SOUTH FLORIDA WATER MANAGEMENT DISTRICT

APPENDICES
2004 UPDATE

Upper East Coast
Water Supply Plan

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SOUTH FLORIDA WATER MANAGEMENT DISTRICT

2004 Update
June 2004

Upper East Coast Water Supply Plan APPENDICES

Water Supply Department
South Florida Water Management District

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Acronyms and Abbreviations

ADF	average daily flow
AFSIRS	Agricultural Field Scale Irrigation Requirements Simulation
ASR	aquifer storage and recovery
BEBR	Bureau of Economic and Business Research
CDD	Community Development District
CERP	Comprehensive Everglades Restoration Plan
cm	centimeter
CM	construction management
CUP	Consumptive Use Permitting
DBKEY	database key
DBHydro	SFWMD's corporate environmental database
District	South Florida Water Management District
DSS	domestic self-supply
ET	evapotranspiration
FASS	Florida Agricultural Statistics Service
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FPL	Florida Power & Light
FY	fiscal year
GIS	geographic information system
GPCD	gallons per capita per day
GPD	gallons per day
GPM	gallons per minute
IFAS	Institute of Food and Agricultural Sciences
MGD	million gallons per day
mg/L	milligrams per liter
MGY	million gallons per year
NRCS	Natural Resources Conservation Service
O&M	operations and maintenance
psi	pounds per square inch
PWS	public water supply

RIB	rapid infiltration basin
RO	reverse osmosis
SFWMD	South Florida Water Management District
SJRWMD	St. Johns River Water Management District
TAZ	Traffic Analysis Zone
TDS	total dissolved solids
TTHM	Total Trihalomethanes
UEC	Upper East Coast
UECFAS	UEC Floridan Aquifer monitoring well network
UEC Plan	Upper East Coast Regional Water Supply Plan
U.S.	United States
USDA	United States Department of Agriculture
USDA-NRCS	United States Department of Agriculture - Natural Resources Conservation Service
USGS	United States Geological Survey
WQ	Water Quality
WQBEL	water quality based effluent limitations
WTP	water treatment plant
WWTF	wastewater treatment facility

APPENDIX A

Methodology for Urban and Agricultural Demand Projections

DEMAND ASSESSMENTS AND PROJECTIONS

Demand assessments for 2000 and projections for 2025 were made for the following water use categories:

1. Public Water Supply (PWS).
2. Domestic Self-Supply (DSS) and Small Public Supply Systems.
3. Commercial/Industrial Self-Supply.
4. Recreational Self-Supply.
5. Thermoelectric Power Generation Self-Supply.
6. Agricultural Self-Supply.

Water demand projections through the year 2025 included analyses under average (mean) rainfall conditions and under drought conditions. These projections are based on current trends and circumstances. Projections should therefore be understood as surprise free, and imply an extension of current production, market and legal circumstances.

In addition, the projections are unconstrained by supply availability or further demand management (conservation). Therefore, there is the opportunity to reduce these projected demand levels through the policies and activities that would be put in place based on potential or observed negative natural resource impacts, or in response to actual drought events.

Wherever population represented an independent variable for projection purposes (the first four categories of use), the county assessment by the U.S. Bureau of the Census (2000) was used for 2000 and the medium range county population projections published by the Bureau of Economic and Business Research (BEBR, 2002) was used for the 2025 time horizon.

Wherever irrigation requirements are calculated (for agricultural and recreational use), the Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) model was used. Irrigation requirements were calculated for average (mean) and 1-in-10 year droughts. Irrigation requirements are equal to the difference between evapotranspiration and effective rainfall. Effective rainfall is equal to the rainfall that is stored in the plant root zone. Changing rainfall levels and timing therefore affect irrigation requirements. However, observed demand levels will vary based on the irrigation managers' perceptions and responses to changing rainfall patterns. Realistically, some may allow plants to experience some level of stress before changing irrigation schedules, while others may habitually over-water at a level that satisfies irrigation demands even during drought events.

For PWS-served and domestic self-supplied demands, the 2000 demand per capita rates were considered to represent the drought level demand rates (per capita), and these demand rates were applied to the relevant projected populations. Projected average demands were reached by subtracting the percentage by which observed demand per capita rates for 2000 exceeded the most recent average rainfall year (1996), as reported by the U.S. Geological Survey (USGS), up to a high of a six percent difference.

Average and 1-in-10 Rainfall

An average rainfall year is defined as a year with rainfall equal to the mean annual rainfall for the period of record. A l-in-10 year drought condition is defined as below normal rainfall with a 90 percent probability of being exceeded over a l2-month period. This means that there is a 10 percent chance that less than this amount will be received in any given year.

CATEGORIES OF WATER USE

(1 & 2) PWS and DSS Demands

Public water supply (PWS) and domestic self-supply (DSS) demand assessments and projections were developed for the District for 2000 and 2025. The domestic self-supplied category includes small public supply systems with projected demands of less than 0.1 million gallons per day (MGD) in 2025, as well as residents that supply their own water needs. Self-supplied residents may be within or outside of utility boundaries. Water demands were forecast by multiplying population projections by per capita water use rates. Per capita water use rates were calculated based on 2000 population data from the U.S. Bureau of the Census (2000) and the water pumpage for each utility, as reported by the USGS (USGS, 2000). The population projections for 2025 for each county were based on the medium range forecasts published by the University of Florida – Bureau of Economic and Business Research (BEBR, 2002).

The 2000 and projected 2025 utility-served areas used in this analysis were obtained from the utilities. Adjustments were made to account for the known future expansion of the current served areas. It was assumed that all projected population within areas being served by a utility would be connected to that PWS system. The breakdown of populations within utility-served areas into PWS-served and domestic self-supplied categories was modified in several instances based on utility input.

Per Capita Rates

Per capita water use rates for 2000 for each utility were calculated by dividing raw water pumped by the permanent resident population served by PWS utilities. The USGS and District pumpage reports provided raw water withdrawal data. The above-

mentioned methodology determined total population and the number of individuals served by the utilities.

These per capita rates include total use, incorporating use by seasonal residents and tourists, commercial and industrial utility supplied use and the losses incurred in water delivery, in addition to the use by permanent residents. Irrigation demand for PWS-served households using private well water for their irrigation was not assessed due to the lack of available data.

The year 2000 was a drought year (which actually exceeded a 1-in-10 year level of recurrence); therefore, per capita rates for 2000 were used to develop the drought 2025 utility demand projections. Adjustments were then made to these projections to normalize them for average rainfall conditions.

Domestic self-supply per capita rates within PWS utility service area boundaries were assumed to be the same as for the utility serving that service area. The per capita rates for the domestic self-supplied users in areas not served by public utilities were assumed to be the weighted average of the PWS per capita rates for the county.

PWS and DSS Average and 1-in-10 Year Drought Adjustments

Indoor use categories need no adjustment from the year 2000 (drought) observed values for an average year, as these categories would have no demand shifts related to drought. Unadjusted base demand for a utility was projected by multiplying a base year per capita rate by a projected population. If desired, the withdrawal distribution (by month) can be derived from historical demand curves for the utility. The difference between the monthly demand for the base year and the unconstrained demand for an average year, or a l-in-10 year will directly depend on the changes in the outdoor use, specifically, changes in demand for landscape irrigation. If the base year is an average year, then there is no need for an adjustment from base to average. However, if the base year is significantly wetter or drier than average, then unconstrained demands for outdoor use will adjust proportionally.

Population Served

2000 Population

U.S. Census data were used as the basis for the 2000 population and the distribution of that population. Block level information from the census count was used as the basic unit of analysis. Total population, occupied housing units and persons per occupied housing unit were retrieved from census data. In the absence of a self-supplied unit count in the 2000 Census, the self-supplied population within utility-served areas was taken as a constant based on the 1990 Census (which included household water source on its long form).

Estimates of occupied units connected to PWS systems and occupied units that are self-supplied for each block were calculated. It was assumed that the percentages of units occupied and the number of occupants per unit for PWS-connected and domestic self-supplied units were the same. Public water supplied populations and self-supplied populations were calculated by multiplying the number of occupied units by the number of persons per occupied unit for the respective block.

The geographic areas represented by the census blocks and the utility service areas were input as polygon layers into the SFWMD Geographic Information System (GIS). Population density PWS-served and self-supplied areas were calculated for each block assuming a uniform density within each block. Imagery was used to review decisions when necessary. The two layers were overlaid to create a polygon layer with the attribute data from the two original layers. Population assessment of PWS-served and domestic self-supplied were then calculated for the new polygon layer by multiplying the polygon area by the population density. The populations for each service area were then totaled.

2025 Population Projections

The medium range county projections as published by the Bureau of Economic and Business Research (BEBR, 2002) were used for 2025 population projections. The geographic distribution of the 2025 population was assessed using the ratio of Traffic Analysis Zone (TAZ) population growth for the areas covered by TAZs. The geographic distribution of the 2025 population for areas not covered by TAZs was based on the population distribution in the 2000 census block data, or was determined from information in the county's comprehensive plans. Total county population was limited to the county total from the BEBR medium range projections.

The geographic areas represented by the TAZs and the utility-served areas were input as polygon layers into the SFWMD GIS. Population density was calculated for each TAZ assuming a uniform density within each zone. The layers were overlaid to create a new polygon layer with the attribute data from the original layers. Population estimates were then recalculated for the new polygon layer by multiplying the area of the polygon by the population density. The populations for each utility-served area were then totaled and limited not to exceed the BEBR medium range population projection for each county.

Existing and future population within an area being served by a utility was assigned to that utility. This means that within utility-served areas, the domestic self-supplied population was assumed to be zero by 2025, as utilities serve formerly self-supplied residents. Any growth in population within an area not planned to be served by a utility was assigned to the domestic self-supplied category. **Table A-1** outlines the columns showing projection calculations for PWS-served and domestic self-supplied users, and **Tables A-2** through **A-4** shows these projections for St. Lucie and Martin counties and eastern Okeechobee County.

Table A-1. Column Legend for the Public Water Supplied and Domestic Self-Supplied Demand Projections Table for each County.

Columns	Heading	Description
(a)	Utility	Name of the public water supply utility, for which 2000 assessments and 2025 projections are made.
(b)	Total Population 2000/2025	Permanent resident population that resides within each utility's area served boundaries.
(c)	PWS Population 2000/2025	Permanent resident population served by each PWS utility.
(d)	PWS Base (drought) MGD 2000/(2025)	For 2000, pumpage reported by the USGS. For 2025, projected demands based on the projected population served multiplied by the gallons per capita day (GPCD) observed in 2000 (column e).
(e)	GPCD 2000/2025: Gallons Per Capita Day	For 2000, pumpage reported by the USGS (column d) divided by permanent resident population served by each PWS utility (column c). For 2025, this per capita rate is the same as observed in 2000 for each utility.
(f)	DSS Population	Permanent resident population not served by each PWS utility that resides within each utility's active service boundaries.
(g)	DSS Base MGD 2000/2025	Assessed demands based on the self-supplied population (column f) multiplied by the gallons per capita day (GPCD) observed in 2000 (column e).
(h)	Average Factor	Proportional difference between county per capita usage for the county in 2000 and the most recent average rainfall year (1996) – as reported by the USGS, up to a maximum of a 6 percent difference (DEP standard).
(i)	PWS Average MGD 2025	For 2025 PWS drought MGD (column d) for each utility for 2025 multiplied by the average factor (column h).
(j)	DSS Average MGD 2000/2025	For 2025 DSS drought MGD (column g) for each utility for 2025 multiplied by the average factor (column h).

Table A-2. Public Water Supplied and Domestic Self-Supplied Demand Projections for St. Lucie County.

a	b	c	d	e	f	g	h	i	j
Utility	**Total Popn 2000**	**PWS Popn 2000**	**PWS Base MGD 2000**	**GPCD 2000**	**DSS Popn 2000**	**DSS Base 2000**			
Ft. Pierce Utilities Authority	61,848	58,612	8.92	152	3,236	0.49			
Spanish Lakes Utilities	4,450	3,769	0.79	210	681	0.14			
City of Port St. Lucie	68,667	61,228	6.65	109	7,439	0.81			
Reserve	1,053	952	0.20	210	101	0.02			
Harbour Ridge	823	823	0.14	170	0	0.00			
St. Lucie West Service District	4,180	4,025	0.75	186	155	0.03			
St. Lucie County – North	901	289	0.13	450	612	0.28			
Panther Woods	206	206	0.09	437	0	0.00			
Not in Utility	50,567			136	50,567	6.88			
Totals	192,695	129,904	17.67		62,791	8.65			
Utility	**Total Popn 2025**	**PWS Popn 2025**	**PWS Drought MGD 2025**	**GPCD 2025**	**DSS Popn 2025**	**DSS Drought MGD 2025**	**Avg Factor**	**PWS Avg MGD 2025**	**DSS Avg MGD 2025**
Ft. Pierce Utilities Authority	103,427	103,427	15.74	152	0	0.00	0.972	15.30	0.00
Spanish Lakes Utilities	4,450	4,450	0.93	210	0	0.00	0.972	0.91	0.00
City of Port St. Lucie	141,102	141,102	15.33	109	0	0.00	0.972	14.90	0.00
Reserve	Reserve served by St. Lucie West by 2025								
Harbour Ridge	823	823	0.14	170	0	0.00	0.972	0.14	0.00
St. Lucie West Service District	26,550	26,550	4.95	186	0	0.00	0.972	4.81	0.00
St. Lucie County – North	12,731	12,731	5.73	450	0	0.00	0.972	5.57	0.00
Panther Woods	929	929	0.41	437	0	0.00	0.972	0.39	0.00
Not in Utility	7,388			136	7,388	1.00	0.972		0.98
Totals	297,400	290,012	43.23		7,388	1.00		42.01	0.98

Note: See Table A-1 for Table Legend.

