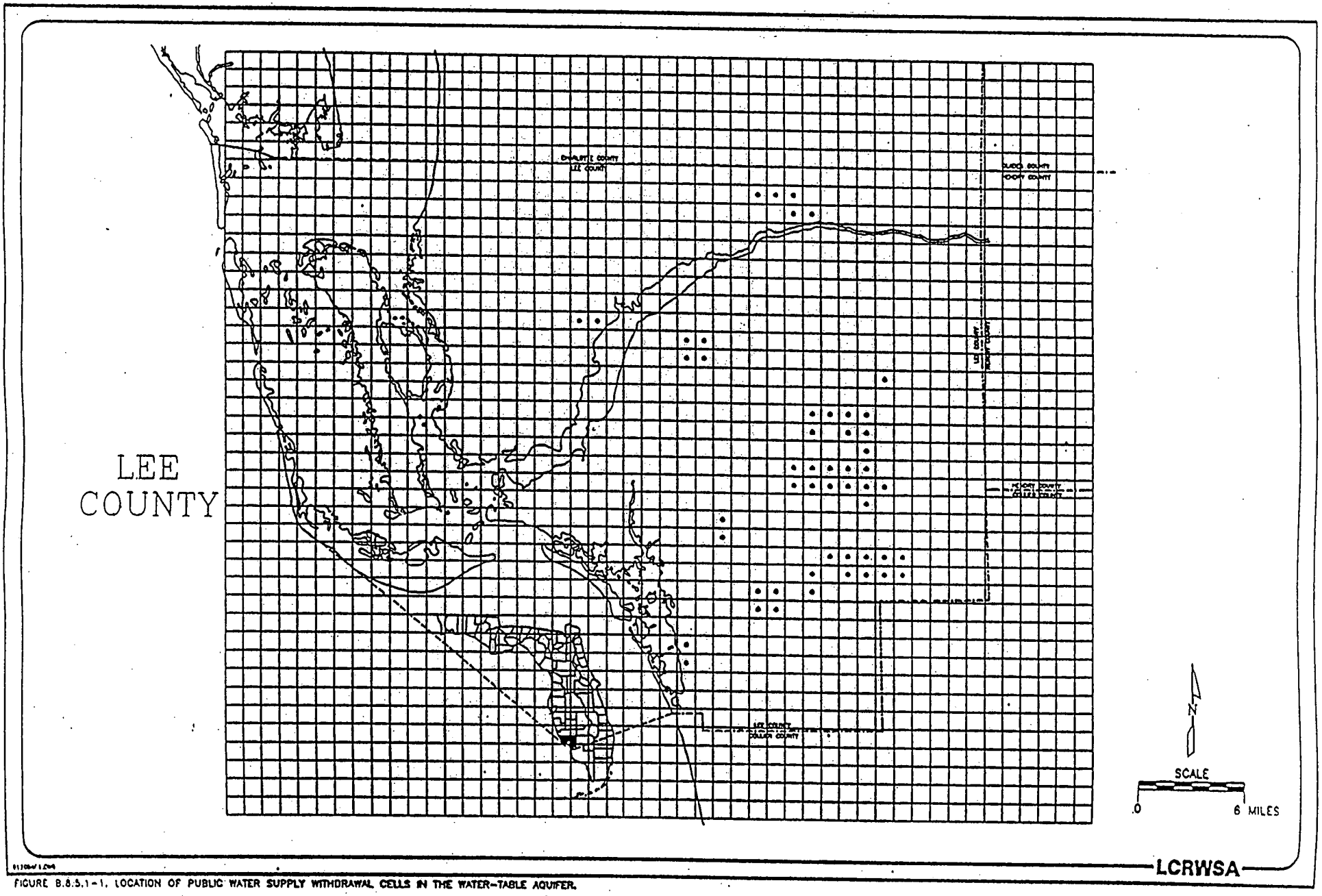


FIGURE B.8.5.1-1. LOCATION OF PUBLIC WATER SUPPLY WITHDRAWAL CELLS IN THE WATER-TABLE AQUIFER.

