FINAL DRAFT

ST. LUCIE COUNTY

WATER AND RELATED LAND RESOURCES REPORT

A PORTION OF THE
COOPERATIVE RIVER BASIN STUDY
FOR
MARTIN AND ST. LUCIE COUNTIES

FLORIDA

1984

ST. LUCIE COUNTY REPORT

A Report Developed From The

MARTIN - ST. LUCIE COUNTIES
COOPERATIVE RIVER BASIN STUDY

A WATER AND RELATED LAND RESOURCES REPORT

Prepared By

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

ECONOMIC RESEARCH SERVICE

In Cooperation With

MARTIN COUNTY SOIL AND WATER CONSERVATION DISTRICT

ST. LUCIE COUNTY SOIL AND WATER CONSERVATION DISTRICT

1984

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INTRODUCTION

The Cooperative River Basin Study for Martin and St. Lucie Counties was initiated at the request of the Soil and Water Conservation Districts of these two counties. Authority for participation in the study by the United States Department of Agriculture is granted under Public Law 83-566, Section 6. Within the USDA, the principal participants for this study are the Economic Research Service and the Soil Conservation Service.

Due to budgetary constraints during the period that this study was initiated and undertaken, the study focus was changed to a study of the relationship of soils, current and projected land use, and habitat. Therefore, the sponsors recognize this study only as a land use study that compiles available published data related to the following items:

1. Potential water storage areas.
2. Future agricultural water needs.
3. Future urban and industrial water demands.
4. Environmentally sensitive areas and areas of special consideration for development.
5. Effects of interchange of groundwater between various aquifer levels.
6. Surface water quality.
7. Water quantities from various storm frequencies and surface runoff.
8. Flood data on non-incorporated areas not covered by flood insurance studies.
9. Potential for storing water outside the county for future use (interchange with Lake Okeechobee and other areas).
10. Water conservation programs.

The St. Lucie Soil and Water Conservation District hopes future funding would allow this land use study to be expanded into a river basin plan that would relate these items to the St. Lucie River and help the District in their soil and water conservation program.

Much of the material included in this report is compiled from, or quoted directly from, reports of other agencies or organizations. All quoted material in this report is printed in script. Opinions and recommendations contained in those reports do not necessarily represent the opinions nor philosphies of the sponsors (St. Lucie Soil and Water Conservation District) nor the USDA agencies that assisted in developing this report.

----ACKNOWLEDGEMENTS----

The Soil Conservation Service and Economic Research Service gratefully acknowledge the contributions of personnel time by the South Florida Water Management District (SFWMD); North St. Lucie River Water Control District; Institute of Food and Agricultural Sciences; Ft. Pierce Utilities Department; St. Lucie Soil and Water Conservation District; St. Lucie County Planning Division, and others who made the compilation of this report possible. Much of the information and illustrative material in the report is taken directly from reports of the SFWMD and reports prepared by and for the COE. These and other public documents on which the report is based are cited as appropriate in the text and are identified in the bibliography.

SUMMARY AND CONCLUSIONS

1. All population figures, past and projected, show an increase in population in St. Lucie County. The maximum projected increase from the 1980 population of 84,520 is 194 percent in the next 55 years as contrasted to the low projection of 69 percent.

2. As a result, pressures on the land and water resources of the county are increasing. This pressure can be expected to result in conflicts over the limited quantity of land and water available. The quality of the environment can be expected to change due to this pressure (some might call it environmental deterioration). A public informed about the consequences of alternative development possibility will make a more rational choice from among future water and land use options.

3. A better understanding is needed regarding the quantity and quality of available water in its relationship to such natural factors as, for example, the frequency, duration, and amount of precipitation; soils and land cover. More information is needed regarding the effect of differing technologies on the amount of water required to be withdrawn or conserved for various uses.

4. The U. S. Geological Survey, South Florida Water Management District, and the Institute of Food and Agricultural Sciences, in particular, should be encouraged to coordinate, expand and intensify their current research on this issue in the St. Lucie County area. The University of Florida Food & Resource Economics Department and the South Florida Water Management District should mount a major study program, in conjunction with the needed physical and biological research to develop and disseminate information on alternative water management policies, including pricing policies. Particular attention should be given to distribution of those costs and benefits among the affected segments of society. Supporting organizations should include, but not be limited to Department of Environmental Regulation, Department of Natural Resources, Department of Agriculture and Consumer Services, Soil Conservation Service, and the other water management districts.

5. Several alternatives are being analyzed by the Corps of Engineers and South Florida Water Management District as potential water sources, as well as their potentials in meeting water resource management objectives (such as preserving natural resources, fish and wildlife). Some alternatives being considered include wellfield development, demand reductions, desalination, dual conveyance systems enabling water of various qualities to be used for different purposes and deep aquifer storage. The South Florida Water Management District reports that there are several ongoing studies to determine the feasible alternatives.

6. The Southwest Florida Water Management District at Brooksville, in cooperation with the Center for Governmental Responsibility, University of Florida College of Law, prepared and published a report designed to meet the minimum criteria of the National Flood Insurance Program (NFIP) so that a community using it may qualify for flood insurance. Each flood insurance study includes a flood boundary map delineating the areas subject to flooding by the 100-year and 500-year floods. The model flood management ordinance should be used as a minimum basis for regulation and the NFIP encourages the use of higher standards in local programs.

7. A small change in the subtle balance among geologic conditions, soils, climate, ground water and surface water regimen, flora, and fauna, can cause significant changes in the environment. Human interference with these natural balances has been a source of controversy throughout the country. To provide a sound basis for resolving such conflicts, future developments should be carefully considered for effects on ground and surface water, habitat, and the general environment/impacts on the quality of life.

The South Florida Water Management District is doing studies on various alternatives encouraging water conservation. The U. S. Army Corps of Engineers is currently doing a major study of water supply in St. Lucie County. The USDA Soil Conservation Service assists individual landowners with soil and water conservation needs as well as local governments.

CHAPTER I. CURRENT AND PROJECTED POPULATION AND ECONOMIC ACTIVITY

Population, employment, and land use information provide an important base on which to estimate potential pressure on land, water, and environmental resources. It is important to recognize that projections are estimates of trends that seem to be occurring. The actual situation that will occur at a future time period may differ substantially even if no controlling actions are taken. However, the public, interested in and concerned about the environment within which they and future generations will live, can use information from projections to encourage development directions which may be preferred. Thus, the projections contained herein should be viewed only as information useful in developing county policy, not as inevitable conditions over which the public has no control.

Current and historical population figures are taken from the Census of Population. Projected population estimates are derived from two sources: Booz-Allen report to the COE and the Treasure Coast Regional Planning Council. Employment projections are taken from the Booz-Allen report. Note that in each case, a range of projections is provided.

Tables 1-1 and 1-1A provide current and historical population figures and alternative projections. Current and projected employment estimates (Table 1-2), are derived from the Booz-Allen report.

Population projections are based on estimates of natural increase (births less deaths) and net immigration of new residents. The low, medium, and high projection (Tables 1-1 and 1-1A) result from different estimates of natural increase and net immigration. Both population and employment projection alternatives reflect differing estimates (high, low, and medium) and assumptions about the growth of the economy in Florida and in the county.

The population projections from the two different sources are not significantly different; probably a common source was used by both references. It is important to note that while the median projection results in a doubling of population by 2020 (40 years), the result is still relatively small considering the land area in the county. In subsequent chapters of the report, the median population

projections are used to derive projected estimates or urban land use and estimates of urban water requirements. The implication of the projection ranges are discussed as appropriate in those chapters.

TABLE 1-1. ST. LUCIE COUNTY -- POPULATION, HISTORICAL AND PROJECTED

St. Lucie County	Historical	Projection Level		
		Low	Medium	High
1960	39,294			
1970	50,836			
% Change (1960-70)	+29.4			
1980	84,520			
% Change (1970-80)	+66.3			
1990		103,200	118,000	126,300
% Change (1980-90)		+22.1	+39.6	+49.4
2000		114,600	137,000	154,700
% Change (1990-2000)		+11.0	+16.1	+22.5
2020		134,700	168,500	199,600
% Change (2000-2020)		+17.5	+22.9	+29.0

Source: Treasure Coast Regional Planning Council: Regional Profile, June 1979

TABLE 1-1A. ST. LUCIE COUNTY -- CORPS OF ENGINEERS, BOOZ-ALLEN PROJECTIONS

St. Lucie County	Projection Level		
	Low	Medium	High
1985	92,000	98,800	105,900
2000	113,800	131,400	151,300
2020	130,500	164,300	206,700
2035	143,000	188,900	248,200

Source: Booz-Allen, and Hamilton - (for complete citation of this and other sources, see Ch. 8, Bibliography).

Table 1-2. ST. LUCIE COUNTY - EMPLOYMENT - 1980 AND PROJECTED

Employment Sector[1/]	1980	1985 Alt.1	1985 Alt.2	1985 Alt.3	2000 Alt.1	2000 Alt.2	2000 Alt.3	2035 Alt.1	2035 Alt.2	2035 Alt.3
Construction	1,200	2,160	2,295	2,460	2,395	2,765	3,180	2,535	3,355	4,405
Manufacturing	1,300	1,870	1,990	2,130	2,050	2,370	2,725	1,950	2,580	3,390
Wholesale Trade	1,000	1,295	1,375	1,475	1,370	1,585	1,815	1,560	2,065	2,710
Retail Trade	5,500	7,095	7,465	8,070	8,035	9,280	10,670	8,770	11,510	5,155
Transportation, Communications & Utilities	1,500	1,870	1,990	2,130	2,395	2,765	3,180	2,925	3,870	5,085
Services	5,150	7,210	7,610	8,150	9,235	10,665	12,250	11,600	15,380	20,205
Finance, Insurance, and Real Estate	1,750	2,015	2,140	2,295	2,565	2,960	3,400	3,120	4,130	5,425
Government	4,450	5,330	5,755	6,070	6,155	7,110	8,170	6,540	8,710	11,425
Agriculture	4,200	4,150	4,080	4,020	4,000	3,800	3,600	3,600	3,000	2,500
Total		33,000	34,700	36,800	38,200	43,300	49,000	42,600	54,600	70,300

1/ Estimates are for total civilian employment by place of work, including covered and noncovered categories

Source: Booz-Allen, and Hamilton, Inc.

SUMMARY Points of Chapter I.

1. All population figures, past and projected, show an increase in population in St. Lucie County. The maximum projected increase from the 1980 population of 84,520 is 194 percent in the next 55 years as contrasted to the low projection of 69 percent.

2. Medium projections of the Corps of Engineers (COE) and the Treasure Coast Regional Planning Council are in reasonable agreement of a population of approximately 166,000 in the year 2020 or about twice as many people in a 40-year period (1980-2020).

3. Medium population projections do not indicate a dense population in the year 2020 when compared to the county size. This would be a density of one person for each 2.4 acres of land.

4. Employment can be expected, according to the COE report, to increase in every major sector except agriculture which is expected to decrease by 14 to 40 percent during the next 55 years (by 2035).

5. Employment increases during the next 55 years will be highest in the areas of Construction, Services, and Transportation, Communications, and Utilities.

6. Other Needs -- A water-related report is being prepared by the COE that is expected to be completed in the near future. Population projections actually used in that report should be compared with those in this report to determine if they have evaluated different trends.

CHAPTER 2. CURRENT AND PROJECTED LAND USE

Current Land Use

A principal focus of this report is on the relationship of soils, current and projected land use and wildlife habitat, and the consequences of land use changes on the environment and water requirements.

The basic land use data and map were provided by the South Florida Water Management District (SFWMD). (Example of map, Figure 2-1). Soils information and aggregations have been developed in cooperation with Soil Conservation Service (SCS) soil scientists, area conservationist, and district conservationists. Costs of production for the major crops in the county were derived from reports by Ron Muraro (University of Florida) in cooperation with USDA specialists.

Land use information presented by the SFWMD has been aggregated into thirteen categories (Appendix II).

The individual soils in the county soil survey report have been aggregated into ten soil groups based on the SCS soil potential study. An eleventh soil group accounts for unmapped land in the county, and the twelfth soil category is provided to account for water areas. The composition and acreage in each soil and water group is provided in Table 2-1.

The detailed land use, soils, and water information were coded, on 3.7 acre plots, into a computer mapping system. With this system; soils, land use, and wildlife habitat information were correlated in order to produce maps and tables which were internally consistent and reasonably representative of existing relationships. Sample illustrations of the land use and soils maps are shown in Figures 2-1 and 2-2 respectively. All maps listed in Appendix I are of the same nature. These maps could not be reduced to a size for inclusion in this report, however, copies are available for use at the Soil Conservation Service Office at Ft. Pierce, Florida. Other copies have been furnished to local agencies involved in planning decisions in St. Lucie County.

TABLE 2-1. ST. LUCIE COUNTY -- SOIL GROUPS

Soil Group Number	Soils and Mapping Unit in Group		Acres
I	Paola	28	318
	St. Lucie	42	2564
	Palm Beach	27	371
	Astatula	7	266
	Welaka Var.	53	1054
	Total - I		4573
II	Jonathan	19	322
	Electra	12	1122
	Canaveral	10	1755
	Hobe	17	1549
	Satellite Var.	41	1657
	Pendarvis	29	1805
	Total - II		8210
III	Chobee	11	9019
	Winder	55	1102
	Hilolo	16	3819
	Riviera	38	10734
	Pineda	32	52388
	Winder Var.	56	861
	Floridana	13	4066
	Pople	36	6771
	Total - III		88760
IV	-	-	-
V	Anclote	1	300
	Malabar	23	6126
	Salerno	39	2592
	Riviera Dep.	37	31107
	Winder Dep.	54	34026
	Fluvaquents	14	1800
	Total - V		75951
VI	Wabasso	48	29356
	Oldsmar	26	5108
	Basinger	8	6532
	Pompano	34	256
	Wabasso Var.	49	1888
	Total - VI		43140
VII	Waveland	50	23714
	Nettles	25	29798
	Lawnwood	21	19293
	Ankona	2	14198
	Pepper	31	9349
	Susanna	43	1486
	Tantile	44	4017
	Waveland-Lawnwood Complex	51	6079
	Myakka	24	2088
	Total - VII		110022
VIII	Hallandale	15	1128
IX	Hontoon Muck	18	446
	Terra Ceia Var. Muck	45	1538
	Kaliga Muck	20	1773
	Samsula Var./ Myakka Var.	40	4188
	Turnbull Var.	46	291
	Pompano Var./ Kaliga Var.	35	3857
	Arents, Org. Subsoil	6	309
	Total - IX		12402
X	Urban	47	948
	Beaches	9	440
	Pitts	33	106
	Arents 0-5%	4	7408
	Arents 45-65%	5	2459
	Pendarvis-Urban	30	385
	Ankona-Urban	3	1131
	Lawnwood-Urban	22	1009
	Waveland-Urban	52	1448
	Total - X		15334
XI	Unmapped		10586
XII	Unclassified		27070
	Total County		397276

Source: Soil survey for St. Lucie County, and consultation with SCS soil scientists; discrepancies between totals and subtotals in this table and subsequent tables are due to unavoidable differences in coding and estimating procedures.

Figure 2-1. Sample Illustration (land use map)

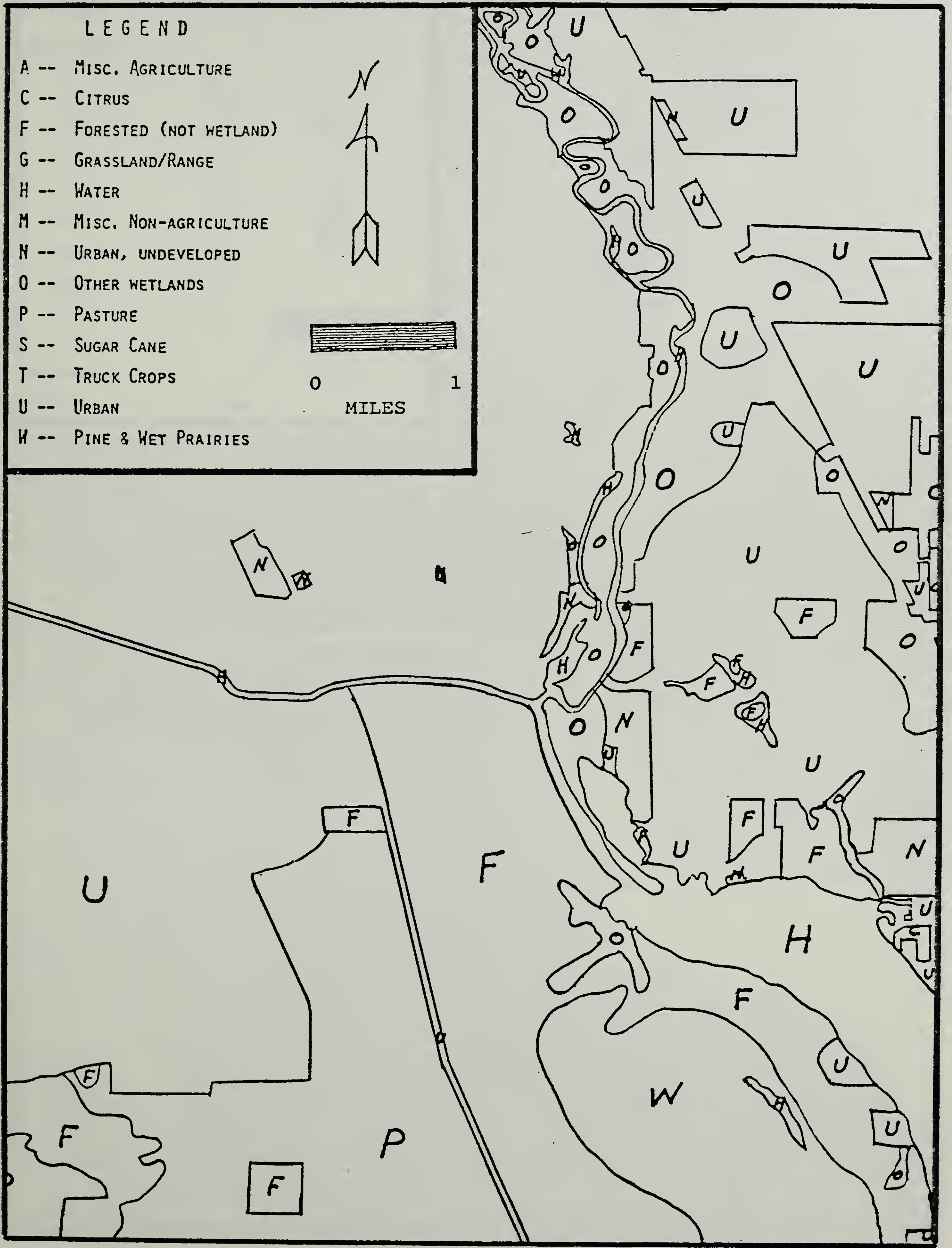
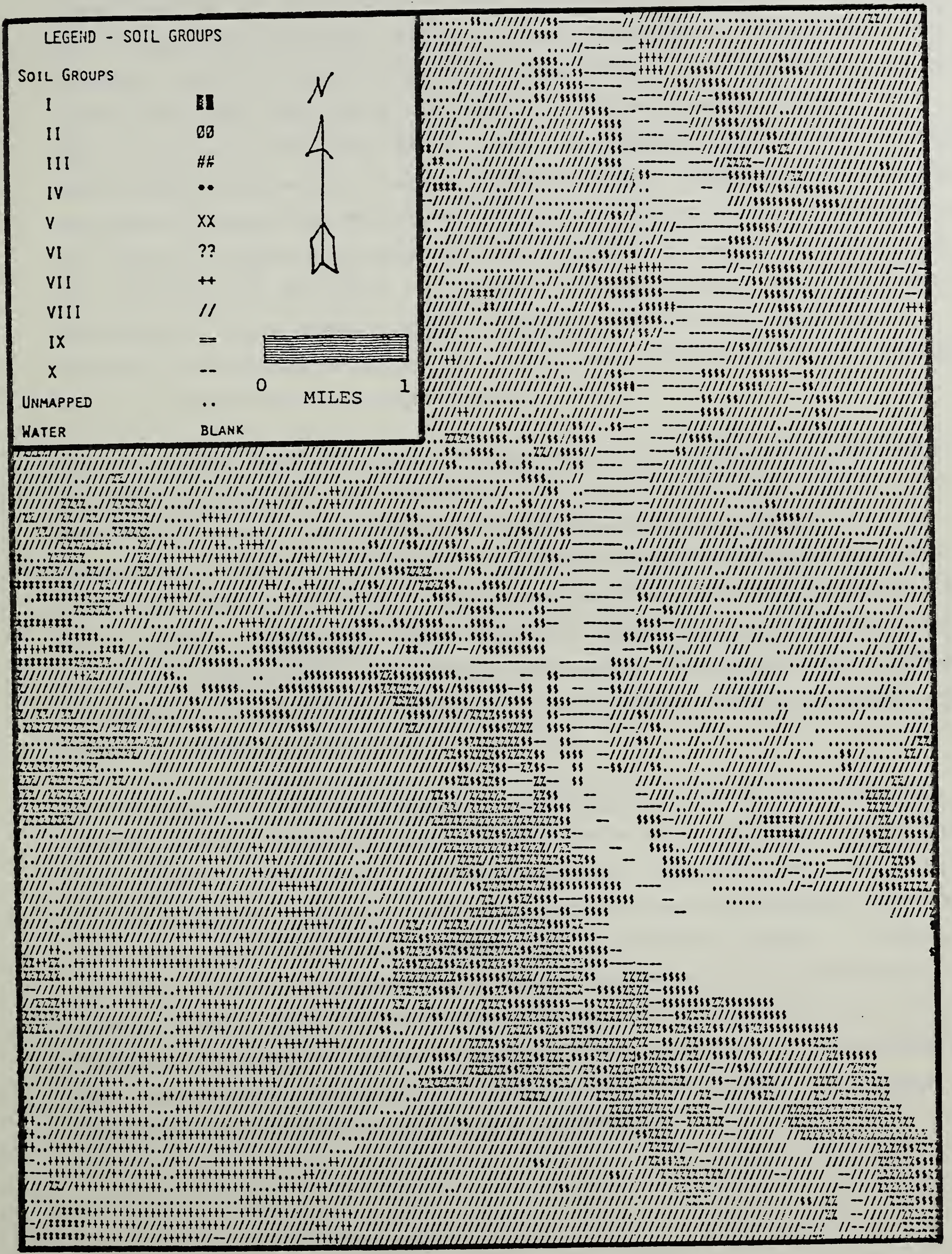


Figure 2-2. Sample Illustration (soils map)



Projected Land Use

Projections are not predictions of what actually will happen at some future date. Land use projections, based on accepted procedures, assumptions, and criteria provide an indication of the directions of land use which might be expected to occur under those assumptions. They are useful because they provide the public with information about the expected consequences of certain choices made by private and public decision-makers. With projections in hand, the public, through the regulations of county planning and zoning activities, can choose to change the course of events toward an alternative future which they consider more desirable. At present, the restrictions and regulations governing St. Lucie County's growth management and resource conservation decisions are spelled out in the St. Lucie County Comprehensive Plan prepared by the St. Lucie County Planning Division.

The projections selected for use in this report are based on the Booz-Allen estimates prepared for the forthcoming COE report. These were chosen in particular because it was considered important for this summary to be as consistent as possible with the work of other agencies and especially with that major effort by the COE. Though the Booz-Allen work included about 75% of the county, it did not reflect permitting and planning actions taken during the period since 1979-80. In order to show these differences and to provide the public with a range of information about possible land use outcomes, this report provides two projection alternatives.

The first projection - the Booz-Allen Equivalent - uses the Booz-Allen projections within the Martin County General Design Memo Study Area and follows these trends for that part of the county outside the study area. As a result of this procedure, citrus acreage is projected to decline somewhat from the 1979 level; pasture and urban acreages are projected to increase. Overall, the changes can be considered quite modest, particularly in consideration of apparent recent trends for population migration to focus on the more central Florida counties rather than the southern areas. In addition, some observers think that citrus acreages will increase rather than decline. With these factors in mind, a second projection was developed.

The second set of projections - the Alternative Projections - is intended to represent a more intensive land use assumption. Again, it should be remembered that these are not predictions; they are presented merely as possible land use situations as one basis on which current public decisions may be made. The Alternative Projections assume that citrus acreage will increase, in this case about 26,500 acres over the 1979 level and about 28,000 acres over the Booz-Allen Equivalent Projections. Furthermore, it was assumed that population migration would increase somewhat, effectively requiring the development of the urban planning area designated by the St. Lucie County Planning document. The only assumed restriction on development in that area was that none of the environmentally sensitive areas (see Chapter 6) would be available.

The data developed, based on the assumption for each projection, were coded into the Current Land Use System. This made it possible to produce maps and tables illustrating the projected changes in relationships between soils and land use habitat.

A summary of current and projected land use, by both sets of projections, is provided in Table 2-2. Table 2-2A presents acreages of land use by soil groups and county totals for the base year (1979). Similar data for each set of projections are provided in Tables 2-2B and 2-2C. In comparing the current land use with the projected, it should be noted that in the most intensive land use projection, citrus would change from 25% to 32% of total land while urban land use would change from about 13% to about 15% of total land. This implies only an insignificant intensification. While this trend is supported by current information, readers would recognize the importance of continued monitoring of population factors. Changes in population characteristics could have important consequences for environmental systems including land and water use.

Potential Value of Soils

Citrus is a key indicator for potential value of land in agriculture. Detailed citrus budgets were developed that are consistent across the soil groups including revenue based on estimated yields, costs of development, costs to alleviate limitations such as wetness or acidity, and costs for regular maintenance (Table 2-3). These budgets were used to develop Table 2-4 which shows the relative value of the soil groups for citrus production. These relative values reflect the potential for agriculture. Table 2-4 also shows

acre distribution and returns for the 1979 base, Booz-Allen Equivalent, and Alternative Projections. Summary conclusions are:

1. Gross return for citrus in all soil groups are positive.
2. Net return with development cost includes: Soils VII, VIII; IX have negative return.
3. Net return without development costs: Soils VIII and IX have negative return.
4. Ordering from most productive economically with development costs are: Soils I, III & VI, II, V, VII, VIII & IX (negative).
5. Ordering from most productive economically without development costs are: Soils I, III, V & VI, II, VII, VIII & IX (negative).
6. More intensive land use for citrus production results in increased net returns, but using Soil Groups VII, VIII, & IX for citrus results in a reduction in net returns on the aggregate county-wide. For the individual owner/producer, there may be compensating reasons for placing that land in production.

Maps

Display maps for information of various local groups have been prepared on a scale of 1 inch equals 3200 feet or 1:38,000. These are available for review at the office of the Soil & Water Conservation District, Fort Pierce, Florida. Because these maps are of specific county interest, they have not been reduced to include in the report. The basic land use map, 1979, provided by SFWMD and aggregated to the 13 land use categories has been provided as a transparent overlay (Map 2-1). This may be used with subsequent maps to identify each set of projected land use changes (Maps 2-2 and 2-3) to identify the correlation of land use with the soil groups (Map 2-4); to identify the relative potential for citrus in correlation with soils and land use (Map 2-5); and to correlate land use with environmentally sensitive areas (Maps 6-1, 6-2, 6-3 & 6-4).

TABLE 2-2. ST. LUCIE COUNTY -- LAND USE - Base Year and Alternative Projection Summary

	Use[1/]	1979	50-Year Projection Booz-Allen Proj.	50-Year Projection Alternative Proj.
		Acres		
1	Citrus	97404	95116	123949
2	Pasture	107318	110,631	95175
3	Truck Crops	716	716	716
4	Sugarcane	0	0	0
5	Miscellaneous Ag.	147	125	147
6	Urban	49810	56678	59411
7	Urban Undeveloped	1634	1550	1550
8	Forested (Not Wetland)	54959	51003	40880
9	Grassland/Range	1315	1297	1271
10	Pine and Wet Prairies	24745	21193	20014
11	Other Wetlands	25564	25439	20877
12	Miscellaneous Non-Ag.	1502	1491	1249
13	Unclassified	26060	25935	25935
	Total	391175	391175	391175

1/ Aggregated into 13 groups, from 65 categories mapped and tabulated by SFWMD; See Appendix II for details.

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[illegible]	[illegible]	[illegible]	[illegible]

[illegible]
[illegible]

TABLE 2-2A ST. LUCIE COUNTY LAND USE CLASSES BY SOIL GROUPS - 1979

(Acres)

LAND USE	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
						SOIL GROUPS							
1	1958.	507.	32701.	0.	39488.	7684.	10747.	584.	477.	2604.	477.	176.	97404.
2	966.	2285.	32664.	0.	14982.	14049.	34945.	162.	1601.	1822.	3713.	129.	107318.
3	0.	0.	121.	0.	70.	70.	441.	0.	0.	11.	0.	4.	716.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	15.	26.	0.	11.	26.	66.	0.	0.	4.	0.	0.	147.
6	2468.	2285.	3111.	0.	2340.	3030.	24653.	0.	882.	10328.	81.	632.	49810.
7	158.	118.	29.	0.	33.	95.	904.	0.	29.	184.	0.	84.	1634.
8	929.	1917.	7247.	0.	6160.	8914.	23757.	187.	1895.	2079.	1701.	173.	54959.
9	37.	224.	323.	0.	114.	125.	349.	0.	55.	59.	0.	29.	1315.
10	26.	426.	4048.	0.	2608.	3706.	12323.	4.	676.	525.	253.	151.	24745.
11	129.	900.	3118.	0.	5300.	1289.	1484.	70.	7280.	213.	4305.	1477.	25564.
12	209.	147.	73.	0.	88.	18.	176.	0.	114.	602.	51.	22.	1502.
13	103.	84.	136.	0.	151.	84.	448.	0.	463.	393.	4.	24194.	26060.
TOTALS	6982.	8907.	83597.	0.	71344.	39092.	110293.	1006.	13473.	18824.	10586.	27070.	391175.