Table A-3. Public Water Supplied and Domestic Self-Supplied Demand Projections for Martin County.

a	b	c	d	e	f	g	h	i	j
Utility	**Total Popn 2000**	**PWS Popn 2000**	**PWS Base MGD 2000**	**GPCD 2000**	**DSS Popn 2000**	**DSS Base 2000**			
Florida Water Services	1,556	518	0.17	328	1,038	0.34			
Martin County Utilities	51,130	45,304	8.30	183	5,826	1.07			
Miles Grant/Utility Inc.	1,028	1,028	0.15	146	0	0.00			
Pipers Landing	584	584	0.15	257	0	0.00			
Sailfish Point	372	372	0.21	565	0	0.00			
City of Stuart	17,979	16,805	3.65	217	1,174	0.25			
Plantation Utilities/Indian River	648	648	0.17	262	0	0.00			
Indiantown Water Company	5,393	5,252	0.70	133	141	0.02			
South Martin Regional Utility	14,818	14,699	3.94	268	119	0.03			
Village of Tequesta	2,713	2,496	1.17	470	217	0.10			
Town of Jupiter	675	594	0.19	313	81	0.03			
Not in Utility	29,835			213	29,835	6.35			
Totals	126,731	88,300	18.80		38,431	8.19			
Utility	**Total Popn 2025**	**PWS Popn 2025**	**PWS Drought MGD 2025**	**GPCD 2025**	**DSS Popn 2025**	**DSS Drought MGD 2025**	**Avg Factor**	**PWS Avg MGD 2025**	**DSS Avg MGD 2025**
Florida Water Services	Florida Water Services purchased by Martin County Utilities in Fall of 2003								
Martin County Consolidated[a]	105,089	105,089	19.25	183	0	0.00	0.967	18.62	0.00
Miles Grant/Utility Inc.	1,090	1,090	0.16	146	0	0.00	0.967	0.15	0.00
Pipers Landing	584	584	0.15	257	0	0.00	0.967	0.15	0.00
Sailfish Point	372	372	0.21	565	0	0.00	0.967	0.20	0.00
City of Stuart	17,979	17,979	3.90	217	0	0.00	0.967	3.78	0.00
Plantation Utilities/Indian River	648	648	0.17	262	0	0.00	0.967	0.16	0.00
Indiantown Water Company	6,193	6,193	0.83	133	0	0.00	0.967	0.80	0.00
South Martin Regional Utility	35,729	35,729	9.58	268	0	0.00	0.967	9.26	0.00
Village of Tequesta[b]	2,713	2,713	1.28	470	0	0.00	0.967	1.23	0.00
Town of Jupiter[c]	4,846	4,846	1.52	313	0	0.00	0.967	1.47	0.00
Not in Utility	12,257			213	12,257	2.61	0.967		2.52
Totals	187,500	175,243	37.04		12,257	2.61		35.82	2.52

a. Formerly Martin County Utilities
b. Village of Tequesta served 4,738 people in 2000 in Palm Beach County. Per capita reflects entire served area boundary.
c. Town of Jupiter served 47,482 people in 2000 in Palm Beach County. Per capita reflects entire served area boundary.

Table A-4. Domestic Self-Supplied Demand Projections for the Eastern Okeechobee County.

a	b	c	d	e	f	g	h	i	j
Utility	**Total Popn 2000**	**PWS Popn 2000**	**PWS Base MGD 2000**	**GPCD 2000**	**DSS Popn 2000**	**DSS Base 2000**			
Not in Utility	1,238	0	0.00	112	1,238	0.14			
Utility	**Total Popn 2025**	**PWS Popn 2025**	**PWS Drought MGD 2025**	**GPCD 2025**	**DSS Popn 2025**	**DSS Drought MGD 2025**	**Avg Factor**	**PWS Avg MGD 2025**	**PSS Avg MGD 2025**
Not in Utility	1,610	0	0.00	112	1,610	0.18	0.940	0.00	0.17

Note: See Table A-1 for Table Legend.

(3) Commercial/Industrial Self-Supply

The employment by sector was evaluated regarding the predominant types of employment found in the District, and whether these employment types could be anticipated to grow at the same rate and in the same direction as the population. In the SFWMD, the majority of the employees are found in the service and retail sales sectors, indicating that water demand by these sectors will generally grow along with the population. Demand for this category of water use was projected to grow at the rate of each county's population growth. Water used for commercial and industrial purposes that is supplied by utilities is included with other utility demands. **Table A-5** summarizes Upper East Coast (UEC) commercial and industrial self-supplied demand projections; 2000 use was assessed from SFWMD permits.

Table A-5. Commercial and Industrial Self-Supplied Demand.

County	2000	2005	2010	2015	2020	2025
St. Lucie MGD	0.10	0.11	0.12	0.13	0.14	0.15
St. Lucie Population	192,695	213,636	234,577	255,518	276,459	297,400
Martin MGD	3.20	3.51	3.81	4.12	4.43	4.73
Martin Population	126,731	138,885	151,039	163,192	175,346	187,500
Total MGD	3.30	3.62	3.94	4.25	4.57	4.89

(4) Recreation Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped and recreational areas (as opposed to private homes), and for golf courses. Because of the data sources available, golf course demands by county are projected separately and added to the other landscape and recreation demands. Non-golf course landscaping and recreational water use was assumed to increase at the same rate as the county population, with 2000 used as the base year. Recreational irrigation requirement estimates for average and l-in-10 year droughts were made using the AFSIRS model. The irrigation requirements were calculated similarly to other irrigation

requirements, using a representative irrigation system/rainfall station/soil type combination for each county.

Landscape

Demand projections for this section include irrigated acreage permitted for landscaping and recreation, excluding golf courses. Landscaping acreage was projected to increase at the same rate as the county population, with 2000 used as the base year. Acreage projections for large-scale landscaping and recreation self-supplied acreage are outlined in **Table A-6**.

Table A-6. Landscape Self-Supplied Acreage.

County	2000	2005	2010	2015	2020	2025
St. Lucie Acres	1,715	1,901	2,088	2,274	2,461	2,647
St. Lucie Population	192,695	213,636	234,577	255,518	276,459	297,400
Martin Acres	1,312	1,438	1,564	1,689	1,815	1,941
Martin Population	126,731	138,885	151,039	163,192	175,346	187,500
Total Acres	3,027	3,339	3,651	3,964	4,276	4,588

Golf Courses

For golf course projections, historical irrigated golf course acreage data were gathered from the District's consumptive use permitting (CUP) database, the Golf Course Directory (National Golf Foundation, 2001) and personal communication with staff from several of the golf courses listed. Irrigated golf course acreage projections were made by statistically correlating historical acreage to historical population, or to a time trend or to both. Acreage projections were made for total irrigated golf course acreage, and those currently supplied by a reuse or potable utility system subtracted from the total irrigated acreage projection.

St. Lucie County

Golf courses currently in St. Lucie County are shown in **Table A-7**. As in other counties, the growth in golf course acreage has occurred irregularly on a year-by-year basis. **Equation A-l** (using simple exponential smoothing) was estimated to project irrigated golf course acreage in St. Lucie County.

Table A-7. Golf Courses in St. Lucie County.

Name	Year Opened	Irrigated Acres	Self-Supplied Acreage
Indian Hills G&CC	1938	89	89
Club Med Sandpiper	1961	187	187
Indian Pines GC	1970	50	50
Spanish Lakes I	1972	8	8
Golf Village CC	1980	5	5
Spanish Lakes Golf Village	1982	8	8
Meadowood (Monte Carlo)[a]	1983	122	0
Spanish Lakes CC	1983	25	25
Legacy G&TC	1984	145	145
Panther Woods CC[b]	1984	149	27
Reserve G&TC (PGA)	1984	146	146
Ocean Village GC	1985	50	50
Gator Trace G&CC	1986	60	60
PGA CC	1988	130	130
Savanna GC	1988	59	59
St Lucie West (PGA)[a]	1988	100	0
Spanish Lakes Fairways[a]	1989	143	0
Fairwinds	1991	144	144
Wilderness GC	1992	46	46
Ballantrae G&YC[a]	1993	120	0
PGA GC in PGA Village	1996	435	435
St James GC	2000	122	122
Total		2,343	1,736

a. Irrigated acreage totally on reuse
b. Irrigated acreage partially on reuse

Equation A-1.

Model Parameters:	Estimate	Standard Error	T	Prob>!T!
LEVEL Smoothing Weight	.9605	.1135	8.4592	<.0001
TREND Smoothing Weight	.11461	.0565	2.0295	0.0494
Residual Variance	11980			
Smoothed Level	2341			
Smoothed Trend	81.7444			

Goodness-of-fit Statistics:	Value
Root Mean Square Error	106.683
Mean Absolute Percent Error	54.97769
R-Square	.979

Census and BEBR population data were used to estimate and project **Equation A-1**. **Equation A-l** was estimated using ordinary least squares, and the results shown in **Table A-8** were obtained.

Table A-8. Historical and Projected Irrigated Golf Course Acreage in St. Lucie County.

Year	Historical Acreage	Projected Acreage
1965	276	
1970	326	
1975	334	
1980	339	
1985	984	
1990	1,476	
1995	1,786	
2000	2,343	2,343
2005		2,750
2010		3,159
2015		3,568
2020		3,976
2025		4,303

Table A-9. Irrigation Requirements for Projected Self-Supplied Golf Courses in St. Lucie County.

		2000	2005	2010	2015	2020	2025
Irrigated Acreage		2,343	2,750	3,159	3,568	3,976	4,303
Self-Supplied Irrigated Acreage		1,736	2,143	2,552	2,961	3,369	3,696
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
Average	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.0	61	76	90	105	119	130
February	1.4	90	111	132	153	174	191
March	2.3	141	175	208	241	274	301
April	3.2	203	250	298	346	393	432
May	2.9	179	221	263	306	348	381
June	1.8	113	140	166	193	220	241
July	2.0	127	157	187	217	247	271
August	1.4	90	111	132	153	174	191
September	0.8	47	58	69	80	91	100
October	0.7	42	52	62	72	82	90
November	0.8	52	64	76	88	101	110
December	0.8	47	58	69	80	91	100
Total	19.0	1,193	1,472	1,753	2,034	2,315	2,539
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
1-in-10	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.4	88	109	129	150	171	187
February	1.8	113	140	166	193	220	241
March	2.4	151	186	222	257	293	321
April	3.5	220	272	323	375	427	468
May	3.5	220	272	323	375	427	468
June	2.3	145	178	213	247	281	308
July	2.7	170	210	249	289	329	361
August	1.9	119	147	176	204	232	254
September	1.1	69	85	102	118	134	147
October	1.0	63	78	92	107	122	134
November	1.1	69	85	102	118	134	147
December	1.0	63	78	92	107	122	134
Total	23.7	1,490	1,839	2,190	2,541	2,891	3,172

Note: Irrigation requirements based on generic sandy soil, Ft Pierce climate station and irrigation efficiency of 75 percent.

Martin County

Golf courses currently in Martin County are shown in **Table A-10**. Martin County has experienced rapid growth in irrigated golf course acreage since the early 1960s. As in other counties, the growth in golf course acreage has occurred irregularly on a year-by-year basis.

Table A-10. Golf Courses in Martin County.

Name	Opened	Irrigated Acreage	Self-Supplied Acreage
Martin County GC	1925	182	182
Jupiter Island GC	1958	103	103
Stuart Y & CC	1969	140	140
Jupiter Hills Club[a]	1970	240	0
Monterey Y & CC	1970	36	36
Pine Lakes GC	1970	50	50
Crane Creek & Tower[a]	1972	186	0
Miles Grant CC[a]	1972	49	0
Mariner Sands CC[a]	1973	215	0
River Bend[a]	1974	68	0
Little Club	1975	60	60
Turtle Creek Club[a]	1976	105	0
Evergreen Club	1978	105	105
Indian River Plantation[a]	1978	70	0
Ocean Club at the Hutchinson Island Beach	1978	75	75
Heritage Ridge Y & CC[a]	1979	110	0
Pipers Landing CG[a]	1981	66	0
Sailfish Point GC[a]	1981	144	0
Martin Downs (Tower) CC[a]	1982	85	0
Island Dunes CC	1983	60	60
Eaglewood Homeowners Association[a]	1984	50	0
Harbour Ridge Y & CC	1984	200	200
Indianwood	1984	86	86
Hobe Sound GC	1987	110	110
Monarch CC	1987	148	148
Cypress Links GC	1988	150	150
Loblolly Pines GC[a]	1988	84	0
Willoughby GC	1988	105	105
Cobblestone CC	1989	100	100
All Golf	1990	60	60
Golf World	1990	8	8
Palm Cove (Cutter Sound)	1990	72	72
Lost Lake GC/Double Tree[a]	1992	136	0
Champions Club at Summerfield	1994	90	90
Medalist[a]	1995	75	0
Florida Club[a]	1996	141	0
Floridian Y & CC	1996	120	120
Hammock Creek GC (Golden Bear)	1996	100	100
Eagle Marsh GC[a]	1997	120	0
McArthur GC[b]	2002	90	60
Total		4,334	2,360

a. Irrigated acreage totally on reuse
b. Irrigated acreage partially on reuse

Equation A-2 was estimated using ordinary least squares, and adjusted for the 2000 acreage to project irrigated golf course acreage in Martin County. Projections are presented in **Table A-11**.