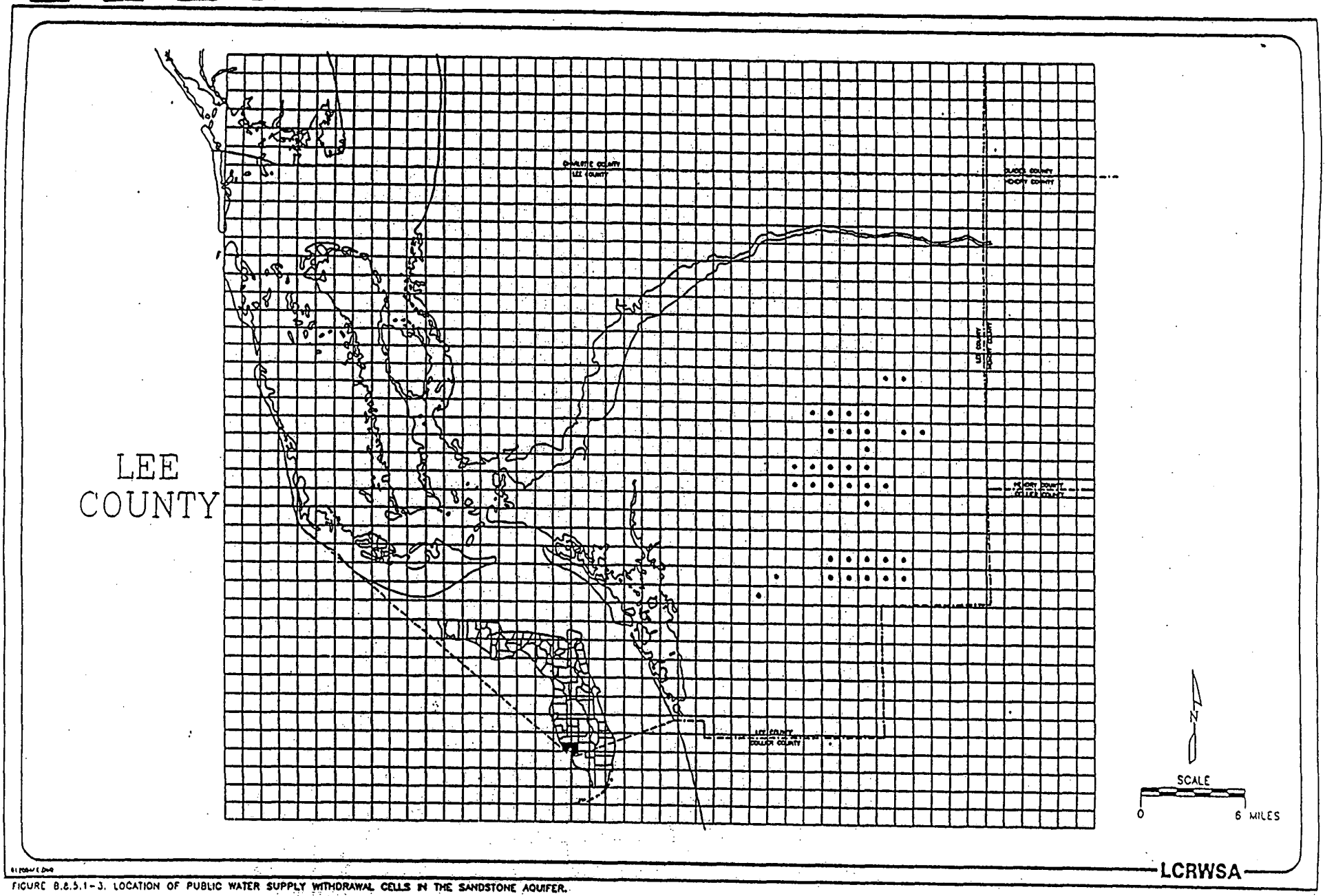


FIGURE B.6.5.1-3. LOCATION OF PUBLIC WATER SUPPLY WITHDRAWAL CELLS IN THE SANDSTONE AQUIFER.

MAP 1C

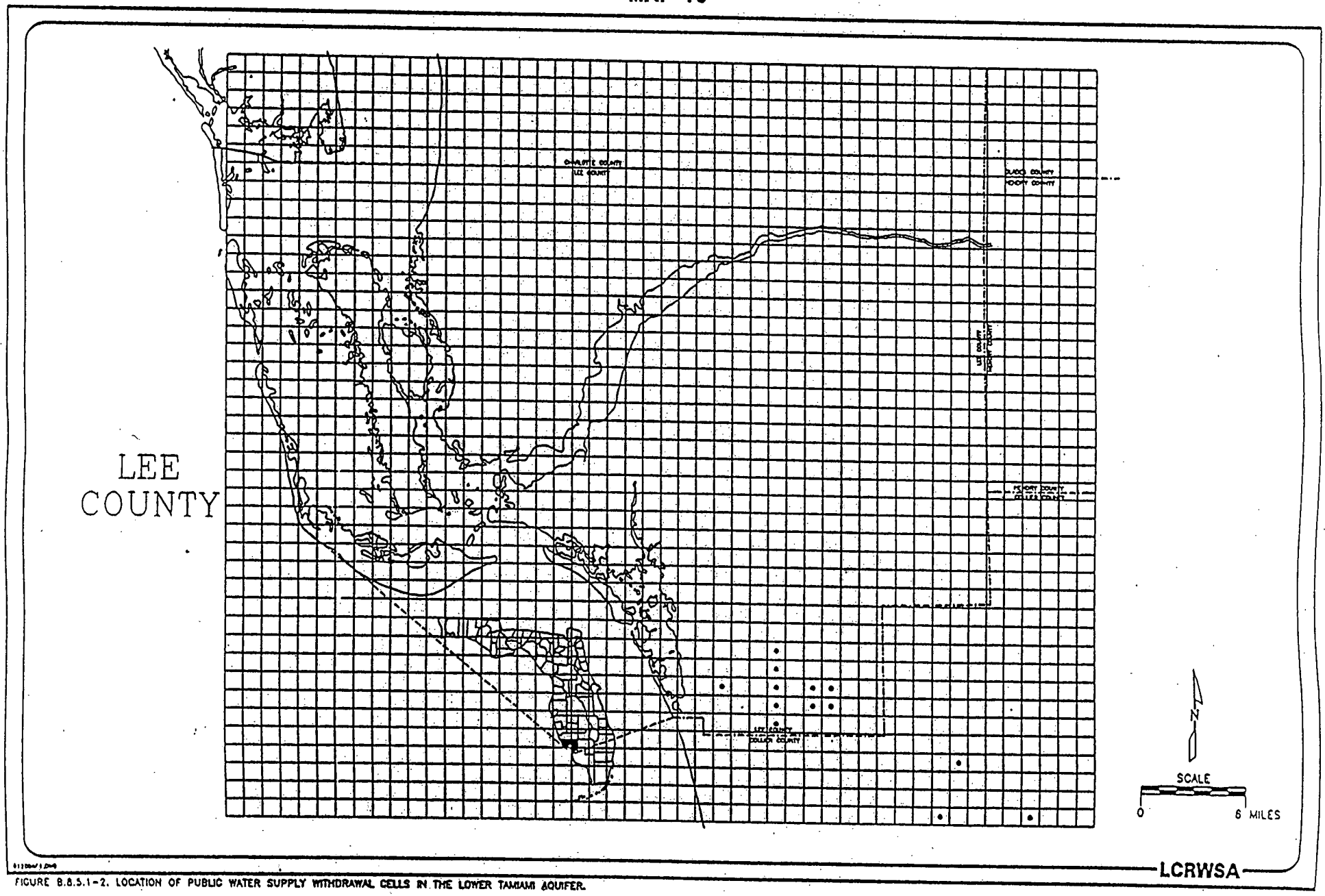


FIGURE B.8.5.1-2. LOCATION OF PUBLIC WATER SUPPLY WITHDRAWAL CELLS IN THE LOWER TAMIAMI AQUIFER.