SOIL GROUPINGS ARE THOSE FOUND IN TABLE 2-1

LAND USE GROUPS ARE AS FOLLOWS
1 - CITRUS
2 - PASTURE
3 - TRUCK CROPS
4 - SUGAR CANE
5 - MISCELLANEOUS
6 - URBAN
7 - URBAN UNDEVELOPED
8 - FORESTED NOT WETLAND
9 - GRASSLAND/RANGE
10 - PINE AND WET PRAIRIES
11 - OTHER WETLANDS
12 - MISC NON-AG
13 - UNCLASSIFIED

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE; CONSULTATION WITH SCS SOIL SCIENTISTS

TABLE 2-2B ST. LUCIE COUNTY LAND USE CLASSES BY SOIL GROUPS
BOOZ-ALLEN EQUIVALENT 50 YEAR PROJECTION
(Acres)

LAND USE	SOIL GROUPS I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
1	1925.	496.	32051.	0.	38603.	7464.	10486.	580.	422.	2435.	477.	176.	95116.
2	962.	2285.	33568.	0.	15603.	14659.	35984.	162.	1612.	1950.	3713.	132.	110631.
3	0.	0.	121.	0.	70.	70.	441.	0.	0.	11.	0.	4.	716.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	15.	7.	0.	11.	26.	62.	0.	0.	4.	0.	0.	125.
6	2509.	2531.	3978.	0.	3783.	3860.	27459.	4.	1039.	10736.	81.	698.	56678.
7	158.	118.	29.	0.	33.	84.	830.	0.	29.	184.	0.	84.	1550.
8	926.	1723.	6909.	0.	5517.	8077.	22042.	187.	1844.	1910.	1701.	169.	51003.
9	37.	224.	309.	0.	110.	125.	349.	0.	55.	59.	0.	29.	1297.
10	26.	397.	3298.	0.	2171.	3346.	10560.	4.	635.	356.	253.	147.	21193.
11	129.	896.	3118.	0.	5230.	1282.	1469.	70.	7258.	213.	4305.	1469.	25439.
12	209.	147.	73.	0.	77.	18.	176.	0.	114.	602.	51.	22.	1491.
13	103.	77.	136.	0.	136.	81.	433.	0.	463.	364.	4.	24139.	25935.
TOTALS	6982.	8907.	83597.	0.	71344.	39092.	110293.	1006.	13473.	18824.	10586.	27070.	391175.

SOIL GROUPINGS ARE THOSE FOUND IN TABLE 2-1

LAND USE GROUPS ARE AS FOLLOWS
1 - CITRUS
2 - PASTURE
3 - TRUCK CROPS
4 - SUGAR CANE
5 - MISCELLANEOUS
6 - URBAN
7 - URBAN UNDEVELOPED
8 - FORESTED NOT WETLAND
9 - GRASSLAND/RANGE
10 - PINE AND WET PRAIRIES
11 - OTHER WETLANDS
12 - MISC NON-AG
13 - UNCLASSIFIED

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE; CONSULTATION WITH SCS SOIL SCIENTISTS; AND BOOZ-ALLEN REPORT TO COE

TABLE 2-2C ST. LUCIE COUNTY LAND USE CLASSES BY SOIL GROUPS
ALTERNATIVE 50 YEAR PROJECTION
(Acres)

LAND USE	SOIL GROUPS I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
1	2002.	698.	42034.	0.	46834.	12734.	14192.	680.	650.	2516.	1432.	176.	123949.
2	893.	2123.	26688.	0.	12084.	12676.	33836.	125.	1543.	1936.	3144.	129.	95175.
3	0.	0.	121.	0.	70.	70.	441.	0.	0.	11.	0.	4.	716.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	15.	26.	0.	11.	26.	66.	0.	0.	4.	0.	0.	147.
6	2509.	2560.	4499.	0.	3776.	4341.	28793.	4.	1039.	11045.	81.	764.	59411.
7	158.	118.	29.	0.	33.	84.	830.	0.	29.	184.	0.	84.	1550.
8	918.	1660.	4488.	0.	3677.	5421.	19298.	140.	1748.	1690.	1693.	147.	40830.
9	37.	224.	309.	0.	110.	125.	349.	0.	55.	59.	0.	4.	1271.
10	26.	397.	2993.	0.	1840.	2847.	10530.	4.	624.	356.	250.	147.	20014.
11	129.	896.	2200.	0.	2696.	668.	1414.	55.	7206.	213.	3930.	1469.	20877.
12	209.	140.	73.	0.	77.	18.	110.	0.	114.	448.	51.	7.	1249.
13	103.	77.	136.	0.	136.	81.	433.	0.	463.	364.	4.	24139.	25935.
TOTALS	6982.	8907.	83597.	0.	71344.	39092.	110293.	1006.	13473.	18824.	10586.	27070.	391174.

SOIL GROUPINGS ARE THOSE FOUND IN TABLE 2-1

LAND USE GROUPS ARE AS FOLLOWS
1 - CITRUS
2 - PASTURE
3 - TRUCK CROPS
4 - SUGAR CANE
5 - MISCELLANEOUS
6 - URBAN
7 - URBAN UNDEVELOPED
8 - FORESTED NOT WETLAND
9 - GRASSLAND/RANGE
10 - PINE AND WET PRAIRIES
11 - OTHER WETLANDS
12 - MISC NON-AG
13 - UNCLASSIFIED

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE; CONSULTATION WITH SCS SOIL SCIENTISTS; AND ST. LUCIE COUNTY COMPREHENSIVE PLAN - APRIL 1982

TABLE 2-3. ST. LUCIE COUNTY-CITRUS BUDGETS BY SOILS GROUPS - 1979 Base[1/]

ITEM	GROUP I	GROUP II	GROUP III	GROUP V	GROUP VI	GROUP VII	GROUP VIII	GROUP IX
I. Gross Return (@$3.73/Bx/Ac)	1268.20	1014.56	984.72	984.72	984.72	704.97	421.49	421.49
Yield (Bx/Ac)[2/]	340	272	264	264	264	189	113	113
II. Expenses								
1. Operating Costs[3/]								
a. Spray Program	154.75	154.75	154.75	154.75	154.75	154.75	154.75	154.75
b. Fertilizer	57.27	57.27	40.99	40.99	40.99	40.99	40.99	40.99
c. Weed Control	86.49	86.49	86.49	86.49	86.49	86.49	86.49	86.49
d. Pruning	26.08	26.08	48.15	48.15	48.15	48.15	48.15	48.15
e. Irrigation Applic.	200.00	200.00	100.00	100.00	100.00	100.00	200.00	40.00
f. Tree Replace. & Care	57.25	57.25	57.25	57.25	57.25	57.25	57.25	57.25
g. Management (5% of Rev.)	63.41	50.73	49.24	49.24	49.24	35.25	21.07	21.07
Subtotal (1-7)	645.25	632.57	536.87	536.87	536.87	522.88	608.70	448.70
2. Development Costs[4/]								
a. Drainage								
(1) Install.	0	0	96.00	128.00	96.00	96.00	96.00	272.00
(2) O&M	0	0	50.00	50.00	50.00	50.00	50.00	100.00
b. Irrigation-Install.	160.00	160.00	80.00	80.00	80.00	80.00	80.00	80.00
c. Lime	6.00	6.00	4.00	4.00	4.00	4.00	4.00	3.00
d. Bedding (Xtra)						26.56	150.00	
TOTAL EXPENSES	811.25	798.57	766.87	798.87	766.87	779.44	988.70	903.70
III. Returns to Land & Trees	456.95	215.99	217.85	185.85	217.85	-74.47	-567.21	-482.21
1979 Acres in Citrus (94,146 Total)	1,958	507	32,701	39,488	7,684	10,747	584	477
Percent of Co. Citrus Ac.	2.1	0.5	134.7	41.9	8.2	11.4	0.6	0.5
Total Production (Bx)	665,720	137,904	8,633,064	10,424,832	2,028,576	2,031,183	65,992	53,901
Percent of Co. Production	2.8	0.6	35.9	43.4	8.4	8.4	0.3	0.2

1/ See Table 2-4 for footnote

2/ Yield based on SCS soil potential studies, and adjusted to correlate with Statistical Reporting Service County Av. Yield

3/ Main Source Ron Muraro: Economic Information Report 131 - Budgeting Costs and Returns: Indian River Citrus Production, 1979-80; Econ. Info. Report 132 - "Budgeting Costs and Returns: Central Florida Citrus Production 1979-80. Expenses Based on Muraro's Indian River Report for spray program, weed control, tree replacement and care, for all soil groups, and for fertilizer and pruning for Groups III-IX. Muraro's Central Florida Report was used for fertilizer and pruning for Groups III-IX. Muraro's Central Florida Report was used for fertilizer and pruning for Groups I and II. Irrigation cost based on SCS soil potential studies.

4/ Costs based on SCS soil potential studies and are the effective annual cost of developing land development for citrus production that was not in that use in the base year 1979.

TABLE 2-4. ST. LUCIE COUNTY - RELATIVE VALUE OF SOIL GROUPS FOR CITRUS PRODUCTION

Summary Citrus Cost and Returns per acre (See Table 2-3)	Units	Soil Groups I	II	III	V	VI	VII	VIII	IX	Total
1. Total Expenses	$	811.25	798.57	766.87	798.87	766.87	779.44	988.70	903.70	NA
2. Development Cost	$	166.00	166.00	230.00	262.00	230.00	256.56	380.00	455.00	NA
3. Operating Cost	$	645.25	632.57	536.87	536.87	536.87	522.88	608.70	488.70	NA
4. Gross Return/Ac.	$	1,268.20	1,014.56	984.72	984.72	984.72	704.97	421.49	421.49	NA
5. Net Return/Ac (W/Dev Cost)	$	456.95	215.99	217.85	185.85	217.85	-74.47	-567.21	-482.21	NA
6. Net Return/Ac (W/O Dev Cost)	$	622.95	381.99	447.85	447.85	447.85	182.09	-187.21	- 27.21	NA
Base Year (1979) Land Use										
7. 1979 Citrus Acres	Ac.	1,958	507	32,701	39,488	7,684	10,747	584	477	94,146
8. Gross Return (1979 Ac.)	$	2,483,135	514,381	32,201,328	38,884,623	7,566,588	7,576,312	246,150	201,050	89,673,567
9. Net Return (W/O Dev. Cost) (1979 Ac.)	$	1,219,736	193,669	14,645,143	17,684,701	3,441,279	1,956,921	-109,331	-12,979	39,019,139
Booz-Allen(B-A) Eq 50-yr Proj.										
10. Booz-Allen Eq. Citrus Ac.	Ac.	1,925	496	32,051	38,603	7,464	10,486	580	422	92,027
11. Gross Return (B-A Eq. Ac.)	$	2,441,285	503,222	31,561,261	38,013,146	7,349,950	7,392,315	244,464	177,869	87,683,512
12. Net Return (W/O Dev. Cost) (B-A Eq. Ac.)	$	1,199,179	189,467	14,354,040	17,288,354	3,342,752	1,909,396	-108,582	-11,483	38,163,123
Alternative 50-Year Projection										
13. Alternate-Total Citrus Acreage	Ac.	2,002	698	42,034	46,834	12,734	14,192	680	650	119,824
14. Alt. Existing (1979) Citrus Acreage	Ac.	1,958	507	32,701	39,488	7,684	10,747	584	477	94,146
15. Alt. new Citrus Acreage	Ac.	44	191	9,333	7,346	5,050	3,445	96	173	25,678
16. Gross Return (All Ac.)	$	2,538,936	708,163	41,391,720	46,118,376	12,539,424	10,004,934	286,613	273,969	113,862,135
17. Net Return W/O Dev. Cost (All Ac.)	$	1,247,146	266,629	18,824,927	20,974,607	5,702,922	2,584,221	-127,303	-17,687	49,455,462
18. Net Return W/Dev.Cost 2/ (All Ac.)	$	1,239,842	234,923	16,678,337	19,049,955	4,541,422	1,700,372	-163,783	-95,585	43,185,483

1/ Urban, unmapped and unclassified soil groups (X, XI, XII) are not included

2/ Item 17 minus cost of developing new acres.

SUMMARY Points of Chapter 2.

1. All projections used indicate an increased amount of land will have to be used for urban development if the projected populations occur.

2. As with most projections, which are merely attempts to predict the future if present trends are allowed to continue, a mixed set of land uses have resulted due to the differences of opinion regarding citrus as a future land use in the Booz-Allen versus the Alternative projections.
   (a) If citrus acres increase by 27 percent over the next 50 years, as projected by the Alternative projections, other land uses must decrease as projected for Pasture, Forested, Wetlands, and a category described as Pine and Wet Prairies.
   (b) If citrus acres are to decrease by two to three percent, as indicated by the Booz-Allen projections, increased land use could also be expected for Pasture. These projections indicate an expectation that citrus lands would primarily be in areas presently used as forests or Pine and Wet Prairies.

3. Neither the Booz-Allen nor the alternative projections show changes in some of the minor land use acreages. Some reviewers think this does not reflect current increasing trends in truck crops (blueberries & grapes). While this may be true, it should be recognized that even a relative large change in those crop acres would have only an insignificant effect on the major land and water management issues. Furthermore, an inordinate focus on projection details may have a tendency to distract attention from the indisputable facts: (1) that the pressures on the land and water resources of the county are increasing; (2) that this pressure can be expected to result in conflicts over the limited quantity of land and water available; (3) that the quality of the environment can be expected to change due to this pressure (some might call it environmental deterioration); and (4) that a public informed about the consequences of alternative development possibility will make a more rational choice from among future water and land use options.

4. Citrus budgets (Table 2-3) which include estimated revenue, development costs, and management costs that are consistent across the soil groups show Soil Group I has the highest net revenue potential for citrus production with or without development costs, while Soil Groups VII, VIII, and IX can be expected to have negative returns; therefore, in strict economic terms they are not feasible for citrus production.

5. The figures in Tables 2-3 and 2-4 are developed from an economic viewpoint and do not consider the environmental effects of development. An estimation of the environmental impact can be made by overlaying the soil map with the land use map, that were developed during this study, to determine the present land use of specific soil groups at a specific location.

CHAPTER 3. PRESENT AND FUTURE ALTERNATIVE WATER REQUIREMENTS

Background Considerations

There are a number of important factors to consider in determining water requirements. Different estimates of any factor will result in different estimates of water requirements. The following are among those which need to be considered:

1. The level of population and economic activities (agriculture, industry, etc.) which use water.
2. The rate at which water is withdrawn, consumed, and returned to the source.
3. The cost of providing the water and the price people are willing to pay for use of water.
4. The amount and quality of water, surface and ground, which is available at different cost levels.
5. The degree to which the public is willing to accept changes in the environment which will result from increasing pressures on the water, land, and environmental resources.

In this chapter, each of these factors has been examined and dealt with in the following manner.

1. Population and economic activity:

   The Booz-Allen median projection (see Chapter 1) are the basis for these projections. From these estimates, two sets of land use projections were derived (see Chapter 2). Present and future water requirements were then based on the assumptions concerning the Booz-Allen Equivalent and the Alternative projections.

2. Consumption rates:

   This is considered the important element under the assumption that withdrawal minus consumption equals return to source and that the amount returned to the source is available for further use. The non-agricultural consumption rates are based on the procedure used by SFWMD (1980 Summary Report, pages 34-36). Agricultural consumption rates are based on data from the USDA-SCS Florida Irrigation Guide.

3. Cost and price of water:

For purposes of this report, water pricing has not been considered because no data is available to develop valid relationships on water supply and demand as a function of price. Studies should be made, however, on the relationship of quantity and quality of water available, the requirement in various uses, and the public interest in pricing policy to determine if such a policy might be one way that scarce water resources could be allocated.

4. The amount of surface and ground water available:

Based on the studies which have been made available for this report, it appears that firm estimates of quantities of surface and ground water available for use in the county have not yet been made. A report of the COE, expected to be distributed in 1984, will contain the best information on which to make judgments. Presumably the COE report will reflect rainfall frequency distribution, runoff-recharge relationships, water supply probability distribution, saltwater intrusion estimates and trends in surface and ground water quality. It can be expected that the COE will identify supplemental water supply potentials. Normally, however, they do not provide quantity-cost relationships in sufficient detail to make a thorough economic analysis of water supply and demand relationships. Such studies are beyond the authority of the scope and intent of this report.

Considering the limitation on information presently available, this report will present information from the USGS on water use in the county for 1975, 1977, and 1980. Projected water requirements will be compared to those use estimates in order to indicate some measure of the impacts the projected water requirements may be expected to have in the county. When the COE report is available, these comments should be reviewed.

5. Environmental changes:

The report will not make judgments on the desirability of the environmental changes which may occur with projected conditions. However, information will be provided in Chapter 6 on the effect future land use changes may have on environmentally sensitive areas in the county.

Present and Projected Water Use Estimates - Introduction

Three basic sources provide information on present water use and projected water requirements; the U.S.G.S., land use and crop water demands developed for this report, and the South Florida Water Management District.

Water use for the years 1975, 1977, and 1980, as reported by the U.S.G.S. are provided in Tables 3-1 and 3-2. The base year (1979) and 50-year alternative projections of water requirements, as developed in this report, are provided in Tables 3-3 to 3-9 (pages 3-6 to 3-10). The SFWMD estimates for 1980 and 2000 are provided and discussed in pages 3-11 to 3-15. Table 3-10 (page 3-19) provides a summary comparison of the water requirements as estimated by the various sources.

United States Geological Survey Water Use Estimates

From time to time, representatives of the U.S.G.S. and the state water management districts collect and publish historical water use summaries; occasionally they are assisted by personnel from the Institute of Food and Agricultural Sciences, University of Florida. Much valuable information useful to local agencies involved in regulation and supply of water for all uses is to be found in the reports from which Tables 3-1 and 3-4 were derived. The 1980 report includes water use by source and disposition of water by month and year. The data are also categorized by county, water management district, and hydrologic unit. The apparent discrepancy between 1977 and 1980 irrigation water withdrawal will be addressed in the discussion section below.

Water Use Estimates Developed in this Report

The basic land and water use information used in this report is derived from the 1979 SFWMD land use estimate, two sets of 50-year land use projections, per capita agricultural water use from SFWMD, and crop consumptive use estimates from the SCS Florida Irrigation Guide.

Estimates of non-agricultural use rates are based on data in the Summary Status Report, Upper East Coast, (SFWMD October 1980, pgs. 34-38). The 1978 daily per capita water use rate was applied to the 1980 population figure in this report (Table 1-1), to determine daily water use for the County. Per capita demand of 170 gallons was assumed for the growth in population beyond 1980.

Applying these procedures provided the estimated future non-agricultural water requirements shown in Table 3-3.

Estimates of agricultural water requirements were developed from estimates of irrigated acreages and per acre net irrigation water requirements by crop. Tables 3-4, 3-5, and 3-6 present monthly evapotranspiration, effective rainfall, and net irrigation requirements for normal and dry years for three major agricultural crops based on Florida Irrigation Guide. Based on information from Tables 3-4, 3-5, and 3-6, and the base year 1979 and two sets of projected crop acreages (Table 2-2), the monthly water requirements and yearly totals for normal and dry years, by crop, for 1979 and each projection set were then developed (Tables 3-7, 3-8, and 3-9). For comparative purposes, 3.07 acre-feet of water is equal to 1 million gallons. Note that, in contrast to the USGS and SFWMD estimates, these tables are based on an assumption that all acres in the three crops are irrigated. First, this seems a reasonable assumption to make for projection years based on recent trends in irrigation development. Second, for 1979, this assumption illustrates how much additional water would have been required if all acres had been irrigated, thus it may be useful information for those who might consider limiting water use on such crops as pasture.

TABLE 3-1. --- ST. LUCIE COUNTY - Precipitation/Water Use

	1975	1977	1980
Annual Precipitation	47.02	44.94	43.90
Departure from Normal (53.18")	-6.16(-12%)	-8.24(-15%)	-9.28(-17%)
Public Supply			
County Population (1000)	69.1	73.6	87.2
Population Served (1000)			
Ground Water only	42.5	42.5	55.6
Water Withdrawn			
Ground Water only (mgd)	6.14	6.65	9.70
Per Capita (gpd)	144	156	174
Water Delivered, By Use (mgd)			
Public Supply	5.70	6.23	8.56
Industry	0.11	0.12	2.76
Commercial	0.27	0.30	0.38
Air Conditioning	0.05	0	0
Water Consumed (mgd)	2.43	2.87	1.93
Rural Water Use			
Self-Supplied County Population (1000)	26.6	31.1	31.6
Domestic Use (mgd)			
Withdrawn - ground water only	3.97	4.64	3.18
Consumed	0.79	1.16	1.00
Livestock Use (mgd)			
Ground water	0.66	0.90	0.32
Surface Water	0.15	0.18	0.42
Total Withdrawn	0.81	1.08	0.74
Consumed	0.81	1.08	0.74
Industrial Self-Supplied			
Withdrawn (mgd)			
Ground Water only	0.19	0.19	2.05
Consumed (mgd)	0.07	0.07	0.27
Irrigated Acres			
Citrus	73000	74200	76000
Truck Crops	1200	1030	800
Pasture	22000	20120	20000
Other	1000	1000	1100
Total Acres Irr.	97200	96350	97900
Irrigation Water (Ac-Ft)			
Ground Water	54800	71300	54389
Surface Water	357400	361000	204606
Total withdrawn	412200	432300	258995
Consumptive Use	78200	80600	73583
Irrigation Water (mgd)			
Ground Water	48.94	63.67	48.58
Surface Water	319.16	322.37	182.71
Total Withdrawn	368.10	386.04	231.28
Consumptive Use	69.83	71.98	65.71
Thermoelectric Power Generation			
Total Withdrawn (mgd)	0	777.6 1/	588.0 2/
Total Consumed (mgd)	1.1	1.4	1.0

1/ All saline water for cooling 2/ 586.6 saline water for cooling

Source: USGS,WRI: Source, Use, and Disposition of Water in Florida, 1975, 1980;
USGS,WRI: Estimated Water Use in Florida, 1977
Precipation Data from NOAA, Annual Climatological Data for Florida for the years noted.

TABLE 3-2. ST. LUCIE COUNTY - WATER USE SUMMARY, 1975 and 1977
(Million gallons per day)

	1975		1977		1980	
	Withdrawn	Consumed	Withdrawn	Consumed	Withdrawn	Consumed
Public Supply						
Urban	5.70		6.23		8.56	
Industrial	0.11		0.12		0.76	
Commercial	0.27		0.30		0.38	
Air Conditioning	0.05		-		-	
Total - Public	6.13	2.43	6.65	2.87	9.70	1.93
Self-Supplied Rural Pop.	3.97	0.79	4.64	1.16	3.18	1.00
Self-Supplied Industrial	0.19	0.07	0.19	0.07	2.05	0.27
Livestock	0.81	0.81	1.08	1.08	0.74	0.74
Irrigation	368.10	69.83	386.04	71.98	231.28	65.71
Thermoelectric		1.10		1.40	1.40 1/	1.00

1/ Does not include cooling water withdrawn from saltwater or brackish water sources.

TABLE 3-3. ST. LUCIE COUNTY -- PRESENT AND PROJECTED NON-AGRICULTURAL WATER REQUIREMENTS

	1980	50-Year Projection Booz-Allen Equiv.	50-Year Projection Alternative
Population (Med. range)	84,520	188,900	197,800
Water Requirements (1000 gpd)	13,016	30,761	32,241
Requirements/Capita (gpd)	154	163	163

Source: Population estimates from Table I-1 and I-1A; water use calculated based on SFWMD assumptions and procedures

TABLE 3-4. ST. LUCIE COUNTY - CITRUS WATER DEMAND - Rainfall/Evapotranspiration Factors 1/ - (Inches)

Month	ET	Normal Year		Dry Year	
		Effective Rainfall	Net Irrigation Requirements	Effective Rainfall	Net Irrigation Requirements
January	1.81	1.04	.77	0.89	0.92
February	1.87	1.24	0.63	1.06	0.81
March	2.64	1.68	0.96	1.44	1.20
April	3.36	1.38	1.98	1.18	2.18
May	4.25	1.80	2.45	1.54	2.71
June	4.75	3.47	1.28	2.97	1.78
July	5.03	3.86	1.17	3.30	1.73
August	4.83	3.64	1.19	3.11	1.72
September	4.17	3.18	0.99	2.72	1.45
October	3.34	1.96	1.38	1.68	1.66
November	2.33	0.94	1.39	0.80	1.53
December	1.87	0.95	0.92	0.81	1.06
Annual	40.25	25.14	15.11	21.50	18.75

1/ Figures based on data from FL IRRIGATION GUIDE, USDA, SCS.

Average Annual Rainfall = 53.18 inches (1941-1970). In any year there is a 20% chance that the dry year net irrigation requirements will be equaled or exceeded and a 50% chance that the normal year net irrigation requirements will be equaled or exceeded. A normal precipitation year is defined as 53.18 inches; a dry year is defined as 45 inches or less.

TABLE 3-5. ST. LUCIE COUNTY - PASTURE WATER DEMAND - Rainfall Evapotranspiration Factors[1/] (Inches)

Month	ET	Normal Year		Dry Year	
		Effective Rainfall	Net Irrigation Requirements	Effective Rainfall	Net Irrigation Requirements
January					
February	1.81	1.21	0.60	1.03	0.78
March	3.16	1.78	1.38	1.53	1.63
April	4.51	1.47	3.04	1.26	3.25
May	6.02	1.98	4.04	1.70	4.32
June	6.78	3.98	2.80	3.41	3.37
July	7.18	4.40	2.78	3.76	3.42
August	6.83	4.18	2.65	3.58	3.25
September	5.70	3.83	1.87	3.28	2.42
October	4.26	2.07	2.19	1.77	2.49
November	2.59	0.95	1.64	0.82	1.77
December	0.85	0.65	0.20	0.56	0.29
Annual	49.69	26.50	23.19	22.70	26.99

1/ Figures based on data from FL IRRIGATION GUIDE, USDA, SCS.

Average Annual Rainfall = 53.18 inches (1941-1970). In any year there is a 20% chance that the dry year net irrigation requirements will be equaled or exceeded and a 50% chance that the normal year net irrigation requirements will be equaled or exceeded. A normal precipitation year is defined as 53.18 inches; a dry year is defined as 45 inches or less.

TABLE 3-6. ST. LUCIE COUNTY-VEGETABLES[1/]-WATER DEMAND-RAINFALL/EVAPOTRANSPIRATION FACTORS[2/] (Inches)

Month	ET	Normal Year: Effective Rainfall	Normal Year: Net Irrigation Requirement	Dry Year: Effective Rainfall	Dry Year: Net Irrigation Requirement
January	1.92	1.07	0.85	0.92	1.00
February	3.08	1.39	1.69	1.19	1.89
March	3.98	1.87	2.11	1.60	2.38
April	1.04	0.45	0.59	0.39	0.65
May	-	-	-	-	-
June	-	-	-	-	-
July	-	-	-	-	-
August	-	-	-	-	-
September	3.50	2.70	0.80	2.31	1.19
October	4.65	2.11	2.54	1.81	2.84
November	3.09	0.98	2.11	0.84	2.25
December	0.47	0.26	0.21	0.22	0.25
ANNUAL	21.73	10.83	10.90	9.28	12.45

1/ Figures assume two 4-month growing seasons, with 100-day growing periods.

2/ Figures based on data from FL IRRIGATION GUIDE, USDA, SCS. Average Annual Rainfall=53.18 inches (1941-1970). In any year there is a 20% chance that the dry year net irrigation requirements will be equaled or exceeded and a 50% chance that the normal year net irrigation requirements will be equaled or exceeded. A normal precipitation year is defined as 53.18 inches; a dry year is defined as 45 in.or less.

TABLE 3-7. ST. LUCIE COUNTY - MONTHLY SUPPLEMENTAL IRRIGATION WATER REQUIREMENTS-CITRUS- 1979 and 50-Year Projection

Month	Supplemental Irrigation Water Requirement (Ac.Ft.)					
	Normal Year			Dry Year		
	1979	Booz-Allen Eq.	Alternative	1979	Booz-Allen Eq.	Alternative
January	6250	6103	7953	7468	7292	9503
February	5114	4994	6507	6575	6420	8367
March	7792	7609	9916	9740	9512	12395
April	16072	15694	20452	17695	17279	22517
May	19887	19420	25306	21997	21480	27992
June	10390	10146	13221	14448	14109	18386
July	9497	9274	12085	14042	13713	17870
August	9659	9432	12292	13961	13633	17766
September	8036	7847	10226	11770	11493	14977
October	11201	10938	14254	13474	13158	17146
November	11283	11018	14357	12419	12127	15803
December	7468	7292	9503	8604	8402	10949
ANNUAL	122649	119767	156072	152193	148618	193671

A normal precipitation year is defined as 53.18 inches; a dry year is defined as 45 inches or less.

TABLE 3-8. ST. LUCIE COUNTY - MONTHLY SUPPLEMENTAL IRRIGATION WATER REQUIREMENTS - Pasture - 1979 and 50-year Projection

	Supplemental Irrigation Water Requirement (Ac.Ft.)					
	Normal Year			Dry Year		
Month	1979	Booz-Allen Eq.	Alternative	1979	Booz-Allen Eq.	Alternative
January	-	-	-	-	-	-
February	5366	5532	4759	6976	7191	6186
March	12342	12723	10945	14577	15027	12928
April	27187	28027	24111	29065	29963	25777
May	36130	37246	32042	38634	39827	34263
June	25041	25814	22208	30138	31069	26728
July	24862	25630	22049	30586	31530	27125
August	23699	24431	21018	29065	29963	25777
September	16724	17240	14831	21642	22311	19194
October	19586	20190	17369	22268	22956	19749
November	14667	15120	13007	15829	16318	14038
December	1789	1844	1586	2594	2674	2300
ANNUAL	207393	213797	183925	241374	248829	214065

A normal precipitation year is defined as 53.18 inches; a dry year is defined as 45 inches or less.

TABLE 3-9. ST. LUCIE COUNTY - MONTHLY SUPPLEMENTAL IRRIGATION WATER REQUIREMENTS 1/ Vegetables - 1979 and 50-year Projection

	Supplemental Irrigation Water Requirement (Ac.Ft.)					
	Normal Year			Dry Year		
Month	1979	Booz-Allen Eq.	Alternative	1979	Booz-Allen Eq.	Alternative
January	51	51	51	60	60	60
February	101	101	101	113	113	113
March	126	126	126	142	142	142
April	35	35	35	39	39	39
May	-	-	-	-	-	-
June	-	-	-	-	-	-
July	-	-	-	-	-	-
August	-	-	-	-	-	-
September	48	48	48	71	71	71
October	152	152	152	169	169	169
November	126	126	126	134	134	134
December	13	13	13	15	15	15
ANNUAL	652	652	652	743	743	743

A normal precipitation year is defined as 53.18 inches; a dry year is defined as 45 inches or less.

1/ Figures assume two 4-month growing seasons with 100-day growing periods.

South Florida Water Management District Projected Water Requirements

The South Florida Water Management District is a responsible and authoritative source for information on water and land use projections. For this reason, they are quoted extensively from their Summary Report dated October 1980:

PART 3 - WATER USE, PRESENT AND PROJECTED

Estimates of present and projected populations and agricultural production for the UEC[1] have been established so that analyses can be made of future supply capabilities to meet these demands. The water demand estimates include residential, commercial, industrial, and major agricultural uses. The availability of water (from aquifers and surface supplies) is still under investigation and will be provided in an update to this document.