Equation A-2.

Model Parameters:	Estimate	Standard Error	T	Prob>!T!
LEVEL Smoothing Weight	.85713	.1273	6.7309	<.0001
TREND Smoothing Weight	.001	.1101	.00908	.9928
DAMPING Smoothing Weight	.999	.003	331.4717	<.0001
Residual Variance	13814			
Smoothed Level	4339			
Smoothed Trend	109.8011			

Goodness-of-fit Statistics:	Value
Root Mean Square Error	12594.8
Mean Absolute Percent Error	4.35574
Mean Absolute Error	92.05873
R-Square	.991

Table A-11. Historical and Projected Irrigated Golf Course Acreage in Martin County.

Year	Historical Acreage	Projected Acreage
1970	751	
1975	1,329	
1980	1,794	
1985	2,485	
1990	3,322	
1995	3,623	
2000	4,104	4,104
2005		4,528
2010		5,074
2015		5,617
2020		6,157
2025		6,695

Table A-12. Irrigation Requirements for Projected Self-Supplied Golf Courses in Martin County.

		2000	2005	2010	2015	2020	2025
Irrigated Acreage		4,104	4,528	5,074	5,617	6,157	6,695
Self-Supplied Irrigated Acreage		2,360	2,784	3,330	3,873	4,413	4,951
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
Average	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.1	96	113	136	158	180	202
February	1.6	135	159	190	221	252	282
March	2.2	186	219	262	305	348	390
April	2.9	250	295	353	410	467	524
May	2.5	211	249	298	347	395	444
June	1.4	115	136	163	189	216	242
July	1.4	122	144	172	200	228	255
August	1.4	115	136	163	189	216	242
September	0.8	64	76	90	105	120	134
October	0.7	58	68	81	95	108	121
November	0.8	64	76	90	105	120	134
December	0.8	70	83	99	116	132	148
Total	17.4	1,487	1,754	2,098	2,440	2,780	3,119
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
1-in-10	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.7	147	174	208	242	276	309
February	2.0	173	204	244	284	324	363
March	2.6	224	265	317	368	419	471
April	3.8	327	386	461	536	611	686
May	3.4	288	340	407	473	539	605
June	2.0	167	197	235	273	312	350
July	1.9	160	189	226	263	300	336
August	2.0	167	197	235	273	312	350
September	1.1	90	106	127	147	168	188
October	1.0	83	98	118	137	156	175
November	1.1	90	106	127	147	168	188
December	1.1	96	113	136	158	180	202
Total	23.6	2,012	2,374	2,839	3,303	3,763	4,222

Note: Irrigation requirements based on generic sandy soil, Stuart climate station and irrigation efficiency of 75 percent.

Table A-13. Recreational Self-Supplied Demand Projections in the Upper East Coast.

County / Acreage / Demand	2000	2005	2010	2015	2020	2025
St. Lucie County Irrigated Golf Course Acres	2,343	2,750	3,159	3,568	3,976	4,303
St. Lucie County Self-Supplied Golf Course Acres	1,736	2,143	2,552	2,961	3,369	3,696
St. Lucie County Self-Supplied Landscape Acres	1,715	1,901	2,088	2,274	2,461	2,647
St. Lucie County Average Recreational Self-Supplied Irrigation Requirement (MGY)	2,371	2,778	3,188	3,596	4,006	4,358
St. Lucie County 1-In-10 Recreational Self-Supplied Irrigation Requirement (MGY)	2,962	3,470	3,982	4,492	5,003	5,443
Martin County Irrigated Golf Course Acres	4,224	4,668	5,214	5,757	6,297	6,835
Martin County Self-Supplied Golf Course Acreage	2,360	2,694	3,240	3,783	4,323	4,861
Martin County Self-Supplied Landscape Acreage	1,312	1,438	1,564	1,689	1,815	1,941
Martin County Average Recreational Self-Supplied Irrigation Requirement (MGY)	2,314	2,660	3,083	3,504	3,923	4,342
Martin County 1-In-10 Recreational Self-Supplied Irrigation Requirement (MGY)	3,131	3,600	4,173	4,743	5,311	5,877
UEC Recreational Self-Supplied Average Irrigation Requirement (MGY)	4,685	5,438	6,271	7,100	7,929	8,700
UEC Recreational Self-Supplied 1-In-10 Irrigation Requirement (MGY)	6,093	7,070	8,155	9,235	10,314	11,320

(5) Thermoelectric Power Generation Self-Supply

Thermoelectric power plants may withdraw large quantities of water for cooling purposes. The vast majority of this water is not consumed in the sense that the same water may pass through the plant repeatedly, sequentially circulating through a series of ponds. There will normally be some process and evaporative losses that must be replaced from an external source above and beyond rainfall and runoff. This replacement was assessed for 2000 use and projected for 2025. Electricity utilities were contacted with regard to anticipated increased water needs for cooling purposes. It is noted that there are significant uncertainties associated with the potential deregulation of the industry, and therefore projections of this water use category may be subject to significant change in subsequent water supply plans.

There are two utilities in the UEC Planning Area that use fresh water for cooling purposes, the Florida Power & Light (FPL) Martin Plant and the Indiantown Cogeneration plant. The Indiantown Cogeneration plant has Taylor Creek/Nubbin Slough as its source, which is in the Kissimmee Basin Planning Area, and therefore these demands will be addressed in the Kissimmee Basin Water Supply Plan.

The FPL plant withdraws a significant quantity of water for cooling purposes. Most of this water is necessary to maintain the reservoir impoundment, with calculated losses of 9.8 MGD to evaporation in 2000, based on information received from FPL. This makeup water is projected to grow to 30 MGD in 2005.

(6) Agricultural Self-Supply

The techniques chosen to project crop acreages were those that best reflected the specific crop scenario in each county. This led to some variation in projection techniques between crop types. While it would have been ideal if a comprehensive functional form could have been found that produced tangible projections universally, no such functional form was found. The acreage projections developed here reflect a combination of methods; each deemed appropriate where used. This is consistent with the way in which crop acreage is projected by the Institute of Food and Agricultural Sciences (IFAS) and other water management districts.

Crop acreage projections were needed for St. Lucie and Martin counties, which are both wholly within the UEC Planning Area, as well as the eastern portion of Okeechobee County. For eastern Okeechobee County, crop acreages were frequently projected for the entire county and these projections apportioned. Unless inappropriate, this was done by assuming changes in acreage proportional to the most recently reported acreage ratios. Acreage ratios were developed with the use of District land use maps and with the cooperation of the local IFAS extension offices.

When no statistically valid trend or convincing empirical knowledge of future changes in a crop's acreage was found, then the specific crop's acreage was projected at its most recently reported value for future time horizons.

Average and l-in-10 irrigation requirements were calculated using the AFSIRS model. Historical weather data from the rainfall station, considered to best represent the crop/county combination, were used to calculate irrigation requirements.

A crop's gross irrigation requirement is the amount of water used for evapotranspiration minus effective rainfall, while an irrigation requirement includes both the gross irrigation requirement and the losses incurred in getting irrigation to the crop's root zone. Irrigation efficiency refers to the average percent of total water applied that is stored in the plant's root zone. This relationship is expressed as follows:

Gross Irrigation Requirement = Net Irrigation Requirement / Irrigation Efficiency

Projections of irrigation system type, and the effect of the corresponding irrigation efficiencies, were based on the interpretation of current ratios and trends. There are three basic types of irrigation systems currently used in south Florida crop production. These are seepage (50 percent), sprinkler (75 percent) and microirrigation (85 percent) systems. The irrigation efficiencies estimated by the District are shown in parentheses.

Available water capacity and depth of soil have a direct effect on effective rainfall. An additional factor considered explicitly by the AFSIRS, but combined with soil properties, is the on-farm irrigation management strategy. The AFSIRS model defines eight "generic" soil types representing the major kinds of soils found in Florida. All model runs were made using the generic sandy soil as defined by the AFSIRS model.

Irrigated Crop Types

The irrigated commercially grown crop categories were based on the categories developed by the Water Demand Projection Subcommittee, which was made up of representatives from Florida's five water management districts. These categories are: (1) citrus, (2) other fruits and nuts, (3) vegetables, melons and berries, (4) field crops, (5) greenhouse/nursery, (6) sod, (7) pasture and (8) miscellaneous. Although all of these crops are grown commercially somewhere within the District, not all are grown in the UEC Planning Area. Crop acreage projections were initially made by District staff based on statistical trends, and then sent out and reviewed by the local IFAS extension office.

Citrus

All categories of citrus (oranges, grapefruit, tangerines, limes, etc.) were grouped together for projection purposes. Historical citrus acreage data were gathered from volumes of the Florida Agricultural Statistics Service (FASS) *Commercial Citrus Inventory*, published biennially. Citrus is by far the main irrigated crop grown in the UEC Planning Area.

Other Fruits and Nuts

Within the SFWMD non-citrus fruit crops (avocados, mangos, papaya, etc.) are produced commercially, but there is no significant production of these crops in the UEC Planning Area.

Vegetables, Melons and Berries

Wide varieties of vegetable crops are produced commercially within the SFWMD. For counties with high levels of historical vegetable production, acreage data were gathered from volumes of the FASS *Vegetable Summary*, which is published annually. Information was provided from the local IFAS extension office for counties where it was not possible to discern acreage from the *Vegetable Summary*.

Field crops

Field crop projections within the SFWMD included sugarcane, rice, seed corn, soybean and sorghum. In the UEC Planning Area, sugarcane is grown commercially in Martin County. Historical sugarcane acreage data were gathered from annual volumes of the FASS *Field Crops Summary*.

Greenhouse/Nursery

Varieties of greenhouse and nursery crops are grown within the SFWMD. Historical commercial nursery acreage data for each county were used to make projections using functional forms that correlated nursery acreage with a time trend variable. Historical commercial nursery acreage data were gathered from annual volumes of the Florida Department of Agriculture and Consumer Services (FDACS), *Division of Plant Industry's Annual Reports*.

In addition to nursery plants, there are also regions within the SFWMD that have significant areas used to produce cut flowers and bulbs (caladiums). The acreages of cut flowers and bulbs were projected based on input from the local IFAS extension office.

Sod

There is some variation in the production practices of sod within the SFWMD. Some harvested sod is irrigated and some is not, serving largely as pasture until the sod is sold. Since the objective here is to project irrigation requirements, only irrigated sod is addressed. County acreages of sod were provided by the local IFAS extension office.

Pasture

Improved pasture has, by District definition, the facilities in place to carry out irrigation. However, these facilities were typically designed for drainage and, with the exception of a few noted areas, are very rarely used for irrigation. This is because the returns associated with cattle production do not justify the expense associated with pasture irrigation. When irrigation is carried out, it is usually in a period of extreme drought, and is done to prevent grass from dying.

The assumption was made that, with a few exceptions, that pasture irrigation is not part of this water supply plan's primary projection. Although this assumption may not be the case universally, it is much closer to actual production practices than the values given by any irrigation requirement model.

Miscellaneous

Cattle Watering

Water required for cattle watering was calculated as a function of the number and type of cattle (beef or dairy). Demand projections for cattle watering were based on the District allocation of 12 gallons/cow/day for beef cattle and 150 gallons/cow/day for dairy cattle. Demand for cattle watering is projected across the District to remain at about the 2000 level throughout the projection period. Cattle numbers for 2000 were obtained from the FASS *Livestock Summary*.

Aquaculture

Aquacultural operations withdraw water for circulation purposes, and to replace evaporative losses. The replacement amount was assessed for each county, for which there was a permitted use in 2000.Demand was projected to remain at the 2000 level through 2025.

Demand Projections

Citrus

Historical citrus acreage data were gathered from volumes of the FASS *Commercial Citrus Inventory*, which is published biennially. These data are available from: http://www.nass.usda.gov/fl/rtoc0ci.htm.

The statistical method used to project county-level citrus acreage in the UEC Planning Area is damped trend exponential smoothing. Damped trend exponential smoothing relies on three "smoothing weights" to construct projections: (a) level smoothing weight; (b) trend smoothing weight; and (c) damping smoothing weight. Damped trend exponential smoothing specifies exponential smoothing of both the series level and trend with a trend damping weight. These weights are determined empirically to select the weights that optimally fit the observed data. Damped trend exponential smoothing allows for a gradual "damping" or tapering off the identified trends.

St. Lucie County

Citrus acreage in St. Lucie County was projected using damped trend exponential smoothing, corrected for the year 2000. Time series data at two-year increments were used to estimate the damped trend exponential smoothing model.

Equation A-3.

Model Parameters:	Estimate	Standard Error	T	Prob>!T!
LEVEL Smoothing Weight	.8153	.2565	3.1783	.0058
TREND Smoothing Weight	.9990	.9187	1.0875	.2929
DAMPING Smoothing Weight	.7782	.1992	3.9060	.0013
Smoothed Level	93074			
Smoothed Trend	-6539			

Goodness-of-fit Statistics:	Value
Root Mean Square Error	4073.4
Mean Absolute Percent Error	3335.2
R-Square	.908

Equation A-3 was used to project citrus acreage in St. Lucie County, and resulting projections are shown in **Table A-14**.

Table A-14. Historical and Projected Citrus Acreage in St. Lucie County.