The Master Plan varies from the Henigar & Ray study in two important ways. First of all, one of the future wellfields is in Area B, not Area A. This is due primarily to limitations placed on the county by the South Florida Water Management District with regard to dry season drawdowns in wetlands. Second, the future wellfields represent a relatively small portion of the DRGR area in the southeastern part of the county. The mere fact that a particular piece of property in Area A or B is not shown as a future wellfield does not mean, however, that it should be excluded from the DRGR, as the county will need sources of potable water beyond the year 2030, the negative impacts of development on groundwater supplies are very difficult to reverse, and SFWMD regulations could be amended in the future to permit the county to put more wellfields in portions of the DRGR that are currently excluded from consideration.

D. The Instant Study

This analysis recommends changes to the DRGR based on the Henigar & Ray study, a review of the planning factors described above, and new data provided by the Regional Water Supply Authority.

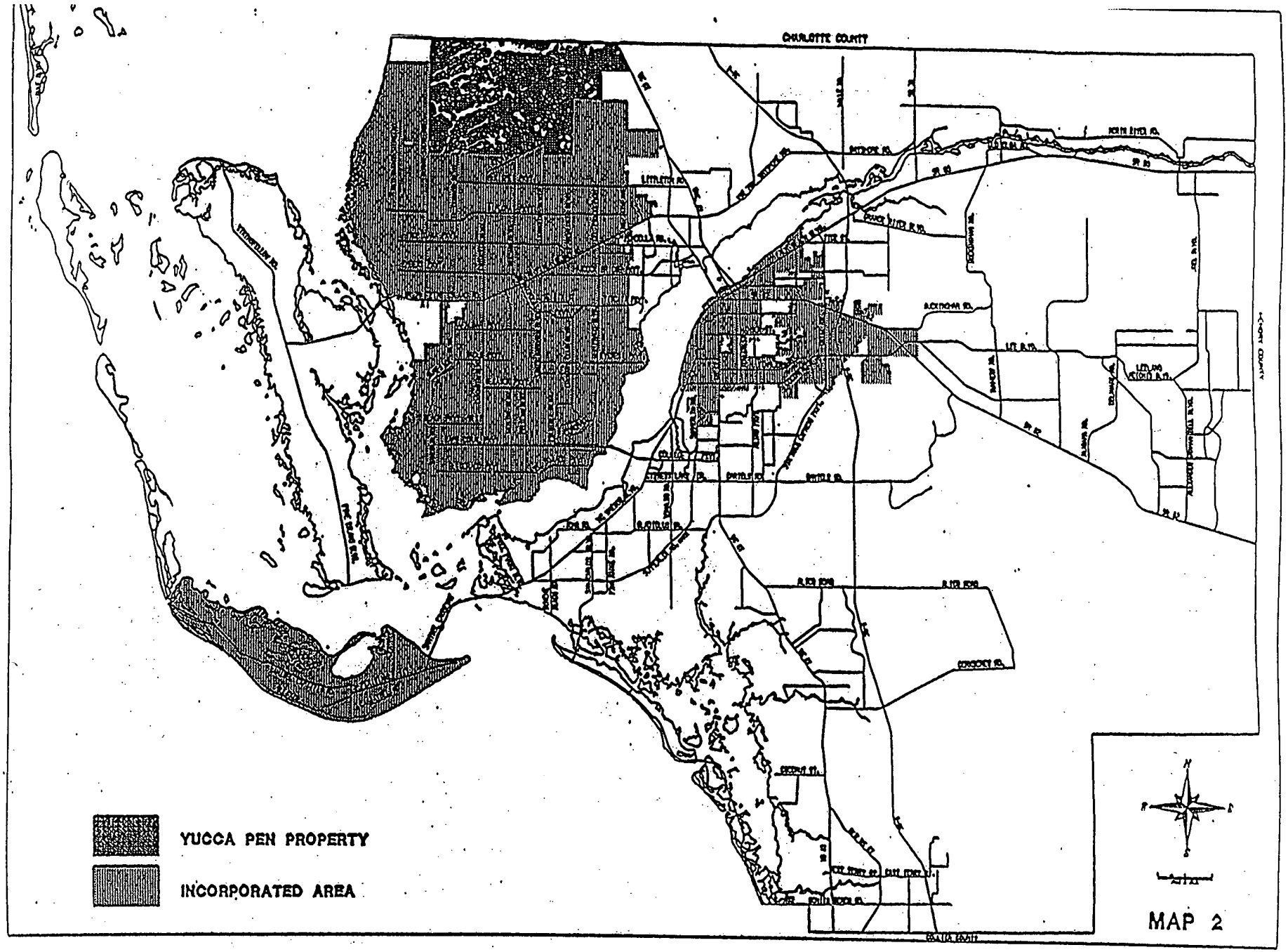
One of the options reviewed during this process was the creation of a TDR Program for Areas A and B. This option was ultimately abandoned, however, due to the apparent absence of potential receiving areas with adequate infrastructure, few environmental or groundwater protection problems, and established demand for higher densities.