WATER DEMAND ESTIMATES (NON-AGRICULTURAL)

In order to develop projections of water demands it was necessary to establish population and water demand estimates for a base year. The estimates developed for the UEC are for calendar year 1978. Water use by the residential self-supplied populations was estimated by multiplying the populations by an estimated per capita use of 167 gallons per day. Available data from the SFWMD and the DER were also collected on the commercial and industrial self-supplied users. Table 3-1 (p. 3-12) *contains the estimates of the water demands for the UEC Planning Area. These estimates show the overall per capita consumption to be about 166 gpd for the UEC area, with Martin County being about 185 gpd and St. Lucie County being about 154 gpd.*

Population Projections

A range of population projections (low and high) rather than a single estimate was chosen to better represent the relevant range of population growth which should be considered for planning purposes. Low and high projections of populations used for Martin, St. Lucie, and Okeechobee Counties were developed from University of Florida estimates. The population projections cover the permanent resident population. These projections are presented in Table 3-2 (p. 3-12) *and were used as a basis for domestic water demand analysis*

Projections of Water Demands

Projections of water demands were formulated using the populations developed in the previous section.

The methodology used for projecting water demands is as follows:

1) No change was projected for water consumption by the present population (present water consumption factors are relatively fixed as to the type of dwelling, lawn size, habits of present residents, etc.).

2) For additional future population, a total per capita demand of 170 gallons per day is assumed. This is about the overall consumption rate for the UEC in 1978.

1/ UEC-Upper East Coast region of Fouth Florida Water Management District consisting of all or part of Martin, St. Lucie & Okeechobee Counties

Application of these procedures to the projected populations provides the projected water demands presented in Table 3-3 (P.3-13).

TABLE 3-1. NON-AGRICULTURAL WATER DEMANDS IN THE UPPER EAST COAST PLANNING AREA - 1978

	Demand (1000 gallons per day)	Population Served
Martin County[a]		
Water Systems	5,628.6	29,992
Residential Self-Supplied	3,513.8	21,003
Commercial/Industrial Self-Supplied	282.8	
TOTAL	9,425.2	50,995
St. Lucie County[a]		
Water Systems	7,599.4	51,972
Residential Self-Supplied	4,266.9	25,505
Commercial/Industrial Self-Supplied	83.5	
TOTAL	11,949.8	77,477
Okeechobee County[a]		
Residential Self-Supplied	24.0	141
TOTAL	24.0	141
Upper East Coast Total	21,399.0	128,613

[a]The population and water demand estimates cover only those portions of each county within the Upper East Coast Planning Area.

TABLE 3-2. POPULATION PROJECTIONS FOR THE UPPER EAST COAST PLANNING AREA

County[a]	1978		1985	1990	1995	2000
Martin	50,995	low	63,868	70,302	74,749	79,102
		high	73,330	89,415	100,959	111,556
St. Lucie	77,477	low	95,500	103,200	109,000	114,600
		high	107,000	126,300	141,100	154,700
Okeechobee	141	low	172	187	198	209
		high	191	228	256	282
Upper East Coast	128,613	low	159,540	173,689	183,947	193,911
		high	180,521	215,943	242,315	266,538

[a]The population projections cover only those portions of the Counties within the Upper East Coast Planning Area.

TABLE 3-3. NON-AGRICULTURAL WATER DEMAND PROJECTIONS FOR THE UPPER EAST COAST PLANNING AREA (Thousands of gallons per day)

County[a]	1978		1985	1990	1995	2000
Martin	9425	low population growth	11,613	12,707	13,463	14,203
		high population growth	13,222	15,957	17,919	19,721
St. Lucie	11960	low population growth	15,013	16,322	17,308	18,260
		high population growth	16,968	20,249	22,765	25,077
Okeechobee	24	low population growth	29	32	34	36
		high population growth	32	39	44	48
Upper East Coast	21399	low population growth	26,655	29,061	30,805	32,499
		high population growth	30,222	36,245	40,728	44,846

[a]The water demand projections cover only those portions of the counties within the Upper East Coast Planning Area

WATER DEMAND ESTIMATES (AGRICULTURAL)

Land Use Projection

The basis for the agricultural water demands is the land use projection for various crop production areas. These projections were developed by establishing a consensus of local farmer, agricultural agent and other government agency planning personnel inputs. This concensus represents the best possible means of estimating future agricultural activity.

The projected agricultural land use acreage is shown in Figure 3-1. There is a slight increased usage suggested for all types of production.

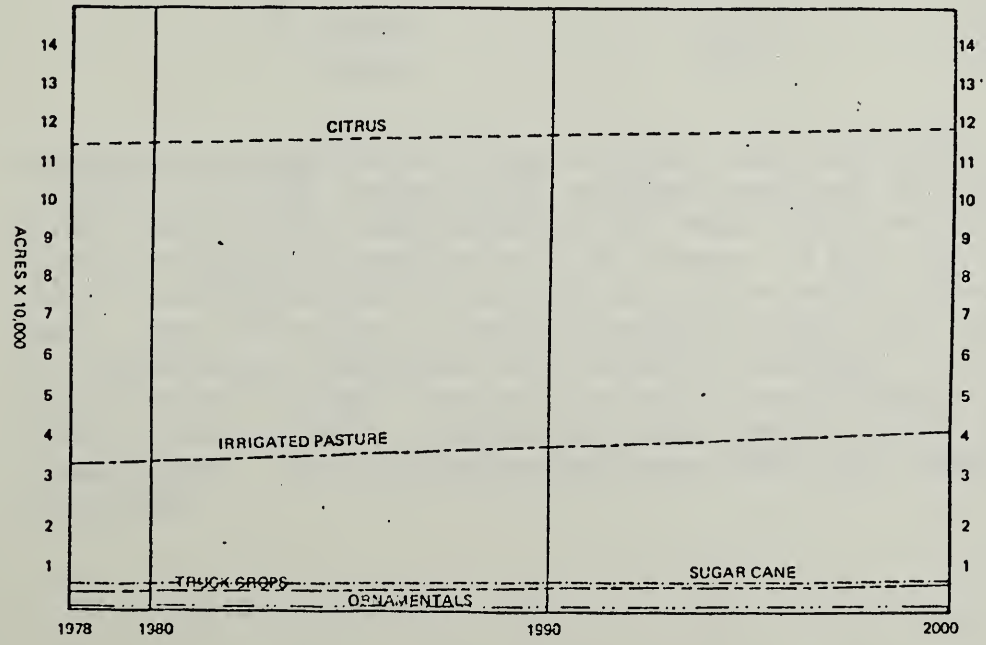


FIGURE 3-1. UPPER EAST COAST AGRICULTURAL ACREAGES

A summary of total agricultural acreages by County is shown below for the current and future time period under consideration: (irrigated acreage)

County	1980	2000
Martin	66,000	74,000
St. Lucie	98,900	107,800
TOTAL	164,900	181,800

Projections of Agricultural Water Demands

Estimates of agricultural water demand were made by computing the amount of water consumed by crops in addition to rainfall, when adequate water is available. The amount of water consumed is more appropriate for generalized water supply studies in this area than the actual amount of irrigation water applied. Estimates of actual water applied (withdrawn) are published by the USGS and U. S. Bureau of Census.

The acreages of various crop types shown above were converted to consumptive water needs using a rainfall record of over 20 years to indicate water use variations (ranges) that might be expected between now and the year 2000. The average yearly supplemental water demand for agriculture in the UEC counties is shown below (based on the projected land use shown above for the year 2000).

County	Average Yearly Supplemental Demand (MGD/Yr)	
	1980	2000
Martin	56	63
St. Lucie	84	92
TOTAL	140	155

Supplemental agricultural water demands could potentially range from about 76 MGD to 213 MGD, based on the rainfall received in a specific year. The lower part of this range would be for water needs when there is above average rainfall during the growing seasons of the year (e.g., there is only a small additional amount of irrigation water needed). The higher range shows the effect of below average rainfall (e.g., when large amounts of supplemental irrigation water would be required). It should be noted that stating "average" numbers for future agricultural water needs may lead to some erroneous conclusions about any one year's total water supply requirements. It is therefore necessary that this "range" be carefully considered.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Summary

The major water uses in the UEC are domestic/residential and agricultural. The total UEC future demands are:

County	Total Water Demand (MGD)/yr. 1980	2000
Martin	65	79
St. Lucie	96	113
TOTAL	161	192

It should be noted that the agricultural water demands are for consumptive use only. Estimates of the amounts of irrigation water withdrawn will be considerably higher than these numbers since they also include water that is eventually returned to the local water resource and not used by the crop concerned.

Discussion

Comparisons of water requirements (Table 3-10), estimated from different sources, must be approached with extreme caution. Estimates of water withdrawn and consumed in the USGS report reflect the amount of rainfall which occurred which ranged from 12-17% less than normal for the three years reported. Data derived from the Florida Irrigation Guide, on which estimates for this report are based, refer to specified "normal" and "dry" years based on records from 1941 to 1970. SFWMD data used as a referral base was based on some unspecified 20-year record. These differences in the bases obviously result in some differences in the projections between this report approach and that of the SFWMD (USGS does not make projections). In the following paragraphs, the individual projections will be briefly discussed to be followed by comments on the implications of the differences among the sources.

The two projections developed for this report differ in the assumptions about the intensity of land use over the next several decades. The Booz-Allen Equivalent, the less intensive land use assumption, projects non-agricultural water use to increase over the next 50 years by about 136% and agricultural water use to increase about 1%. In the Alternative projection, non-agricultural water use would increase about 150% and agricultural water use would increase about 3%. The difference between this estimate and the previous one result from a higher population estimate, more citrus acreages and fewer pasture acres; both crops are assumed to be fully irrigated in both cases but citrus has lower irrigation requirements than pasture (Tables 3-4 & 3-5).

The SFWMD projects an increase in non-agricultural water requirements between 1978 and 2000 of 53 to 109%, depending on the population assumption. Their estimates of agricultural consumptive use indicate an increase of about 9% between 1980 and 2000.

A number of important points about the differences among the sources needs to be considered. The focus will be on agricultural differences, where the vast majority of the water is used.

Only the USGS has recorded water withdrawn. The amount withdrawn is important in that it reflects the amount of water that needs to be available at particular levels of efficiency in order to deliver to the plant the amount needed to be consumed without stress. The amount consumed represents that absolute minimum required to be available to the plant in order that it grows at the required standard. It should be noted that much of the water withdrawn is not consumed and is, in fact, recycled through the system time and again. This is particularly true of the particular irrigation approach practiced in this county. For this reason particularly, the SFWMD is absolutely correct in the view that for general studies the critical factor to consider is the amount of irrigation water needed to supplement natural precipitation in order to provide the amount the plant needs to consume in order to grow. This net irrigation requirement is calculated based on the plant total consumptive use requirement or evapotranspiration rate (ET), the total amount of precipitation, and the effective precipitation considering runoff and other uses of the water that is not available to the plant and, of course, the total acres of the crop which are irrigated. The data that is presently available for each of these topics will be discussed separately below.

1. <u>Crop Consumptive Use Estimates</u>: The total amount of water consumed by the plant in order to sustain non-stressed growth is expressed by the evapotranspiration rate (ET) and varies by crop. Unfortunately, there seems not to be complete agreement on the proper method of calculating this factor. Tables 3-4, 3-5, and 3-6 provide the ET estimates used for this report for the three major crop categories by month and by year. Tables 3-11, 3-12, and 3-13 provide ET estimates prepared by IFAS which have been supplied to SFWMD and COE for the last few years. In comparing the two sets of tables, it is clear that differences are significant by crop, by month and annually.

2. Precipitation Estimates: The water use estimates by the USGS reflect the actual precipitation in the years recorded - ranging from 12% to 17% below normal (53.18" average over the period 1941 to 1970). SFWMD based their estimates on some unspecified 20 years of record. The Florida Irrigation Guide estimates (on which these report figures are based) are in reference to a 30 year period from 1940 to 1971. IFAS, on the other hand, uses an average annual rainfall of 53.07" at Ft. Pierce based on National Oceanic and Atmospheric Administration records from 1925 to 1981.

3. Effective Precipitation (rainfall): Tables 3-4, 3-5, and 3-6 contain estimates taken from the Florida Irrigation Guide. Similar estimates are not available from other sources at this time. Depending on the estimating procedure used, this could be a source of differences among the agencies working on irrigation water requirements.

4. Net Irrigation Requirements (NIR) by crop type: Estimates used in calculations for this report and those estimates by IFAS can be compared and contrasted by reviewing Tables 3-4, 3-5, 3-6 with Tables 3-11, 3-12, and 3-13.

5. Acres Irrigated: There are differences in estimates of total acres irrigated and in acres irrigated by crop.

   a. Total irrigated acres differ:

USGS (1980)	97,900 acres
SFWMD (1980)	98,900 acres
This Report (1979)	205,438 acres

   b. Irrigated acres by crop differ:

Crop	USGS (1980)	SFWMD (1980)	This Report (1979)
Citrus	76,000	< 115,000	97,404
Pasture	20,000	< 35,000	107,318
Truck Crops	800	< 800	716
Other	1,100	< 600	0
Total	97,900	98,900	205,438

The SFWMD individual crop data are shown as "less than" a certain amount because the data vailable is for the Upper East Coast which includes St. Lucie County, Martin County, and part of Okeechobee County. Both USGS and SFWMD indicate about 98,000 to 99,000 total irrigated acres for St. Lucie County compared to a total of 205,438 acres used for this report. 1979 SFWMD estimated citrus acres alone

amounted to 97,404 acres (Table 2-2). Surely we have to assume that all citrus acres are irrigated. This leaves about 500 to 1500 acres in the USGS and SFWMD base year estimates for truck crops, minor acres, and pasture. On the other hand, the estimates for this report assume all pasture acreages to be irrigated. Probably neither estimate is absolutely correct. Given the shallow water table representative of the area, it can probably be assumed that in normal to wet years, the natural sub-irrigation character of the area provides adequate water for much of the pasture; but in dry years, it can be expected that a substantial portion of pasture acres will receive specific attention by farmers for supplemental irrigation application. Perhaps, in normal to wet years, the USGS and SFWMD estimates are more nearly chacteristic of the irrigation regimen for the area, while the dry year irrigated acreage will approach the higher estimates for this report, depending on the amount of irrigation water available.

c. Projected Developments: The SFWMD projection estimates are somewhat different from those used for this report; this report deliberately provides two sets of of projections, based on different assumptions. Clearly, having more than one set of projections can contribute to information needed for public choices. An analysis of the consequences of the different projections can help in the choice of the nature of the development preferred (assuming that change is inevitable and that change=development), and the choice of public actions to improve the chances that the preferred direction can evolve.

Recommendation:

The technical representatives of the USGS, SFWMD, IFAS, SCS, and COE should get together on the appropriate methods of estimating the factors which determine the net irrigation requirements for a particular plant species. No doubt, at this point in technical developments, the conclusions will involve a considerable amount of risk and uncertainty. A clear understanding of the nature of the risk and uncertainty can be most useful in public and private decision-making because those factors translate into both public and private costs and returns. For this reason, it is particularly important that resource economists from the several agencies mentioned should have an important role in designing the research required to develop the methods to estimate the critical factors. They should then be required to carry that information into appropriate professional studies of the risks and uncertainty implications for public and private investments in resource developments considering competing demands for the resources.

TABLE 3-10. ST. LUCIE COUNTY - SUMMARY OF ANNUAL WATER REQUIREMENTS ESTIMATED BY VARIOUS SOURCES

Year	Total Required			Non-Agricultural		Agricultural			
	Withdrawn	Consumed		Withdrawn	Consumed	Acres Irrigated	Withdrawn	Consumed	
A. USGS Historical Record [1/]									
1975	424,638	82,795		11,530	3,687	97,200	413,108	79,108	
1977	446,374	86,404		12,864	4,594	96,350	433,510	81,810	
1980	276,554	77,998		16,730	3,586	97,900	259,824	74,412	
B. South Florida Water Management District (Summary Report Oct. 1980) [2/]									
1980	NA [3/]	107,573		NA	13,447	98,900	NA	94,126	
2000	NA	126,622		NA	23,531	107,800	NA	103,091	
C. Estimates for this Report [4/]									
		Normal Yr	Dry Yr					Normal Yr	Dry Yr
1979	NA	345,279	408,895	NA	14,585 [5/]	205,438	NA	330,694	394,310
50-Yr Projections:									
1) Booz-Allen Equiv.	NA	368,685	432,659	NA	34,469	206,463	NA	334,216	398,190
2) Alternative	NA	376,777	444,607	NA	36,128	219,840	NA	340,649	408,479

1/ Precipitation based on years of record from 1941 to 1970; normal = 53.18. Precipitation in 1975 was 47.02" (12% less than normal); 1977 precipitation 44.94" (15% less than normal); 1980 precipitation 43.90" (17% less than normal)- Both 1977 and 1980 were dry years as defined in the report.

2/ Precipitation based on the average of an unspecified 20-year period.

3/ Not available.

4/ Based on acreage estimates for 1979 and 50-year projection in Chapter 2 (Tables 2-2A, 2-2B, 2-2C) and on Tables 3-4, 3-5, and 3-6. All citrus, pasture, and truck crop acreages are assumed to be irrigated. Normal year precipitation equals 53.18 inches with a 50% chance of occurring in any year. Dry year precipitation is equal to or less than 45 inches with a 20% chance of occurring in any year.

5/ Based on 1980 population.

TABLE 3-11. ST. LUCIE COUNTY - IFAS ESTIMATES OF CONSUMPTIVE USE & NET IRRIGATION REQUIREMENTS*

	Citrus (in)		Pasture (in.)		Vegetables (in.)	
Month	ET 1/	NIR-80 2/	ET 1/	NIR-80 2/	ET 3/	NIR-80 3/
January	2.1	1.0	2.1	1.0	2.7	1.8
February	2.6	0.8	2.6	0.8	2.7	1.7
March	3.6	1.0	3.6	1.0	3.4	1.9
April	4.5	1.2	4.5	1.2	3.7	2.2
May	5.3	2.0	5.3	2.0	4.8	3.3
June	4.4	1.5	4.4	1.5	4.8	2.7
July	4.9	2.1	4.9	2.1	5.2	1.2
August	4.8	1.6	4.8	1.6	5.1	1.2
September	4.0	0.6	4.0	0.6	4.5	1.0
October	3.6	0.5	3.6	0.5	3.5	1.8
November	2.7	1.1	2.7	1.1	2.9	1.8
December	2.1	1.0	2.1	1.0	2.6	1.8
Total	44.6	14.4	44.6	14.4	45.9	22.4

*Taken from Memo: From Dalton Harrison to All County Extension Directors, Subject: Water Use (ET) Values for Crops and NIR (Net Irrigation Requirement) Values at 50%, 80% and 90% Rainfall Probabilities, Given to Corps of Engineers and Water Management Districts

Source of Data:

1/ Combined data from research at S.W.A.P. project, Ft. Pierce and lysimeter data at ARS Ft. Lauderdale.

2/ Calculated from SCS-21 procedures for using effective rainfall.

3/ Data extrapolated from UF WRC-2 as an average for all vegetables.
NIR-80 = Net irrigation requirement at 80% rainfall probability

[illegible]

TABLE 3-12. CONSUMPTIVE USE (ET) of Citrus and NIR 50%, 80% and 90% Values, Based on SCS-21, and 53.07 inches NOAA (1925-1981) Annual Rainfall Average, for Ft. Pierce, Florida 1/

	Citrus, Ft. Pierce, Florida			
Month	ET 2/	NIR-50 3/	NIR-80 3/	NIR-90 3/
	inches			
January	2.1	0.8	1.0	1.1
February	2.6	0.9	1.1	1.2
March	3.6	1.6	1.9	2.0
April	4.5	2.3	2.6	2.7
May	5.3	2.2	2.6	2.8
June	4.4	0.4	1.0	1.2
July	4.9	1.1	1.6	1.9
August	4.8	1.0	1.5	1.8
September	4.0	0	0	0.2
October	3.6	0	0.1	0.3
November	2.7	1.0	1.2	1.3
December	2.1	0.7	0.9	1.0
ANNUAL	44.6	12.0	15.5	17.5

1/ From Table 3-11

2/ Combined data from S.W.A.P. Ft. Pierce and ARS lysimeter, Ft. Lauderdale, Florida.

3/ NOAA 53.07 average annual rainfall, Ft. Pierce, Florida, and SCS-21.

TABLE 3-13. CONSUMPTIVE USE (ET) of Vegetables and NIR 50%, 80% and 90% Values, based on UF WRC-2 and SCS-21; and 53.07 inches NOAA (1925-1981) Annual Rainfall Average for Ft. Pierce, Florida 1/

Month	ET 2/	Vegetables, Lower East Coast, Florida NIR-50 2/3/	NIR-80 2/3/	NIR-90 2/3/
	inches			
January	2.7	1.3	1.5	1.6
February	2.7	1.0	1.2	1.3
March	3.4	1.4	1.7	1.8
April	3.7	1.6	1.9	2.0
May	4.8	1.8	2.2	2.4
June	4.8	0.8	1.4	1.6
July	5.2	1.4	1.9	2.2
August	5.1	1.3	1.8	2.1
September	4.5	0	0.2	0.5
October	3.5	0	0	0.2
November	2.9	1.2	1.4	1.5
December	2.6	1.1	1.3	1.4
ANNUAL	45.9	12.9	16.5	18.5

1/ From Table 3-11

2/ Data from UF WRC-2 and ARS lysimeter, Ft. Lauderdale, Florida

3/ NOAA 53.07 average annual rainfall, Ft. Pierce, Florida and SCS-21

SUMMARY Points of Chapter 3.

1. Present and future alternative water requirements were determined by examining population and economic activity and consumption rates. Cost, availability, and environmental changes which may occur with projected conditions were used in the determination, but were examined and identified as factors with a possible influence.

2. Present non-agricultural water consumption includes: 1.0 mgd for thermoelectric power generation, 0.27 mgd by self-supplied industry, 1.0 mgd by self-supplied rural domestic users, and 1.93 mgd by public supply users for a total of 4.2 mgd (12.9 AF/day) consumed.

3. The projected non-agricultural water use for St. Lucie County is estimated to be between 15.01 and 16.97 mgd by 1985 depending on population increases, between 16.32 and 20.25 mgd by 1990, between 17.31 and 22.77 mgd by 1995, and between 18.26 and 25.08 mgd by the year 2000. Fifty year projected non-agricultural water use could range from about 30.7 to 32.2 mgd. These projections represent a 50-year increase of about 136%-150% over 1979 use.

4. Average annual net irrigation requirements during normal rainfall years vary from 11 inches for growing vegetables to 23 inches for pasture, with citrus at 15 inches. During dry years, these requirements increase to 13 inches for vegetables and 27 inches for pasture with citrus at almost 18 inches.

5. High irrigation requirement months for vegetables are February, March, October, and November. For irrigated pasture, months having highest irrigation requirements are March through August. Citrus requires most irrigation water in April and May.

6. The total projected agricultural water requirements for the year 2000 are estimated by SFWMD to be 92.0 mgd with 107,800 acres being irrigated. The 50-year projected agricultural water requirements are estimated to range from about 334,216 A.F. to 408,479 A.F., depending on whether normal or dry precipitation year, and assuming about 206,000 to 220,000 irrigated acres.

SUMMARY Points for Chapter 3 (Cont.)

7. Other Needs

   a. A better understanding is needed regarding the quantity and quality of available water in its relationship to such natural factors as, for example, the frequency, duration, and amount of precipitation, soils and land cover.

   b. More information is needed regarding the amount of water required under different technology to be withdrawn and/or conserved for various uses. The USGS, SFWMD and IFAS, in particular, should be encouraged to expand and intensify their current research on this issue in the St. Lucie County area.

   c. The University of Florida Food & Resource Economics Department and the SFWMD should mount a major study program, in conjunction with the needed physical research noted elsewhere, to develop and disseminate information on alternative water management policies, including pricing policies. Particular attention should be given to the private and public costs and benefits and to distribution of those costs and benefits among the affected segments of society. Supporting organization should include, but not be limited to DER, DNR, Department of Agriculture and Consumer Services, and SCS.

   d. Additional information is presently being collected, as a result of a targeting effort in the county by the Soil Conservation Service, toward increased efficiency in agricultural irrigating. These information and targeting efforts should result in less water pumped for irrigation and less agricultural chemicals being flushed into the groundwater system. This information should be used, as it becomes available, in future decisions regarding water permitting and development of additional lands for irrigated agricultural use.

   e. Adequate estimates of the quantity of available surface and ground water are not presently available; however, the upcoming report from the COE is expected to contain such information that will be useful in future decisions affecting water use. When that information becomes available, it should be used to review many of the tables in this chapter for updating affected values.

CHAPTER 4. WATER CONVEYANCE, STORAGE, AND RECHARGE AREAS

Introduction

The COE will be distributing a report in 1984 which is expected to contain extensive and competent treatment of water supply possibilities.

The material presented in this chapter, derived from previous sources cited, provides the best information on this subject available to date. It is recognized that some of the sources present information and views which may be controversial. For example, one source suggests that agricultural chemicals may be a cause of water pollution. The extent to which this view is valid may be in question; however, the difference of opinion emphasizes the fact that more research is required in order to determine the consequences of the general use of the chemicals.

Current Situation

Surface Water

The following discussion of the surface water system and drainage areas, which affects St. Lucie County, is taken from the South Florida Water Management District Summary Status Report, Upper East Coast, October 1980.

> *Conveyance Systems* - There are seven primary conveyance works and eight major control structures within the Upper East Coast Area operated and maintained by the South Florida Water Management District. In addition, there are two other conveyance systems operated and maintained by other agencies, St. Lucie Canal in the south (Corps of Engineers) and Taylor Creek in the northwest (Okeechobee Soil and Water Conservation District). The major structures and conveyance works under District control are shown in Figure 4-1 and listed below:

Conveyance Channels	Control Structures
C-25	S50, S99
C-24	S-49
C-23	S48, S97
L-65 Borrow	S-153
L-64 Borrow	-
L-63 N&S Borrow	S-192
C-59	S-191

> The St. Lucie Canal, a major outlet from Lake Okeechobee, has two lock and spillway structures that are operated for boat passage and water control. The newest, located at Port Mayaca on the west end, is S300 while S-80 is located to the east. Taylor Creek was improved by the Soil Conservation Service and provided drainage from the Taylor Creek Watershed into Lake Okeechobee prior to the construction of S192 and L-63N. The construction of S192 and L63N established water diversion capabilities from Taylor Creek,

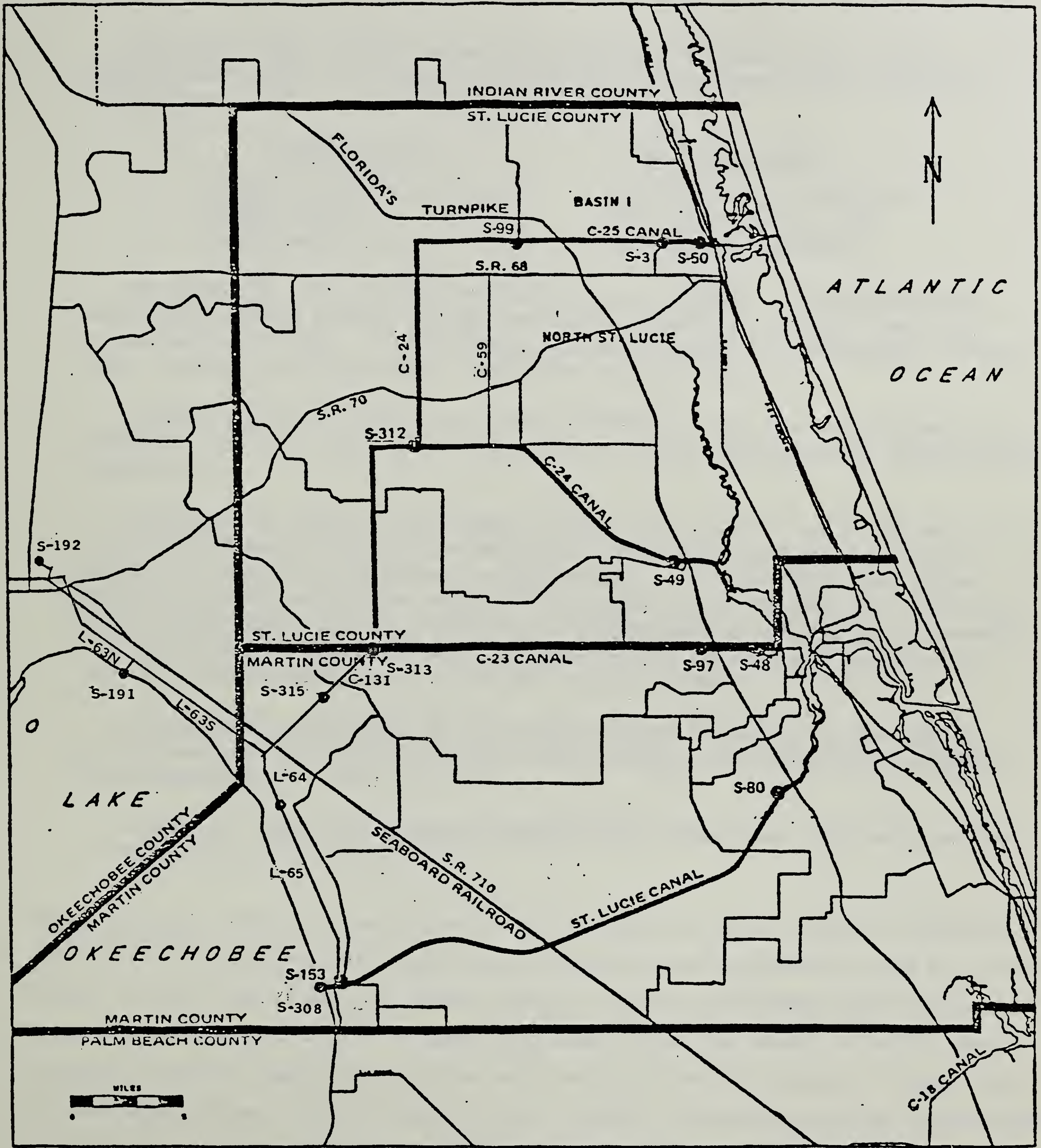


FIGURE 4-1

SURFACE WATER DRAINAGE

UPPER EAST COAST PLANNING AREA

Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

to the upper east coast. However, if C-131 and its affiliated water control structures as designated under the Central and Southern Florida Flood Control Project is completed, then all of the above mentioned basins become part of the same hydrologic unit.

The major water control structures within the Taylor Creek Basin constructed under the auspices of the SCS are as shown in the following tabulation.

Water Course	Main Structure
Taylor Creek Main Channel	S2, S3, Runoff structure
Otter Creek	S13, S13A, S13B, S13C
Williamson Ditch	S8, Runoff Structure

The North St. Lucie Drainage District is a legally constituted water management system located in the northeast portion of the UEC and is 94 square miles in area. The drainage district manages and maintains conveyance channels, pump stations, and water control structures.

Located within the Upper East Coast Planning Area near Indiantown is a Florida Power and Light generating station and an accompanying cooling water reservoir.

The District canals in St. Lucie County (C-23, C-24, and C-25) have no source of recharge except from rainfall; therefore, care must be and is exercised in the use of these surface waters. To accomplish the proper degree of flood protection and still not waste water to the sea, there are three gated water control structures equipped with automatic gate controls. The set points on the automatic sensing/control devices are adjusted to provide seasonal settings for the wet and dry seasons.