Year	Historic Acreage	Projected Acreage
1966	63,703	
1968	74,962	
1970	75,397	
1972	73,822	
1974	73,036	
1976	73,912	
1978	70,462	
1980	75,140	
1982	76,863	
1984	80,402	
1986	82,770	
1988	88,893	
1990	94,878	
1992	105,117	
1994	108,448	
1996	107,224	
1998	103,894	
2000	98,889	98,889
2002	92,490	91,856
2005		87,945
2010		84,082
2015		82,259
2020		81,345
2025		80,974

Table A-15 shows the projected irrigation demands associated with 2000 and projected acreages.

Table A-15. Irrigation Requirements for Projected Citrus in St. Lucie County.

		2000	2005	2010	2015	2020	2025
Irrigated Acreage		98,889	87,945	84,082	82,259	81,345	80,974
Net Irrigation Requirements		2000	2005	2010	2015	2020	2025
Average	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	0.43	1,480	1,317	1,259	1,231	1,218	1,212
February	0.51	1,756	1,562	1,493	1,461	1,444	1,438
March	1.87	6,438	5,726	5,474	5,355	5,296	5,272
April	2.64	9,089	8,083	7,728	7,561	7,477	7,443
May	2.38	8,194	7,287	6,967	6,816	6,740	6,710
June	1.28	4,407	3,919	3,747	3,666	3,625	3,609
July	1.19	4,097	3,644	3,484	3,408	3,370	3,355
August	0.51	1,756	1,562	1,493	1,461	1,444	1,438
September	0.17	585	521	498	487	481	479
October	0.17	585	521	498	487	481	479
November	0.26	895	796	761	745	736	733
December	0.34	1,171	1,041	995	974	963	959
Total	11.75	40,454	35,977	34,396	33,651	33,277	33,125
Net Irrigation Requirements		2000	2005	2010	2015	2020	2025
1-in-10	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	0.92	3,167	2,817	2,693	2,635	2,605	2,594
February	0.92	3,167	2,817	2,693	2,635	2,605	2,594
March	1.74	5,991	5,328	5,094	4,983	4,928	4,905
April	2.60	8,951	7,961	7,611	7,446	7,363	7,330
May	2.65	9,124	8,114	7,757	7,589	7,505	7,471
June	1.50	5,164	4,593	4,391	4,296	4,248	4,229
July	1.30	4,476	3,980	3,806	3,723	3,682	3,665
August	0.63	2,169	1,929	1,844	1,804	1,784	1,776
September	0.00	0	0	0	0	0	0
October	0.87	2,995	2,664	2,547	2,492	2,464	2,453
November	0.87	2,995	2,664	2,547	2,492	2,464	2,453
December	0.87	2,995	2,664	2,547	2,492	2,464	2,453
Total	14.87	51,195	45,530	43,530	42,586	42,113	41,921

Note: Irrigation requirements based on generic sandy soil, Ft. Pierce climate station and irrigation efficiency of 78 percent (80/20 micro/seepage ratio).

Martin County

Citrus acreage in Martin County was projected using damped trend exponential smoothing. Time series data at two-year increments was used to estimate the damped trend exponential smoothing model.

Equation A-4.

Model Parameters:	Estimate	Standard Error	T	Prob>!T!
LEVEL Smoothing Weight	.8905	.2204	4.0402	.0009
TREND Smoothing Weight	.9990	.7724	1.2934	2142
DAMPING Smoothing Weight	.7738	.1532	5.0500	.0001
Smoothed Level	43263			
Smoothed Trend	-2498			

Goodness-of-fit Statistics:	
	Value
Root Mean Square Error	3706.9
Mean Absolute Percent Error	6.120
Mean Absolute Error	2517.1
R-Square	.537

Equation A-4 was used to project citrus acreage in Martin County, and resulting projections are shown in **Table A-16**.

Table A-16. Historical and Projected Citrus Acreage in Martin County.

Year	Historical Acreage	Projected Acreage
1966	21,889	
1968	39,157	
1970	41,385	
1972	41,358	
1974	40,473	
1976	40,264	
1978	38,361	
1980	40,768	
1982	40,646	
1984	40,483	
1986	41,095	
1988	40,921	
1990	46,283	
1992	46,335	
1994	48,221	
1996	47,090	
1998	46,439	
2000	44,746	44,746
2002	42,208	44,746
2005		44,746
2010		44,746
2015		44,747
2020		44,748
2025		44,748

Table A-17 shows the projected irrigation demands associated with the 2000 and projected citrus acreages in Martin County.

Table A-17. Irrigation Requirements for Projected Citrus in Martin County.

		2000	2005	2010	2015	2020	2025
Irrigated Acreage		44,746	44,746	44,746	44,747	44,748	44,748
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
Average	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	0.68	1,059	1,059	1,059	1,059	1,059	1,059
February	0.77	1,200	1,200	1,200	1,200	1,200	1,200
March	2.04	3,178	3,178	3,178	3,178	3,178	3,178
April	2.30	3,583	3,583	3,583	3,583	3,583	3,583
May	2.13	3,318	3,318	3,318	3,318	3,318	3,318
June	0.77	1,200	1,200	1,200	1,200	1,200	1,200
July	0.51	795	795	795	795	795	795
August	0.68	1,059	1,059	1,059	1,059	1,059	1,059
September	0.17	265	265	265	265	265	265
October	0.17	265	265	265	265	265	265
November	0.26	405	405	405	405	405	405
December	0.34	530	530	530	530	530	530
Total	10.82	16,856	16,856	16,856	16,856	16,857	16,857
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
1-in-10	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.45	2,259	2,259	2,259	2,259	2,259	2,259
February	1.53	2,384	2,384	2,384	2,384	2,384	2,384
March	1.74	2,711	2,711	2,711	2,711	2,711	2,711
April	2.60	4,050	4,050	4,050	4,050	4,051	4,051
May	2.65	4,128	4,128	4,128	4,128	4,128	4,128
June	1.50	2,337	2,337	2,337	2,337	2,337	2,337
July	1.30	2,025	2,025	2,025	2,025	2,025	2,025
August	0.63	981	981	981	981	981	981
September	0.00	0	0	0	0	0	0
October	0.87	1,355	1,355	1,355	1,355	1,355	1,355
November	0.87	1,355	1,355	1,355	1,355	1,355	1,355
December	0.87	1,355	1,355	1,355	1,355	1,355	1,355
Total	16.01	24,941	24,941	24,941	24,942	24,942	24,942

Note: Irrigation requirements based on generic sandy soil, Stuart climate station and irrigation efficiency of 78 percent (80/20 micro/seepage ratio).

Eastern Okeechobee County

Citrus acreage in Okeechobee County was projected using damped trend exponential smoothing. Time series data at two-year increments was used to estimate the damped trend exponential smoothing model.

Equation A-5.

Model Parameters:	Estimate	Standard Error	T	Prob>!T!
LEVEL Smoothing Weight	.9990	.1935	5.1627	<.0001
TREND Smoothing Weight	.0010	.1309	0.0076	.9940
DAMPING Smoothing Weight	.9952	.0135	73.6307	<.0001
Smoothed Level	12036			
Smoothed Trend	508.889			

Goodness-of-fit Statistics:	Value
Root Mean Square Error	740.484
Mean Absolute Percent Error	8.168
Mean Absolute Error	551.16513
R-Square	.954

Equation A-5 was used to project citrus acreage in Okeechobee County, and resulting projections are shown in **Table A-18**.

Table A-18. Historical and Projected Citrus Acreage in Eastern Okeechobee County.

Year	Historical County Acreage	Projected Okeechobee County Acreage	Projected Eastern Okeechobee County Acreage
1966	2,508		
1968	3,329		
1970	3,597		
1972	3,676		
1974	4,087		
1976	4,162		
1978	4,171		
1980	4,281		
1982	6,954		
1984	8,044		
1986	7,449		
1988	8,124		
1990	8,541		
1992	10,439		
1994	11,270		
1996	12,206		
1998	12,244		
2000	12,170	12,170	5,878
2002	12,035	12,094	5,841
2005		12,937	6,248
2010		14,890	7,192
2015		16,273	7,860
2020		17,646	8,523
2025		18,193	8,787

Table A-19 shows the projected irrigation demands associated with the 2000 and projected citrus acreages in eastern Okeechobee County.

Table A-19. Irrigation Requirements for Projected Citrus in the Eastern Okeechobee County.

		2000	2005	2010	2015	2020	2025
Eastern Okeechobee County Irrigated Acreage		5,878	6,248	7,192	7,860	8,523	8,787
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
Average	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	0.94	184	196	225	246	267	275
February	0.94	184	196	225	246	267	275
March	2.38	466	495	570	623	676	697
April	2.64	517	550	633	691	750	773
May	2.89	566	602	693	757	821	846
June	1.19	233	248	285	312	338	348
July	0.43	84	90	103	113	122	126
August	0.43	84	90	103	113	122	126
September	0.17	33	35	41	45	48	50
October	0.26	51	54	62	68	74	76
November	1.02	200	212	244	267	290	299
December	0.68	133	142	163	178	193	199
Total	13.97	2,736	2,908	3,348	3,659	3,967	4,090
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
1-in-10	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.96	384	408	470	513	557	574
February	2.04	400	425	489	534	579	597
March	4.42	866	920	1,059	1,158	1,255	1,294
April	4.93	966	1,026	1,181	1,291	1,400	1,443
May	5.78	1,132	1,203	1,385	1,514	1,641	1,692
June	2.72	533	566	652	712	772	796
July	0.94	184	196	225	246	267	275
August	0.51	100	106	122	134	145	149
September	0.00	0	0	0	0	0	0
October	1.45	284	302	347	380	412	425
November	1.96	384	408	470	513	557	574
December	0.00	0	0	0	0	0	0
Total	26.71	5,231	5,561	6,401	6,995	7,585	7,820

Note: Irrigation requirements based on generic sandy soil, Okeechobee climate station and irrigation efficiency of 81.5 percent (90/10 micro/seepage ratio).

Sugarcane

Sugarcane is initially propagated vegetatively by planting stalk cuttings. The first harvest takes place approximately 13 months after planting. Roots are left in the ground (ratooned) and yield additional crops of sugarcane, which take about 12 months to reach maturity. Sugar production per unit of land surface declines gradually and progressively with each additional ratoon, and there comes a point where the increased yields associated with replanting outweigh the cost of replanting. In Florida, this point comes on average after four years (one planting and three ratoons).

After the final ratoon in the cycle is harvested on a parcel of land from November through March, and before replanting takes place from September through January, there is no sugarcane on that parcel. In the UEC Planning Area, this land is invariably fallowed during this period. This means there is approximately 20 percent of the land associated with sugarcane production that will not be reported as production by the FASS. This 20 percent of land will not require irrigation and is not included in the projections presented here. In the UEC Planning Area, Martin County is the only sugarcane producer.

Historical sugarcane acreage data were gathered from annual volumes of the FASS *Field Crops Summary*, and are presented in **Table A-20**.

Sugarcane production in Martin County grew gradually from 3,015 acres in 1975 to 7,180 acres in 1984. Between 1984 and 1986, production almost doubled to 14,044 acres and has remained relatively stable since. This growth between 1984 and 1986 was due to expansion by one large landowner, and according to the local IFAS extension office, no significant future changes in acreage are anticipated. Therefore, the primary projection for sugarcane production in Martin County was developed by holding the acreage at its most recent level. There may be some slight fluctuation in acreage due to the planting cycle and weather limitations.

The mean and 1-in-10 irrigation requirements for sugarcane in Martin County are shown in **Table A-21**.

Table A-20. Historical Martin County Sugarcane Acreage.

Year	Acreage
1975	3,015
1976	3,091
1977	3,158
1978	5,198
1979	5,722
1980	6,029
1981	6,664
1982	7,171
1983	6,724
1984	7,180
1985	12,570
1986	14,044
1987	14,211
1988	14,589
1989	14,415
1990	13,433
1991	13,455
1992	13,518
1993	13,518
1994	12,478
1995	12,478
1996	12,478
1997	12,478
1998[a]	12,478
1999[a]	12,478
2000[a]	12,478

a. Martin County sugarcane acreage has been combined with Palm Beach County starting in 1998; Martin County acreage is held constant at the 1997 level as confirmed by the local IFAS Extension office.

Table A-21. Irrigation Requirements for Projected Sugarcane in Martin County.

Irrigated Acreage = 12,478		
Average	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	0.5	356
February	0.5	356
March	1.0	661
April	1.9	1,271
May	2.1	1,423
June	0.9	610
July	1.0	661
August	1.1	712
September	0.4	254
October	0.3	203
November	0.4	254
December	0.5	305
Total	10.4	7,065
1-in-10	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	0.8	540
February	0.8	540
March	1.5	1,003
April	2.6	1,775
May	3.2	2,199
June	1.4	969
July	1.4	926
August	1.6	1,080
September	0.6	386
October	0.6	386
November	0.7	463
December	0.7	463
Total	15.8	10,729

Note: Irrigation requirements based on generic sandy soil, Stuart climate station and irrigation efficiency of 50 percent.

Vegetables

Vegetable crops were grouped together for projection purposes. This was validated by the lack of significant difference between the irrigation requirements of the different types of vegetables cultivated in the UEC Planning Area, and the production practices used on vegetable farms (different types of vegetables are sometimes grown interchangeably). Vegetables in the planning area are grown commercially in St. Lucie and Martin counties. There is some vegetable production in Okeechobee County, but not in that portion of the county within the UEC Planning Area.