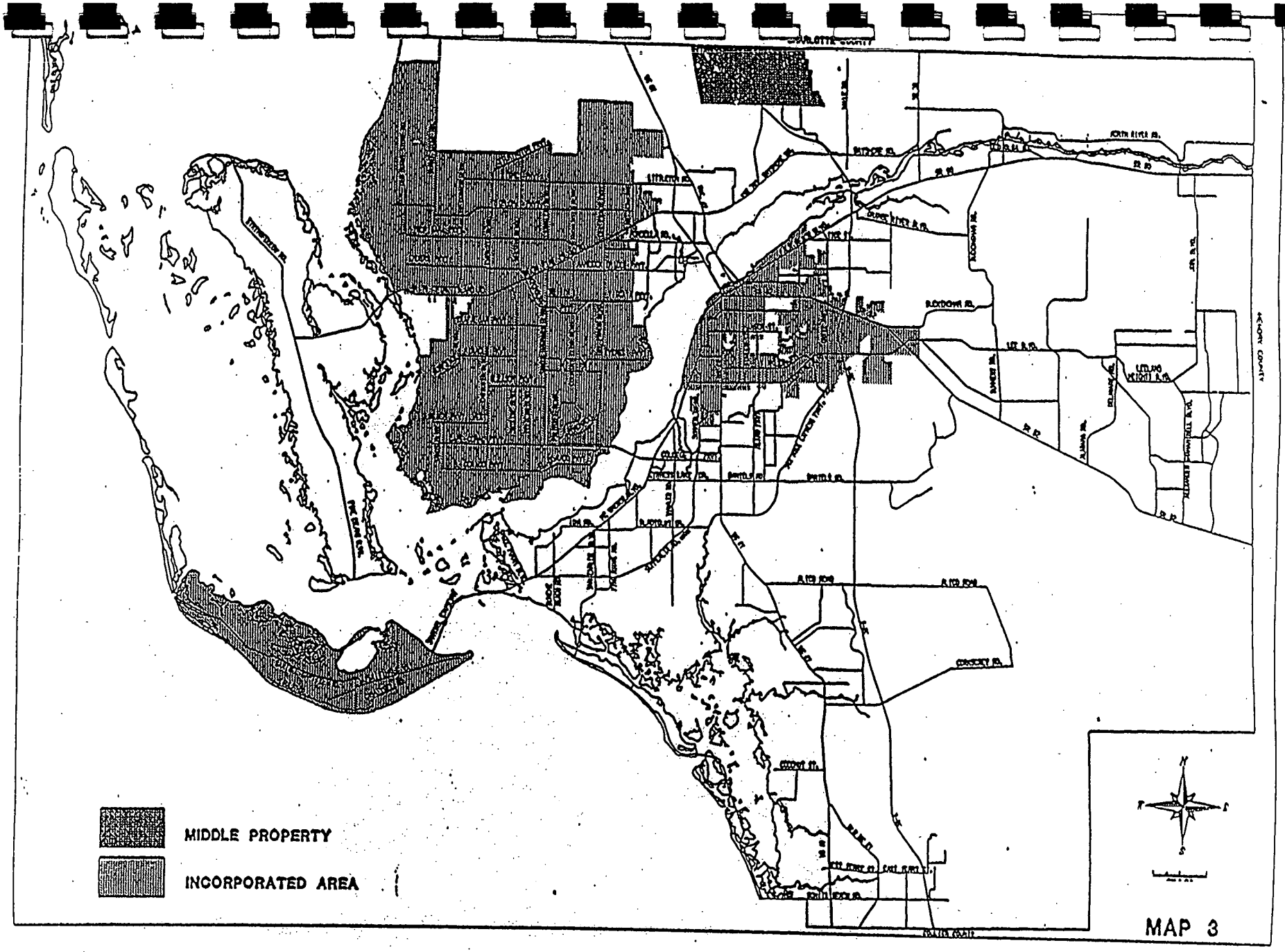
II. Analysis and Recommendations

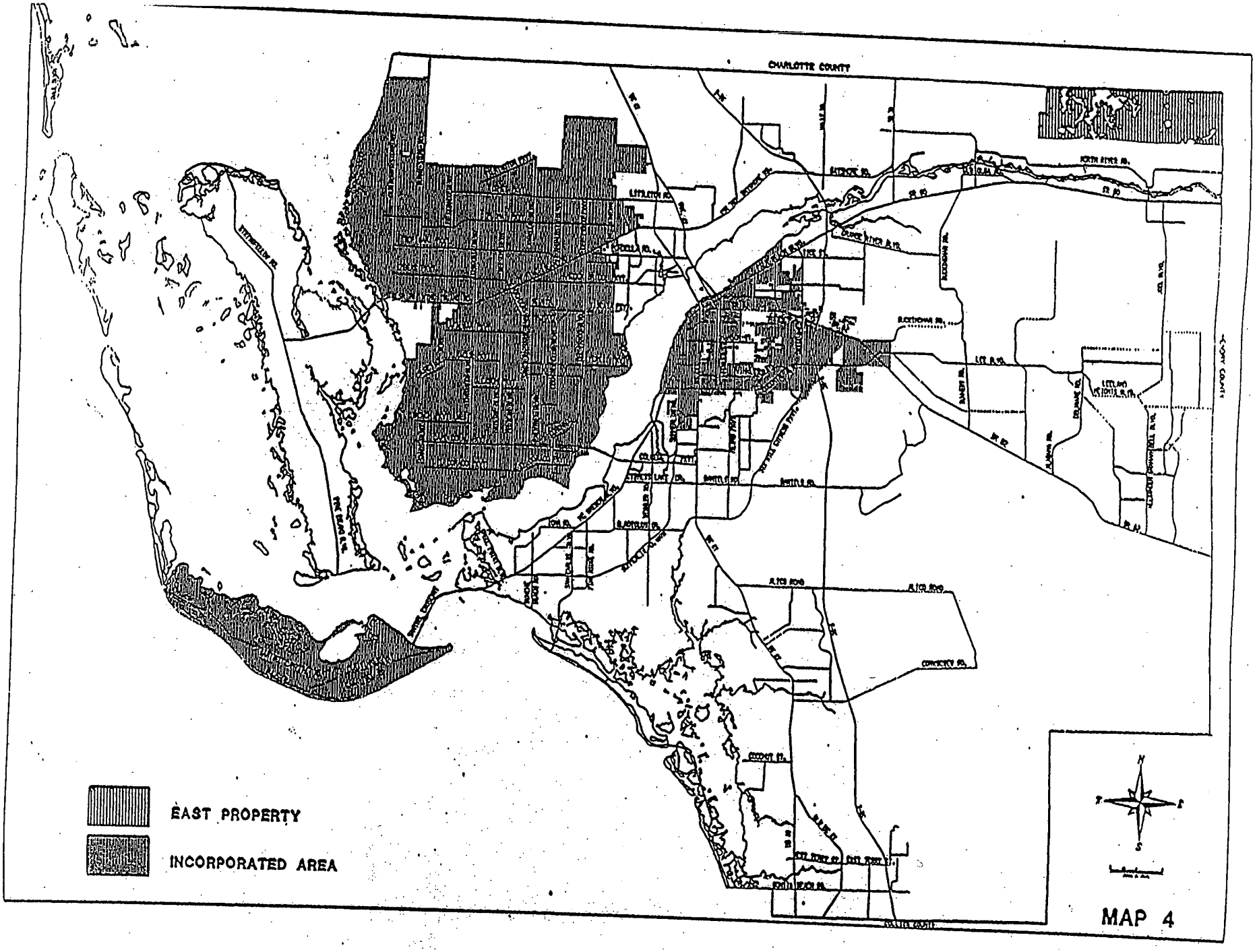
A. Area C

Area C consists of three distinct areas located north of the Caloosahatchee River. The first of these is a number of tracts (Map 2) (collectively described as the "Yucca Pen property" in this analysis) bounded to the west by Burnt Store Road and to the east by various urban areas and U.S. 41. The second (Map 3) is bounded to the west by urban areas and to the east by property in Area B. The third (Map 4) is located between property in Area B and the Hendry County line.

The Henigar & Ray study indicates that Area C has minimal potential for wellfield development (see, e.g., pages 42 and 55). Information subsequently received from the Regional Water Supply Authority does not show any property in Area C being used for wellfields, with the exception of wellfields utilizing the Floridian aquifer, which does not interchange water with other aquifers and which is not, therefore, in danger of pollution from land uses.


CHARLOTTE COUNTY
YUCCA PEN PROPERTY
INCORPORATED AREA
MAP 2


MIDDLE PROPERTY
INCORPORATED AREA
MAP 3


CHARLOTTE COUNTY
EAST PROPERTY
INCORPORATED AREA
MAP 4

The application of the DRGR to this property would appear, therefore, to be inappropriate.

1. Analysis of Yucca Pen Property

a. DCA's Definition of Urban Sprawl

The Department of Community Affairs, in its 1989 technical memo and proposed Rule 9J-5.006, has identified numerous characteristics and "indicators" of urban sprawl. Briefly summarized, urban sprawl is premature, one-dimensional, low-density residential development that is not in proximity to existing urban developments, facilities, and services. Urban sprawl frequently results in the premature conversion of agricultural land and the degradation of important environmental resources and discourages the efficient use of urban services and urban infill.

As described in section b.-g. below, the Yucca Pen property lacks urban services, is (at least in its interior) distant from existing urban developments, lacks potential for non-residential uses, and contains large quantities of environmentally-sensitive lands. In light of DCA's position in many plan compliance cases that one unit per acre is an "urban" density, it is clear that any attempt by Lee County to reclassify the Yucca Pen property to the Rural category would be viewed by the department as a violation of Rule 9J-5.006(3)(b)7.