A technical publication on the surface water hydrology of the UEC is in preparation and will cover data availability, instrumentation networks and meteorological data.

Figure 4-2 shows the present surface water monitoring stations currently in operation in the UECPA.

Water Quality - Until recently, most of the specific water quality information available in the Martin-St. Lucie area concerns data collected in the St. Lucie Canal at Port Mayaca and the Stuart Locks. The data indicates that the composition of the water flowing from Lake Okeechobee into the canal is fairly representative of the composition of the main body of the lake during a large part of the time (Joyner, 1971; Parker, et.al., 1955). Chemical quality fluctuations are due mainly to seasonal response and rainfall (General Development and Engineering, 1975).

The South Florida water Management District, in February 1983, published a report - "Technical Publication 83-1, Upper East Coast Water Quality Studies, January 1983."

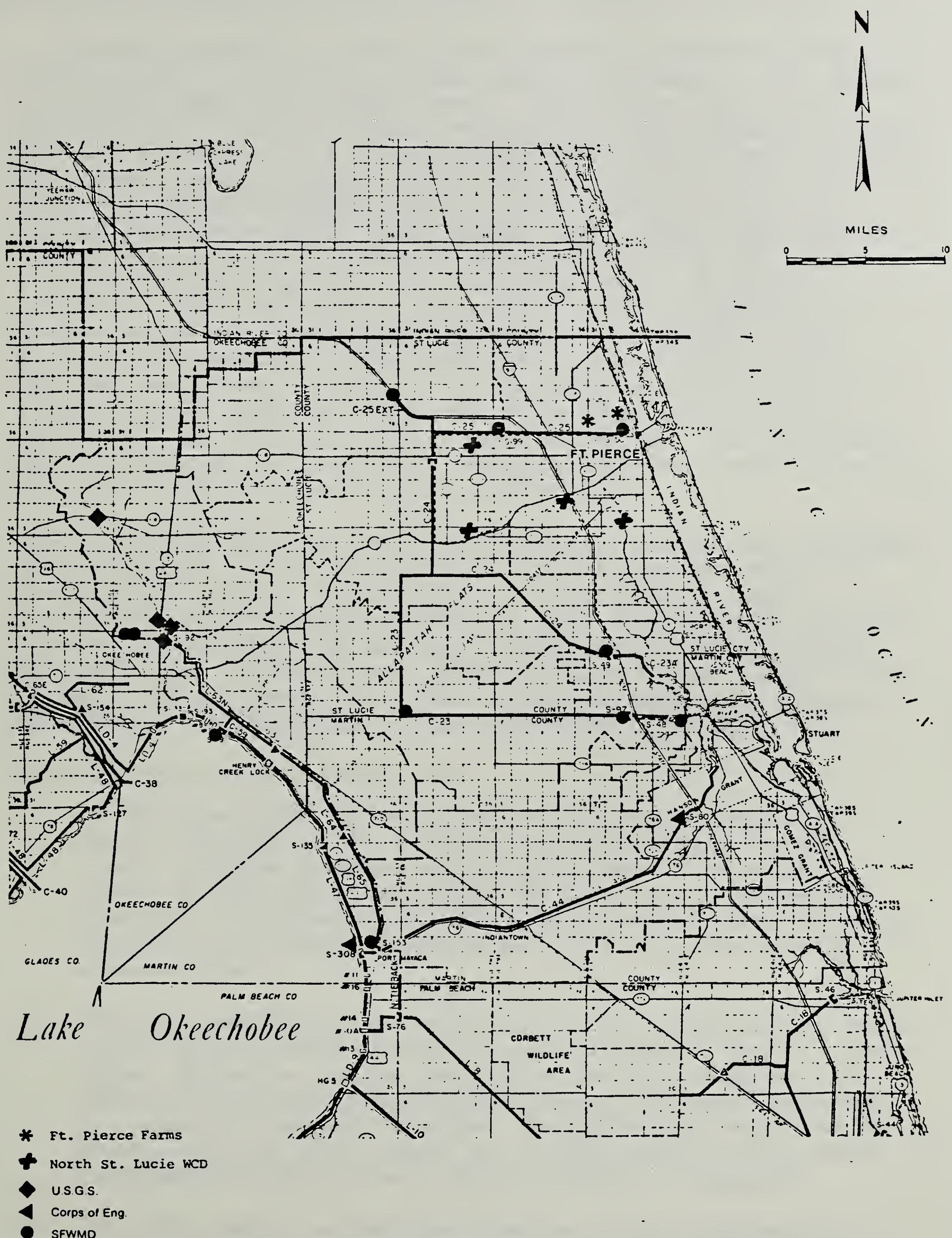


FIGURE 4-2

SURFACE WATER MONITORING STATIONS IN THE UPPER EAST COAST AREA

Source: Summary Status Report - Upper East Coast, SFWMD Oct. 1980

The following discussion of water quality is taken from that report:

Drainage for Martin and St. Lucie Counties is provided primarily by three major canal systems: C-23, (County Line Canal), C-24, (Diversion Canal), and C-25 (Belcher Canal). These three canals total approximately 78 miles in length and primarily drain improved pasture and citrus. Due to the lack of available data and the importance of this surface water resource to the region, the South Florida Water Management District (SFWMD) began, in 1974, studies of the water quality characteristics of these canals. Five studies were found to contain some water quality data on these canals (Price 1962, Bearden 1972, Frieberger 1972, Pitt 1972, and Miller 1975). Except for Frieberger (1972) and Miller (1975), these studies contained only a limited amount of water quality information. The purpose of this study was to establish a water quality data base for this system. This data base forms the basis for a characterization of the quality of water and an evaluation of the St. Lucie Water Supply Plan for connecting C-23, C-24, and C-25 to Lake Okeechobee. This Plan would allow the lake to serve as both a receiving body for surplus water from the UEC area and as a source of irrigation water.

Daily composite and weekly water chemistry grab samples were collected on C-23 at S-97, C-24 at S-49, and C-25 at S-99 from November 1976 through October 1977. The objectives of this sampling were to: (1) characterize the quality of water at each structure, (2) identify seasonal and discharge related water quality trends, (3) calculate material loads, basin-wide area export rates, and flow weighted concentrations, and (4) compare the effect of varying sampling frequencies and collection methodologies on the calculation of material loads.

General results of this study were:

(1) In all three canals the major cations and anions tended to increase through the dry season and decrease during the wet season. Daytime dissolved oxygen also tended to be higher during the dry season than during the wet season. Phosphorous displayed the opposite trend with higher concentrations occurring during the wet season. Nitrogen did not display any readily apparent trend.

(2) Nitrogen, phosphorous, and silica had higher concentrations during periods of wet season discharge resultant from rainfall. Chloride, sodium, potassium, calcium, magnesium, sulfate, hardness, and alkalinity had lower concentrations during wet season discharge as a result of rainfall dilution. During the dry season, major ion levels increased in the canals due to the influence of artesian groundwater irrigation and a lack of dilution by rainfall.

(3) The water quality between each structure during discharge was variable, (Table 4-1). The following rankings were based upon flow-weighted concentrations (except conductivity):

Total Phosphorous (mg/L): S-49 (.260) S-97 (.158) S-99 (.113)

Total Nitrogen (mg/L): S-97 (1.58) S-49 (1.54) S-99 (1.38)

TABLE 4-1. RELATIVE RANKING OF C-23 (S-97), C-24 (S-49), AND C-25 (S-99)

Parameter (mg/L)[1/]	Ranking
Major Ions (flow weighted)	
Cl^-	S-49 (337.5) > S-99 (270.6) > S-97 (161.3)
Alkalinity(HCO_3) (as $CaCO_3$)	S-49 (141.1) > S-97 (140.1) > S-99 (127.8)
SO_4^{-2}	S-99 (101.1) > S-49 (90.2) > S-97 (57.2)
Na^+	S-49 (150.1) > S-99 (98.1) > S-97 (78.3)
K^+	S-49 (8.2) > S-99 (5.9) > S-97 (5.1)
Ca^{+2}	S-49 (93.3) > S-99 (89.9) > S-97 (76.2)
Mg^{+2}	S-49 (28.0) > S-99 (21.7) > S-97 (15.8)
Hardness (as $CaCO_3$)	S-49 (346.4) > S-99 (312.6) > S-97 (255.3)
Nutrients (flow weighted)	
Total P	S-49 (.260) > S-97 (.158) > S-99 (.113)
Ortho P	S-49 (.201) > S-97 (.110) > S-99 (.062)
Total N	S-97 (1.58) > S-49 (1.54) > S-99 (1.38)
NO_3	S-97 (.143) > S-49 (.130) > S-99 (.051)
NO_2	S-97 (.017) > S-49 (.011) > S-99 (.010)
NH_4	S-49 (.146) > S-99 (.108) > S-97 (.093)
Inorganic N	S-49 (.297) > S-97 (.253) > S-99 (.153)
Organic N	S-97 (1.33) > S-49 (1.25) > S-99 (1.22)
Field & Physical Parameters (time weighted)	
Dissolved Oxygen	S-97 (5.5) > S-49 (5.1) > S-99 (4.4)
Sp. Conductance (micromhos/cm)	S-49 (1605) > S-99 (1592) > S-97 (1039)
pH	S-97 (7.4) > S-49 (7.3) > S-99 (7.2)
Turbidity (NTU)	S-97 (3.6) > S-49 (3.0) > S-99 (2.7)

[1/] unless otherwise noted

Source: Technical Publication 83-1, January 1983, Upper East Coast Water Quality Studies, SFWMD

Major cations and anions (mg/L): S-49 S-99 S-97

Conductivity (micromhos/cm): S-49 (1506) S-99 (1592) S-97 (1039)

The phosphorous and nitrogen levels at the three structures were moderately low. The levels of major cations and anions were high.

(4) Turbidity levels were low at all structures. Dissolved oxygen was highly variable with a typical range of less than 0.2 to over 8.0 mg/L. Mean concentrations ranged from 4.4 mg/L (S-99) to 5.5 mg/L (S-97).

(5) Based on this one year study the following material loads were calculated:

Flow (acre-ft): S-97 (48,116) S-99 (38,766) S-49 (27,097)

Total P (10^6g): S-97 (93.9) S-99 (66.2) S-49 (51.4)

Total N (10^6g): S-99 (12,946) S-49 (11,281 S-97 (9,575)

(6) The error in total phosphorous, total nitrogen, and chloride loading calculations, based upon subsurface samples, is approximately linear with respect to sampling frequency up to a period of at least two months. For each week's decrease in the sampling frequency, the error in calculated loads increased approximately 5 percent for total phosphorous, 4 percent for total nitrogen, and 1.5 percent for chloride. A biweekly sampling frequency appears to have errors of similar size to those of the analytical chemistry measurements and daily hydrology data.

(7) Sampling methodology can affect loading calculations more than sampling frequency. Chloride loads based upon weekly surface grab samples were the same as those based upon daily subsurface samples; however, total nitrogen loads based upon weekly surface samples ranged from 14 to 29 percent higher than those based upon daily subsurface samples. The discrepancy for phosphorous loads was even greater, with the loads based upon weekly samples ranging from 28 to 126 percent higher. The grab sampling technique which collects a surface film can result in substantially different phosphorous and nitrogen concentrations as compared to subsurface levels and may, therefore, greatly influence material loading calculations.

The most distinguishing water quality characteristics at S-49, S-97, and S-99 were the high dissolved solids levels. Mean annual specific conductance ranging between 1039 and 1605 micromhos per centimeter for the three structures were indicative of the high dissolved solids levels at these locations. Surface waters at the three structures could, however, be differentiated based upon relative difference in the major ion levels. The generalized ranking of the structures, in descending order based upon flow-weighted major ion concentrations was S-49, followed by S-99 and S-97 (Table 4-1).

During this water quality study, there were two distinct discharge periods at each structure, one during the dry season and one during the wet season. Dry season discharges were in response to higher canal stages which resulted from artesian groundwater irrigation. Wet season discharges were in response to intense rainfall activity and subsequent runoff. The sources of the discharge water appear to play a major role in determining the temporal quality characteristics of the water in the canals.

Interpretation of Water Quality Data

The U. S. Geological Survey is an authoritative source for water quality information. Their report: Water Resources Data for Florida, (Tallahassee, Florida 1981) contains a discussion of the significance of a number of constituents and properties of natural waters. The following information is extracted from that report.

Sediment

Suspended sediment samples were collected monthly at stations in the Hydrologic Benchmark Network and National Stream Quality Accounting Network with depth-integrating samplers. Depth integrated samples were collected at three or more verticals in the cross section to determine variations in the cross section and to more accurately determine suspended sediment loads. Daily sediment loads in tons per day are reported for day on which samples were collected.

Mineral constituents in solution

All natural waters contain dissolved mineral matter. The quantity of dissolved mineral matter in natural water depends primarily on the type of rocks or soils with which the water has been in contact and the length of time of contact. Ground water is generally more highly mineralized than surface runoff because it remains in contact with the rocks and soils for much longer periods. Many streams are fed by both surface runoff and ground water from seepage or direct spring inflow. Such streams reflect the character of the more mineralized ground water during dry periods and are diluted by surface runoff during wet periods.

The mineral constituents and physical properties of waters reported in this report include those that have a practical bearing on water use. The results of analyses generally include silica, iron, calcium, magnesium, sodium, potassium, carbonate, sulfate, chloride, flouride, nitrate, pH, dissolved solids, and specific conductance. Aluminum, manganese, color, dissolved oxygen, and other dissolved constituents and physical properties are reported for certain streams. Microbiologic and organic components (pesticides, total organic carbon) and minor elements (arsenic, cobalt, cadmium, copper, lead, mercury, nickel, strontium, zinc, etc.) are determined occasionally for some streams in connection with specific studies and the results are reported. The source and significance of a number of constituents and properties of natural waters are discussed in the following table.

Table 1. Significance of dissolved mineral constituents and properties of water 1/

Constituent or property	Source or cause	Significance
Alkalinity	Caused primarily by bicarbonate, carbonate, and hydroxide. Other weak acid radicals like borate, phosphate, and silicate may contribute to alkalinity.	Ability of water to neutralize strong acid. High alkalinity itself not detrimental but usually associated with high pH, hardness, and dissolved solids which can be detrimental.
Aluminum (Al)	Usually present only in negligible quantities in natural waters except where the waters have been in contact with the more soluble rocks of high aluminum content. Acid waters often contain large amounts.	May be troublesome in feed waters forming scale on boiler tubes. High concentrations usually indicate the presence of acid mine drainage or industrial waste.
Arsenic (As)	Natural arsenic-bearing minerals. Found in some ground waters, in wastes from industry and mining activity, and residues from some insecticides and herbicides.	National Interim Primary Drinking Water Regulations (U.S. Environmental Protection Agency, 1975) give a limit of 50 ug/L for potable waters. Lethal dose for animals is believed to be about 20 milligrams per animal pound. Small concentrations in drinking water can accumulate in man and other animals until lethal dosage is reached.
Bicarbonate (HCO3) and Carbonate (CO3)	Produced by reaction of atmospheric carbon dioxide with water. Dissolved from carbonate rocks such as limestone and dolomite.	Bicarbonate and carbonate produce alkalinity. Bicarbonates of calcium and magnesium decompose in steam boilers and hot water facilities to precipitate as scale and release corrosive carbon dioxide gas. In combination with calcium and magnesium cause carbonate hardness.
Cadmium (Cd)	Found in wastes from pigment works, textile printing, lead mines, and chemical industries.	The results of animal studies suggest that very small amounts of cadmium can produce nephrotoxic and cardiovascular effects. The reproductive organs of animals are specifically affected after parenteral administration of very small amounts of cadmium salts. National Interim Primary Drinking Water Regulations (U.S. Environmental Protection Agency, 1975) state that cadmium in excess of 10 ug/L is cause for rejection of the water supply. Cadmium is also toxic to fish and aquatic life in varying concentrations.
Calcium (Ca) and Magnesium (Mg)	Dissolved from practically all soils and rocks, but especially from limestone, dolomite, and gypsum. Calcium and magnesium are found in large quantities in some brines. Magnesium is present in large quantities in seawater.	Causes most of the hardness and scale-forming properties of water; consumes soap (see hardness). Waters low in calcium and magnesium are desired in electroplating, tanning, dyeing, and in textile manufacturing.
Chloride (Cl)	Dissolved from rocks and soils. Present in sewage and found in large amounts in ancient brines, seawater, and industrial brines.	About 300 mg/L in combination with sodium gives salty taste to water. Increases the corrosiveness of water. Proposed National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 1977) recommends that the chloride content should not exceed 250 mg/L.
Chromium (Cr)	Few if any waters contain chromium from natural sources. Natural waters probably contain only traces of chromium as a cation unless the pH is very low. When chromium is present in water, it is usually the result of pollution by industrial wastes such as metal pickling, plating, manufacturing of paints, dyes, explosives, ceramics, paper, glass, and photography processing.	National Interim Primary Drinking Water Regulations (U.S. Environmental Protection Agency, 1975), limit the maximum concentration of hexavalent chromium to 50 ug/L. Toxicity to aquatic life varies widely with the species, temperature, pH, and other factors.

Table 1 (con't.)

Constituent or property	Source or cause	Significance
Cobalt (Co)	Cobalt occurs in nature in the minerals smaltite, (Co,Ni)As^2, and cobaltite, CoAsS. Alluvial deposits and soils derived from shales often contain cobalt in the form of phosphate or sulfate, but other soil types may be markedly deficient in cobalt in any form. Biological activity may aid in the solution of small amounts of cobalt. May also be present in industrial wastes especially those from manufacture of ceramics, inks, electric heating units, and cobalt pigments.	Usually suggests pollution. Relatively low toxicity to man. Fish and aquatic life tolerance varies widely from less than 3 mg/L to more than 10 mg/L. Essential in trace quantities for plant growth.
Color	Yellow-to-brown color of some water is usually caused by organic matter extracted from leaves, roots, and other organic substances. Objectionable color in water also results from industrial wastes and sewage.	Water for domestic and some industrial uses should be free from perceptible color. The National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 1977) proposes a limit of 15 Pt-Co units. Color in water is objectionable in food and beverage processing and many manufacturing processes. Limits light penetration in water, thus preventing growth of some organisms.
Copper (Cu)	Copper is a fairly common constituent of natural water. Small amounts may be introduced into water by solution of copper and brass water pipes and other copper-bearing equipment in contact with the water or from copper salts added to control algae in open reservoirs. Copper salts such as the sulfate and chloride are highly soluble in waters with a low pH but in water of normal alkalinity the salts hydrolyze and copper may be precipitated. In the normal pH range of natural water containing carbon dioxide, the copper might be precipitated as carbonate.	Copper imparts a disagreeable metallic taste to water. As little as 1.5 mg/L can usually be detected, and 5 mg/L can render the water unpalatable. Copper is not considered to be a cumulative systemic poison like lead and mercury; most copper ingested is excreted by the body and very little is retained. The pathological effects of copper are controversial, but it is generally believed very unlikely that humans could unknowingly ingest the toxic quantities from palatable drinking water. The National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 1977) recommends that copper should not exceed 1000 ug/L in drinking and culinary water. Copper is essential in trace amounts for plant growth but becomes toxic in large amounts.
Dissolved Oxygen (DO)	Dissolved in water from air and from oxygen given off in the process of photosynthesis by aquatic plants.	Dissolved oxygen increases the palatability of water. The amount necessary to support fish life varies with species and age, with temperature, and concentration of other constituents in the water. Under average stream conditions, 5 mg/L is usually necessary to maintain a varied fish fauna in good condition. For many industrial uses, zero dissolved oxygen is desirable to inhibit corrosion.

Table 1 (con't)

Constituent or property	Source or cause	Significance
Dissolved solids	Chiefly mineral constituents dissolve from weathering of rocks and soils	The National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 1977) recommends that the dissolved solids should not exceed 500 mg/L, however, 1,000 mg/L is permitted under certain circumstances. Waters containing more than 1,000 mg/L of dissolved solids are unsuitable for many purposes. The Geological Survey classifies the degree of salinity of these more mineralized bodies of water as follows (Swenson and Baldwin, 1965): Dissolved solids (mg/L) — Degree of salinity Less than 1,000..... Nonsaline. 1,000 to 3,000...... Slightly saline. 3,000 to 10,000..... Moderately saline. 10,000 to 35,000.... Very saline.
Fluoride (F)	Dissolved in small to minute quantities from most rocks and soils. Enters many waters from fluoridation of municipal supplies.	Fluoride in drinking water reduces the incidence of tooth decay when the water is consumed during the period of enamel calcification. However, it may cause mottling of the teeth depending on the concentration of fluoride, the age of the child, amount of drinking water consumed, and susceptibility of the individual.
Hardness (as $CaCO_3$)	In most waters nearly all the hardness is due to calcium and magnesium. All of the metallic cations other than the alkali metals also cause hardness.	Consumes soap before a lather will form. Deposits soap curd on bathtubs. Hard water forms scale in boilers, water heaters, and pipes. Hardness equivalent to the bicarbonate and carbonate is called carbonate hardness. Any hardness in excess of this is called non-carbonate hardness.
Iron (Fe)	Iron is dissolved from many rocks and soils. On exposure to air, normal basic waters that contain more than 1 mg/L of iron soon become turbid with the insoluble reddish ferric compounds produced by oxidation. Surface waters, therefore, seldom contain as much as 1 mg/L of dissolved iron, although some acid waters carry large quantities of iron in solution.	On exposure to air, iron in ground water oxidizes to reddish-brown sediment. More than about 300 ug/L may stain laundry and utensils reddish-brown. Objectionable for food processing, textile processing, beverages, ice manufacture, brewing and other processes. Proposed National Secondary Drinking Water Resulations (U.S. Environmental Protection Agency, 1977) for esthetic reasons, recommend that iron should not exceed 300 ug/L. Larger quantities cause unpleasant taste and favor growth of bacteria.
Lead (Pb)	Lead seldom occurs in most natural waters, but industrial mine and smelter effluents may contain relatively large amounts of lead which contaminates the streams. Also, atmospheric contamination which is produced from several types of engine exhausts has considerably increased the availability of this element for solution in rainfall, resulting in contamination of lead in streams (Hem, 1970).	National Interim Primary Drinking Water Regulations, (U.S. Environmental protection Agency, 1975), state that lead shall not exceed 50 ug/L in drinking and culinary water on carriers subject to Federal quarantine regulations. Maximum safe concentrations for animal watering is reported to be 500 ug/L. Toxicity of lead to fish decreases with increasing water hardness.

Table 1 (con't)

Constituent or property	Source or cause	Significance
	Lead in the form of sulfate is reported to be soluble in water to the extent of 31 mg/L (Seidell, 1940) at 25C. In natural water this concentration would not be approached however, since a pH of less than 4.5 would probably be required to prevent formation of lead hydroxide and carbonate. It is reported (Pleissner, 1907) that at 18°C water free of carbon dioxide will dissolve the equivalent of 1.4 mg/L of lead and the solubility is increased nearly four fold by the presence of 2.8 mg/L of carbon dioxide in the solution. Presence of other ions may increase the solubility of lead.	
Manganese (Mn)	Dissolved from some rocks and soils. Not as common as iron. Large quantities often associated with high iron content and with acid waters.	Same objectionable features as iron. Causes dark brown or black stain. The National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 1977) recommends that manganese not exceed 0.05 mg/L.
Nickel (Ni)	Chiefly from metal plating works, manufacturing of ceramic colors, and inks.	Presence of nickel in water may suggest pollution. Federal drinking water standards do not place a limit on nickel. In the Soviet Union the maximum permissible concentration is 1.0 mg/L, (Kirkor, 1951).
Nitrogen, Ammonia (N)	Includes nitrogen in the form of NH_3 and NH_4^+. Found in many waters but usually only in trace amounts. Waters from hot springs may contain high concentrations. Found also in waters polluted with sewage and other organic waste.	Usually indicates organic pollution. Toxicity to fish is dependent on the pH of the water; 2.5 mg/L ammonia nitrogen can be harmful in the 7.4 to 8.5 pH range (Ellis, M.M., 1931). Ammonium salts are destructive to concrete made from portland cement.
Nitrogen, Organic (N)	Amino acids, proteins, and polypeptides. Derived from living organisms and their life processes and from wastes and sewage.	Sometimes indicates pollution. Increases nutrient content of water through decomposition and formation of other nitrogen forms.
Nitrogen, Nitrate (N)	Decaying organic matter, sewage, fertilizers, and nitrates in soil.	Concentrations much greater than the local average may suggest pollution. The National Interim Primary Drinking Water Regulations (U.S. Environmental Protection Agency, 1975) have established a 10 mg/L maximum contamination level. More than about 10 mg/L of nitrate (N) may cause a type of methemoglobinemia in infants, sometimes fatal. Water of high nitrate content should not be used in baby feeding (Maxcy, K.F., 1950). Nitrate has shown to be helpful in reducing intercrystalline cracking of boiler steel. It encourages growth of algae and other organisms which produce undesirable tastes and odors.
Nitrogen, Nitrite (N)	Unstable in the presence of oxygen and is present in only small amounts in most waters. Found in sewage and other organic wastes.	Presence of nitrite is usually an indication of recent organic pollution. Undesirable in waters for some dyeing and
Nitrogen, Total Kjeldahl (N)	Includes ammonia nitrogen and organic nitrogen.	See organic and ammonia nitrogen.
Nitrogen, total (N)	All forms of nitrogen - inorganic and organic.	See ammonia nitrogen, nitrite, nitrate, and organic.
pH Hydrogen ion concentration	Hydrogen ions derived from ionization of weak and strong acids. Hydrogen ion concentration is expressed in terms of pH where pH = log (H+). Acid generating salts and dissolved gases such as SO_2 and CO_2 increases the number of hydrogen ions. Carbonates, bicarbonates, hydroxides, phosphates, silicates, and borates reduce the number of hydrogen ions.	pH ranges between 0 and 14. A pH of 7.0 indicates solution having equal numbers of hydrogen and hydroxide ions. pH higher than 7.0 denotes predominance of hydroxide ions; values lower than 7.0 indicate predominance of hydrogen ions. Corrosiveness of water generally increases with decreasing pH. However excessively alkaline waters may also attack metals. A pH range of 6.5–8.5 is recommended in the National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 1977).

Table 1 (con't)

Constituent or property	Source or cause	Significance
Strontium (Sr)	Dissolved from rocks and soil. Found in seawater and many brines. Present in waters of local areas where strontium minerals such as celestite and strontianite are present.	Naturally occurring strontium is similar chemically to calcium and only adds to the hardness of water.
Sulfate (SO4)	Dissolved from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Usually present in mine waters and in some industrial waters.	Sulfate in water containing calcium forms hard scale in steam boilers. In large amounts, sulfate in combination with other ions gives bitter taste to water. Some calcium sulfate is considered beneficial in the brewing process. The National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, r1977) ecommend that the sulfate content nshould ot exceed 250 mg/L.
Temperature	Solar energy, thermal pollution from waste outfalls and heat from earth's core.	Affects usefulness of water for many purposes. For most uses, a water of uniformly low temperature is desired. Shallow wells show some seasonal fluctuations in water temperature. Ground waters from moderate depths usually are nearly constant in temperature, which is near the mean annual air temperature of the area. In very deep wells, the water temperature generally increases on the average about 1°C with each 100-foot increment of depth. Seasonal fluctuations in temperatures of surface waters are comparatively large, depending on the depth of water, but do not reach the extremes of air temperature.
Turbidity	Colloidal suspensions of sediment, precipitates, and other small particles.	The National Interim Primary Drinking Water Regulations (U.S. Environmental Protection Agency, 1975) has established a maximum contaminant level as a monthly average of one nephelometric turbidity unit (NTU) (or 5 turbidity units (NTU) with state approval, provided it does not interfere with disinfection, maintenance of chlorine residual, or bacteriological testing). Interferes with light penetration and limits growth of organisms. Also directly lethal to some life forms.
Zinc (Zn)	Dissolved from some rocks and soils. Found in high concentrations in some mine waters havin a low pH. Zinc is used in many commercial products and industrial wastes may contain large amounts. May be derived from zinc plated or galvanized metal products.	High concentrations may be toxic to aquatic plants and animals. Zinc may have such a toxic action on purifying bacterial flora of streams as to present serious sewage pol- lution problems. The National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 1977) standards recommend that zinc should not exceed 5,000 ug/L (5 mg/L).

1/ Source: USGS, Water Resources Data for Florida, Tallahassee, Florida 1981

Surface Water Storage

There are certain soils in St. Lucie County which, because of internal soil conditions, are suitable for above ground storage of surplus water for later use. Some storage systems have already been installed in the Martin-St. Lucie area, and others are being considered. During periods of excess rainfall, surplus water is pumped into these diked areas, reducing the volume of water which must be discharged into and handled by the outlet channels. Water is held in these retention areas until such time as it is needed for supplemental irrigation or for other uses. Even though the water in these reservoirs will likely be depleted during the dry seasons, they will provide temporary storage and can supplement the primary source of irrigation water. Technical Publication 75-3, entitled "Agricultural Reservoir Study", Central and Southern Florida Flood Control District (now SFWMD), provides a detailed analysis of an existing grove-reservoir system, using a water budget. This publication is available through the Water Management District and a copy is filed at the SCS State Office in Gainesville.

Soils in St. Lucie County which are best suited for above-ground water storage are those which have very slow permeability rates in the soil surface or sub-soil layers, (Table 4-2). A map of St. Lucie County has been developed showing the location of these soils (listed in Appendix I as map 4-1). A copy of this map is located in the Soil Conservation Service Office at Ft. Pierce, Florida.

TABLE 4-2. SOILS WITH SLIGHT OR MODERATE LIMITATIONS FOR RESERVOIR AREAS

Soil Name	Mapping Unit	Acres in St. Lucie County
Winder	55	1102
Hilolo	16	3819
Chobee	11	9010
Total		13940

Source: Soil Survey of St. Lucie County, Florida

The practicality of constructing surface storage systems that would result in significant amounts of supplemental irrigation water needs extensive study. The amount of land that would be removed from production, the value of the land taken out of production, pumping costs, evaporation and seepage losses, construction costs, and limited soils suitable for such storage are some of the major factors which raise the question of the practicality of such systems. However, as water demands increase, additional systems for storing supplemental irrigation water may become feasible.

Groundwater

The following discussion of the groundwater system is taken from the SFWMD Summary Status Report.

In the Upper East Coast Planning Area, groundwater is found in a series of shallow aquifers (the Shallow Aquifer) and a series of deep aquifers (the Floridan Aquifer).