Average evapotranspiration values were developed based on AFSIRS runs with planting dates of January and September. The growing season was assumed to be four months. Vegetable fields are planted and harvested sequentially, and some portion of the total acreage used for vegetable production is commonly vacant. This temporal area of vegetable land vacancy effects total irrigation requirements, but it is difficult to quantify. Production timing may change for several reasons. For example, growers may enter into a contract to harvest vegetables in a specific time window, which would in turn determine their growing season. In addition, as seepage irrigation is the predominant type of irrigation system used for vegetable production, some of these vacant fields are unavoidably irrigated, either in part or in whole. With these constraints in mind, planting and harvesting schedules were developed to calculate irrigation requirements.

St. Lucie County

St. Lucie County vegetable production is included in the “East Central” area as defined by the FASS *Vegetable Summary*, and acreage data for St. Lucie County individually is not available from the FASS. Due to the lack of historical data, future vegetable acreage was projected at its current level, which was gathered from the local IFAS extension office. Present vegetable production uses about 1,270 acres of land in St. Lucie County. This production is anticipated to remain relatively constant by the local extension office. **Table A-22** represents the irrigation requirements for vegetable crops in St. Lucie County.

Table A-22. Irrigation Requirements for Projected Vegetables in St. Lucie County.

Average	Irrigated Acreage	Net Irrigation Requirements (inches)	Gross Irrigation Requirements (million gallons)
January	1,270	0.3	21
February	1,270	0.9	62
March	1,270	2.3	155
April	1,270	2.9	197
May	0	n/a	
June	0	n/a	
July	0	n/a	
August	0	n/a	
September	1,270	0.3	21
October	1,270	0.5	31
November	1,270	0.8	52
December	1,270	0.6	41
Total		8.4	579
1-in-10	**Irrigated Acreage**	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	1,270	0.4	31
February	1,270	1.3	88
March	1,270	2.7	189
April	1,270	4.0	273
May	0	n/a	
June	0	n/a	
July	0	n/a	
August	0	n/a	
September	1,270	0.4	31
October	1,270	0.7	48
November	1,270	1.3	88
December	1,270	0.8	53
Total		11.6	802

Note: Irrigation requirements based on generic sandy soil, Ft. Pierce climate station, irrigation efficiency of 50 percent and growing seasons as shown.

Martin County

Martin County vegetable production is included in the "Southeast" area as defined by the FASS *Vegetable Summary*; therefore, acreage data for Martin County individually is not available from the FASS. Vegetable acreage data were supplied by the local IFAS extension office.

Table A-23. Irrigation Requirements for Projected Vegetables in Martin County.

Average	Irrigated Acreage	Net Irrigation Requirements (inches)	Gross Irrigation Requirements (million gallons)
January	1,700	0.4	35
February	1,700	1.0	90
March	1,700	2.0	187
April	1,700	2.6	235
May	0	n/a	
June	0	n/a	
July	0	n/a	
August	0	n/a	
September	1,700	0.2	21
October	1,700	0.4	35
November	1,700	0.7	62
December	1,700	0.8	69
Total		8.0	734
1-in-10	**Irrigated Acreage**	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	1,700	0.6	51
February	1,700	1.4	126
March	1,700	2.8	263
April	1,700	3.5	325
May	0	n/a	
June	0	n/a	
July	0	n/a	
August	0	n/a	
September	1,700	0.4	40
October	1,700	0.7	63
November	1,700	1.1	103
December	1,700	1.1	103
Total		11.6	1,073

Note: Irrigation requirements based on generic sandy soil, Indiantown climate station, Irrigation efficiency of 50 percent and growing seasons as shown.

Sod

The sod projections presented here refer to irrigated sod. There is additional sod harvested from non-irrigated areas (often pasture).

St. Lucie County

Currently there are two companies producing irrigated sod in St. Lucie County. Based on agricultural commodity reports and communication with the local IFAS extension office, a total estimate of 760 acres was made for these two companies. No meaningful trend could be established due to the lack of historical acreage data, and this acreage has remained constant in recent years. Therefore, irrigated sod acreage was projected to remain constant through the year 2025.

Table A-24. Irrigation Requirements for Projected Sod in St. Lucie County.

Irrigated Acreage = 760		
Average	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	1.0	40
February	1.4	59
March	2.3	93
April	3.2	133
May	2.9	118
June	1.8	74
July	2.0	84
August	1.4	59
September	0.8	31
October	0.7	28
November	0.8	34
December	0.8	31
Total	19.0	783
1-in-10	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	1.4	56
February	1.8	73
March	2.4	99
April	3.5	146
May	3.5	146
June	2.3	94
July	2.7	110
August	1.9	77
September	1.1	45
October	1.0	42
November	1.1	45
December	1.0	40
Total	23.6	972

Note: Irrigation requirements based on, generic sandy soil, Ft. Pierce climate station and irrigation efficiency of 50 percent.

Martin County

According to the local IFAS extension office, there are about 100 acres of irrigated sod produced annually in Martin County (primarily in Hobe Sound), and no meaningful trend could be established due to the lack of historical data. Therefore, irrigated sod acreage was projected to remain constant through the year 2025, and irrigation requirements are presented in **Table A-25**.

Table A-25. Irrigation Requirements for Projected Sod in Martin County.

Irrigated Acreage = 100		
Average	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	1.1	6
February	1.6	9
March	2.2	12
April	2.9	16
May	2.5	13
June	1.4	7
July	1.4	8
August	1.4	7
September	0.8	4
October	0.7	4
November	0.8	4
December	0.8	4
Total	17.4	95
1-in-10	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	1.7	9
February	2.0	11
March	2.6	14
April	3.8	21
May	3.4	18
June	2.0	11
July	1.9	10
August	2.0	11
September	1.1	6
October	1.0	5
November	1.1	6
December	1.1	6
Total	23.6	128

Note: Irrigation requirements based on, generic sandy soil, Stuart climate station and irrigation efficiency of 50 percent.

Eastern Okeechobee County

The local IFAS extension office estimates that there are about 350 acres of irrigated sod in Okeechobee County, all of which takes place within the District. Of these 350 acres, about 100 acres takes place in the UEC Planning Area (eastern Okeechobee County). No meaningful trend could be developed due to the lack of historical acreage data. Therefore, irrigated sod acreage was projected to remain constant through the year 2025. Irrigation requirements are presented in **Table A-26**.

Table A-26. Irrigation Requirements for Projected Sod in Eastern Okeechobee County.

Irrigated Acreage = 100		
Average	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	1.3	7
February	1.7	9
March	2.5	13
April	3.2	18
May	3.2	17
June	1.6	9
July	1.3	7
August	1.1	6
September	0.8	4
October	1.2	7
November	1.2	7
December	1.2	7
Total	20.2	110
1-in-10	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	1.8	10
February	2.0	11
March	2.8	15
April	4.0	22
May	4.1	22
June	2.4	13
July	1.9	10
August	1.6	9
September	1.2	6
October	1.5	8
November	1.5	8
December	1.6	9
Total	26.3	143

Note: Irrigation requirements based on, generic sandy soil, Okeechobee climate station and irrigation efficiency of 50 percent.

Greenhouse/Nursery

Ornamental nurseries in the UEC Planning Area are in St. Lucie and Martin counties. Nurseries in Okeechobee County are not in the UEC Planning Area. In order to project nursery acreage in the UEC Planning Area, the models shown in **Equations A-6** and **A-7** were estimated.

Equation A-6.

XORNt = f(XPOPt, D)

Equation A-7.

XORNt = f(TIMEt, D)

where:

XORNt = field nursery acreage in X county in year t.

XPOPt = historic or forecast population of X county in year t.

TIME = a time-trend variable equal to 1 in 1972 and increasing by 1 unit each subsequent year.

D = a dichotomous variable designed to catch an intercept shift in the historical acreage data.

St Lucie County

Ornamental nursery acreage has varied widely since 1972, but has generally grown in the 1990s. A model of the form shown in **Equation A-5** was estimated using robust regression, and the results shown in **Equation A-8** were obtained.

Equation A-8.

Robust Multiple Regression Using Huber's Method (C=1.345)

Dependent Stlunoncit

Regression Equation Section

Independent Variable	Regression Coefficient b(i)	Standard Error Sb(i)	T-Value to Test H0:B(i)=0	Prob Level	Reject H0 at 5%?	Power of Test at 5%
Intercept	7.4776	16.8528	0.444	0.6618	No	0.0708
D	61.9599	16.4954	3.756	0.0012	Yes	0.9473
Stlupop	0.5846	0.1358	4.304	0.0003	Yes	0.9838

Goodness-of-fit Statistics

R2	0.6079
Square Root of MSE	26.72553
Ave Abs Pct Error	37.311
F-Ratio	16.281
Durbin-Watson Value	2.0588

The projections derived from **Equation A-8** are presented in **Table A-27**. Robust regression was used to lessen the impact of unusual observations on the regression parameters.

Table A-27. Historical and Projected Ornamental Nursery Acreage in St. Lucie County.

Year	Historical Acreage	Projected Acreage
1972	53	
1973	97	
1974	36	
1975	22	
1976	34	
1977	42	
1978	31	
1979	20	
1980	108	
1981	29	
1982	47	
1983	97	
1984	178	
1985	116	
1986	118	
1987	95	
1988	79	
1989	70	
1990	79	
1991	86	
1992	117	
1993	124	
1994	127	
1995	112	
1996	112	
1997	115	
1998	123	
1999	159	
2000	120	120
2005		141
2010		163
2015		184
2020		204
2025		226

Table A-28. Irrigation Requirements for Projected Ornamental Nurseries in St. Lucie County.

		2000	2005	2010	2015	2020	2025
Irrigated Acreage		120	141	163	184	204	226
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
Average	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.1	5	6	7	7	8	9
February	1.7	7	8	10	11	12	14
March	2.6	11	13	15	17	19	21
April	3.5	15	18	20	23	25	28
May	3.0	13	15	18	20	22	25
June	2.1	9	11	12	14	16	17
July	2.3	10	12	14	15	17	19
August	1.7	7	8	10	11	12	14
September	1.1	5	5	6	7	8	9
October	1.0	4	5	6	6	7	8
November	1.0	4	5	6	6	7	8
December	1.0	4	5	6	6	7	8
Total	21.8	95	111	129	145	161	179
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
1-in-10	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.5	7	8	9	10	11	12
February	2.0	8	10	12	13	14	16
March	2.7	12	14	16	18	20	22
April	3.8	17	20	23	25	28	31
May	3.7	16	19	22	24	27	30
June	2.6	11	13	15	17	19	21
July	2.9	12	15	17	19	21	23
August	2.3	10	11	13	15	17	18
September	1.4	6	7	8	9	10	11
October	1.4	6	7	8	9	10	11
November	1.2	5	6	7	8	9	10
December	1.2	5	6	7	8	9	10
Total	26.5	115	135	156	176	196	217

Martin County

Martin County ornamental nursery acreage has fluctuated historically, but has shown some growth in recent years. In order to project Martin County field nursery acreage, the model shown in **Equation A-6** was estimated using ordinary least squares and robust regression, and the results shown in **Equation A-9** were obtained.

The variable POPt is included to account for the relationship between landscape nursery plantings for new homes and population. Historical and projected population data were as reported by the U.S. Bureau of the Census and BEBR (2002). Robust regression was used to lessen the impact of unusual observations on the regression parameters.

Equation A-9.

Robust Multiple Regression Using Huber's Method (C=1.345)

Dependent MARNON

Regression Equation Section

Independent Variable	Regression Coefficient b(i)	Standard Error Sb(i)	T-Value to Test H0:B(i)=0	Prob Level	Reject H0 at 5%?	Power of Test at 5%
Intercept	162.2456	77.1027	2.104	0.0465	Yes	0.5224
D2	-143.8812	38.4699	-3.740	0.0011	Yes	0.9474
MARPOP	0.0034	0.0007	4.892	0.0001	Yes	0.9967

Analysis of Variance Section

Source	DF	R2	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1		2482451	2482451			
Model	2	0.9015	507287.8	253643.9	105.224	0.0000	1.0000
Error	23	0.0985	55442.07	2410.525			
Total(Adjusted)	25	1.0000	562729.8	22509.19			

Goodness-of-fit Statistics

R2	0.9015
Square Root of MSE	49.0971
Avg Abs Pct Error	19.390

Durbin-Watson Test for Serial Correlation

Parameter	Value	Did the Test Reject H0: Rho(1) = 0?
Durbin-Watson Value	1.6415	
Prob. Level: Positive Serial Correlation	0.3436	No
Prob. Level: Negative Serial Correlation	0.5677	No

Equation A-9, corrected for 2000, was used to generate a set of primary projections, which are shown in **Table A-29**.

Table A-29. Historical and Projected Nursery Acreage in Martin County.

Year	Historical Acreage	Projected Acreage
1972	160	
1973	141	
1974	225	
1975	182	
1976	110	
1977	175	
1978	141	
1979	106	
1980	334	
1981	313	
1982	273	
1983	274	
1984	290	
1985	282	
1986	365	
1987	294	
1988	200	
1989	402	
1990	518	
1991	521	
1992	543	
1993	562	
1994	510	
1995	555	
1996	486	
1997	616	
1998	692	
1999	670	
2000	742	742
2005		786
2010		830
2015		874
2020		918
2025		963

Table A-30. Irrigation Requirements for Projected Ornamental Nurseries in Martin County.