b. Economic Diversification

The Yucca Pen property does not have access to the services that are necessary to support industrial development.

c. Service Availability

The property has four miles of frontage on Burnt Store Road, an arterial operating at LOS "A," to the west and one mile of frontage on U.S. 41 (also operating at LOS "A") to the east. There are no existing east-west or north-south arterials or collectors running through the property, and none are included in the county's 2010 Traffic Circulation maps. Section 5-43-24 is included in the county's water franchise area. The remainder of the property lacks public sewer and water service. The nearest fire station is one mile west and the nearest EMS station is one mile east.

d. Ownership and Development Patterns

The Yucca Pen property is vacant and consists of a number of large tracts, virtually all of which are in excess of 10 acres.

e. Population Accommodation Capacity Concerns

Using the assumptions for percentage of residential use and population per household that are found in the EAR, the Yucca Pen property would accommodate 8,293 people and 3,968 dwelling units at a density of one unit per acre and 2,073 people and 992 units at one unit per five acres.

f. Environmental Limitations

The Yucca Pen property contains large areas of wetlands. A portion of the property is included in the Charlotte Harbor flatwoods area, which has been targeted for public acquisition as part of the CARL program.

g. Classification of Adjoining Property

The Yucca Pen property abuts property designated Outlying Suburban and Suburban on three sides. Most of this property, however, is shown as urban solely due to ownership patterns; the City of Cape Coral does not anticipate that it will be built out until well after the 2020 horizon of this plan.

h. Affordable Housing

Property in this area will be relatively inexpensive throughout the time frame of this plan. The cost of providing services and resolving environmental problems, however, would make it more difficult to provide affordable housing here than in the undeveloped portions of Lehigh Acres and Cape Coral.