Shallow Aquifer - The Shallow aquifer system is one of the major sources of potable water in the UEC. To determine its potential for water supply and other uses, a cooperative program between the U. S. Geological Survey and the South Florida Water Management District was initiated in 1976. The purpose of this study was to investigate and document the hydrogeologic properties of the shallow strata using previous studies, available data, and new data collected over the period of study. The output from this program so far consists of: (1) a compilation of available basic data, "Hydrologic and Geologic Data from the Upper East Coast Planning Area, Southeast Florida", U.S.G.S. Open File Report 79-1543, 1979, by Wesley L. Miller; (2) A map showing altitude to the base of the aquifer and a series of litho-logic cross-sections and accompanying text "Geologic Aspects of the Surficial Aquifer System in the Upper East Coast Planning Area, Southeast Florida", Provisional (U.S.G.S.) 1979, by Wesley L. Miller; (3) A water quality map and accompanying text "Well Locations and Water Quality Characteristics of Ground Waters from Selected Wells Finished in the Surficial Aquifer, Upper East Coast Water Use Planning Area, Southeast Florida"; (4) A map and accompanying tables showing aquifer characteristics, "Aquifer Test Data from the Surficial Aquifer, Upper East Coast Water Use Planning Area, Southeast Florida".

The base of the Shallow (or Surficial) aquifer, as investigated by the U.S.G.S. has an elevation which varies from 40 to more than 200 feet below National Geodetic Vertical Datum (Figure 4-3). The base of the aquifer is highly irregular and undulating, but generally the aquifer is thinnest towards the west and northwest sections of the area and thickens towards the east and south. The lithology of the aquifer system is primarily sand, clay, silt, shell, and limestone deposited during the Pleistocene and Pliocene epochs (Figure 4-4). Strata included in this series have been assigned to the Fort Thompson and Anastasia formations, and the overlying Pamlico Sand. Shell and sand lenses in the Caloosahatchee Marl are also included.

The geology of the area is characterized by complex facies changes which affect the hydrogeologic properties of the aquifer. The base of the aquifer is formed by impermeable and semi-permeable clays and marls of the Tamiami and Hawthorn formations upon which the rocks of the aquifer system lie unconformably.

The aquifer is, in general, unconfined (water table aquifer), but local leaky artesian conditions exist, notably in the vicinity of Fort Pierce and Indiantown where discontinuous clay lenses act as confining units.

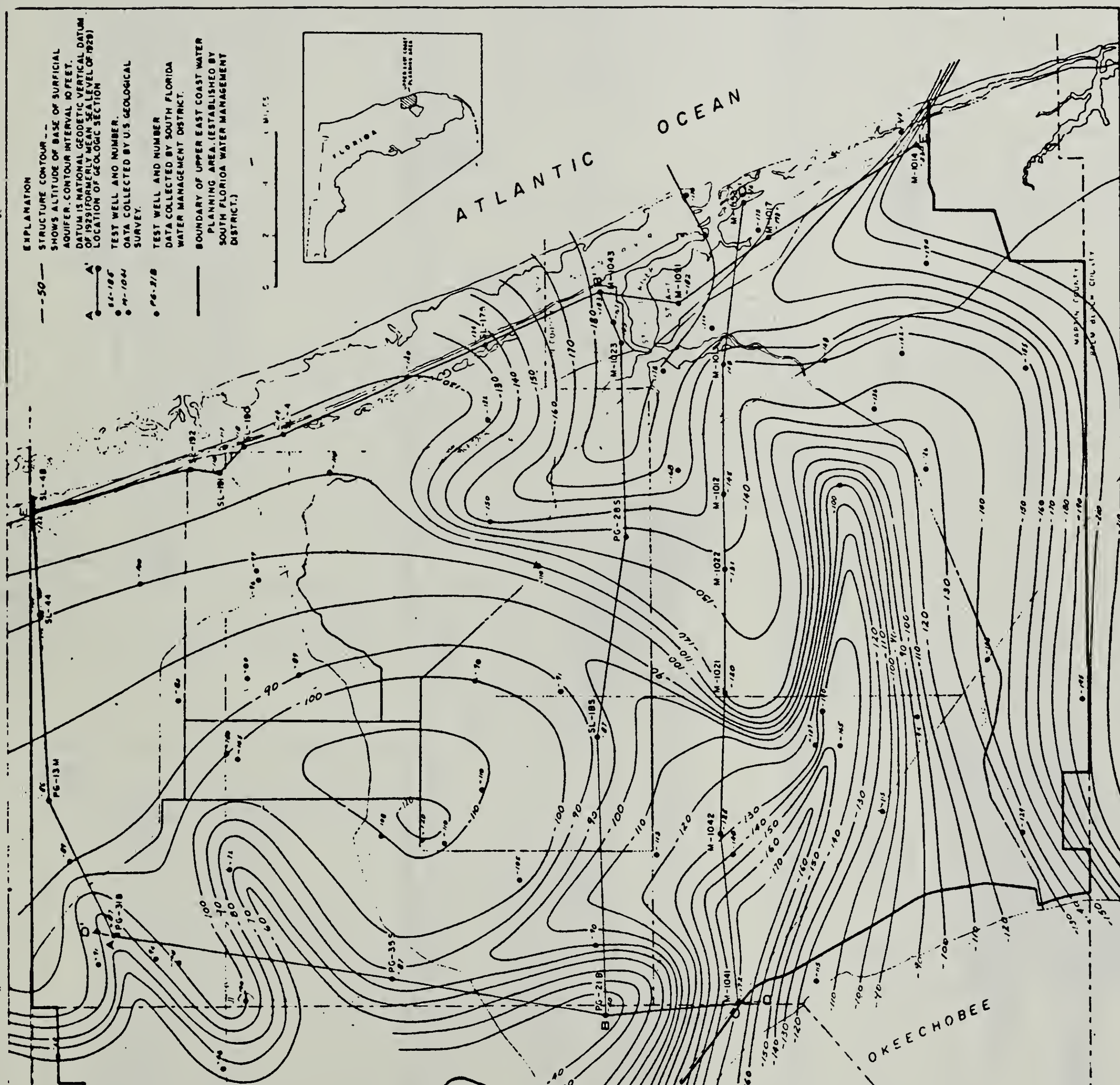


FIGURE 4-3. LOCATION OF UPPER EAST COAST PLANNING AREA, LINES OF SECTION AND ALTITUDE OF BASE OF SURFICIAL AQUIFER SYSTEM

Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

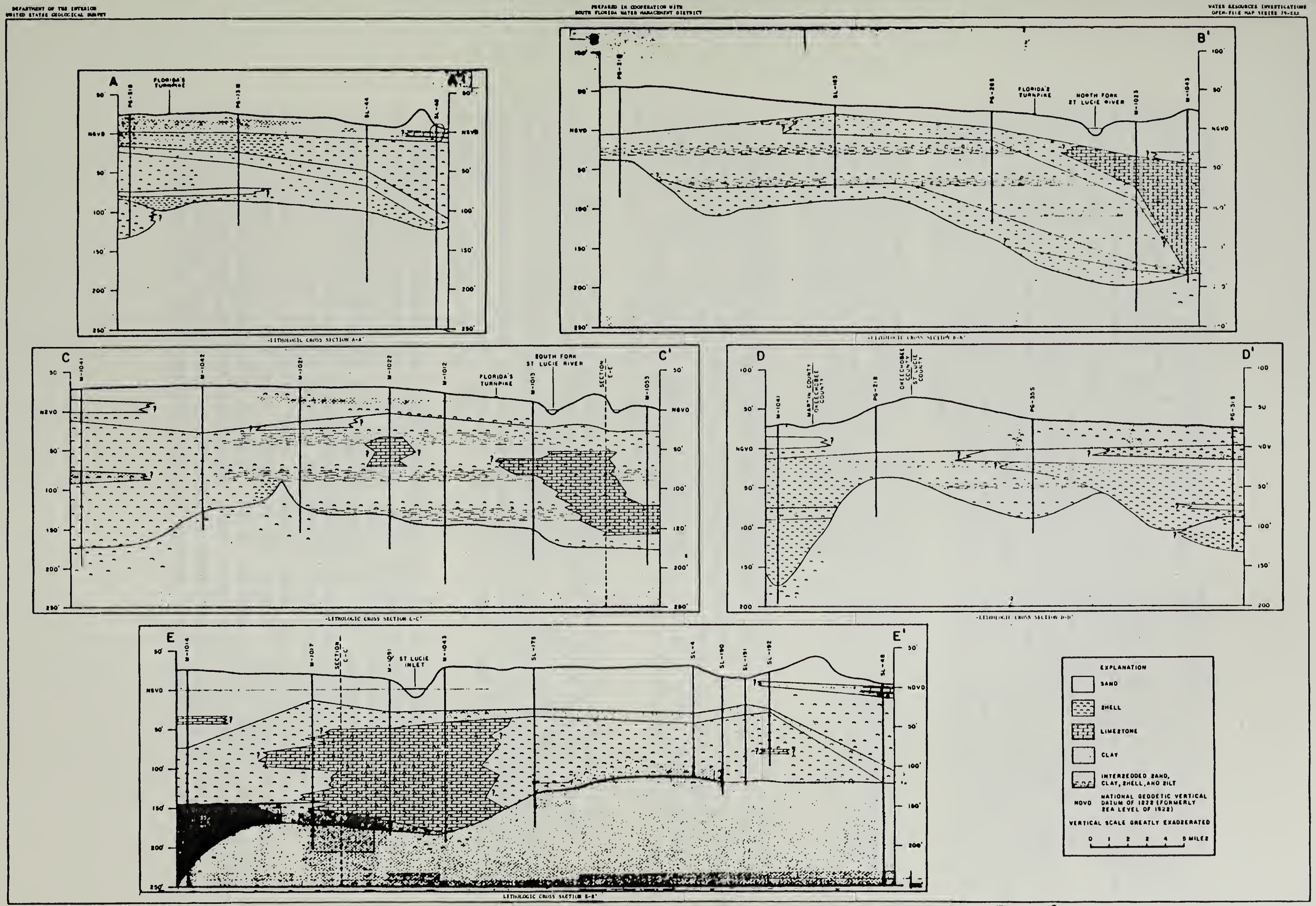


FIGURE 4-4. Geologic Aspects of the Surficial Aquifer System in the Upper East Coast Planning Area, Southeast Florida by Wesley L. Miller, 1979

Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

Water quality data, based on analyses of major cations and anions, indicate generally good quality water (less than 1000 ppm Total Dissolved Solids as shown in Figure 4-5). With the exception of the coastal area and local areas inland, water at all depths sampled within the Surficial aquifer is predominantly calcium-magnesium bicarbonate type. Water from wells along the coast north of the St. Lucie River and east of North Fork and St. Lucie River is predominantly sodium chloride water. In local areas, sodium chloride type waters were also noted. These higher than expected concentrations of sodium chloride may be related to agricultural development or contamination from canals. Other possible causes may be (1) residual salts in fine sediments derived from inundations by ancient seas, (2) upward leakage of saline artesian water, or (3) use of artesian water for irrigation.

The information available so far on the Shallow aquifer series provides insight into the suitability of the aquifer for groundwater development. It does not, however, provide adequate data for quantification of the available resources. It will therefore be necessary to continue collection and analysis of data to achieve this goal.

Floridan Aquifer - The hydrogeologic characteristics of the Floridan aquifer system in the UEC have been documented through the Floridan reconnaissance investigation. A monitoring network consisting of Floridan aquifer wells was established to give broad coverage to the overall planning area. Several types of data were collected from these wells to acquire knowledge of the hydrogeologic aspects important in the management of such an extensive aquifer.

Data for 60 wells is used in the SFWMD Technical Map Series 79-1, "Hydrogeologic Reconnaissance of the Floridan Aquifer System, Upper East Coast Planning Area", (Brown and Reece, 1979). The map series consists of 10 plates which illustrate the location of the wells, the potentiometric surface for the wet and dry seasons, water quality in the Floridan aquifer and its various producing zones, and generalized hydrogeologic sections of the UEC.

Wells were chosen from the private sector by using the following criteria: (1) cooperation of owner, (2) capability of obtaining representative water samples, (3) access into well for borehole geophysical logging, (4) suitability for aquifer testing, (5) deepest penetration of aquifer, (6) absence of uncontrolled flowing wells in the surrounding area, and (7) even distribution throughout the area, where possible. Wells chosen were monitored on a monthly basis for water levels and water chemistry for one year. Most of the wells within the monitoring network were geophysically logged. Rock cuttings along with other hydrogeologic information were collected from seven wells in the planning area during drilling operations of privately owned water supply wells. The data allowed for defining the aquifer system both areally and vertically.

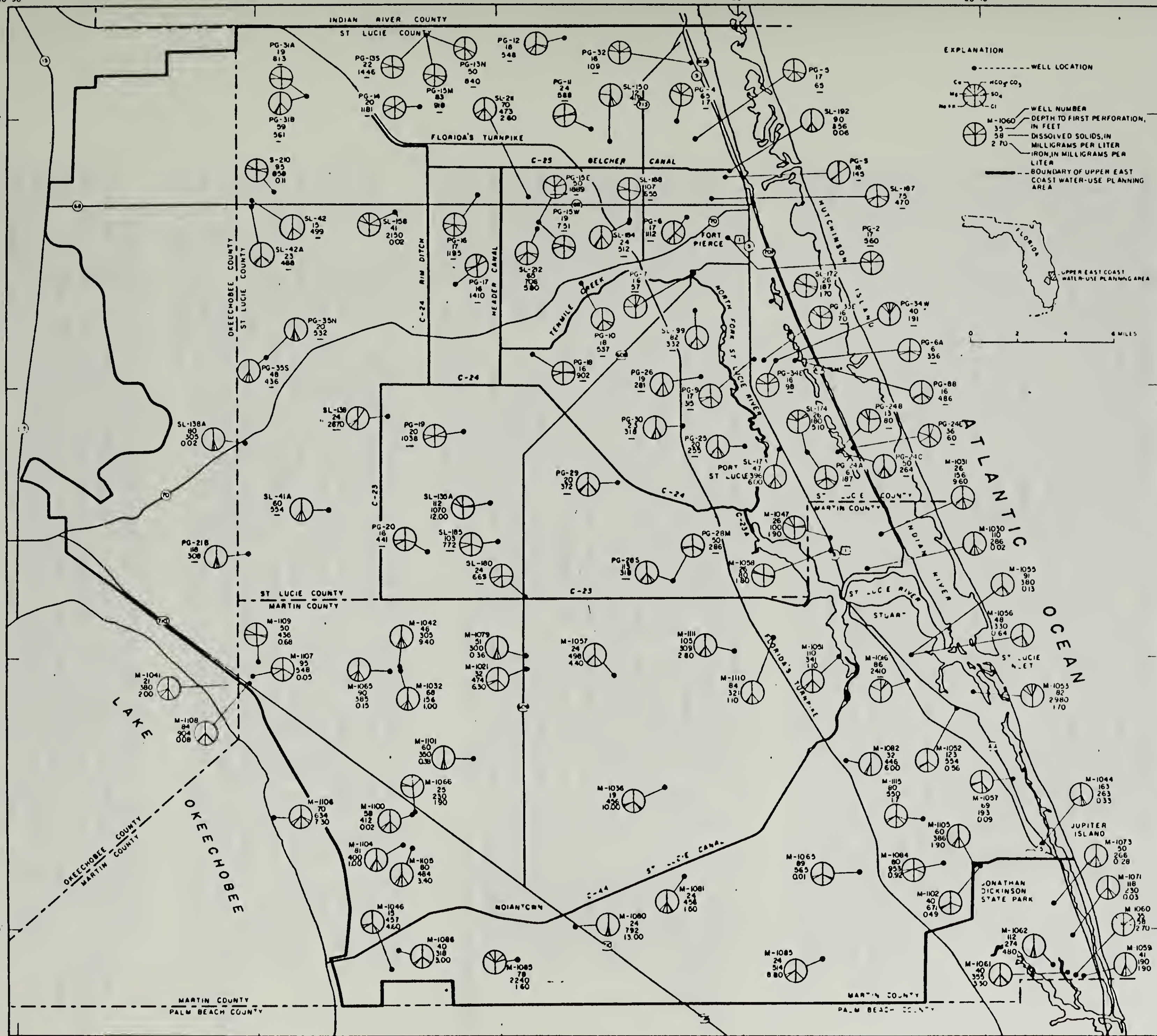


FIGURE 4-5 BY: U.S.G.S. 1979

WELL LOCATIONS AND WATER-QUALITY CHARACTERISTICS OF GROUND WATERS FROM SELECTED WELLS FINISHED IN THE SURFICIAL AQUIFER, UPPER EAST COAST WATER-USE PLANNING AREA, SOUTHEAST FLORIDA.

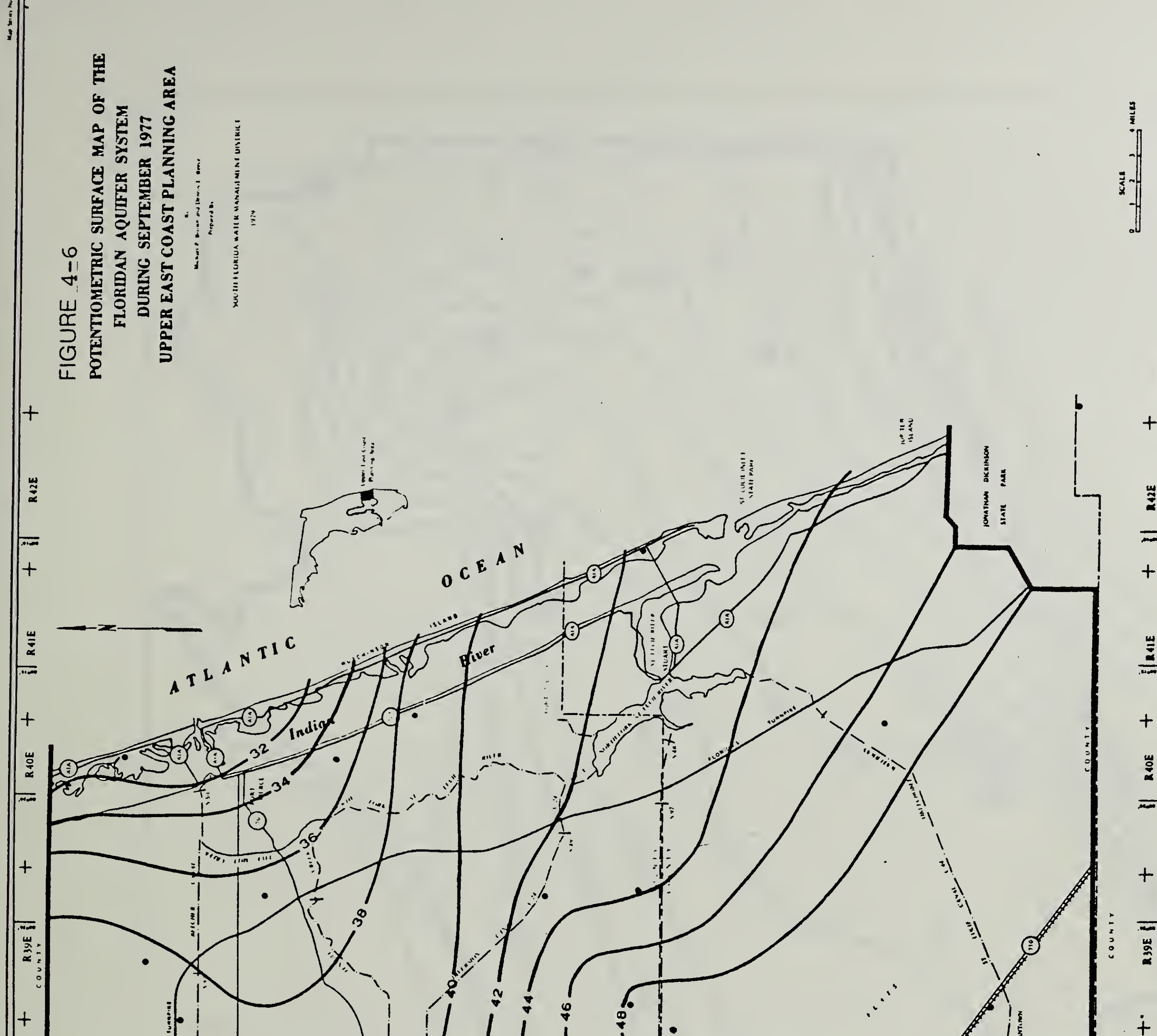
Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

Shut-in pressures in the aquifer were measured with calibrated mechanical pressure gauges to determine the potentiometric head of the Floridan aquifer at that point. This allowed the determination of the potentiometric surface, or the surface to which water in an aquifer would rise by hydrostatic pressure. When expressed areally this results in a potentiometric surface map (Figure 4-6). Throughout the area, potentiometric heads are above land surface, resulting in flowing artesian wells. Heads vary generally less than one foot between high water level conditions and low water level conditions. Only slight head variations (less than 1 foot average) have been noted in head measurements made in 1977 and measurements made in 1979. Water stored in the Floridan aquifer system in the UEC exists in a dynamic state in which hydraulic gradients are controlled by recharge, discharge, and aquifer properties. Because groundwater flows down-gradient from areas of higher to lower heads, and perpendicular to lines of equal potential, it was shown that much of the water enters the planning area from the south.

Wellhead samples were collected and analyzed in the field for temperature, specific gravity, specific conductance, pH, and alkalinity. One liter samples were also collected for complete laboratory analysis of inorganic constituents. It was found that the total dissolved solids (TDS) content varied areally and vertically in the Floridan aquifer system (Figure 4-7). Total dissolved solids are relatively high in waters of the Floridan aquifer system due to the presence of highly mineralized water trapped in sediments during an earlier geologic time. Chloride was found to be the predominant anion with lesser amounts of sulfate, bicarbonate, and sulfide also present. Sodium, calcium, and magnesium are the major cations in association with minor amounts of potassium and strontium. Other ions are generally present in only trace amounts.

The presence of chloride in high concentrations in the Floridan aquifer is not due to direct saltwater intrusion from the Atlantic Ocean. Reverse flow of salt water from the ocean into the Floridan aquifer below the UEC is not hydraulically possible due to high potentiometric heads along the coast. A 'ridge' of relatively poor quality water having a chloride concentration ranging from 1200 to 1400 milligrams per liter (mg/ℓ) strikes northwest/southeast across the UEC. Fresher water parallels this ridge on both sides with chloride concentrations as low as 200-400 mg/ℓ occurring in western portions of St. Lucie County.

Throughout the UEC contributing intervals within the Floridan aquifer system were identifiable, with the percent water contribution to the open borehole from each interval varying areally. This indicates that in the UEC the Florida aquifer system consists of a number of producing zones of different hydrologic properties separated by semi-permeable zones in a sequence of lower Oligocene, upper, and middle Eocene limestones.



Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

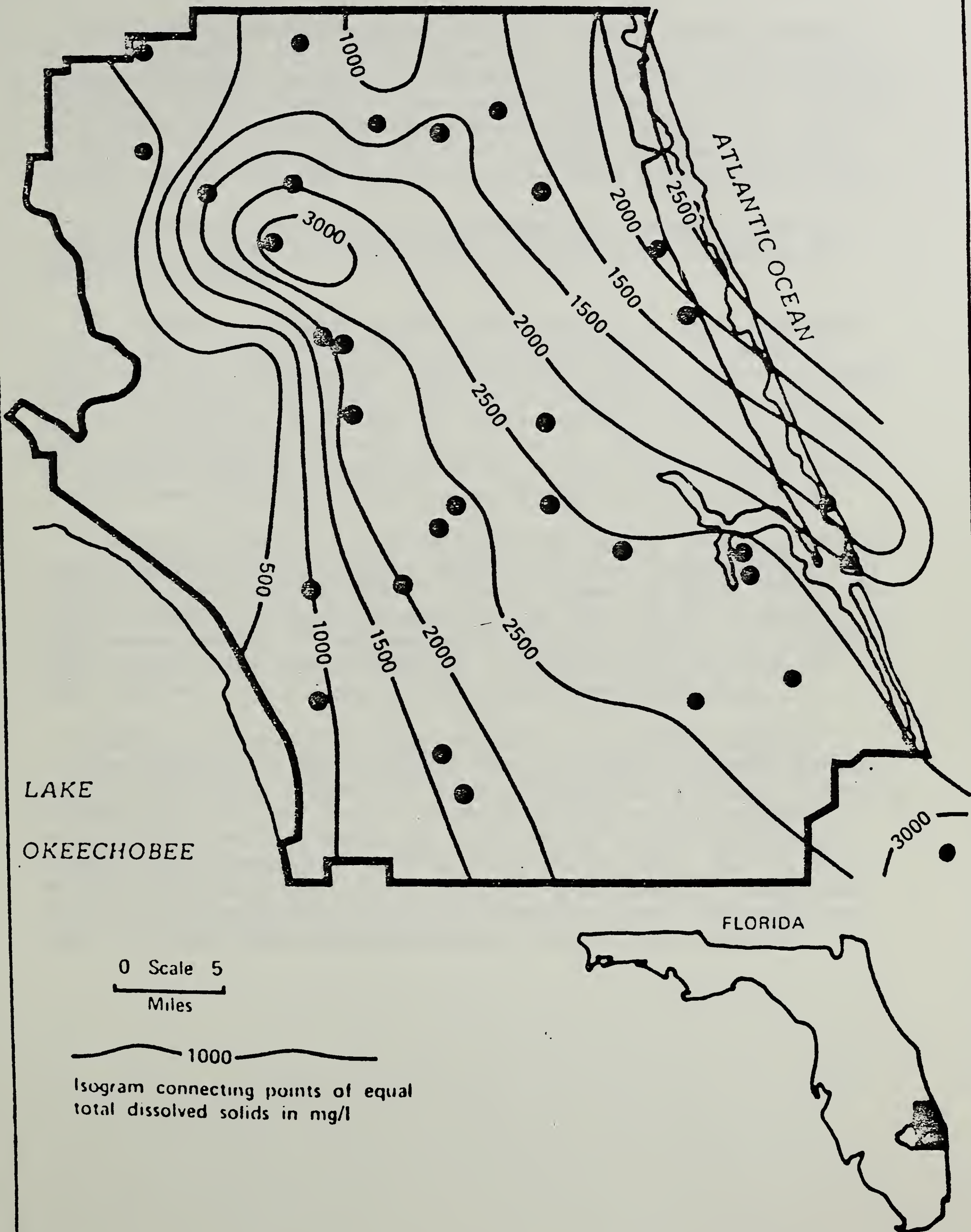


FIGURE 4-7. Total Dissolved Solids of Floridan Aquifer System Waters for September, 1977 (replotted from Brown and Reece, 1979)

Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

The geologic formations comprising the Floridan aquifer system in St. Lucie, Martin, and northern Palm Beach Counties have been studied through lithologic analysis of cuttings and analysis of the geophysical signatures of the formations from borehole geophysical logs. At least three units make up the Floridan aquifer system in the study areas: - an unnamed grey calcilutite, the Ocala Limestone of the upper Eocene series, and the Avon Park Limestone of the upper middle Eocene series.

The formations show a south to southeasterly dip and a slightly undulating surface. No hard evidence for faults postulated in this area was discerned.

The unnamed calcilutite is less than thirty feet thick throughout most of the study area but does reach a thickness of 168 feet in easternmost St. Lucie County. More detailed study is needed to better define this unit. The Ocala Limestone is thickest along a linear feature trending NW-SE through St. Lucie and Martin Counties. Water wells penetrating the Floridan aquifer system along this trend record the highest composite transmissivities, but the lowest quality water (highest composite total dissolved solids) within the study area.

A summary of the basic data collected during the three year Floridan aquifer reconnaissance study is found in TP 80-5, "Hydrogeologic Data Collected from the UECPA, SFWMD", (Reece, Brown and Hynes, 1980). The report contains the following data for the UEC: (1) potentiometric level measurements, (2) wellhead water quality analyses, (3) borehole point sample water quality analyses, (4) geologic descriptions of drill cuttings, and (5) copies of borehole geophysical logs.

Pertinent data is still being collected. Of special note is: (1) the abundance of well cuttings being collected from newly drilled wells on Hutchinson Island, (2) although population growth is occurring in that area, 1200 ft. deep wells are producing only 50 gallons per minute of poor quality water, (3) wells in the current monitoring network are measured semi-annually for pressure head. This is done in conjunction with the U.S.G.S. regional potentiometric survey and allows for determination of possible locations where overpumping may occur and thus reduce the productivity of the Floridan aquifer.

Potential Water Sources and Management Alternatives

The following summary of potential water storage and management alternatives is taken from the SFWMD Summary Status Report.

> *This section discusses several means for increasing the future water supplies within the UEC. These systems are being analyzed with respect to their abilities to supply desired amounts and qualities of water, as well as their potentials in meeting water resource management objectives (such as preserving natural resources, fish and wildlife).*
>
> *These alternatives include conventional systems such as shallow aquifer wellfields and surface water supplies. More advanced systems such as deep aquifer storage and dual conveyance are also considered.*
>
> *Wellfield Development*
>
> *An important element of future development of potable water supplies in the UEC is the additional development of groundwater resources, primarily in the form wellfields. Groundwater wells are limited in the amount of water that they can yield by the rate of water movement in the subsurface aquifers, the rate that these aquifers are recharged from the surface, and the overall water holding capacity of the aquifer. These factors determine the number, size, and distribution of wells that can be developed at a specific site.*
>
> *Two major options are available in planning for future wellfield development for public water supply. The first option would be to look at the available groundwater resources in the vicinity of existing treatment plants, purchasing additional land and upgrading existing facilities at these plants to handle the increased water supplies. The second option would be to find a suitable site within the county to develop a regional wellfield, and to transfer water from this wellfield to local utilities for treatment. There are several variations of this "regionalized" system possible, depending on institutional considerations, overall areas to be covered, and development costs.*
>
> *There is still more work that will have to be done to quantify the available shallow groundwater resources that can be used for public water supply. As these studies are completed, the results will be integrated into the Water Use Plan and used as the basis for specific recommendations. There are indications that St. Lucie County public water supply can develop further by building wellfields to the west of where the existing facilities are located. In Martin County, further westerly development will have to be carefully evaluated with respect to water quality impacts and may be substantially constrained by these results.*

Demand Reductions

A non-structural alternative for reducing and/or making more efficient use of existing water supplies is reducing the demand for water (or water conservation). If an efficient water conservation program is initiated and implemented, it could tend to accommodate increasing public and agricultural water use requirements in the future with a decreased number of new construction projects such as wellfields, storage areas, and treatment plants. Reducing the demand for water can extend the range of a domestic water supply system as population increases. Since the UEC is a rapid growth area, an efficient water conservation program could offset heavy capital construction funding. Local water resource agencies and utilities could educate the public within their service areas on demand reduction techniques and programs. Water conservation has environmental, social and economic benefits. Installing water-saving devices on toilets, showers and faucets, and using pressure reducing valves can reduce domestic water use by as much as 55 percent without significantly altering personal habits. Results from the recent California drought have shown that a 64 percent reduction is possible with a tight mandatory water conservation program. The SFWMD has the ability to provide information on how demand reduction programs have worked in other parts of the state, the nation, and the world, and the techniques for their implementation. (Contact the District Public Information Office.)

Desalination/Demineralization

Desalination is the process of removing dissolved materials from saline or mineralized water to produce fresh water. In many cases the treated water can be mixed with brackish water to provide a blend or product water that still meets all state and federal requirements for drinking water quality and at the same time greatly increases the amount of water that can be supplied from the treatment plant.