		2000	2005	2010	2015	2020	2025
Irrigated Acreage		742	786	830	874	918	963
Net Irrigation Requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
Average	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.4	36	38	41	43	45	47
February	1.7	46	49	52	55	57	60
March	2.5	66	70	74	78	82	86
April	3.2	85	90	95	100	105	110
May	2.8	75	79	83	88	92	97
June	1.6	42	45	47	50	52	55
July	1.8	48	51	54	57	60	63
August	1.6	42	45	47	50	52	55
September	1.0	26	28	29	31	32	34
October	1.0	26	28	29	31	32	34
November	1.0	26	28	29	31	32	34
December	1.1	28	30	32	33	35	37
Total	20.4	548	581	613	646	678	711
Net irrigation requirements		**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
1-in-10	(inches)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)	(million gallons)
January	1.9	50	53	56	59	62	65
February	2.2	60	63	67	70	74	77
March	2.8	76	81	86	90	95	99
April	3.9	104	110	116	122	129	135
May	3.5	93	99	104	110	115	121
June	2.3	61	65	68	72	76	79
July	2.3	63	66	70	74	78	81
August	2.4	64	68	72	76	79	83
September	1.3	34	36	38	40	42	44
October	1.3	34	36	38	40	42	44
November	1.3	34	36	38	40	42	44
December	1.3	35	37	39	41	44	46
Total	26.3	708	750	792	834	876	919

Martin County is the only producer of cut flowers in the UEC Planning Area. The local IFAS extension office estimated that approximately 40 acres of land is used at any one time for cut flower operations, and this acreage is not anticipated to change significantly through the projection horizon.

Table A-31. Irrigation Requirements for Projected Cut Flowers in Martin County.

Average	Irrigated Acreage	Net Irrigation Requirements (inches)	Gross Irrigation Requirements (million gallons)
January	40	1.1	2
February	40	1.6	2
March	40	2.2	3
April	40	2.9	4
May	20	2.5	2
June	0	1.4	0
July	20	1.4	1
August	40	1.4	2
September	40	0.8	1
October	40	0.7	1
November	40	0.8	1
December	40	0.8	1
Total		17.4	20
1-in-10	**Irrigated Acreage**	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	40	1.7	2
February	40	2.1	3
March	40	2.7	4
April	40	3.9	6
May	20	3.5	2
June	0	2.0	0
July	20	1.9	1
August	40	2.0	3
September	40	0.6	1
October	40	1.0	1
November	40	1.1	2
December	40	1.1	2
Total		23.6	27

Note: Irrigation requirements based on generic sandy soil, Stuart climate station and irrigation efficiency of 75 percent.

Improved Pasture

Improved pasture is defined by the District as pasture that has the facilities in place to carry out irrigation. As of 2003, there are about 60,000 acres encompassed in water use permits issued by the District for pasture irrigation in the UEC Planning Area. Based on District knowledge and consulting with local soil and water conservation district scientists, much of this acreage is rarely irrigated. This is because the returns associated with cattle production in recent years do not justify the expense associated with pasture irrigation. When irrigation is used, it is usually in a period of drought and is done to prevent grass from dying. In many cases, this occurs on a much smaller area of pasture than the "improved" total. Unless there was evidence of active pasture irrigation within a specific county, the irrigation of that acreage was not included in the primary projection scenario analyzed in the District's regional water supply plans. Although this assumption may not be the case in some rare instances, it is much closer to actual production practices than the values given by any irrigation requirement model or permit.

The Plan assumption that most improved pasture is not irrigated does not preclude ranchers from acquiring District consumptive use permits, or carrying out pasture irrigation; however, this irrigation activity is not part of the primary projection for irrigation demand in a mean or 1-in-10 year drought year.

In the UEC Planning Area, the District and U.S. Department of Agriculture – Natural Resources Conservation Service (USDA–NRCS or NRCS) used land use maps and NRCS soil maps combined with local knowledge to estimate there are approximately 19,000 acres of improved pasture in the UEC Planning Area. This acreage is potentially routinely irrigated. Estimated average and 1-in-10 withdrawals for this acreage are shown in **Table A-32**.

Table A-32. Irrigation Requirements for Projected Pasture in St. Lucie County.

Irrigated Acreage	St. Lucie County		Martin County		Eastern Okeechobee County	
	14,300		3,700		1,000	
Average	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**	**Net Irrigation Requirements (inches)**	**Gross Irrigation Requirements (million gallons)**
January	0.0	0	0.1	20	0.3	16
February	0.0	0	0.2	40	0.6	33
March	0.7	524	0.7	141	1.2	65
April	1.7	1,340	1.5	301	2.7	147
May	1.8	1,398	1.5	301	3.2	174
June	0.8	582	0.4	80	1.0	54
July	1.1	815	0.4	80	0.4	22
August	0.2	175	0.4	80	0.4	22
September	0.1	58	0.1	20	0.1	5
October	0.0	0	0.0	0	0.3	16
November	0.1	58	0.0	0	0.3	16
December	0.1	58	0.2	40	0.4	22
Total	6.5	5,009	5.5	1,105	10.9	592
1-in-10						
January	0.0	0	0.0	0	1.4	76
February	0.0	0	2.0	402	1.7	92
March	1.3	990	2.3	462	1.9	103
April	2.6	1,980	4.0	804	3.7	201
May	2.9	2,272	4.0	804	4.4	239
June	1.3	990	0.9	181	1.5	81
July	1.9	1,456	2.0	402	1.6	87
August	1.2	932	0.6	121	1.6	87
September	0.0	0	0.0	0	0.0	0
October	0.0	0	0.0	0	2.0	109
November	0.0	0	0.0	0	2.0	109
December	0.0	0	0.0	0	2.1	114
Total	11.1	8,621	15.8	3,175	23.9	1,298

Note: Irrigation requirements based on generic sandy soil, Ft. Pierce climate station and irrigation efficiency of 50 percent.

Cattle Watering

Water required for cattle watering was calculated as a function of the number of and type (beef or dairy) of cattle. Water demand estimates for cattle watering is based on the District's allocation of 12 gal/cow/day for beef cattle, and 185 gal/cow/day for dairy cattle; (35 gal/cow/day for drinking and 150 gal/cow/day for barn washing), and kept constant over the projection horizon.

St. Lucie County

In 2000, St. Lucie County had approximately 34,000 head of cattle, of which 1,000 were dairy cows, according to the 2002 FASS *Livestock Summary.*

Martin County

In 2000, Martin County had approximately 34,900 head of cattle, of which 1,900 were dairy cows (FASS 2002c).

Eastern Okeechobee County

In 2000, Okeechobee County had about 187,000 head of cattle, of which 34,000 were dairy cows (FASS 2002c). Estimates were developed for dairy and beef cattle numbers in eastern Okeechobee County based on acreages mapped by the District as dairy farms (for dairy cattle) and pasture (for beef cattle) of the area for eastern Okeechobee County. Water demand estimates were based on these cattle numbers, which are shown in **Table A-33**.

Table A-33. Water Use for Cattle Watering in the UEC Planning Area.

County/Area	Beef Cattle	Dairy Cattle	MGD	MGY
St. Lucie	33,000	1,000	0.6	212
Martin	33,000	1,900	0.7	273
Eastern Okeechobee	31,300	3,800	1.1	394
Total	97,300	6,700	2.4	879

Total Irrigated Acreage

Total irrigated agricultural acreages for the UEC Planning Area are presented in **Table A-34**, which does not include the non-irrigated land used for pasture.

Table A-34. Irrigated Agricultural Acreage in the UEC Planning Area.

Category	St. Lucie County	Martin County	Eastern Okeechobee County	Total UEC	Percent of Total
2000					
Citrus	98,889	44,746	5,878	149,513	80.4%
Vegetables	1,270	1,700	0	2,970	1.6%
Sugarcane	0	12,478	0	12,478	6.7%
Sod	760	100	100	960	0.5%
Greenhouse/ Nursery	120	782	0	942	0.5%
Improved Pasture (irrigated)	14,300	3,700	1,000	19,000	10.2%
Total	115,339	63,506	6,978	185,863	100.0%
2025					
Citrus	80,974	44,748	8,787	134,509	78.6%
Vegetables	1,270	1,700	0	2,970	1.7%
Sugarcane	0	12,478	0	12,478	7.3%
Sod	760	100	100	960	0.6%
Greenhouse/ Nursery	226	1,003	0	1,269	0.7%
Improved Pasture (irrigated)	14,300	3,700	1,000	19,000	11.1%
Total	97,530	63,729	9,887	171,186	100.0%

Total Annual Water Demand

Estimated and projected demands for the UEC Planning Area are shown in **Table A-35**.

Table A-35. Overall Water Demands for 2000 and 2025 (MGD).

Category	Estimated Demands 2000 (MGD)	Projected Demands 2025 (MGD)	Percent Change 2000-2025	Percent of Total 2000	Percent of Total 2025
Public Water Supply	36.5	77.8	113%	12%	36.5
Domestic Self-Supply	17.0	3.7	-78%	6%	17.0
Commercial & Industrial Self-Supply	3.3	4.9	50%	1%	3.3
Recreational Self-Supply	12.8	23.8	86%	4%	12.8
Thermoelectric Power Generation Self-Supply	9.8	30.0	206%	3%	9.8
Agricultural Self-Supply	212.8	197.1	-7%	73%	212.8
Total	292.2	337.3	15%	100%	292.2

Comparison with 1998 UEC Projected Water Demand

Table A-36 shows the average projected demands in the 1998 UEC Water Supply Plan and those projected in this update.

Table A-36. Average Projected Demands in the 1998 UEC Water Supply Plan and 2004 Update.

Category	1998 UECWSP for 2020	2004 UECWSP Update for 2025	Percent Change 1998 Plan (2020) vs. 2004 Update (2025)
Population	445,925.0	485,510.0	9%
Water Use (MGD)	565.4	337.3	-40%
Public Water Supply (MGD)	64.4	77.8	21%
Domestic Self-Supply and Small Public Supply Systems (MGD)	18.8	3.7	-80%
Commercial & Industrial Self-Supply (MGD)	4.3	4.9	14%
Recreational Self-Supply (MGD)	38.1	23.8	-38%
Thermoelectric Power Generation Self-Supply (MGD)	Not Addressed	30.0	
Agricultural Self-Supply (MGD)	439.8	197.1	-55%

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APPENDIX B

Potable and Wastewater Treatment Facilities

POTABLE WATER TREATMENT FACILITIES

Most potable water used in the Upper East Coast (UEC) Planning Area is produced by large water treatment facilities, smaller "package" water treatment plants and self-supply. This section will focus on the larger regional facilities (equal to or greater than 0.10 MGD), which due to their existing and/or future design capacities, could have an impact on the water resource.

There are 20 existing water treatment facilities with a capacity of 0.10 MGD or greater in the planning region. These water treatment facilities are mostly located in the urbanized areas throughout the UEC Planning Area. The facilities and other information are tabulated in **Table B-1**. The 2003 potable water treatment facility service areas are shown in **Figure B-1** and the projected 2025 service area facilities are shown in **Figure B-2**.

Summary Descriptions of Existing Water Facilities:

Fifteen facilities use the Surficial Aquifer as their supply source only; one facility uses the Floridan Aquifer as their supply source only, and three use a combination of the Surficial Aquifer and Floridan Aquifer.

Summary descriptions for each of the water treatment facilities located in the UEC Planning Area are presented in this section for each utility. The following information is presented:

Raw Water Supply – This section provides a summary of withdrawal facilities, supply sources and 2003 (October 2002 – September 2003) pumpage. The annual allocations are expressed in million gallons per year (MGY) and the maximum daily allocations are expressed in million gallons per day (MGD).

Treatment – This section presents the current Florida Department of Environmental Protection (FDEP)-rated capacity, the method of treatment and the average daily flow. The concentrate/brine reject disposal method, if a desalination technology is used for treatment, is also provided.

Proposed/Future – This section states any current construction or permitting underway, future treatment facility expansions and plans and projected utility flows (as provided by the utility).

Martin County Potable Water Treatment Facilities

Indiantown Company

Raw Water Supply

Raw water is withdrawn from eight Surficial Aquifer wells located in Indiantown. The wells are 8 to 10 inches in diameter, have total depths between 115 and 125 feet and cased depths between 85 and 125 feet. These wells have pumping capacities between 85 and 250 gallons per minute (GPM).

The current SFWMD permit was issued on November 14, 2002 and expires on November 14, 2007.

Annual Allocation:	355 MGY (0.973 MGD)
Maximum Daily Allocation:	1.4 MGD

The 2003 average daily pumpage from the Surficial Aquifer wells was 0.606 MGD with a maximum day of 0.980 MGD.

Treatment

A 1.2-MGD FDEP-rated capacity aeration and chlorination facility provides treatment. The average daily demand was 0.553 MGD with a maximum day average of 0.811 MGD.

Proposed/Future

The projected water use for the service area is expected to increase to 1.4 MGD average daily demand by the year 2006, based on 300 gallons per day per capita and a population of 5,800. The utility is considering expanding the plant to 1.5 MGD using aeration and filtration.

Information Source

Information was provided by the Indiantown Company and SFWMD water use permit files.

Martin County Correctional Institute

Raw Water Supply

Raw water is withdrawn from nine Surficial Aquifer wells. The wells are 8 to 10 inches in diameter, with total depths between 100 and 139 feet and cased depths between 75 and 109 feet. The well pumping capacities are between 100 and 225 GPM.