2. Analysis of East Property

a. Urban Sprawl

The east property presents largely the same issues as the Yucca Pen property. Adjacent property owned by the Babcock Florida Company in Charlotte County was originally given a maximum density of one unit per acre; DCA successfully challenged this

designation in an administrative proceeding, and the density was subsequently reduced to one unit per 10 acres.

b. Economic Diversification

The east property is currently being used primarily for agricultural purposes. The parcel has little potential for industrial purposes due to the lack of service availability.

c. Service Availability

The property does not have access to public sewer or water service. There are no planned or existing east-west or north-south arterials or collectors running through the parcel. The nearest fire station is 1.5 miles away and the nearest EMS station is 1.7 miles away.

d. Ownership and Development Patterns

The vast majority of the east property is owned by the Babcock Florida Company. A subdivision consisting primarily of 10, 5, and 2.5 acre lots has been created in Sections 1, 2, 3, 11, 12, and 13 of Township 43 South, Range 27 East.

e. Population Accommodation

The east property would accommodate 3,834 people, or 1,834 units, at one unit per acre and 958 people, or 459 units, at one unit per five acres.

f. Environmental Limitations

The property contains large quantities of wetlands in a relatively pristine condition.

g. Classification of Adjoining Property

The adjoining property in Charlotte County has a maximum density of one unit per 10 acres. The property to the south is Rural. Property to the west is in the DRGR category. Hendry County has given the property to the east a maximum density of one unit per five acres.

h. Affordable Housing

The prospects for affordable housing here are similar to those for the Yucca Pen property.

3. Analysis of Middle Property

a. Urban Sprawl

Staff's conclusions regarding urban sprawl are the same as for the Yucca Pen and east areas.

b. Economic Diversification

This area is characterized by a proliferation of large lot residential subdivisions, some of which have agricultural uses. Industrial uses would not be appropriate in this area, due to compatibility and service availability problems.

c. Service Availability

The property does not have access to public water or sewer facilities. The area is serviced by a number of arterial and collector roads (Slater Road, Nalle Road, and Nalle Grade Road) as well as by an extensive network of local streets; the area west of I-75, however, is currently inaccessible. The nearest fire station is two miles away and the nearest EMS station is 7.5 miles away.

d. Ownership and Development Patterns

The area east of I-75 consists largely of residential subdivisions at densities of not less than one unit per five acres.

e. Population Accommodation

This area would accommodate 5,482 people, or 2,623 units, at one unit per acre and 1,370 people, or 656 units, at one unit per five acres.

f. Environmental Limitations

There are relatively few wetlands in the middle property.

g. Classification of Adjoining Property

Property to the east of this area is in the DRGR. The Charlotte County property to the north has a maximum density of one unit per 10 acres. Property to the south is designated Rural and Outlying Suburban, while the property to the west is designated Suburban and Outlying Suburban.

h. Affordable Housing

Since this property is reasonably accessible and contains relatively few wetlands, its potential as a location for affordable housing exceeds that of the east and Yucca Pen tracts. Lots in this area would not, however, be as inexpensive as existing lots with more services in Lehigh Acres or Cape Coral.

4. Conclusion

Two of the Henigar & Ray scenarios allocated one unit per acre to Area C, while a third provided a base density of one unit per five acres and a maximum density (with TDRs) of one unit per acre. DCA is likely to object to any amendment that has the potential to increase the density in this area above the one unit per five acres on urban sprawl and population accommodation grounds. A maximum of one unit per five acres is consistent with ownership patterns in the middle area, reflects the limitations on the potential of all three areas for the development of wellfields, and is compatible with the densities permitted in Charlotte and Hendry counties, provided that the planned development process is used to prevent adverse impacts on the many environmentally sensitive lands in these areas. Staff consequently recommends that all property in Area C be placed into a new category with a maximum density of one unit per five acres, to read as follows:

POLICY 1.4.5: Open Lands are upland areas that are located north of rural and/or sparsely developed areas in Township 43 South. These areas are extremely remote from public services and are characterized by agricultural and low-density residential uses. Commercial and industrial uses are permitted in this category in accordance with the standards in the Rural category. The maximum density in this category is one unit per ten acres (1 du/10 acres); except that a maximum density of one dwelling unit per five acres (1 du/5 acres) is permitted if the planned development process is used to prevent adverse impacts on environmentally sensitive lands (as defined in Policy 77.1.1.4).

B. Areas A and B

Map 5 shows the boundaries of Areas A and B. These areas, according to both the Henigar & Ray and the Regional Water Supply Authority studies, have the greatest potential for development of wellfields using the surficial and intermediate aquifers. It is clear, therefore, that the groundwater protection rationale for the DRGR is appropriate as applied to these areas.

In light of the economic diversification issue discussed in Section I.F.1 of the Future Land Use Element EAR, the Density Reduction/Groundwater Resource Category was examined to determine the feasibility of redesignating property to Wholesale/Industrial or Airport Commerce. Only one parcel was determined to have significant potential for industrial uses. This parcel is discussed below.

1. Analysis of Alico, Inc. Property-North (Map 6)

This property consists of approximately 1,400 acres located north of Alico Road and immediately south of the airport expansion area. It abuts property designated Airport Commerce to the west.