The District has active programs that were developed to study and evaluate the various types of desalination systems that are in use today and to provide cost information, training, etc. to parties that are interested in pursuing this alternative for water supply development. Further information on the application or desalination to the UEC is provided in Exhibit "A" of this document. (See Exhibit 4A, beginning on page 4-30).

Dual Conveyance

Dual conveyance systems enable water of various qualities to be used for different purposes. For example, non-potable water could be used for various industrial processes, flushing toilets, washing cars, or lawn irrigation. Use of potable water could be restricted to drinking, cooking, and hygienic activities. Dual systems are generally comprised of a potable component serving the total community, and a sub-potable or non-potable component serving only a part of the community or a user outside the community such as an agricultural or industrial site.

The Sailfish Point Water and Wastewater Treatment Systems on Hutchinson Island, Florida, will use a dual system of water distribution lines and a wastewater treatment and disposal method which meets EPA's zero discharge goals for 1985. Additional information on dual water systems is available from the SFWMD.

Deep Aquifer Storage

The injection, storage, and retrieval of fresh water in the saline portions of the deeper Floridan aquifer has the potential for providing large quantities of water (which are generally available during the wet season) for withdrawal and use during the dry season. If adequate water is available for storage, this method has the potential for alleviating some of the water supply problems in the UEC.

The injection phase requires the pumping of fresh water through wells of suitable construction into the Floridan aquifer. Once injected, the water is allowed to remain in storage until needed. This storage period could range from 3 months to a year or more.

Within the District, two major field investigations have been initiated to evaluate the feasibility of storing fresh water in the Floridan Aquifer. One of these is near Ft. Myers and the other is located at the City of Miami's Hialeah wellfield.

Further application potential of this alternative in the UEC is provided in Exhibit "A". (See Exhibit 4A, beginning on page 4-30).

Proposed UEC Water Management Program

The program for future water resources management in the UEC can only be partially defined at this time. There are three basic District responsibilities that must be carried out:

1) Operation and Maintenance of District Works (structures, canals, pump stations, etc.),

2) Planning for total water resource management (including coordination with local, regional, and other agencies), and

3) Regulation (permitting) of water use and surface water management systems.

Goals and Objectives

The starting point for the UEC water management program is to identify each local government's goals and objectives with respect to water resources and compare these to those of the SFWMD. Where there is agreement as to the direction of future system management, only normal coordinating and status reviews need to be accomplished. Where there is a question or concern about a specific goal or objective, then more detailed coordination must take place to resolve any potential future conflict. This process can be done using the Local Comprehensive Plans as a basis.

Corps of Engineers Study - The St. Lucie County Water Supply Study[1/] was initiated in October 1979. This study will place emphasis on design alternatives to convey agricultural irrigation waters to St. Lucie County from Lake Okeechobee or inflow streams to Lake Okeechobee. An initial meeting was held on Oct. 31, 1979, in Jacksonville between members of the South Florida Water Management District (SFWMD), and the Corps' Engineering Division (Design, Environmental and Planning) personnel. As a result of that meeting, the Corps is also considering plans to divert Taylor Creek - Nubbin Slough flows directly to St. Lucie County or in combination with a reservoir. Several alternative plans will be investigated by the Corps of Engineers, as follows:

1) Taking water out of Lake Okeechobee and conveying it to the southwest corner of Canal 23 via the shortest route, C-131.

2) Taking water out of Lake Okeechobee and conveying it to Canal 23 via St. Lucie Canal from upstream of St. Lucie Lock (S-80) to Canal 23 upstream of Structure 97.

3) Diversion of flows from the Taylor Creek - Nubbin Slough area via Levees 63S, L-64, and L-65 borrow canals and St. Lucie Canal.

4) Diversion of flows from the Taylor Creek - Nubbin Slough area via the Hoover Dike Borrow and St. Lucie Canal.

5) Diversion of flows from the Taylor Creek - Nubbin Slough area via the Hoover Dike Borrow and Canal 131.

6) Diversion of flows from the Taylor Creek - Nubbin Slough area via the Hoover Dike Borrow, a Reservoir and Canal 232.

The plans would be designed to convey only the water supply required to meet the irrigation demands in St. Lucie County plus losses enroute due to seepage and evaporation. All of the plans may include improvements (enlarge canals, modify existing structures, and add new structures) to C-23, C-24, and C-25).

The General Design Memorandum study can be expected to be extensive requiring two to three years to complete. Efforts to expedite this study will be made by the District staff by providing data and study results from work currently underway and scheduled as a part of the Upper East Coast Water Use Plan. The current SFWMD position is that the most straightforward and direct means of providing supplemental irrigation water to St. Lucie County should be emphasized (such as alternative No. 1 above).

Other Studies - There are other ongoing studies that can influence the selection and recommendation of water supply alternatives for the UEC. These include investigations of the Loxahatchee River area and Lake Okeechobee inflows. As these studies are completed, their results will be incorporated into subsequent updates of the Water Use Plan.

1/ Includes portions of Martin and St. Lucie Counties

The Local Government Comprehensive Planning Act (LGCPA) of 1975, as defined in Chapter 75-257 Laws of Florida (F.S. 163.3161 to 163.3211) is a statement of intent by the Florida Legislature that each local government should plan for and manage its own future growth and development. The LGCPA requires that each unit of local government establish a planning process and prepare, adopt, and implement a comprehensive plan.

A recent legislative change to Chapter 380 F.S. requires that the Regional Planning Councils and the Water Management Districts within Florida coordinate their activities with respect to water related goals, objectives, and policies so that a comprehensive and consistent set of regional guidelines can be defined and implemented. The WMD and the RPC should compare their goals, objectives, and policies, and work to resolve any conflicts that exist between the two agencies. The goals, objectives, and policies of the comprehensive plans are mutually supportive of the goals, objectives, and policies of both the District and the Regional Planning Council.

The purpose of the analyses shown in Table 4-3 was to identify conflicts between District and local government guidelines. These differences will be resolved in subsequent updates of the Water Use Plan and the Comprehensive Plans.

Basically, the matrix shows to what degree the goals and objectives inventoried in each plan are represented. Limited representation does not mean that there is no mention of the goals and objectives, but that some improvement in the detail of the study is needed.

<u>Current Studies</u>

The continuing planning process for the UEC Water Use Plan provides for the conduct of studies to assure that all water-related subjects involving potential supply alternatives, environmental impacts, etc., are considered and evaluated.

The basic SFWMD study programs for the UEC include (for FY-80-81) the following areas:

1) Improving irrigation water use and practices
2) Floridan aquifer monitoring
3) Water quality evaluation
4) Estuarine study continuation (St. Lucie Estuary)
5) Land use trend development

In addition, a number of studies are being conducted by the District in conjunction with other agencies, the results of which may impact the selection and implementation of future water management alternatives. These are briefly summarized to provide an overview of all planning activities going on in the UEC.

WMD WATER USE PLAN GOALS AND OBJECTIVES	Fort Pierce	Treasure Coast Regional Planning Council	St. Lucie County Growth Management Plan	City of Stuart	Port St. Lucie
SURFACE WATER	C	L	L	L	L
GROUNDWATER	C	C	L	M	M
WATER SUPPLY	C	C	C	M	C
LAND USE	L	L	L	L	M
CONSERVATION	L	M	L	L	L
DRAINAGE	M	M	C	L	C

REPRESENTATION OF COMPREHENSIVE PLAN GOALS

C = Complete

M = Moderate

L = Limited

TABLE 4-3 : Coverage of Goals and Objectives of Local Comprehensive Plans

Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

Interim Program Recommendations

The Plan for the UEC has been started by concentrating on water use and supply development. Based on available inventory information, previous analysis and current research results, a set of preliminary recommendations has been suggested as a guide to actions by local governments, either independently, or in conjunction with the District (for regional alternatives).

Most of the recommendations in Figure 4-8 deal with alternative water supply systems that would have to be developed by local governments or utilities since they serve local or limited supply areas without regional water resource impact.

The rationale for selection of the alternatives is briefly discussed under each alternative. These recommendations will be reviewed and updated when the results of COE -------studies in the UEC are completed, or when additional research data is available.

The updating of water supply recommendations is especially important with respect to the Agricultural Water Use Alternatives shown in Figure 4-8. The ability to implement a regional water source to support St. Lucie County irrigation needs will depend to a great extent on the results from the COE studies noted above. These results will probably be available within 2 years and will form the basis for subsequent SFWMD actions on this alternative. Other agricultural water supply alternatives are being evaluated under the "Additional Water Needed" column, specifically the potential for deep aquifer storage techniques.

- Exhibit 4A - Technical Publications -

Technical publications are reports of the SFWMD which present the results of either major scientific/engineering studies, major methodological developments, or applications which warrant widespread distribution. Such publications constitute a contribution to knowledge of a specific problem or a general solution to problems that may affect District policy. Copies of technical publications may be obtained by writing the South Florida Water Management District in care of Public Information.

A brief review of the technical publications that have been completed on the UEC is provided in this exhibit.

I. Technical Publication #80-6, August 1980 - Advanced Water Supply Alternatives for the Upper East Coast Planning Area by Nagendra Khanal.

Part I. Deep Aquifer Storage

Part I of this publication considers the feasibility of cyclic storage of fresh water in a brackish aquifer. This study assessed the potential for using deep aquifer storage systems to augment future potable and non-potable water supplies for St. Lucie and Martin Counties. The deep aquifer storage alternative makes use of excess surface water which is now usually discharged to the ocean.

FIGURE 4-8

WATER SUPPLY RECOMMENDATIONS

SUPPLY CONDITIONS	Increased Demand near existing facilities	Additional water needed to meet short term or peak demands	Areas with chronic water supply problems	Agricultural water use
RECOMMENDED ALTERNATIVES (& RATIONALE)	* Develop additional wellfields in the UEC within the limits of safe aquifer yields. (Recent research indicates that additional groundwater supplies may be available further west of the existing wellfields) * Regionalize water supply and treatment facilities (Full or partial regionalization could provide substantial cost savings and could improve water availability under drought conditions)	* Encourage water conservation - demand reduction (During periods of drought it will be necessary to reduce water demand and/or rely on source of stored water.) * Develop Water Shortage Plans (Plans should be carefully developed before need arises, rather than during a shortge crisis.) ** Continue research on deep aquifer storage techniques in UEC (Technique has been effective in other parts of U.S., but additional feasibility tests are required under specific UEC aquifer conditions.)	* Support development of demineralization processes. (Some areas in UEC have highly mineralized water available for treatment that is competitive with conventional systems. * Support development of dual conveyance systems for residential, commercial, and industrial applications. (When integrated into early design of a project, dual water systems can save substantial amounts of potable water by using subpotable or recycled water for irrigation, outdoor washing, process water, etc.) * Encourage reuse of wastewater for nonpotable and irrigation applications. (Systems are available to completely preclude endangering public health.)	* Encourage use of self-contained surface reservoirs. (Allows for retention and reuse of stormwater runoff in an economical manner.) ** Support development of regional water source for St. Lucie County - from Lake Okeechobee. (Studies are underway that will allow a determination of the amount of irrigation water that could be allocated.) * Encourage use of improved irrigation techniques. (Agricultural conservation can be achieved by employing optimum watering systems for each type of specific crop.)

NOTE

* Alternative must be implemented by local authority or private interest

** Alternative must be implemented by regional authority

Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

The objectives of the study are as follows:

1) To predict the recovery efficiency of the cyclic storage/retrieval system using mathematical modeling techniques.

2) To perform sensitivity analyses of the model parameters in order to predict the effect of a change of a parameter on the recovery efficiency.

3) To run the model for other planning areas where the hydrogeologic data are different from those of the Upper East Coast.

The report also examines the effects of certain parameters on the recovery efficiency including:

1) Effect of the density of the native fluid on the recovery efficiency.

2) Effect of the aquifer thickness on the recovery efficiency.

3) Effect of the aquifer transmissivity on the recovery efficiency.

4) Effect of the dispersivity on the recovery efficiency.

5) Effect of long-term storage on the recovery efficiency.

Some of the major conclusions reached are as follows:

1) Based on computer programs developed by Louisiana State University, the model calculated that at least 50% of the injected water can be recovered after the water is left in storage for 180 days.

2) Recovery efficiencies (how much fresh water can be recovered after storage in a brackish water environment) increases from 50% to 60% after several cycles of operation.

Part II. Desalination

Part II of this publication considers desalination, using commercially available reverse osmosis to supplement existing water needs. These systems may soon become competitive with conventional treatment plants in terms of cost and reliability. The objective of this study was to evaluate the feasibility of its impact on the water resources of the area and economic feasibility.

In the UEC, desalination started about 1972. The first desalt plant (Indian River Plant) with a production capacity of 50,000 gallons per day of potable water was installed in Martin County. About the same time another plant was installed in St. Lucie County with a capacity of 150,000 gallons per day. Presently, 337,000 gallons of potable water can be produced in Martin County and 248,000 in St. Lucie County from desalting plants on a daily basis. The table below lists the desalting plants located in the UEC as of December 1979.

Desalination Plants in Martin and St. Lucie Counties

County	Name of Plant		Capacity (1000 gallons/day)
Martin	Indian River Plantation		50
	Sailfish Point		150
	Ocean Tower		40
	Joe's Point		40
	Stuart River Club		57
		Total	337
St. Lucie	Brynmar Camp Resort		150
	Ft. Pierce Jai Alai		39
	Harbor Br. Foundation		19
	Queens Cove		10
	Seminole Shores		20
	Queens Cove, Additional		10
		Total	248

The report includes a brief description of water resources, desalination plant design necessary to meet the potable water demand, and the economics of desalination for the UEC. The report does not consider the interim treatment capability of desalination necessary to upgrade present water quality to EPA's drinking standards. Rather, the subject matter contains the use of desalination as a water supply alternative for meeting the future water requirements of the UEC.

II. Technical Publication #80-3, January 1980 - Some Seasonal Fisheries Trends and Effects of a 1000 cfs Fresh Water Discharge on the Fishes and Macroinvertebrates in the St. Lucie Estuary, Florida, by Daniel E. Haunert and J. Robb Startzman.

There has been considerable concern about the effects of freshwater discharges from Lake Okeechobee on the St. Lucie Estuary. Unfortunately, only a limited amount of research has been completed that documents the effects of freshwater discharges upon this estuary. Previous investigators studied effects of discharges as they occurred. These discharges often fluctuated widely from day to day. They did not have a fixed rate of freshwater discharge for a predetermined amount of time for a controlled study.

A baseline study of the fishes of the St. Lucie Estuary was initiated by the District in 1975. During this study (January 1975 to October 1976) there were no significant discharges from the St. Lucie River into the estuary. Therefore, the information obtained from this period of study reflected natural dynamics of fish species composition. From June 13, 1977, to July 15, 1977, and from June 12, 1978, to July 14, 1978, the District monitored the effects of controlled freshwater discharges. These discharges were 1000 ft^3/sec (cfs) and 2500 cfs respectively. Effects on the fishes, benthic fauna, salinity and turbidity throughout the estuary were monitored. A full report on the 1000 cfs study was published in January 1980 (Haunert and Startzman, 1980). The sample sites are shown in Figure 4A-1.

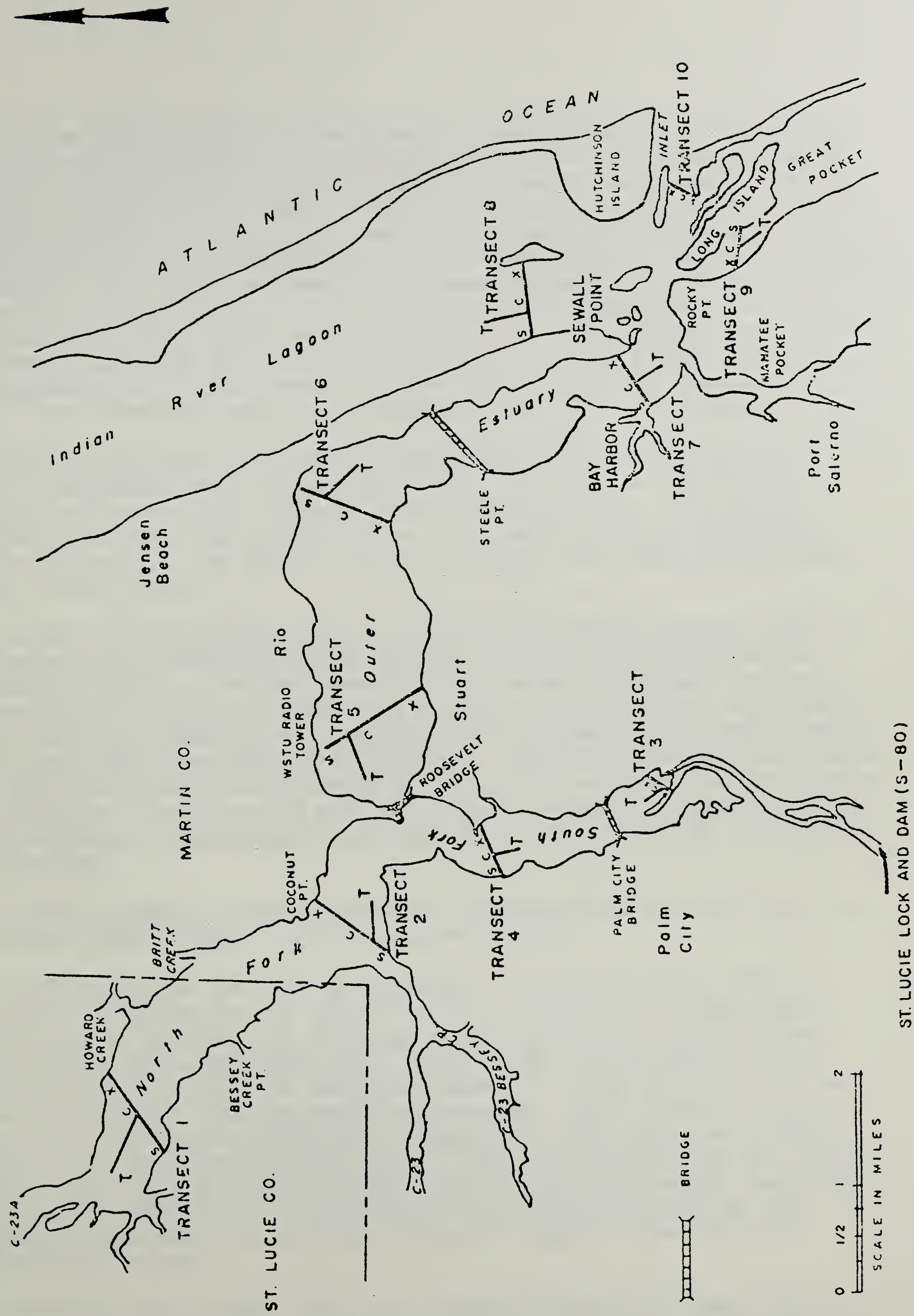


FIGURE 4A-1. ST. LUCIE TRANSECT SAMPLE SITES

Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

Data from the baseline program showed seasonal changes in temperature, rainfall, and salinity and the related distribution of St. Lucie Estuary fishes. Species presence data revealed three major categories of fishes: (1) the resident species, which spend the majority of their lives in the estuary, (2) the winter species, and (3) the spring migratory juvenile marine species, which were present on a seasonal basis. The vast majority of fishes in all three categories were found throughout broad ranges of salinity. Juvenile marine fishes demonstrated a tendency to inhabit the low salinity waters of the inner estuary. During the period of the 1000 cfs discharge, fisheries data showed no significant change in the number of species captured at each sample station; or the number of times each of the 31 most abundant species were captured throughout the estuary.

Reduced salinities during the investigation were the result of the 1000 cfs discharge and local rainfall within the basin. These values were not as low as those recorded in the estuary in June 1976 which resulted from seasonal rainfall alone. Suspended solids and turbidity data collected for the study revealed low values that probably had little impact on the fishes.

Benthic macroinvertebrate data indicated that sample stations closest to the point of discharge had the greatest changes among physical and chemical parameters, and the number of species and individuals collected. Community structures, as measured by species diversity index, were lower at the channel locations when compared with adjacent littoral zone sample sites both before and after the discharge. Changes in species composition and recruitment were not indicated by the species diversity index; however, low diversity values coupled with the overall abundance of five pollution tolerant benthic species indicated that the benthic estuarine environment was stressed.

Overall, analyses of most parameters indicated that this 1000 cfs discharge had little effect on the fishes or benthos.

A full report on the 2500 cfs discharge is expected during FY80-81. General observations on the results of this study are presented here. The effects of the 2500 cfs discharge on the salinities in the estuary were far more pronounced than those of the 1000 cfs discharge. Within one week after the 2500 cfs discharge began, the North and South Fork were transformed into a near freshwater environment. Additionally, salinity in the area downstream of Roosevelt Bridge to Sewalls Point was highly stratified. The inner estuary remained fresh water throughout the investigation while the mean salinity values for the remaining waters continually decreased to about 10 to 15 ppt at low tide. Immediately after the discharge terminated the salinities began to increase from the outer to the inner estuary.

Fisheries data revealed that the community associations among the dominant species were not significantly affected. However, the distribution of the lower trophic level fishes (eg.Anchoa mitchelli) increased during the first two weeks of the discharge only to decrease back to pre-discharge conditions during the remainder of the study. There was also an increase in the number of species captured in the whole estuary during the second and the third week of discharge but this also decreased to pre-discharge findings.

Benthic macroinvertebrate communities changed considerably in the inner estuary. Before the discharge began, the inner estuary was dominated by 13 opportunistic, pollution tolerant species which indicates that this environment receives high organic loading. Other species, which are generally characteristic of unpolluted estuarine systems, were found in low densities. After the discharge, most of the pollution tolerant species were still present but at lower densities. Six freshwater species, dominated by bloodworms, were added to the inner estuary benthic fauna during the discharge period. However, the community structure of benthos in the outer estuary demonstrated little change.

Turbidity data indicated that bottom-sediment material (consisting mostly of silt and clay particle sizes) were put into suspension between the St. Lucie Lock and Palm City Bridge. This material was deposited downstream with the majority of the mass settling out between Roosevelt Bridge and the A1A Bridge. This phenomenon, along with the high stratification of salinity in the "Settling Area" may have caused the extremely low dissolved oxygen concentrations found during the discharge period.

III. Technical Publication #80-1, January 1980 - Aquifer Recovery Test Data and Analyses for the Floridan Aquifer System in the Upper East Coast Planning Area, South Florida Water Management District by Michael P. Brown, and

Technical Publication #80-5, May 1980 - Hydrogeologic Data Collected from the Upper East Coast Planning Area, South Florida Water Management District by Dennis E. Reece, Michael P. Brown, and Sharon D. Hynes.

In October 1979, the District published a series of technical maps aimed toward informing individual property owners, drillers, and city planners about water related aspects of the Floridan Aquifer system in the UEC.

Entitled the "Hydrogeologic Map Atlas: Floridan Aquifer System", the 11 maps concentrate on water quality and water quantity and levels in the UECPA.

Basically, the maps allow an individual to pinpoint how deep he must drill a well to tap a certain quality of water. This can save time and money for new users who want to irrigate crops, communities wanting to desalinate water for potable supply, and well drillers who contract for various jobs.

T.P. #80-1 presents Floridan aquifer test data and analyses along with the documentation of well construction and borehole hydrologic conditions which can be used by modelers as input parameters for modeling purposes. Aquifer recovery test data collected from 16 selected wells and drawdown data from 2 wells were analyzed by the modified non-equilibrium formula for transmissivity.

T.P. #80-5 presents the basic data collected during a 3-year reconnaissance study to define the physical system making up the Floridan aquifer, and to establish a monitoring network to detect changes in potentiometric levels and water quality.

The following data is included in the report for the UEC:

1) Potentiometric level measurements.
2) Wellhead water quality analysis.
3) Borehole point sample water quality analyses.
4) Geologic descriptions of drill cuttings.
5) Copies of borehole geophysical logs.

Forty wells were used as data collection sites for the Floridan aquifer system in the UEC. These are generally shown in Figure 4A-2.

Results of this aquifer reconnaissance and study can be summarized as follows:

1) Transmissivity values range from 24,600 gpd/ft to 956,700 gpd/ft.

2) The storage coefficient is approximately 5.0×10^{-4}.

3) The current salt content of the Floridan System in the UEC is not caused by present day saltwater intrusion.

4) Due to the high Floridan head, the water quality of the system has not deteriorated.

5) Water levels within the system have not decreased.

6) TDS values of water from the aquifer do not appear to have significantly changed in the last 20 years.

7) Chloride concentrations of the aquifer have not significantly changed in the past 20 years.

Recharge Areas

The following discussion of recharge areas is taken from Florida Regional Coastal Zone Environmental Quality Assessment, Region 10, South Florida, Part I, prepared by the South Florida Regional Planning Council, October 1976.

Criteria for Managing Aquifer Recharge Areas

Since recharge of the shallow aquifer occurs over the land surface of the entire region, unique recharge areas cannot be identified. Rather, land use management decisions must consider the cumulative effect of those decisions on the quantity and quality of the groundwater supply. Certain areas can then be selected and managed to insure that the water resource will be renewed.

Criteria for delineating an area as suitable for shallow aquifer recharge include a number of considerations. The surface of the geologic formation must be permeable. Water must be available, either in the form of adequate rainfall or as overland flow. Ideally, both would occur. The maximum possible permeable surface must be preserved. This implies low surface coverage by impermeable materials, such as paving or buildings. The areal extent of the recharge zone must be sufficient to balance depletion of water resources from evaporation from water bodies, runoff from canals, and urban use.

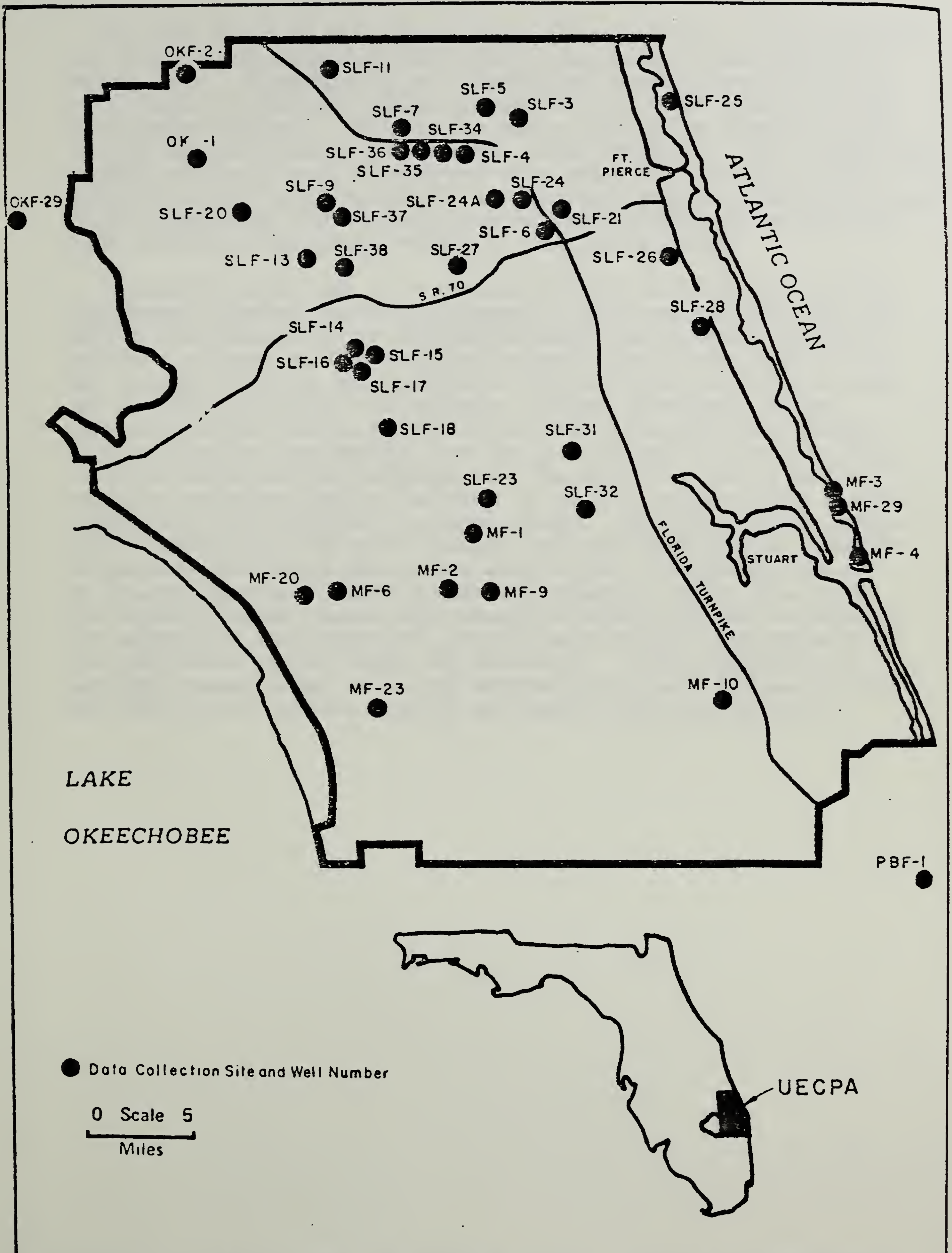


Figure 4A-2. LOCATION OF UPPER EAST COAST PLANNING AREA AND DATA COLLECTION SITES

Source: Summary Status Report - Upper East Coast, SFWMD, Oct. 1980

The area should be in a relatively pristine condition. Least desirable are agricultural lands with their load of pesticides; fertilizers; and animal waste. Areas near sewage outfalls are obviously unsuitable, and most canals are polluted both by agricultural and urban runoff, as well as by sewage effluent. Rockpits are not an undesirable element, as long as they are not connected to the canal system (Hartwell, 1975). Sufficient organic soil cover must be preserved to maintain water quality. The filtering action of soil particles and the biological and chemical processes at and beneath the soil surface inactivate many viruses and bacteria, as well as other surface water pollutants (Greenfield, 1974).

Designation of an area as an aquifer recharge area does not preclude development; however, careful assessment of local and regional needs for water in the future must be carefully assessed and the areal extent of necessary recharge must be evaluated to match these future needs. Then the recharge areas can be developed as long as certain criteria are met and important constraints are observed. Before development occurs, natural drainage patterns of the site and the surrounding area should be identified and incorporated into the site design in order to maintain overland flow through the development. This objective can be achieved by design solutions, such as buildings on stilts, or green swale drainage systems that are imitative of natural systems. Where the natural pattern must be interrupted, culverts, bridges, and similar structures should be designed to approximate the natural water regime. Landscaping should be designed to permit natural growth and attrition, rather than mowing and trimming, while natural cover should be retained as much as possible. Low maintenance plant materials should be used to avoid the necessity for application of fertilizers and pesticides. Native vegetation is admirably suited, since it is well adapted to the South Florida environment and does not require chemical and energy inputs for survival.