The current SFWMD permit was issued on November 15, 2001 and expires on November 15, 2006.

Annual Allocation:	100 MGY (0.27 MGD)
Maximum Daily Allocation	0.4096 MGD

The 2003 average daily pumpage from the Surficial Aquifer was 0.195 MGD.

Treatment

The treatment method employed at this facility is lime softening and reverse osmosis (RO). The lime softening plant has a FDEP-rated capacity of 0.432 MGD and a RO capacity of 0.216 MGD. The 2003 average daily demand was 0.195 MGD. The RO facility was shut down in May 2001 due to operational problems.

Proposed/Future

There is a plan to interconnect Indiantown's utility with the Correctional facilities public water supply. This was initiated because the Correctional Institute came close to losing the ability to provide water several years ago. This was due to well failures, RO treatment problems and drought causing increased demands.

Information Source

Information was obtained from the FDEP and SFWMD files.

Martin County – Martin Downs

Raw Water Supply

Raw water is withdrawn from five existing Surficial Aquifer wells located in the Martin Downs area. The wells are 12 inches in diameter, have total depths of 125 and 165 feet and cased depths of 70 and 165 feet. The wells were drilled in 1992, 1997 and 2001. The wells have a pumping capacity of 300 to 700 GPM.

The current SFWMD permit was issued on August 14, 1997 and expires on August 14, 2007. The approved allocations are:

Annual Allocation:	586 MGY (1.50 MGD)
Maximum Daily Allocation:	2.68 MGD

The 2003 average daily pumpage was 1.79 MGD with a maximum day of 2.07 MGD.

Treatment

A 4.0-MGD FDEP-rated lime softening facility located in Martin County provides treatment. The 2003 average daily demand was 1.79 MGD with a maximum daily flow of 2.27 MGD.

Proposed/Future

In 2003, Martin County Utilities applied for a permit modification to combine the four water supply facilities it currently operates (North, Martin Downs, Port Salerno and Tropical Farms) into a single Martin County Consolidated Water System (MCCWS). The permit modification has not been issued. Martin County proposes to construct five Floridan Aquifer wells, a RO plant and an iron treatment facility for Surficial Aquifer water treatment at their Tropical Farms facility. The county's current long-term plan considers the abandonment of the Martin Downs plant, converting it to a water pump station in 2008.

Information Source

Information was provided by Martin County Utilities and SFWMD water use files.

Martin County – North

Raw Water Supply

Raw water is withdrawn from Surficial and Floridan Aquifer wells located in Jensen Beach. There are ten existing Surficial Aquifer wells, which are 8 inches in diameter, with total depths between 115 and 152 feet and cased depths between 70 and 100 feet. The wells were drilled between 1982 and 1988. The well pumping capacity is between 115 and 140 GPM. Five additional wells were completed in 2002. Their pumping capacity is 200 to 700 GPM.

There are four existing Floridan Aquifer wells, which are 12 inches in diameter with total depths between 1,260 and 1,400 feet and cased depths between 967 to 1,165 feet. The wells were drilled in 1998 and 2000. The Floridan Aquifer wells have a combined capacity of 1,578 GPM.

The current SFWMD permit was issued on March 15, 2001 and expires on March 15, 2006. The approved allocations are:

Combined Surficial and Floridan Aquifers	
Annual Allocation:	2,396 MGY (6.56 MGD)
Maximum Daily Allocation:	8.07 MGD

The 2003 average daily pumpage from the Surficial Aquifer was 2.04 MGD and the Floridan Aquifer was 4.11 MGD, or 6.15 MGD combined, with a maximum day of 7.91 MGD (Surficial – 2.60 MGD; Floridan – 5.31 MGD).

Treatment

The treatment methods employed at this facility are lime softening and RO. The lime softening plant has a FDEP-rated capacity of 3.3 MGD. The RO plant has a capacity of 5.5 MGD and was placed in operation in 1994. Concentrate is disposed of by deep well injection. The unaccounted-for water is estimated to be about 13.3 percent.

Proposed/Future

In 2003, Martin County Utilities applied for a permit modification to combine the four water supply facilities it currently operates (North, Martin Downs, Port Salerno and Tropical Farms) into a single Martin County Consolidated Water System (MCCWS). The permit modification has not been issued.

Information Source

Information was provided by Martin County Utilities and SFWMD water use files.

Martin County – Port Salerno

Raw Water

Raw water is withdrawn from five Surficial Aquifer wells located in the Salerno area. The wells are 6 to 8 inches in diameter with total depths between 100 and 130 feet, and cased depths between 40 and 63 feet. The wells were drilled between 1983 and 1985. The pumping capacities of the wells are between 270 and 450 GPM.

The current SFWMD permit was issued on October 14, 1993 and expired on December 31, 1997. The approved allocations were:

Annual Allocation:	1,046 MGY (2.86 MGD)
Maximum Daily Allocation:	4.41 MGD

The 2003 average daily pumpage was 0.012 MGD with a maximum day of 0.04 MGD.

Treatment

Treatment is provided by a facility known as the Vista Salerno Plant. The treatment method employed is aeration and chlorination. The plant has a FDEP-rated capacity of 0.64 MGD. The 2003 average daily demand was 0.012 MGD with a maximum daily flow of 0.105. The unaccounted-for water is estimated to be about 10.2 percent.

Proposed/Future

In 2003, Martin County Utilities applied for a permit modification to combine the four water supply facilities it currently operates (North, Martin Downs, Port Salerno and Tropical Farms) into a single Martin County Consolidated Water System (MCCWS). The permit modification has not been issued. This facility will be modified to supplement reclaimed water supplies in the area, and disconnected from the water supply system in the future. Public water supply will be provided from Martin County's Tropical Farms facility when this occurs.

Information Source

Information was provided by Martin County Utilities and SFWMD water use files.

Martin County – Tropical Farms

Raw Water Supply

Raw water is withdrawn from eight Surficial Aquifer wells. The wells are 8 inches in diameter, have total depths of 100 feet and cased depths of 60 feet. The pumping capacities of the wells are 100 and 150 GPM.

The current SFWMD permit was issued on March 14, 1996 and expires on March 14, 2006. The approved allocations are:

Annual Allocation:	487 MGY (1.33 MGD)
Maximum Daily Allocation:	2.27 MGD

The 2003 average daily pumpage was 1.38 MGD and the maximum day flow was 1.13 MGD.

Treatment

A 1.5-MGD FDEP-rated membrane softening treatment facility with an efficiency of about 80 percent provides treatment. The facility is located in Martin County. Concentrate from the treatment process is blended with reclaimed water for reuse.

Proposed/Future

In 2003, Martin County Utilities applied for a permit modification to combine the four water supply facilities it currently operates (Port Salerno, Tropical Farms and Martin Downs) into a single Martin County Consolidated Water System (MCCWS). The permit modification has not been issued. Martin County is constructing five Floridan Aquifer wells, a RO plant and an iron treatment facility for Surficial Aquifer water treatment at this facility.

Information Source

Information was provided by Martin County Utilities and SFWMD water use files.

Miles Grant

Raw Water Supply

Raw water supply is withdrawn from six Surficial Aquifer wells located in eastern Martin County. The wells are 8 inches in diameter, have total depths between 127 and 143 feet and cased depths between 110 and 126 feet. These wells were drilled in 1972 and 1975 and a have pumping capacity of 150 GPM.

The current SFWMD permit was issued on September 4, 2003 and expires on September 7, 2008.

Annual Allocation:	53 MGY (0.145 MGD)
Maximum Monthly Allocation:	6.39 MGD

The 2003 average daily pumpage from the Surficial Aquifer wells was 0.144 MGD with a maximum day of 0.242 MGD.

Treatment

A 0.330-MGD FDEP-rated capacity lime softening treatment facility with chlorination and filtration provides treatment. The 2003 average daily demand was 0.144 MGD with a maximum day of 0.242 MGD. The unaccounted-for water is estimated at about 21.40 percent.

Future/Proposed

The service area is essentially built-out. No further plant expansion or modifications are required or proposed at this time.

Information Source

Information was provided by Utilities Inc., of Florida and SFWMD water use files.

Pipers Landing

Raw Water Supply

Raw water is withdrawn from two Surficial Aquifer wells. The wells are 8 and 12 inches in diameter, have total depths of 130 and 141 feet and cased depths of 100 feet. The wells were drilled in 1981, with pumping capacities between 145 and 350 GPM.

The current SFWMD permit was issued on October 13, 1994 and expires on November 10, 2004. The approved allocations are:

Annual Allocation:	44 MGY (0.12 MGD)
Maximum Daily Allocation:	0.18 MGD

The 2003 average daily pumpage was 0.133 MGD with a maximum day of 0.190 MGD.

Treatment

In 2003, treatment was provided by a 0.200-MGD FDEP-rated capacity aeration facility.

Proposed/Future

Piper's Landing is built-out; therefore, no growth in water demand is anticipated. There are currently 301 houses with an estimated population of 678. The per capita water use is 178 gallons per day.

Information Source

Information was provided by Piper's Landing and SFWMD water use permit files.

Plantation

Raw Water

Raw water is withdrawn from two existing Floridan Aquifer wells. The wells are 8 inches in diameter, have a total depth of 1,025 feet and cased depths of 590 and 1000 feet. The wells have a capacity of 420 GPM.

The current SFWMD permit was issued on January 11, 1996 and will expire on January 11, 2006. The approved allocations are:

Annual Allocation:	82 MGY (0.22 MGD)
Maximum Daily Allocation:	0.51 MGD

The 2003 average daily pumpage was 0.151 MGD.

Treatment

Treatment is provided by a 0.40-MGD FDEP-rated capacity RO facility.

Proposed/Future

There are no plans for expanding this facility.

Information Source

Information was provided by SFWMD water use files.

Sailfish Point

Raw Water Supply

Raw water is withdrawn from two existing Floridan Aquifer wells located on Hutchinson Island. The wells are 6 inches in diameter, have total depths between 1,000 and 1,100 feet and cased depths of 662 and 720 feet. The wells were drilled in 1978 and 1982. The capacities for both wells are 1,400 GPM.

The current SFWMD permit was issued on October 10, 2002 and will expire on October 10, 2022. The approved allocations are:

Annual Allocation:	80 MGY (0.219 MGD)
Maximum Daily Allocation:	0.44 MGD

The 2003 average daily pumpage was 0.207 MGD with a maximum day of 0.388 MGD.

Treatment Method

Treatment is provided by a 0.35-MGD FDEP-rated capacity RO treatment facility.

Proposed/Future

There are no plans to expand the treatment capacity beyond this quantity. No additional facilities are proposed.

Information Source

Information was obtained from the Sailfish Point Utility Corporation and SFWMD water use files.

South Martin Regional Utility

South Martin Regional Utility (SMRU) was formed in 1998 when the Town of Jupiter Island purchased Hydratech Utilities and Hobe Sound Water Company, two privately owned utilities. These two utilities were combined and now operate as a public utility, known as the South Martin Regional Utility.

Raw Water Supply

Raw water is withdrawn from approximately 27 existing wells (two Floridan Aquifer System wells and 25 Surficial Aquifer System wells) located within the SMRU service area. There are four proposed Surficial Aquifer System wells. The wells are 4 to 20 inches in diameter, have total depths between 82 and 1,400 feet and cased depths between 48 and 1,150 feet. The wells were drilled between 1963 and 2003. The well capacities are between 100 and 1,725 GPM.

The current SFWMD permit was issued on January 9, 2003 and will expire on November 9, 2010. The approved allocations are:

Annual Allocation:	1,997 MGY (5.47 MGD)
Maximum Daily Allocation:	8.41 MGD

These allocations are a combination of Surficial and Floridan Aquifer withdrawals.

Treatment

Treatment is provided by aeration and RO. The combined capacity of these treatment systems is 8.14 MGD FDEP-rated capacity. Concentrate disposal is via discharge to the ocean. The 2003 average daily demand was 4.24 MGD with a maximum day of 6.74 MGD.

Proposed/Future

The utility estimates water use for the service area will increase to 5.07 MGD average daily demand with a maximum day flow of 8.07 MGD by 2010. They plan to continue to use the Floridan and Surficial Aquifers.

Information Source

Information was provided by the South Martin Regional Utility and SFWMD water use permit files.

City of Stuart

Raw Water Supply

Raw water is withdrawn from 24 Surficial Aquifer wells located in the central and southern portion of the City of Stuart. In addition to the city's 24 Surficial Aquifer wells, the city receives 0.900 MGD from eight wells operated by Northrup Grumman Corporation in accordance with Grumman's water use permit. The wells are 6 to 8 inches in diameter, have total depths between 120 and 135 feet and cased depths between 104 and 120 feet. The wells were drilled between 1950 and 1979. The pumping capacities of the wells are between 140 and 520 GPM.

The current SFWMD permit was issued on May 10, 2001 and expires on May 10, 2006. The approved allocations are:

Annual Allocation:	1,087 MGY (2.97 MGD)
Maximum Daily Allocation:	4.53 MGD

The 2003 average daily pumpage was 3.32 MGD with a maximum day of 3.778 MGD.

Treatment

A 6.0-MGD FDEP-rated capacity lime softening facility provides treatment. The 2003 average daily demand was 3.32 MGD with a maximum day of 3.778 MGD. The 2003 unaccounted for water was estimated to be approximately 12 percent.

Future

The 2001 City of Stuart Reserve Capacity Technical Memorandum indicates that the build-out average daily finished water demand for the service area is anticipated to increase to 3.70 MGD with a maximum day flow of 5.55 MGD in 2041.