(a) Urban Sprawl

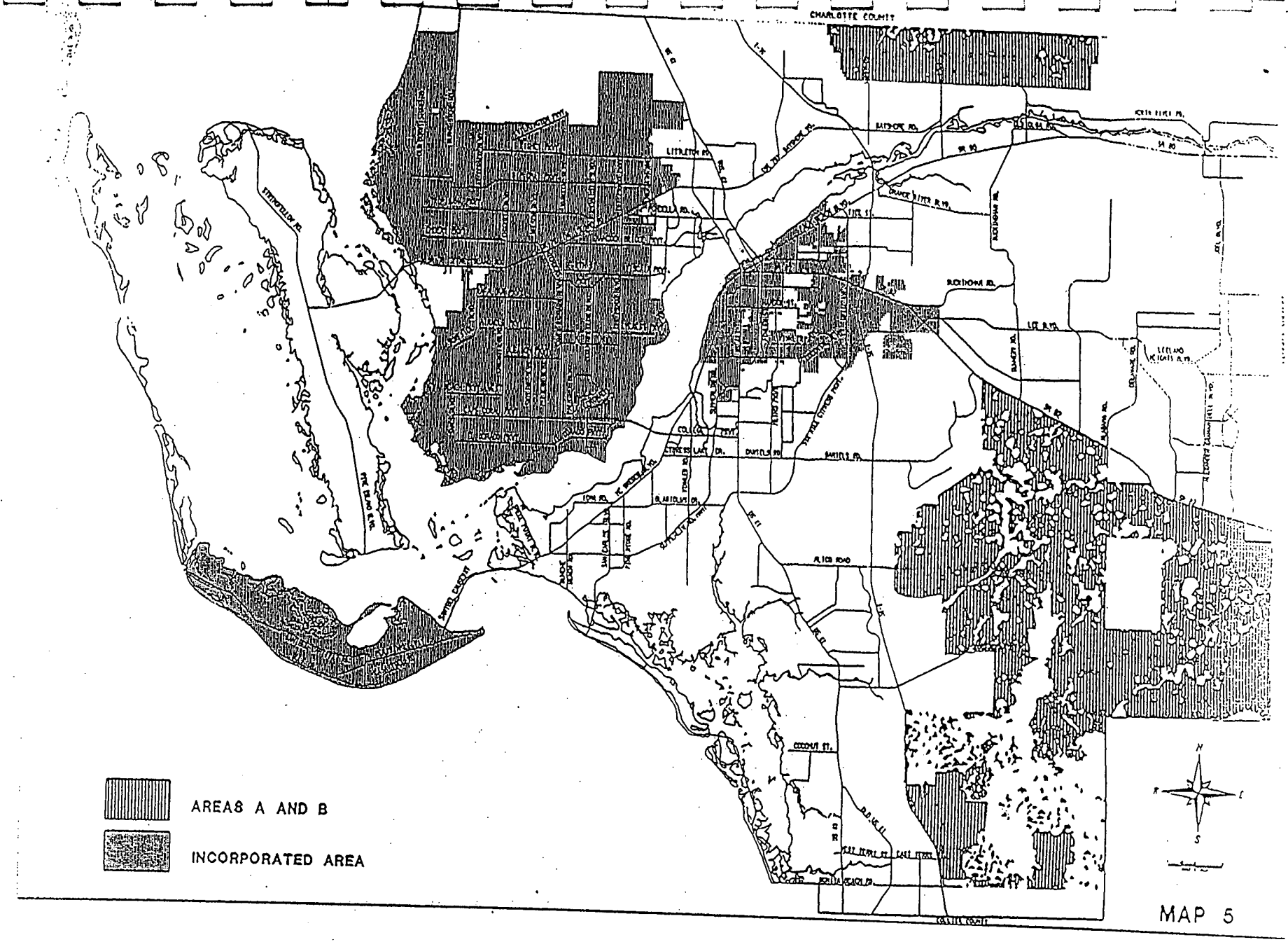
A redesignation of this land from the DRGR category would not constitute urban sprawl, as the property has or will have access to urban services, abuts urban uses on two sides, and will not be used for low-density residential purposes.