SUMMARY Points of Chapter 4.

1. The Corps of Engineers will be distributing a report in 1984 which is expected to contain extensive and competent treatment of water supply possibilities.

2. There are seven primary conveyance works and eight major control structures within the Upper East Coast area operated and maintained by the South Florida Water Management District.

3. There are two additional conveyance systems operated and maintained by other agencies. The St. Lucie Canal is operated and maintained by the Corps of Engineers. It is a major outlet from Lake Okeechobee, has two lock and spillway structures that are operated for boat passage and water control in the south part of the county. Taylor Creek, located in the northwest part of the county, is operated and maintained by the Okeechobee Soil & Water Conservation District. It provided drainage from the Taylor Creek Watershed into Lake Okeechobee prior to construction of certain structures and levees by the South Florida Water Management District.

4. There is an additional conveyance system which includes conveyance channels, pump stations and water control structures operated and maintained by the Florida Power & Light Company.

5. The three major canals in St. Lucie County (C-23, C-24 & C-25), have no source of recharge except from rainfall.

6. Water quality sampling is done regularly at each of these three channels. A past study showed phosphorous and nitrogen levels were moderately low at all three. The levels of major cations and anions were high. Turbidity levels were low and dissolved oxygen was highly variable.

7. At three other sites monitored as part of the study (S-49, S-97 & S-99), there were high dissolved solids levels.

8. The Winder, Hilolo, and Chobee soils in St. Lucie County are suitable for above ground storage of water. During periods of excess rainfall, surplus water could be pumped into these areas reducing the volume of water which must be discharged into and handled by the outlet channels and supplementing the water needed for irrigation. The economic feasibility of such storages has not been investigated.

9. If there is to be an increase in above ground storage facilities, some of the things to consider are the amount of land that would be taken from production and the value of that land, pumping costs, evaporation and seepage losses, construction costs and finding suitable soils.

10. In St. Lucie County and the surrounding area, groundwater is found in a series of shallow aquifers (the Shallow Aquifer) and a series of deep aquifers (the Floridan Aquifer).

11. The Shallow Aquifer varies from 40 to more than 200 feet thick with the lithology primarily sand, clay, silt, shell, and limestone deposited during the Pleistocene and Pliocene epochs. Water quality is generally good with less than 100 ppm total dissolved solids. Some of the water has high concentrations of sodium chloride which may be related to agricultural development or contamination from canals or from residual salts in fine sediments derived from inundations by ancient seas, upward leakage of saline artesian water or use of artesian water for irrigation.

12. Studies show that the Floridan Aquifer has potentiometric heads above land surface, resulting in flowing artesian wells. Heads vary generally less than one foot between high and low water conditions. Total dissolved solids are relatively high in waters of the Floridan aquifer system due to the presence of highly mineralized water trapped in sediments during an earlier geologic time. Chloride concentration ranges from as high as 1200 to 1400 mg/l in some areas to as low as 200-400 mg/l in others. At least three units make up the Floridan aquifer system including an unnamed grey calcilutite, the Ocala Limestone of the upper Eocene series, and the Avon Park limestone of the upper middle Eocene series.

13. Several alternatives are being analyzed as potential water sources with respect to their abilities to supply desired amounts and qualities of water, as well as their potentials in meeting water resource management objectives (such as preserving natural resources, fish and wildlife). Some alternatives being considered include wellfield development, demand reductions, desalination, dual conveyance systems enabling water of various qualities to be used for different purposes and deep aquifer storage. The South Florida Water Management district reports that there are several ongoing studies to determine the feasible alternatives.

14. The South Florida Water Management District has responsibilities as follows:

    (1) Operation and maintenance of District works

    (2) Planning for total water resource management (including coordination with local, regional, and other agencies, and

    (3) Regulation of water use and surface water management systems.

15. The starting point for SFWMD to accomplish their goals is to identify each local government's goals and objectives. Ths Corps of Engineers is doing an in-depth study of various water management alternatives so that they might make recommendations. Several local governments are also doing studies.

CHAPTER 5. FLOOD INFORMATION

Water Quantities from Storms - Frequencies and Runoff

The COE has a study of the Martin-St. Lucie area now in progress. This study is expected to provide the best information on this subject for the area. Search of publication does not reveal information to be available for this area in sufficient detail for meaningful discussions. Generalized rainfall data can be found in SFWMD Technical Publication 81-3, May 1981, Frequency Analysis of Rainfall Maximums for Central and South Florida.

Flood Plain Information

The COE, in 1972, published two flood plain information reports, one for the coastal areas of St. Lucie, and one for the North Fork St. Lucie River. These reports were prepared to give information on flood potential and flood hazards which are important in land use planning, and for management decisions regarding flood plain utilization.

Maps, photographs, profiles, and cross sections depict conditions that existed during past hurricans and identify those areas that are subject to future floods. Copies of these reports are filed in the SCS State Office in Gainesville, the Area Office in West Palm Beach, and at the Corps of Engineers District Office in Jacksonville.

The Federal Emergency Management Agency (FEMA), an agency of the Federal Insurance Administration, has responsibility for conducting Flood Insurance Studies. The purposes of these studies are to investigate the existence and severity of flood hazards for specific areas and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The initial use of these studies is to convert the studied area to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development. Each Flood Insurance Study includes a flood boundary map delineating the areas subject to flooding by the 100-year and 500-year floods. Flood Insurance Rate Maps, published separately, contain the official delineations of flood insurance zones and base flood elevation lines.

The Flood Insurance Study report provides information on principal flood problems, existing protection measures, hydrologic and hydraulic analyses used to determine flood hazard data, methods used to transform engineering data into flood insurance criteria, and other useful material.

The Southwest Florida Water Management District at Brooksville, in cooperation with the Center for Governmental Responsibility, University of Florida College of Law, in 1982, prepared and published a report for a model flood management ordinance. This model was developed to assist counties and municipalities in that water management district in implementing good water management practices as they regulate the development and use of land. Modifications would be necessary to fit the model to a specific local situation. It was designed to meet the minimum criteria of the National Flood Insurance Program (NFIP), so that a community using it may qualify for flood insurance. The NFIP mapping would have to be used as a minimum basis for regulation. The NFIP encourages the use of higher standards in local programs, however, and the model ordinance is designed to encourage more comprehensive regulation, using mapping to higher standards.

The model ordinance is not intended to replace existing ordinances designed to solve specific local problems. It may be used in part, incorporated into other ordinances, or adopted in its entirety to reduce the destruction caused by flooding and the degradation of water resources.

Objectives of the ordinance are:

1. *To minimize the potential for property damage and personal injury from flooding;*
2. *To restrict adverse interference with the normal movement of surface waters;*
3. *To maintain the optimum storage capacity of watersheds;*
4. *To maintain desirable groundwater levels;*
5. *To maintain the natural hydrological and ecological functions of wetlands and other flood prone lands;*
6. *To prevent increased erosion and sedimentation;*
7. *To maintain water quality;*
8. *To protect the public from the economic and social disruption of flood damage;*
9. *To protect the public from the costs of flood relief;*

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

10. *To avoid the need to construct costly and environmentally disruptive flood management structures;*

11. *To assist the community in qualifying for participation in the National Flood Insurance Program.*

The objectives of this ordinance are to be achieved by implementing a flood development review system that:

1. *Restricts the construction of buildings in the most frequently flooded areas;*
2. *Requires the elevation or flood proofing of buildings in less frequently flooded areas;*
3. *Restricts interference with the normal movement of flood waters;*
4. *Restricts increases in the rate or volume of surface water discharge.*
5. *This ordinance is not intended to waive more stringent local regulations or the permitting requirements of any other governmental agency.*

The model flood management ordinance is general in nature, leaving room for local officials to include concerns specific to their areas. It offers objectives, definitions, and procedures for implementing and enforcing a flood management ordinance. It also provides detailed technical information and tips on reviewing certain types of development including subdivisions, water control structures, and commercial buildings or facilities, and for identifying flood elevations, flood hazard zones, and critical flood zones. Additionally, it provides standards for reviewing development proposals, emphasizing the importance of assessing the cumulative effects of the project in combination with those of existing and potential development in an area. Finally, the model ordinance lists guidelines for reviewing development designs. Accompanying the model ordinance are comprehensive sections of legal commentary and analysis which provide useful background and historical information on flood management.

The Southwest Florida Water Management District in Brooksville may be contacted for additional information.

Areas in St. Lucie County covered by flood insurance studies include unincorporated areas, city of Ft. Pierce, town of St. Lucie Village, and city of Port St. Lucie.

SUMMARY Points of Chapter 5.

1. The U. S. Army Corps of Engineers is currently doing a study expected to provide information on water quantities from storms, taking both frequencies and runoff into account.

2. The Southwest Florida Water Management District at Brooksville, in cooperation with the Center for Governmental Responsibility, University of Florida College of Law, prepared and published a report designed to meet the minimum criteria of the National Flood Insurance Program (NFIP) so that a community using it may qualify for flood insurance. Each flood insurance study includes a flood boundary map delineating the areas subject to flooding by the 100-year and 500-year floods. The model flood management ordinance should be used as a minimum basis for regulation and the NFIP encourages the use of higher standards in local programs.

CHAPTER 6. ENVIRONMENTALLY SENSITIVE AREAS AND AREAS FOR SPECIAL DEVELOPMENT CONSIDERATION

As with much of peninsular Florida, a large portion of St. Lucie County is environmentally sensitive in the sense that a subtle balance has existed among geologic conditions, soils, climate, ground water and surface water regimen, flora and fauna. A small change in this balance can cause significant changes in the environment. Human interference with these natural balances and the significance of the effects have been a source of existing water supply and quality controversy throughout the country.

This report will not go into detail on the environmental characteristics of the county. Instead, the following discussion will be limited to identifying characteristics which need consideration in planning and development. The discussion centers on pollution and conservation.

Pollution

The following discussion is based on limited information, which is restricted to waste disposal systems including septic tanks and surface impoundment, agricultural practices including the use of poor quality artesian water for irrigation and the migration of chemicals, fertilizer, and pesticides into the aquifer.

Waste Disposal

It was reported in 1980 that St. Lucie County had 52 municipal, 7 industrial, and 4 agricultural waste disposal impoundments [State of Florida, Department of Environmental Regulation (FDER), Florida Surface Impoundment Assessment: Final Report, January 1980]. Based on their studies, surface impoundments have a serious potential for polluting ground water. Recommendations made to the state by the authors of the report are provided below:

> RECOMMENDATION 1 --- THE FDER SHOULD INCREASE THE SCOPE AND CAPABILITIES OF THE GROUND WATER POLLUTION CONTROL PROGRAM. IMPROVEMENTS SHOULD INCLUDE THE DEVELOPMENT OF A CONSISTENT PERMITTING APPROACH.
>
> *Specific recommendations supporting this recommendation include:*
>
> *1. The FDER must make major operational changes to achieve a unified approach to permitting ground water pollution sources.*

2. At the District permitting level, efforts to achieve a consistent approach include emphasizing industrial permitting, requiring more information about impoundments on permit applications, generating a Surface Impoundment Assessment on a continuous basis, and inventorying all ground water pollution sources and assessing their impact.

3. Staff and resources must be directed to those programs which have objectives directly related to the protection of the ground water resource.

RECOMMENDATION 2 --- AS A PREREQUISITE TO EFFECTIVE GROUND WATER QUALITY MANAGEMENT, THE FDER MUST IDENTIFY AND PROHIBIT HYDROGEOLOGICALLY UNACCEPTABLE SURFACE IMPOUNDMENT LOCATIONS. FDER MUST DISCOVER AND ADOPT ALTERNATE LOCATIONS AND METHODS OF WASTE DISPOSAL.

Recommendations supporting this recommendation include:

1. The FDER should broaden its perspective on waste disposal in order to accept and adopt this recommendation. The FDER should consider the effects of waste effluent in a disposal environment which, in Florida, is also the drinking water environment. A more realistic outlook on the illogical practice of discharging into a drinking water source should encourage reconsideration of alternative disposal environments such as surface waters, ocean outfall, or deep well injection.

2. A surface impoundment evaluation needs to be an ongoing process, to assure that the existence of all surface impoundments is known and that the locations are hydrogeologically and environmentally acceptable.

3. The hydrogeology of Florida necessitates a modification of the EPA-SIA scheme. A revised system adapted to Florida's hydrogeology would be beneficial in implementing Recommendation 2, and is within the Department's ability to develop.

4. The concept of collectively treating industrial wastes at special industrial waste treatment facilities becomes a practical alternative under the new perspective. Industrial parks are ideally set up for such centralized treatment methods.

RECOMMENDATION 3 --- THE PRACTICE OF DISCHARGING WASTE WATER INTO DRINKING WATER SUPPLIES IN FLORIDA SHOULD BE PROHIBITED.

Specific recommendations include:

1. FDER and the Water Management Districts need to develop a joint inventory and data system to obtain water well location information in order to delineate the lateral extent of a drinking water source and protect it from all types of waste water discharges. The Water Management Districts have in effect, a permitting system requiring a well drilling permit and a Water Well Completion Report, with varying levels of storage for this information on data systems. There still exists the problem of locating and cataloging all water wells drilled prior to implementation of the Water Management District's system, and making all water well information available to FDER.

2. There is a need to define the waste plumes in existence. This information is essential because of the persistent nature of waste plumes, and because occurrence of previously despoiled portions of aquifers is essential data for the accurate zonation of aquifers. Given the huge numbers of impoundments in existence, and assuming that at least every unlined impoundment will have an associated waste plume, the best approach to monitoring existing waste plumes may be through limited use of computer modeling.

3. Waste water discharges should not be sanctioned in aquifer recharge areas. The problems involved with this practice are threefold: the recharge area itself and water supplies derived from it are jeopardized; the sporadic flow path of waste plumes in carbonate environments is difficult to track and predict, and water supplies downgradient from the recharge area are endangered. When applying the zonation of aquifers concept, recharge areas of the aquifer should be zoned "off-limits" to any type of waste water discharge.

Three areas in the State, the Sand-and-Gravel Aquifer, the Biscayne Aquifer, and the unconfined Floridan Aquifer in Marion County, are presented as existing situations where recharge areas are currently jeopardized due to improper waste disposal practices. The aquifer characteristics are different in the hydrogeologic environments represented, which influences the waste plume flow paths.

4. The concept and use of well field "rights-of-way" should be developed concurrently with the aquifer zonation approach. A well field "right-of-way" is a protective buffer zone of land surrounding the recharge area to the cone of depression and the zone of depression itself, in which no waste discharges may occur. The amount of land necessary to protect the well field would vary with the aquifer's lithology, withdrawal rates, transmissivity, hydraulic gradient and hydrologic divide.

5. Before all waste water discharges into drinking water sources can be prohibited, the location of all past and present sources of ground water pollution needs to be determined. A uniform, statewide approach is essential to develop an effective file of these sources. The RCRA program is geared toward this type of inventory and should attempt to assist with this task.

6. A horizontal and vertical zonation of aquifers, according to use, should be established and enforced. Preliminary information necessary to distinguish aquifer zones includes locating all water wells and waste water discharges, delineating sole source and recharge areas, and distinguishing those portions of aquifers that are already naturally or artificially degraded to a point where they can no longer feasibly be used as a drinking water source.

Once the background information has been assimilated, it should be possible to map the State's aquifers so that simultaneous use of waste disposal and potable water withdrawal is possible. SIA recommends that "off-limits" segments of aquifers for all types of waste disposal should include recharge areas and portions of sole source aquifers that still possess acceptable drinking water quality. These areas, including well field "rights-of-way". would then be considered as a "Drinking Water Preserve", and their primary function of supplying drinking water would be carefully protected. Those areas in which the water quality is unacceptable for drinking water by existing standards would be designated waste disposal areas. Possibly the collective industrial waste treatment system could be extended and all collectively treated, high scoring (Step 4) industrial wastes could be discharged in the extremely poor water quality areas of the aquifer. The intermediate zones of aquifers could then receive less toxic wastes such as municipal effluent.

The aquifer zonation concept appears to be the best available solution to Florida's dilemma of relying on the same aquifers for waste disposal and drinking water supply.

RECOMMENDATION 4 ---FLORIDA NEEDS TO ADOPT AND IMPLEMENT A STATEWIDE GROUND WATER PROTECTION AND MANAGEMENT PLAN.

Specific recommendations include:

1. A ground water protection scheme needs to be developed by the FDER Groundwater Section and Permitting, to create an effective ground water pollution source management process. The protection scheme must continue the ongoing surface impoundment assessment, integrate all existing inventories and monitoring systems of pollution sources, and locate and catalog those sources currently undocumented.

2. One possible way to accomplish a statewide ground water protection scheme would be through the use of a data base system. This system would be centralized and would include existing permitting and inventory data files (such as MSIS, WPIS, GWSI) from FDER, USGS, and the Water Management Districts. However, before these data files could be useful, they need to be reviewed for accuracy and completeness. The location and inventory aspect of the data base would also include creation of new inventories covering the currently uncataloged ground water pollution sources.

A second aspect of this master data base would be the geologic and hydrogeologic information available. Information from the FDNR Bureau of Geology and the USGS would be incorporated. Additionally, a new file for site-specific hydrogeologic information (that information requested on the FDER permit application) would be established. This type of information would be entered into the interactive system at the District permitting level.

New information that would most efficiently be entered at the Tallahassee level would include location, extent, and composition of existing waste plumes, and the hydrogeologic information necessary to delineate aquifer zones (i.e. water quality data, flow paths, drainage basin boundaries, fracture patterns). This aspect of the data base file should be managed by the FDER Groundwater Section in Tallahassee.

Once all the necessary elements of information are in the data base, a third aspect of the proposed system is its capabilities to assess each proposed waste discharge site, based on its location, and determine if that site is feasible in terms of the overall ground water protection and management plan.

A statewide data base system to support the ground water protection and management plan is the most cost effective and expedient method practical in the long range. Without a usable data base, the concept of a consistent statewide plan becomes difficult and unworkable. However, an interim alternative providing continuity in the development process would be an increase in professional personnel at the District permitting level. These professional functions would include an interim manual evaluation of proposed ground water discharge sites, and the responsibility of organizing and implementing the data base at the District level.

At the present time most of the elements necessary for an effective statewide ground water protection and management plan exist. These elements are, unfortunately, fragmented and scattered throughout different agencies, and exist at different levels of accuracy and refinement. The FDER has the potential to capably integrate these elements into an effective plan that will protect Florida's ground water resource.

3. Attendant with the long range development of a data base system is the need for more professional studies. Some of these studies should be designed to enhance existing hydrogeologic information. Results of applicable studies would be entered into the data base. More coordination with the research oriented agencies (Florida Bureau of Geology, U. S. Geological Survey, Soil Conservation Service, Water Management Districts, and State universities) through expansion of existing interagency cooperative agreements, would facilitate achievement of the long range plan.

Some areas of needed research that became apparent during the Surface Impoundment Assessment include more detailed descriptions of near-surface geology and hydrology, greater delineation of shallow aquifer water quality (i.e., salt water intrusion line for the entire coastline), mapping of water table contours, location of water wells, mapping of well field cones of depression, and further stratigraphic delineation of the confining units.

4. A final recommendation to facilitate adoption of the State plan is to initiate an organized public education program. A mass campaign approach is suggested, which might include flyers attached to permit applications, a mail-out campaign, billboards, public and commercial television and radio information spots, and programming.

Contamination from septic tank effluents may not be as identifiable and pervasive as that from agricultural activities and storm water infiltration, according to the report, Florida Regional Coastal Zone Environmental Quality Assessment, Region 10, South Florida, Part I (pages 50-51, prepared by the South Florida Regional Planning Council, October 1976). This report concluded that "Where septic tanks do not unduly affect the quality of ground water, they provide a means of recycling domestic wastewater and returning it to the aquifer.-----Use of septic tanks may not be as harmful as previously assumed, and their selective use may be warranted."

Agricultural Practices

An important source of information on the control of pollution from agriculture is contained in Agricultural Practices to Control Non-Point Pollution in the Okeechobee-Kissimmee Basin (State of Florida, DER, Technical Series, Vol. 1, No. 4, December 1975 by L. B. Baldwin). That report emphasizes these points:

1. Total drainage capability is detrimental to water availability throughout the year, and to water quality.
2. It is reasonable to assume that an acceptable balance of preserved wetlands and intensified agriculture can be achieved.
3. Wetlands have a demonstrated capability of absorbing significant percentages of phosphorous runoff from improved pastures, (p. 36).

While that report did not deal with pesticides specifically, it noted that

> *"most pollution abatement practices which reduce transport of organics and nutrients from land also reduce movements of pesticides. With the exception of some pesticides, most pollutants attributed to agriculture are not undesirable if retained on the land, provided they are properly disbursed over sufficient area for assimilation and crop production."*

That report makes recommendations for each agricultural enterprise for pollution abatement. Those recommendations are summarized by enterprise.

Pasture

1. *Maintain a balance of wetlands and pasture, retaining as much water as feasible while routing it through wetlands.*
2. *Use leguminous varieties when possible.*
3. *Maintain a favorable soil ph.*

Beef Cattle

1. Block cattle from water holes and loafing areas which are subject to flushing following heavy rains.
2. Locate and manage mineral and winter feeding areas to prevent losses of accumulated manure.
3. Schedule pastures to graze away from major drain outlets in summer.
4. Drag pastures to spread manure accumulated during heavy grazing.

Dairy Cattle

1. Capture and disperse all waste to fields or wetlands.
2. Block cows from drainways and water holes.
3. Attract cows to dispersed, high ground loafing areas with artificial shade structures or cow-proof trees.
4. Rotate herds to back pastures to achieve better dispersal.
5. Reduce the import of nutrients and make better utilization of wastes by producing feed crops.

Sugar Cane and Vegetables

1. Muckland
   a) Reduce discharge of drainage water to the Lake. The vastness of the agricultural area, the lack of on-farm marsh areas, and the permeable subsurface strongly suggest a project, rather than on-farm approach.
   b) Hold high water tables wherever possible. Flood fallow fields.
   c) Convert less productive fields to pasture, or other crops tolerant of a high water table.
2. Sandlands
   a) Plan retention and/or renovation of drainage water, particularly the first flush after fertilization. More controls are indicated for permanent operations.
   b) Locate where drainage to wetlands is possible.
   c) Reduce leaching through use of plastic mulch, slow release fertilizers, and/or multiple applications.

Citrus on Artificially Drained Soils

1. As new groves are developed drainage should be planned to route through natural or modified wetlands, if possible.
2. Careful location of new groves.
3. Retention and/or renovation of drainage water in wetlands.
4. Use of better, slow release fertilizers as they become available.

In general, the report recommends that "Best Preventive Techniques" (BPT) be developed and a program to promote them should be implemented. The author suggests a certification program on these lines:

1. *Inspection and BPT recommendations by the Extension Service and the Soil Conservation Service.*
2. *Overall plan development by the owner and his consultants.*
3. *Plan review and approval by the regulatory agencies.*
4. *Construction and implementation by the owner, possibly with USDA or other agency monetary assistance.*
5. *Certification of compliance with BPT standards by the regulatory agency(ies) with the help of the Extension Service and the Soil Conservation Service.*

Best Management Practices and Effects on Agricultural Pollution

Information is presently being developed regarding the effects of best management practices especially on pollution from dairies. The following was obtained from the "Taylor Creek Headwaters Project Phase I Report; Water Quality", South Florida Water Management District Technical Publication 82-8 dated October 1982:

> *Over the past two decades, the Taylor Creek/Nubbin Slough Watershed[1/] has evolved into a major agricultural area with emphasis on dairy farming. Due to the influx of dairy, beef cattle and citrus operations along this watershed, it has become a concern as to how these agricultural practices have affected the overall water quality of the basin, and in turn, Lake Okeechobee. A recent study by Anthony C. Federico, K. G. Dickson, C. R. Kratzer, and F. E. Davis (1981) concerning the eutrophication of Lake Okeechobee points out that the Taylor Creek/ Nubbin Slough Watershed (on an annual basis) contributes about 30% of the phosphorous and 5% of the nitrogen to the lake while contributing only 4% of the total water budget. This contribution of phosphorous is greater than that of any of the other tributaries that supply the lake, including the Kissimmee River. The nutrient enrichment of this watershed has been identified as a result of both agricultural point and non-point source pollution, primarily from dairy operations within the basin. Non-point sources are generally runoff from grazing pastures and dairy staging areas near milking barns, and the unrestricted access of cattle to the open channel and their tributary ditches. The animals utilize these water courses for drinking and to alleviate heat stress. High nutrient concentrations (nitrogen and phosphorous) have been attributed to the discharge of feces and urine from dairy and beef cattle which have direct access and are predisposed to standing in and around these waterways. Because of the unspecific nature of non-point pollution, it becomes more difficult to control than point sources. Point sources generally occur due to improper maintenance of wastewater systems in and around dairy operations. These systems include lagoons,*

1/ Located immediately west of St. Lucie County along the eastern side of Okeechobee County.

degraded drainage ditches, and improperly functioning seepage fields due to high water tables in this area.

Early chemical and biological investigations on Lake Okeechobee by Boyd F. Joyner (1971), F. E. Davis and M. L. Marshall (1975), the report concerning the special project to prevent the eutrophication of Lake Okeechobee by R. A. MacGill, S. E. Gatewood, C. Hutchison, and D. D. Walker (1976), along with water quality studies within the Taylor Creek/Nubbin Slough basin by L. H. Allen, Jr., E. H. Stewart, W. G. Knisel, Jr., and R. A. Slack (1976), E. H. Stewart, L. H. Allen, Jr., and D. H. Calvert (1978) and Anthony C. Federico (1977), have documented the need and provided the emphasis for the establishment of two programs designed to institute the use of best management practices (BMP's) aimed at alleviating the water quality problems of this area. These programs are: 1) The Taylor Creek Headwaters Program (TCHW) which provides 100% of the cost for landowners to install BMP's in the Taylor Creek headwaters area, and 2) a Federal Rural Clean Waters Program (RCWP) that provides 75% cost sharing with landowners to implement BMP's over the entire Taylor Creek/Nubbin Slough Basin.

The initial TCHW and more recent RCWP programs are designed to address non-point pollution sources in order to evaluate the effectiveness of BMP's in alleviating high nitrogen and phosphorus loads. The incorporation of the following BMP's: 1) fencing, 2) watering facilities, 3) shade structures, 4) detention areas, and 5) water conservation practices will determine whether or not nutrient loads can be controlled and if so, what impact will this have on the water quality of the Taylor Creek/Nubbin Slough Basin, and in turn, Lake Okeechobee. BMP's suggested for installation and use in the RCWP and TCHW programs were introduced by the Coordinating Council for the Restoration of the Kissimmee River Valley and Taylor Creek/Nubbin Slough Basin (KRVCC). Efficient wastewater utilization, fencing cows out of the open channels, and better herd rotation were suggested by Baldwin (1975) in a report dealing with non-point source agricultural pollution as well as management alternatives for non-point pollution abatement in the Okeechobee-Kissimmee Basin. The rationale behind these types of BMP's were adapted from standard SCS soil erosion practices that have been employed in agricultural pollution problem areas throughout the country. However, modifications of these practices were made in order to address the specific nutrient problems that plague south Florida.

This watershed is being monitored for water quality. Until October 1981, the monitoring was carried out by the Agricultural Research Service. Since then, monitoring is carried out by the South Florida Water Management District. Technical Publication 82-8 presents some of the BMP's effects; however, increased efforts in establishing BMP's and monitoring their effects should result in important data that can be used for guiding future efforts to reduce point and non-point agricultural pollution.

The goals and expected results of this effort listed in Technical Publication 82-8 are as follows:

1) The TCHW and RCWP projects are designed to determine the extent of the effects of BMP's (fencing, watering, shade, detention, and water conservation practices) on alleviating high nutrient loads coming from the Taylor Creek/Nubbin Slough Basin.

2) The TCHW project will absorb 100 percent of the BMP implementation costs for landowners participating in the project area. The RCWP project will pay up to 75 percent of the BMP installation costs up to $50,000 for approved practices, while the landowners will pay the additional 25 percent.

3) Presently, 50 percent of the land area, as well as 100 percent of the dairies in the TCNS are signed up for water quality management plans under the joint TCHW/RCWP programs. All of the dairies in the TCHW project area have signed contracts and are beginning BMP implementation.

4) The wash water recycling system began operating on 04/14/82. Early results show a savings of 797 m^3 (210,240 gallons) of water a day. This translates into 292,221 m^3/year (237 acre feet/year).

5) BMP's installed above S-13B (i.e., fencing, wash water recycling system) should decrease N and P loads as well as discharge in this area.

6) More efficient utilization and management of dairy wastewater systems and the implementation of BMP's in the Nubbin Slough subwatershed should have a positive impact on stream water quality as well as downstream water quality at S-191.

7) Mini-studies, such as Gomez Creek and analysis of phosphotus in stream-bed sediments, will provide additional tools with which to analyze the effectiveness of BMP's.

Conservation

In order to determine environmentally sensitive areas, endangered species and their habitat must be considered. This section will begin with an identification of rare, endangered and threatened flora and fauna thought to have some association with St. Lucie County. Then, attention will focus on land areas to be considered in a conservation program.

Mammals

(Sources: James N. Layne (edit), Mammals, Vol. 1 of Rare and Endangered Biota of Florida, University Presses of Florida, 1978), Endangered and Potentially Endangered Fauna and Flora in Florida - Official lists, Oct. 1983. Florida Game and Fresh Water Fish Commission.

Threatened species include Florida Mouse on the Florida list, and endangered species include the Florida Panther and West Indian Manatee on the US and

Florida lists. The Round-tailed muskrat and Sherman's Fox Squirrel are identified as a species of special concern.

Birds

Sources: Herbert W. Kale II (edit), Birds, Vol. II of above series), Endangered and Potentially Endangered Fauna and Flora in Florida - Official lists, Oct. 1983. Florida Game & Fresh Water Fish Commission.

Endangered or threatened species whose habitat ranges include St. Lucie County are by US and Florida listings:1/

	US	FL		US	FL
Bachman's Warbler	E	E	Bald Eagle	E	T
Brown Pelican	E	T	Peregrine Falcon	E	E
Caracara	-	T	Red-Cockaded Woodpecker	E	E
Everglades Kite	E	E	Florida Sand Hill Crane	-	T
Florida Scrub Jay	-	T	Snowy Plover	-	E
Kirtland's Warbler	E	E	Wood Stork	-	E
Least Tern	-	T			
Southeastern Kestrel	-	T			

Plants

(Sources: Daniel B. Ward (edit), Plants, Vol. J of above series), Endangered and Potentially Endangered Fauna and Flora in Florida Official Lists, Oct. 1983. Florida Game and Fresh Water Fish Commission.

Threatened Species	Endangered Species
Curtiss Milkweed (Asclepias curtissii)	Beach Star (Remierea maritima)
Beach Creeper (Ernodea littoralis)	Hand Fern (Ophioglossum palmatum)
Sea Lavender (Mallotonia gnaphalodes)	
Florida Coontie (Samia floridana)	
Climbing Dayflower (Commelina gigas)	

Amphibians & Reptiles

Sources: Roy W. McDiarmid, (edit), Amphibians & Reptiles, Vol. 3 of above)2/. Endangered and Potentially Endangered Fauna and Flora in Florida, Official Lists, Oct. 1983, Florida Game and Freshwater Fish Commission.

	US	FL		US	FL
Atlantic Green Turtle	E	E	Atlantic Hawkbill Turtle	E	E
Leatherback Turtle	E	E	American Alligator	T	-
Atlantic Loggerhead Turtle	T	T	Eastern Indigo Snake	T	T

1/ E = Endangered, T = Threatened

2/ Updated by Official State List published by Florida Game & Fresh Water Fish Commission.

Land

This discussion is intended to identify some of the land characteristics that should be considered, from an environmental conservation standpoint, in county planning and development. It should be emphasized that the discussion is not all inclusive; other forseeable characteristics and considerations will also be important in any particular decision and at the time of decision making. Conservation criteria to be considered here are: habitat for endangered species, retention of wetlands, and maintenance of soils which are important for recharge, wetlands, tidal areas and beaches. Two different criteria to define wetlands have been considered in this report - land cover as reported by the SFWMD and wet soils as reported in the St. Lucie County Soil Survey Report. Other criteria to define wetlands, such as that being developed by the U.S. Fish and Wildlife Service or the classification developed by the U.S. Fish and Wildlife Service as described in their Circular 39, should also be carefully considered in any proposed land use changes. Other environmental and/or conservation criteria may also be important and should be considered, as appropriate.

Habitat for Endangered Species include the following areas:

- Pine flatwoods
- Sandpine scrub
- Longleaf Pine - Xerophytic Oaks
- Cypress Swamp
- Coastal marshes
- Freshwater marshes/wet prairies
- Scrub vegetation on old dunes inland from present coast
- Cabbage palm trees in low moist shaded hammocks
- Coastal dunes
- Scrub vegetation areas associated with Florida Rosemary, Chapman Oak, Myrtle Oak, and similar scrub species
- Open swamps and wet hammocks in vicinity of Lake Okeechobee
- Longleaf Pine - Turkey Oak association
- Mangrove Swamps

The distribution of endangered species habitat is displayed on Map 6-1. (Not included in this document). Table 6-1 provides the acreage distribution of the habitat by soil group and total acres for the county. Note that the table aggregates habitat into categories. The impact of projected land use changes (from Chapter 2) are presented in Tables 6-1A and 6-1B.

TABLE 6-1 ST. LUCIE COUNTY ENVIRONMENTALLY SENSITIVE AREAS HABITAT - 1979
(Acres)

LAND USE	SOIL GROUPS I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
1	764.	1609.	5734.	0.	5094.	7566.	21167.	107.	771.	1994.	595.	151.	45553.
2	0.	7.	66.	0.	29.	7.	305.	0.	4.	29.	0.	4.	452.
3	59.	11.	4.	0.	0.	7.	44.	0.	26.	7.	0.	0.	158.
4	0.	0.	657.	0.	2630.	529.	0.	7.	51.	0.	15.	0.	3890.
5	7.	143.	4.	0.	426.	15.	73.	0.	1579.	44.	0.	184.	2476.
6	26.	426.	4048.	0.	2608.	3706.	12323.	4.	676.	525.	253.	151.	24745.
7	107.	81.	0.	0.	0.	0.	0.	0.	0.	48.	51.	4.	290.
TOTALS	962.	2277.	10512.	0.	10788.	11831.	33913.	118.	3107.	2648.	915.	492.	77563.

SOIL GROUPINGS ARE THOSE FOUND IN TABLE 2-1

LAND USE GROUPS ARE AS FOLLOWS
1 - PINE FLATWOODS
2 - SAND PINE SCRUB
3 - PINE / OAK
4 - CYPRESS SWAMP
5 - COASTAL MARSH
6 - FRESH WATER MARSH / WET PRAIRIE
7 - COASTAL DUNES

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE; CONSULTATION WITH SCS SOIL SCIENTISTS

TABLE 6-1A ST. LUCIE COUNTY ENVIRONMENTALLY SENSITIVE AREAS HABITAT
BOOZ-ALLEN EQUIVALENT 50 YEAR PROJECTION
(Acres)

	SOIL GROUPS												
LAND USE	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
1	764.	1414.	5535.	0.	4558.	6832.	19617.	107.	724.	1829.	595.	151.	42126.
2	0.	7.	66.	0.	29.	7.	305.	0.	4.	29.	0.	4.	452.
3	59.	11.	4.	0.	0.	7.	44.	0.	26.	7.	0.	0.	158.
4	0.	0.	657.	0.	2630.	529.	0.	7.	51.	0.	15.	0.	3890.
5	7.	143.	4.	0.	389.	15.	73.	0.	1561.	44.	0.	176.	2413.
6	26.	397.	3298.	0.	2171.	3346.	10560.	4.	635.	356.	253.	147.	21193.
7	107.	81.	0.	0.	0.	0.	0.	0.	0.	48.	51.	4.	290.
TOTALS	962.	2053.	9564.	0.	9778.	10736.	30600.	118.	3001.	2314.	915.	481.	70522.

SOIL GROUPINGS ARE THOSE FOUND IN TABLE 2-1

LAND USE GROUPS ARE AS FOLLOWS
1 - PINE FLATWOODS
2 - SAND PINE SCRUB
3 - PINE / OAK
4 - CYPRESS SWAMP
5 - COASTAL MARSH
6 - FRESH WATER MARSH / WET PRAIRIE
7 - COASTAL DUNES

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE; CONSULTATION WITH SCS SOIL SCIENTISTS
BOOZ-ALLEN REPORT TO CORPS OF ENGINEERS

[illegible]

TABLE 6-1B ST. LUCIE COUNTY ENVIRONMENTALLY SENSITIVE AREAS HABITAT
ALTERNATIVE 50 YEAR PROJECTION
(Acres)

	SOIL GROUPS												
LAND USE	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
1	757.	1359.	3636.	0.	2755.	4239.	17248.	59.	720.	1649.	595.	147.	33164.
2	0.	7.	66.	0.	29.	7.	305.	0.	4.	29.	0.	4.	452.
3	59.	11.	4.	0.	0.	7.	44.	0.	26.	7.	0.	0.	158.
4	0.	0.	147.	0.	477.	77.	0.	0.	11.	0.	0.	0.	713.
5	7.	143.	4.	0.	393.	15.	73.	0.	1561.	44.	0.	176.	2417.
6	26.	397.	2993.	0.	1840.	2847.	10530.	4.	624.	356.	250.	147.	20014.
7	107.	81.	0.	0.	0.	0.	0.	0.	0.	48.	51.	4.	290.
TOTALS	955.	1998.	6850.	0.	5495.	7192.	28201.	62.	2946.	2134.	896.	477.	57207.

SOIL GROUPINGS ARE THOSE FOUND IN TABLE 2-1

LAND USE GROUPS ARE AS FOLLOWS
1 - PINE FLATWOODS
2 - SAND PINE SCRUB
3 - PINE / OAK
4 - CYPRESS SWAMP
5 - COASTAL MARSH
6 - FRESH WATER MARSH / WET PRAIRIE
7 - COASTAL DUNES

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE; CONSULTATION WITH SCS SOIL SCIENTISTS; ST. LUCIE COUNTY COMPREHENSIVE PLAN

The bulk of environmentally sensitive habitat is on Soil groups III, V, VI, and VII. Soil groups III, V, and VI are also important citrus soils. The alternative, most intensive land use projection results in more than a proportional reduction in the environmentally sensitive habitat on Soil groups III, V, and VI.

Wetlands Habitat

Concern has been expressed by some observers that agriculture and urban development may result in the loss of wetlands required for an appropriate environmental balance in the county. Without passing judgment on the validity of that concern, this report includes a map (Map 6-2, not included in this document), which locates wetland areas in the county. These areas have been identified based on the description of land use associated with the land use map (1979) provided by the South Florida Water Management District.

The categories of wetland habitat identified are:

Description	SFWMD Code
Cypress	WFCY 621
Mixed Forest	WFMX 630
Willow	WFWL 610
Sloughs (salt water)	WNSL 641
Sloughs (fresh water)	WNWL 641
Non-forested fresh	WN 640
Red Mangrove	WSRM 612
Forested Salt	WS 641
Cypress & Wet Prairie	WXCP 643
Pine & Wet Prairie	WXPP 643
Forested Fresh	WF 610
Non-forested salt	WM 642
Bullrushes	WNBR 641
Cattails	WNCT 641

Table 6-2 shows the distribution of these wetlands habitat by soil group and total acres for the county. Note that the table aggregates wetland habitat into 8 categories. The impacts of projected land use changes (from Chapter 2) are presented in Tables 6-2A and 6-2B.

The bulk of wetlands habitat is on soil groups III, V, VI, VII, and IX. Soil groups III, V, and VI are also important citrus soils. The alternative, most intensive land use projection, results in a more than proportional reduction in soil groups III, V, and VI. Overall, there is a total of 19% reduction in wetland habitat in the alternative projection.

Environmentally Sensitive Soils

In cooperation with the State Soil Scientist (SCS), these soils in the county have been identified by four major categories: Sensitive for recharge, Sensitive as wetlands, Sensitive as tidal areas, and Sensitive as beaches. The soils in each category and the soil map symbols are listed below.

Soils Sensitive for recharge (SR)

Soil Name	Soil Map Symbol	Soil Name	Soil Map Symbol
Paola	28	Welaka Variant	53
St. Lucie	42	Canaveral	10
Palm Beach	27	Satellite	41
Astatula	7		

Soils Sensitive for Wetlands (SW)

Soil Name	Soil Map Symbol
Chobee	11
Floridana fine sand	13
Riviera dep.	37
Winder sand dep.	54
Waveland-Lawnwood complex	51
Hontoon muck	18
Tierra Ceia var.	45
Kaliga muck	20
Samsula var/Myakka	40

Soils Sensitive for Wetland-Tidal areas (ST)

Turnbull var.	46
Pompano var./Kaliga var.	35

Soils Sensitive for Beaches (SB)

Beaches	9

TABLE 6-2. ST. LUCIE COUNTY WETLANDS (Based on Land Use) - 1979
(Acres)

	SOIL GROUPS												
LAND USE	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	59.	228.	2002.	0.	1892.	342.	819.	62.	518.	62.	2369.	59.	8411.
3	26.	426.	4705.	0.	5238.	4235.	12323.	11.	727.	525.	268.	151.	28635.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	4.	44.	455.	0.	353.	404.	544.	0.	2134.	55.	1917.	1021.	6931.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	59.	485.	0.	0.	0.	0.	48.	0.	2997.	51.	4.	213.	3857.
8	7.	143.	4.	0.	426.	15.	73.	0.	1579.	44.	0.	184.	2476.
TOTALS	154.	1326.	7166.	0.	7908.	4995.	13807.	73.	7956.	738.	4558.	1627.	50309.

SOIL GROUPINGS ARE THOSE FOUND IN TABLE 2-1

LAND USE GROUPS ARE AS FOLLOWS
1 - WILLOW, BULLRUSH, CATTAIL
2 - CYPRESS, MIXED FORESTED, SLOUGHS
3 - CYPRESS & WET PRAIRIES, PINE & WET PRAIRIES
4 - NON FORESTED SALT
5 - NONFORESTED FRESH
6 - FORESTED FRESH
7 - FORESTED SALT
8 - RED MANGROVE

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE MAP; AND CONSULTATION WITH SCS SOIL SCIENTISTS

TABLE 6-2A. ST. LUCIE COUNTY WETLANDS (Based on Land Use) BOOZ-ALLEN EQUIVALENT 50 YEAR PROJECTION

(Acres)

	SOIL GROUPS												
LAND USE	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	59.	224.	2002.	0.	1870.	338.	812.	62.	514.	62.	2369.	59.	8371.
3	26.	397.	3956.	0.	4801.	3875.	10560.	11.	687.	356.	268.	147.	25083.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	4.	44.	455.	0.	342.	400.	536.	0.	2134.	55.	1917.	1021.	6909.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	59.	485.	0.	0.	0.	0.	48.	0.	2997.	51.	4.	213.	3857.
8	7.	143.	4.	0.	389.	15.	73.	0.	1561.	44.	0.	176.	2413.
TOTALS	154.	1293.	6417.	0.	7401.	4628.	12029.	73.	7893.	569.	4558.	1616.	46632.

SOIL GROUPINGS ARE THOSE FOUND IN TABLE 2-1

LAND USE GROUPS ARE AS FOLLOWS
1 - WILLOW, BULLRUSH, CATTAIL
2 - CYPRESS, MIXED FORESTED, SLOUGHS
3 - CYPRESS & WET PRAIRIES, PINE & WET PRAIRIES
4 - NON FORESTED SALT
5 - NONFORESTED FRESH
6 - FORESTED FRESH
7 - FORESTED SALT
8 - RED MANGROVE

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE MAP; AND CONSULTATION WITH SCS SOIL SCIENTISTS
BOOZ-ALLEN REPORT TO CORPS OF ENGINEERS

TABLE 6-28. ST. LUCIE COUNTY WETLANDS (Based on Land Use)
ALTERNATIVE 50-YEAR PROJECTION

(Acres)

LAND USE	SOIL GROUPS I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	59.	224.	1818.	0.	1631.	231.	801.	55.	511.	62.	2039.	59.	7489.
3	26.	397.	3140.	0.	2318.	2924.	10530.	4.	635.	356.	250.	147.	20727.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	4.	44.	231.	0.	195.	345.	492.	0.	2127.	55.	1892.	1021.	6406.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	59.	485.	0.	0.	0.	0.	48.	0.	2997.	51.	0.	213.	3853.
8	7.	143.	4.	0.	393.	15.	73.	0.	1561.	44.	0.	176.	2417.
TOTALS	154.	1293.	5194.	0.	4536.	3515.	11945.	59.	7831.	569.	4180.	1616.	40892.

SOIL GROUPINGS ARE THOSE FOUND IN TABLE 2-1

LAND USE GROUPS ARE AS FOLLOWS
1 - WILLOW, BULLRUSH, CATTAIL
2 - CYPRESS, MIXED FORESTED, SLOUGHS
3 - CYPRESS & WET PRAIRIES, PINE & WET PRAIRIES
4 - NON FORESTED SALT
5 - NONFORESTED FRESH
6 - FORESTED FRESH
7 - FORESTED SALT
8 - RED MANGROVE

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE MAP; AND CONSULTATION WITH SCS SOIL SCIENTISTS
ST. LUCIE COUNTY COMPREHENSIVE PLAN

The distribution of these sensitive soils in the county is displayed on Map 6-3 (not included in this document), with appropriate symbols to designate the sensitive categories. Table 6-3 presents the acreage in each soil category by the twelve land use categories being used in this report. The impacts of projected land use changes (from Chapter 2) are presented in Tables 6-3A and 6-3B.

Comparing the base year land use distribution with the alternative (most intensive) projection, it is clear that the sensitive soils are projected to become more intensively used. Citrus and urban use of these soils increases 16% and 23% respectively. Less intensive uses decline: pasture use declines 13%, forest not wetland declines 30%, pine and wet prairies use of these sensitive soils declines 24%, and other wetlands use declines 20%. These shifts raise the question as to whether or not development will have the effect of changing the characteristics and thus reducing the acreage of these important sensitive soils.

TABLE 6-3 ST. LUCIE COUNTY SENSITIVE SOILS BY AGGREGATE LAND USE- 1979
(Acres)

LAND USE	SOIL GROUPS 1	2	3	4	TOTAL
1 - CITRUS	2285.	45413.	316.	0.	48013.
2 - PASTURE	2443.	15041.	507.	0.	17990.
3 - TRUCK CROPS	0.	73.	0.	0.	73.
4 - SUGAR CANE	0.	0.	0.	0.	0.
5 - MISCELLANEOUS	15.	7.	0.	0.	22.
6 - URBAN	3232.	2692.	246.	44.	6215.
7 - URBAN UNDEVELOPED	195.	95.	0.	7.	298.
8 - FORESTED NOT WETLAND	1601.	6542.	511.	7.	8661.
9 - GRASSLAND / RANGE	257.	169.	48.	11.	485.
10 - PINE AND WET PRAIRIES	44.	4863.	37.	0.	4944.
11 - OTHER WETLANDS	896.	9014.	4106.	18.	14035.
12 - MISC NON-AG	349.	184.	33.	345.	911.
13 - UNCLASSIFIED	151.	327.	309.	0.	786.
TOTALS	11467.	84420.	6112.	433.	102433.

SOIL GROUPS ARE AS FOLLOWS:
1 - SENSITIVE FOR RECHARGE
2 - SENSITIVE WETLANDS
3 - SENSITIVE WETLANDS - TIDAL AREAS
4 - SENSITIVE BEACHES

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE MAP; AND CONSULTATION WITH SCS SOIL SCIENTISTS

TABLE 6-3A ST. LUCIE COUNTY SENSITIVE SOILS BY AGGREGATE LAND USE
BOOZ-ALLEN EQUIVALENT 50 YEAR PROJECTION
(Acres)

LAND USE	SOIL GROUPS 1	2	3	4	TOTAL
1 - CITRUS	2248.	44451.	261.	0.	46959.
2 - PASTURE	2421.	16143.	485.	0.	19048.
3 - TRUCK CROPS	0.	73.	0.	0.	73.
4 - SUGAR CANE	0.	0.	0.	0.	0.
5 - MISCELLANEOUS	15.	7.	0.	0.	22.
6 - URBAN	3320.	3974.	356.	44.	7695.
7 - URBAN UNDEVELOPED	195.	95.	0.	7.	298.
8 - FORESTED NOT WETLAND	1572.	6024.	489.	7.	8092.
9 - GRASSLAND / RANGE	257.	165.	48.	11.	481.
10 - PINE AND WET PRAIRIES	44.	4007.	26.	0.	4077.
11 - OTHER WETLANDS	896.	8992.	4106.	18.	14012.
12 - MISC NON-AG	349.	173.	33.	345.	900.
13 - UNCLASSIFIED	151.	316.	309.	0.	775.
TOTALS	11467.	84420.	6112.	433.	102433.

SOIL GROUPS ARE AS FOLLOWS:
1 - SENSITIVE FOR RECHARGE
2 - SENSITIVE WETLANDS
3 - SENSITIVE WETLANDS - TIDAL AREAS
4 - SENSITIVE BEACHES

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE MAP; AND CONSULTATION WITH SCS SOIL SCIENTISTS
BOOZ ALLEN REPORT TO CORPS OF ENGINEERS

TABLE 6-3B ST. LUCIE COUNTY SENSITIVE SOILS BY AGGREGATE LAND USE
ALTERNATIVE 50 YEAR PROJECTION
(Acres)

LAND USE	SOIL GROUPS 1	2	3	4	TOTAL
1 - CITRUS	2421.	52843.	272.	0.	55536.
2 - PASTURE	2299.	12811.	474.	0.	15585.
3 - TRUCK CROPS	0.	73.	0.	0.	73.
4 - SUGAR CANE	0.	0.	0.	0.	0.
5 - MISCELLANEOUS	15.	7.	0.	0.	22.
6 - URBAN	3320.	3930.	356.	44.	7651.
7 - URBAN UNDEVELOPED	195.	95.	0.	7.	298.
8 - FORESTED NOT WETLAND	1521.	4070.	489.	7.	6086.
9 - GRASSLAND / RANGE	257.	165.	48.	11.	481.
10 - PINE AND WET PRAIRIES	44.	3677.	26.	0.	3746.
11 - OTHER WETLANDS	896.	6259.	4106.	18.	11280.
12 - MISC NON-AG	349.	173.	33.	345.	900.
13 - UNCLASSIFIED	151.	316.	309.	0.	775.
TOTALS	11467.	84420.	6112.	433.	102433.

SOIL GROUPS ARE AS FOLLOWS:
1 - SENSITIVE FOR RECHARGE
2 - SENSITIVE WETLANDS
3 - SENSITIVE WETLANDS - TIDAL AREAS
4 - SENSITIVE BEACHES

SOURCE: BASED ON DATA FROM SOIL SURVEY FOR ST. LUCIE COUNTY; SFWMD 1979 LAND USE MAP; AND CONSULTATION WITH SCS SOIL SCIENTISTS
ST. LUCIE COUNTY COMPREHENSIVE PLAN

SUMMARY Points of Chapter 6.

1. A small change in the subtle balance among geologic conditions, soils, climate, ground water and surface water regimen, flora and fauna, can cause significant changes in the environment. Human interference with these natural balances has been a source of controversy throughout the country.

2. The Florida Department of Environmental Regulation (FDER), reports that St. Lucie County has 52 municipal, 7 industrial and 4 agricultural waste disposal impoundments. Surface impoundments have a serious potential for polluting ground water.

3. The FDER made the following recommendations which have relevance for St. Lucie County:

   a) The FDER should increase the scope and capabilities of the ground water pollution control program.
   b) As a prerequisite to effective ground water quality management, the FDER must identify and prohibit hydrologically unacceptable surface impoundment locations. FDER must discover and adopt alternate locations and methods of waste disposal.
   c) The practice of discharging wastewater into drinking water supplies in Florida should be prohibited.
   d) Florida needs to adopt and implement a statewide ground water protection and management plan.

4. The South Florida Regional Planning Council prepared a report addressing certain environmental issues. The FDER also prepared one on non-point pollution. Several recommendations were made for each agricultural enterprise for pollution abatement. The South Florida Water Management District prepared a report on water quality which discussed pollution from dairies. Further study is being conducted by SFWMD.

5. This report provides lists of rare and endangered mammals, birds, plants, amphibians and reptiles. The report tabulates by soil groups habitat for endangered species, wetland habitat, and environmentally sensitive soils in St. Lucie County. These areas are mapped by soils and land use. A copy of each map is available at the Soil Conservation Office in Ft. Pierce.

CHAPTER 7. WATER CONSERVATION

Water conservation in St. Lucie County is a primary concern of the people of all interests - agriculture, municipalities, industry, and owners of private household water systems. Anticipated growth in population and agriculture will cause added demands to be placed upon the water resources in the area. Degradation of quality is an ever-increasing concern as these demands continue to expand. Governmental agencies at all levels, as well as individuals, are aware of the need for water conservation and of the consequences of disregarding the problem.

South Florida Water Management District

The South Florida Water Management District is actively engaged in studies and other activities related to water use, management, and conservation. In the Summary Status Report - Upper East Coast[1/], several recommendations are presented. Water conservation and demand reduction are emphasized. Specific recommendations include: (1) encouraging conservation by all users, especially in rapid growth areas of St. Lucie County, through local agencies with basic water supply responsibilities, (2) development of water shortage plans that can be employed during dry periods, (3) continued research and development of deep aquifer storage capabilities and costs, (4) development of desalination and demineralization facilities in areas where raw water does not meet public health standards, (5) development of dual conveyance systems for potable and subpotable water and for recycling, (6) encouraging the reuse of wastewater for nonpotable and irrigation application where public health is not endangered, (7) encouraging additional development of well-fields within limits of safe aquifer yields, (8) encouraging regionalization of water supply and treatment facilities for cost savings, (9) encouraging the use of self-contained surface detention areas for irrigation, (10) supporting the development of a system to deliver irrigation water from Lake Okeechobee to St. Lucie County, (11) encouraging the use of the most efficient means of crop irrigation compatible with local conditions.

1/ Water Use and Supply Development Plan, October 1980

Soil Conservation Service

The Soil Conservation Service (SCS), an agency of the United States Department of Agriculture, assists individual landowners with soil and water conservation problems under Public Law 46. This program of direct technical assistance is administered through the St. Lucie Soil and Water Conservation District (SWCD) with technical assistance provided by SCS. The District is a governmental subdivision of the State of Florida. The creation of districts was authorized by the "Soil and Water Conservation Law", Chapter 582, Florida Statutes, for the purpose of developing and carrying out a program of conservation of the State's soil and water resources. The St. Lucie Soil and Water Conservation District develops plans and provides technical assistance to county land users and units of government in the areas of soil erosion and flood prevention, and in the conservation, development, and utilization of soil and water resources within the District.

The lack of adequate quantities of surface water for irrigation of citrus and the generally poor quality of available ground water are of major concern to the SWCD and to the citrus industry in St. Lucie County.

The SCS is responsible for the administration of Public Law 566, the Watershed Protection and Flood Prevention Act, which includes agricultural water management as a purpose. Two of these projects have been completed in St. Lucie County - North St. Lucie River Drainage District Watershed and Ft. Pierce Farms Drainage District Watershed. The agricultural water management portions of these projects involved the installation of structures in the canals for maintaining more desirable water levels in the citrus groves and for storing irrigation water.

A recently initiated program of the SCS is the Florida Water Conservation Project. Under this program, six Florida counties have been designated as recipients of targeted funds for assistance in conservation and management of irrigation water for more efficient and effective use. St. Lucie County is one of the designated counties. Soil Conservation Service personnel assigned to this program will work through the Soil and Water Conservation Districts and in cooperation with the South Florida Water Management District, Extension Service, and Agricultural Stabilization and Conservation Service. Priority will be given to irrigated cropland with low irrigation efficiencies. The primary objective is to conserve water resources by improving irrigation application efficiency, reducing energy requirements, and improving irrigation water management.

U. S. Army Corps of Engineers

The COE initiated the St. Lucie County Water Supply Study in 1979. Emphasis of this study is on design alternatives to convey agricultural irrigation water to St. Lucie County from Lake Okeechobee or from inflow streams to the Lake. Consideration is being given to diversion of Taylor Creek-Nubbin Slough flows directly to St. Lucie County, or in combination with a reservoir. Several alternatives are being considered and are outlined in the SFWMD Summary Status Report. The COE report is scheduled for completion in the near future.

SUMMARY Points of Chapter 7.

1. Individuals and government agencies are concerned with anticipated growth in population, degradation of water quality, and the need for water conservation in St. Lucie County.

2. The South Florida Water Management District is doing studies on various alternatives encouraging water conservation.

3. The USDA Soil Conservation Service assists individual landowners with soil and water conservation needs as well as local governments.

4. The U. S. Army Corps of Engineers is currently doing a major study of water supply in St. Lucie County.

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APPENDIX I. MAPS - In separate package - Available for display

Chapter 1. None

Chapter 2. Map 2-1: 1979 Land Use - Transparent Overlay

Map 2-2: Booz-Allen Equivalent 50 Year Projected Land Use Change

Map 2-3: Alternative 50-year Projected Land Use Map

Map 2-4: Soil Groups

Map 2-5: Relative Value of St. Lucie County Soils for Citrus

Chapter 3. None

Chapter 4. Map 4-1: Soils most suitable for water storage

Chapter 5: None

Chapter 6. Map 6-1: Endangered species habitat

Map 6-2: Wetland Habitat

Map 6-3: Sensitive Soils

Chapter 7: None

APPENDIX II -- Background Data

1. Aggregation of SFWMD Land Use Categories

Land Use in Report	Code	SFWMD Land Cover Code & 1979 Acres	Acres
1. Citrus	AMCT	Citrus	96,834
2. Pasture	APIM	Improved Pasture	108,026
	APUN	Unimproved Pasture	233
3. Truck Crops	ACTC	Truck Crops	808
4. Sugar Cane	ACSC	Sugar Cane	0
5. Miscellaneous	AFDF	Dairy Farms	10
	AFFF	Fish Farms	15
	AMOR	Ornamentals	13
	AMSF	Sod Farms	44
	AFHT	Horse Training	0
6. Urban	UCCE	Cultural & Entertainment	46
	UCHM	Hotel-Motel	60
	UCMC	Marinas & Boatyards	54
	UCSC	Shopping Center	139
	UCSS	Sales & Service	906
	UIJK	Junk Yards & Auto Salvage	33
	UI	Industrial	708
	UOCM	Cemeteries	76
	UOGC	Golf Courses	927
	UOPK	Parks	441
	UORC	Recreational Facility	313
	UOUD	Open Under Development	20974
	URMF	Multi-Family	706
	URMH	Mobile Homes	1086
	URSL	Single Family-Low Density	8934
	URSM	Single Family-Medium Density	8720
	USCF	Correctional Facility	14
	USED	Educational Facility	495
	USGF	Other Government Facility	177
	USMD	Medical Facility	47
	USRL	Religious	79

Land Use in Report	SFWMD Land Cover Code & 1979 Acres: Code		Acres
6. Urban (Cont.)	UTAG	Small grass airport	354
	UTAP	Airports	931
	UTEP	Electric Power Facility	477
	UTHW	Major Highway & Right-of-way	1882
	UTOG	Oil & Gas Storage	11
	UTPF	Port Facility	91
	UTRR	Railroad Yards & Terminals	60
	UTRS	Broadcasting or Receiving Towers	21
	UTSP	Sewage Treatment Facility	62
	UTSW	Solid Waste Disposal	408
	UTTL	Major Electric Transmission Line	233
	UTWS	Water Supply Facility	16
	URSH	Single Family High Density	0
	USMF	Military Facility	0
	US	Institutional	0
7. Urban Undeveloped	UOUN	Open & Undeveloped	2050
8. Forested Not Wetland	FEPF	Pine Flatwoods	45809
	FMCO	Cabbage Palm/Oaks	2516
	FMOF	Old Fields Forested	3116
	FMPC	Pine/Cabbage Palm	2407
	FMPO	Pine/Oak	155
	FOAP	Australian Pine	390
	FOOK	Oak	270
	FOPA	Palms	454
	FESP	Sand Pine Scrub	0
9. Grassland/Range	RG	Grassland	538
	RSPP	Palmetto Prairies	326
	RS	Scrub & Brushland	492
10. Pine & Wet Prairies	WXPP	Pine & Wet Prairies	24948

Land Use in Report	Code	SFWMD Land Cover Code & 1979 Acres	Acres
11. Other Wetlands	WFCY	Cypress	4244
	WFMX	Mixed Forest	3562
	WNSL	Sloughs	688
	WN	Non-forested Fresh	6997
	WSRM	Red Mangrove	2474
	WS	Forested Salt	3917
	WXCP	Cypress & Wet Prairies	3999
	WFWL	Willow	0
	WF	Forested fresh	0
	WM	Non-forested salt	0
	WNBR	Bullrush	0
	WNOT	Cattail	0
12. Miscellaneous Non-Agriculture	BB	Beaches	451
	BP	Extractive	553
	BS	Spoil Areas	284
	FMCD	Coastal Dunes	305
	BL	Levees	0

13. Unclassified - Miscellaneous small areas of water, ditchbanks, etc. were accumulated into this unclassified category.

NOTE: All the detailed SFWMD land uses were coded into the computer and were available for use in various aggregations; for example, in the various environmentally sensitive categories. The aggregations were used as appropriate for reporting purposes.

NOTE: It should also be noted that the land cover and codes listed are those of the SFWMD; therefore, the land cover aggregations developed for use in this report will not necessarily coincide with other common definitions. For instance, land uses classified as wetlands in this report do not necessarily fit those definitions used in USFWS Cir. 39.