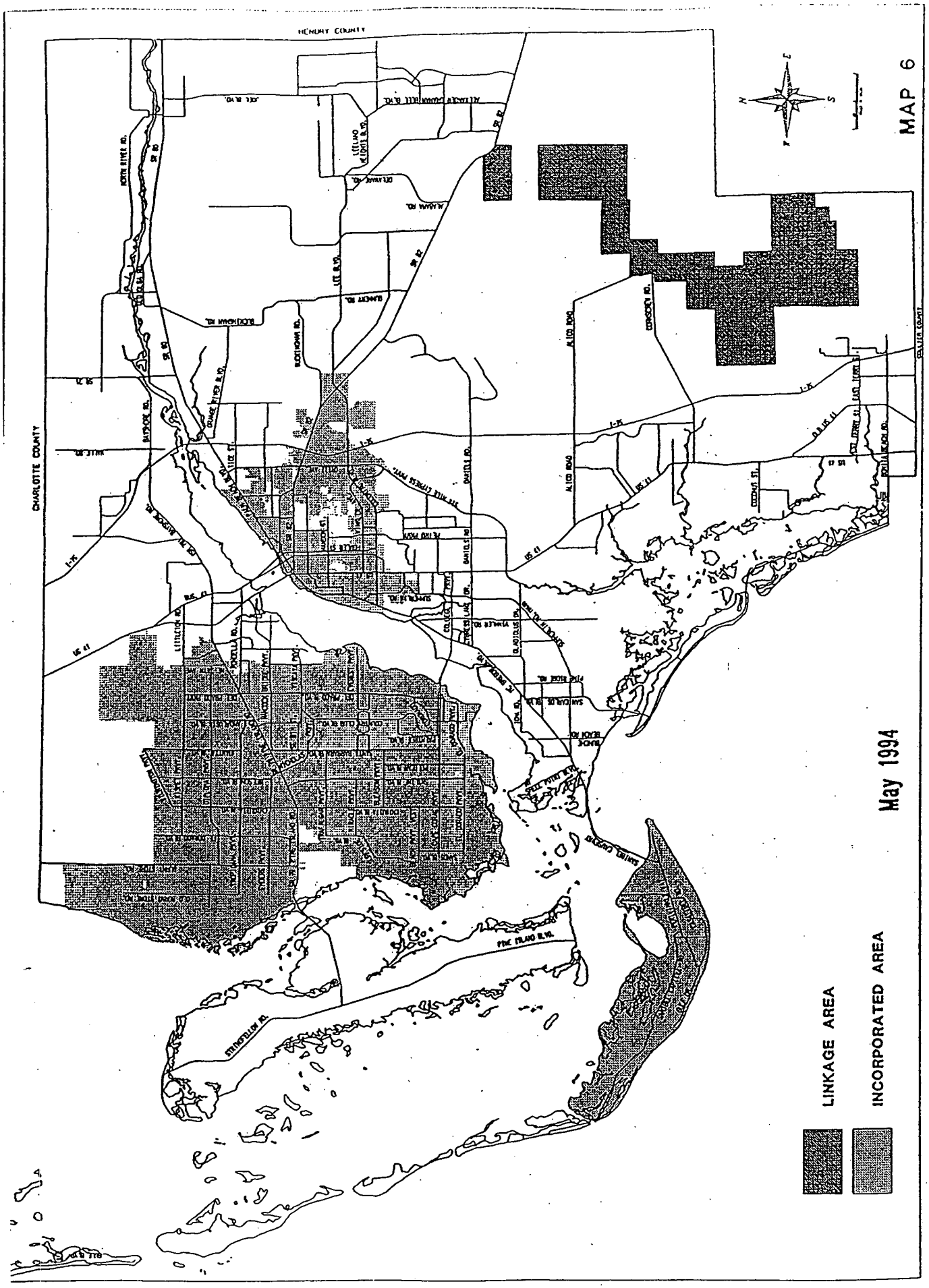
(b) Economic Diversification

The property will be ideally located for airport commerce uses following the airport expansion. The industrial allocations section of the Future Land Use element EAR describes the urgency of the need to identify additional industrial land to diversify the county's economy.

(c) Service Availability

The property abuts Alico Road, an arterial operating at LOS "A." The 2010 Needs Plan shows a new east-west freeway, the Alico Expressway, and a north-south collector, Treeline Boulevard, running through or close to the property. A 30-inch water line runs along Alico Road from the county's Corkscrew wellfield past


CHARLOTTE COUNTY
AREAS A AND B
INCORPORATED AREA
MAP 5



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the subject parcel. The property is not currently served by a central wastewater disposal facility.

(d) Ownership and Development Patterns

The entire parcel is vacant and is owned by Alico, Inc.

(e) Population Accommodation

The proposed revision would reduce the accommodated population by 10 units, or 21 people.

(f) Classification of Adjoining Property

The airport expansion area is located to the north of this area. The property to the east is in the DRGR, while the parcel to the south contains a large excavation.

(g) Environmental Features

The property contains wetlands, but it consists mostly of pine flatwoods, fallow croplands, and a rock quarry.

(h) Affordable Housing

The property has very limited potential for affordable housing at the present time due to its proximity to the International Airport and the one unit per 10 acre maximum density. The proposed amendment would prohibit residential uses at this location.

(i) Consistency with Henigar & Ray Study

This property is located in Areas A and B, but is not shown by LCRWSA as being a future wellfield site. All development at this location should be subject to the requirements described in Section II.B.2. below.

(j) Recommendation

The Future Land Use Map should be amended to show the Alico-North property as Airport Commerce. The definition of the Airport Commerce category should be revised to require that all development in this area be undertaken pursuant to the Planned

Development process. BEMPs will be required in accordance with Section II.B.2. below.

2. Best Environmental Management Practices (BEMPs)

Section V.C. and Appendices C and D of the Henigar & Ray study set out a series of BEMPs for development in Area B. These standards were reviewed by the Executive Director of the Lee County Regional Water Supply Authority (LCRWSA) and by the Director of the Division of Natural Resources Management (DNRM). Their reactions, generally summarized, were as follows:

a. LCRWSA agreed with, and put particular emphasis on, BEMP #1, while DNRM staff expressed concern about the absence of supporting documentation.

b. DNRM staff expressed concern about the enforceability and legality of BEMPs #2 and #3.

c. DNRM staff suggested that the prohibition against disposing of toxic substances or hazardous materials by means of discharge to a septic tank in Appendix D was unenforceable.

d. DNRM staff indicated that the use of BEMPs for sewer design and construction would be helpful.

e. Both LCRWSA and DNRM agreed with the representatives of some property owners that the .35 impervious surface ratio could, in particular cases, be too strict.

f. DNRM staff was concerned about the costs of expanding and enforcing the Wellfield Protection Ordinance.

In light of the differing views on the proposed BEMPs, it would be inappropriate to use them as hard-and-fast rules and preclude other potential engineering solutions. This issue is addressed in the recommendation in two ways. First of all, any property owner in the Alico industrial area will be required to utilize the Planned Development rezoning process. Second, applicants who deviate from the Henigar & Ray BEMPs will be required to rebut the presumption that the BEMPs listed in the study are necessary to protect groundwater resources during the rezoning hearings by providing evidence that alternative engineering solutions will accomplish the same purpose.

C. Staff Recommendations

The following revisions should be made to the DRGR:

1. Area C should be excluded from the category and placed in a new Open Lands category, as described above;

2. Areas A and B should remain in the DRGR and retain their current base density of one unit per 10 acres;

3. The Alico-North area should be redesignated Airport Commerce, but shall be subject to Planned Development and BEMP requirements.