Information Source

Information was provided by the City of Stuart and SFWMD water use files.

St. Lucie County Potable Water Treatment Facilities

Fort Pierce

Raw Water Supply

Raw water is withdrawn from Surficial and Floridan Aquifer wells located within the Fort Pierce area of St. Lucie County. There are 42 existing Surficial Aquifer wells, which were drilled between 1963 and 1987. These wells are between 10 and 16 inches in diameter, have total depths between 92 and 129 feet, cased depths between 45 and 72 feet and pumping capacities between 200 and 700 GPM. There are nine Floridan Aquifer wells that were drilled between 1986 and 2001. These wells are either 12 or 16 inches in diameter, have total depths between 1,000 and 1,300 feet, cased depths of approximately 500 feet and pumping capacities between 600 and 1,200 GPM. One of these Floridan Aquifer wells is used as a blending well only.

The current SFWMD permit was issued on July 11, 1996 and expires on July 11, 2006. The approved allocations are:

Surficial Aquifer	
Annual Allocation:	4,007 MGY (10.98 MGD)
Maximum Daily Allocation:	14.6 MGD
Floridan Aquifer	
Maximum Daily Allocation:	6.8 MGD
Maximum Daily Allocation from Both:	14.6 MGD

The 2003 average pumpage was 9.15 MGD (Surficial – 3.15 MGD; Floridan – 6.0 MGD).

Treatment

The Fort Pierce Utility Authority (FPUA) Water Treatment Plant employs two methods of treatment, lime softening system and Reverse Osmosis (RO). The RO system was constructed in 2002. The RO system produces approximately 5.3 MGD. This water is then blended with water treated by a 14.7-MGD lime softening facility. The combined system has a FDEP-rated capacity of 20 MGD.

Proposed/Future

Fort Pierce Utility Authority Engineering predicts the water service demand to increase to 17.3 MGD average daily demand with a maximum day flow of 21.8 MGD by

the year 2025. The current master plan is in review and will be available in late 2004. More accurate water demand projections will be available at that time.

Information Source

Information was provided by the Fort Pierce Utility Authority (FPUA) and SFWMD water use files.

Harbour Ridge

Raw Water Supply

Raw water is withdrawn from two Surficial Aquifer wells located on the Harbour Ridge property in St. Lucie County. The wells are 8 inches in diameter, have total depths of 110 feet and are cased to 80 feet. These wells were drilled in 1982 and have pumping capacities of 250 GPM.

The current SFWMD permit was issued on June 29, 2003 and expires on June 29, 2008. The approved allocations are:

Annual Allocation:	52.59 MGY (0.144 MGD)
Maximum Daily Allocation:	0.20 MGD

The 2003 average daily pumpage was 0.125 MGD with a maximum daily flow of 0.289 MGD

Treatment

The treatment employed at this facility is lime softening, chlorination and ammoniation with a FDEP-rated capacity of 0.360 MGD. The aqueous ammonia feed system was employed to reduce Total Trihalomethanes (TTHM) levels.

Proposed/Future

Harbour Ridge reached build-out in 1996 with 695 housing units and a population of approximately 1,573 persons. There are no plans to modify existing allocations/ or treatment.

Information Source

Information was provided by the Harbour Ridge utility and SFWMD water use files.

Meadowood/Panther Woods Utility

Raw Water Supply

Raw water is withdrawn from the Surficial Aquifer from wells located within the Fort Pierce area of St. Lucie County. There are four existing Surficial Aquifer wells, which are between 3 and 4 inches in diameter, have total depths between 90 and 125 feet and cased depths between 45 and 70 feet. The wells were drilled between 1987 and 1999, and have pumping capacities between 100 and 200 GPM.

The current SFWMD permit was issued on February 10, 1994 and expired on February 10, 2004*****. The approved allocations are:

Annual Allocation:	66.98 MGY (0.183 MGD)
Maximum Daily Allocation:	0.323 MGD

The 2003 average daily pumpage from the Surficial Aquifer wells was 0.050 MGD; the minimum daily pumpage was 0.030 with a maximum day of 0.080 MGD.

Treatment

The treatment method employed at this facility is lime softening. The facility has a FDEP-rated capacity of 0.20-MGD. The 2003 average daily demand was 0.045 MGD with a maximum daily flow of 0.70 MGD.

Proposed/Future

No plans at this time.

Information Source

Information was provided by Walsh Environmental Services, Inc. and SFWMD water use permit files.

***Note**: When this document was prepared, Meadowood/Panther Woods was in the process of submitting a revised consumptive use permit application.

Port St. Lucie

Raw Water Supply

Raw water is withdrawn from 29 Surficial Aquifer wells and six Floridan Aquifer wells located in the central area of Port St. Lucie. The Surficial Aquifer wells are 8 inches in diameter and the Floridan Aquifer wells are 16 to 24 inches in diameter. The Surficial Aquifer wells have total depths of 90 to 114 feet, and cased depths between 40 and 79 feet. The Floridan Aquifer wells have total depths of 1,350 feet, and cased depths to 650 feet. The Surficial Aquifer wells were drilled between 1969 and 1996 and have well capacities between 150 and 600 GPM. The Floridan Aquifer wells were drilled between 1997 and 2003 and have capacities of 1,700 to 1,800 GPM.

The current SFWMD permit was issued on October 11, 2001 and expires on October 11, 2006. The approved allocations are:

Annual Allocation:	5,137 MGY (14.07 MGD)
Maximum Daily Allocation:	19.56 MGD

The 2003 average daily pumpage was 9.29 MGD (Surficial – 4.22 MGD/ Floridan – 5.07 MGD).

Treatment

An 8.0-MGD FDEP-rated capacity lime softening facility and a 10.0-MGD FDEP-rated capacity RO facility provides treatment. The RO plant has an efficiency of about 80 percent. The remaining 20 percent is concentrate and is disposed of via deep well injection.

Proposed/Future

A 6.0-MGD RO plant is under construction at the city's LTC Ranch that is designed for expansion up to 20 MGD. The water treatment facility will consist of an operations building, transfer pumps, odor control facilities and a 4.0 MGD potable water ground storage reservoir. The storage tank and high service pumps were completed in 2003. A deep injection well will be constructed to provide disposal of concentrate from the plant. For secondary disposal, a pumping system will be designed to transfer concentrate to the Northport wastewater treatment facility for disposal.

Information Source

Information was supplied by the City of Port St. Lucie and SFWMD water use files.

Reserve Utility Corporation

Raw Water Supply

Raw water is withdrawn from five Surficial Aquifer wells located west of the St. Lucie West area. The wells are six inches in diameter, have total depths between 80 and 88 feet and cased depths between 40 and 55 feet. The wells were drilled between 1986 and 1990 and have capacities between 30 and 80 GPM.

The current SFWMD permit was issued on May 9, 2002 and expires on May 9, 2007. The approved allocations are:

Annual Allocation:	151 MGY (0.413 MGD)
Maximum Daily Allocation:	0.410 MGD

The 2003 average daily pumpage was 0.243 MGD with a maximum day of 0.379 MGD.

Treatment

A 0.414-MGD FDEP-rated capacity lime softening facility provides treatment. The 2003 average daily flow was 0.193 MGD with a maximum day of 0.318 MGD.

Proposed/Future

The Reserve Utility Corporation plans to purchase additional water as needed, and install a direct fill line to the storage tank system at the Reserve facility.

***Note:** The Reserve Utility receives 50,000 gallons per day of potable water from St. Lucie West and will receive all of its water and sewer service from St. Lucie West Service District in the future.

Information Source

Information was obtained from the Reserve Utility Corporation and SFWMD water use permit files.

Spanish Lakes Fairways

Raw Water Supply

Raw water is drawn from four Surficial Aquifer wells all located on site. The wells are 8 inches in diameter and have total depths between 80 and 90 feet. The wells are cased between 65 and 75 feet. The pumping capacities of the wells are 150 GPM. The wells were drilled in 1988.

The current SFWMD permit was issued on April 10, 2003 and expires on April 10, 2013. The approved allocations are:

Annual Allocation:	140.16 MGY (0.38 MGD)
Maximum Daily Allocation:	0.73 MGD

The average daily pumpage for 2003 was 0.239 MGD with a maximum daily flow of 0.326

Treatment Method

A 0.570-MGD FDEP-rated capacity membrane softening facility located in northern St. Lucie County provides treatment. The average daily demand for 2003 was 0.219 MGD with a maximum daily pumpage of 0.322 MGD. There was an average 0.02 MGD average daily loss due to brine discharge.

Proposed/Future

There are 1,493 homes in the community, with a total of 1,520 at build-out and a seasonal population of approximately 2,550. There are no plans for future expansion.

Information Source

Information was obtained from Spanish Lakes Fairways and SFWMD water use files.

St. Lucie County – North (Holiday Pines)

Raw Water Supply

Raw water is withdrawn from two Surficial Aquifer wells located in the Holiday Pines area. The wells are 8 inches in diameter, have total depths of 95 and 108 feet and cased depths of 65 and 76 feet. The wells were drilled in 1977 and 1989 and have capacities of 200 GPM.

When this document was prepared, the current SFWMD permit had expired, but the utility company had applied for a new permit. The allocations are:

Annual Allocation:	153 MGY (0.419 MGD)
Maximum Daily Allocation:	0.58 MGD

The 2003 average daily pumpage was 0.122 MGD with a maximum day of 0.202 MGD.

Treatment

Treatment is provided by a 0.24-MGD FDEP-rated capacity membrane softening treatment facility. The 2003 average daily demand was 0.112 MGD with a maximum day of 0.170 MGD. The unaccounted-for water is estimated to be about 4 percent. Concentrate is disposed of via blending with wastewater treatment facility effluent, which is discharged into rapid infiltration basins (RIBS).

Proposed/Future

The future water use is unknown at this time due to heavy growth in the area and the possibility of a different water source.

Information Source

Information was provided by St. Lucie County Utilities and SFWMD water use files.

St. Lucie West Services District

Raw Water Supply

Raw water is withdrawn from 12 Surficial Aquifer wells located in the St. Lucie West area. The wells are 8 inches in diameter, have total depths between 60 and 75 feet and cased depths between 37 and 46 feet. Each well has a capacity of 175 GPM.

The current SFWMD permit was issued on May 14, 1992 and expired May 14, 2001. The approved allocations are:

Annual Allocation:	979.00 MGY (2.68 MGD)
Maximum Daily Allocation:	4.03 MGD

The 2003 average daily pumpage was 1.195 MGD with a maximum day of 1.78 MGD.

Treatment

Treatment is provided by a 2.0-MGD FDEP-rated capacity membrane softening treatment facility. The 2003 average daily demand was 0.95 MGD with a maximum day of 1.41 MGD. The unaccounted-for water is estimated to be approximately 5 percent. Concentrate is disposed of via blending with reclaimed water in St. Lucie West's irrigation water holding pond.

Proposed/Future

The current consumptive use permit allows for construction of an additional 19 Surficial Aquifer wells. The utility projects water use for the service area to increase to 2.12 MGD average daily demand with a maximum daily withdrawal of 4.03 MGD based on 100 gallons per day per capita and a population of 22,600. The plant was designed so that it could be expanded to 10 MGD.

Information Source

Information was provided by St. Lucie West and SFWMD water use permit files.

***Note:** St. Lucie West is currently applying for a 20-year consumptive use permit renewal. This renewal involves the Surficial and Floridan Aquifer Systems. The Water Management District has requested additional information from St. Lucie West to support their request. Also, the Reserve Utility is under contract to receive 50,000 gallons per day from St. Lucie West and will receive all of its water and sewer service from St. Lucie West.

Table B-1. Potable Water Treatment Facilities in the UEC Planning Area – 2003.

Facility	SFWMD		2003 Total Raw Water Pumped (MGD)[a]	Withdrawal Source		FDEP Rated Capa-city (MGD)	Treatment Method		
	Permit Number	Annual Allocation (MGD)		Surficial Aquifer System	Floridan Aquifer System		Lime Softening	Membrane Technology	Aeration
Martin County									
Indiantown	43-00041-W	Average - 0.97; Maximum - 1.4	0.61	0.61		1.20			1.20
Martin County Correctional	43-00089-W	Average- .27; Maximum - .4096	0.20	0.20		0.65	0.43	0.22	
Martin County – Martin Downs	43-00169-W	Average - 1.50 Maximum - 2.68	1.79	1.79		4.00	4.00		
Martin County – North[b]	43-00102-W	Average - 6.56 Maximum - 8.07	6.15	2.04	4.11	8.80	3.30	5.50	
Martin County – Port Salerno	43-00089-W	Average- 2.86; Maximum - 4.41	0.01	0.01		0.64			0.64
Martin County – Tropical Farms	43-00752-W	Average - 1.33 Maximum - 2.27	1.38	1.38		1.50		1.50	
Miles Grant	43-00086-W	Average - .145; Maximum - 6.39	0.14	0.14		0.33	0.33		
Piper's Landing	43-00173-W	Average - 0.12; Maximum - .18	0.13	0.13		0.20			0.20
Plantation	43-00328-W	Average - .22; Maximum. - .51	0.15		0.15	0.40		0.40	
Sailfish Point	43-00146-W	Average - .219; Maximum - 0.44	0.21		0.21	0.35		0.35	
South Martin Regional	43-00066-W	Average - 5.47; Maximum - 8.41	4.24	4.24		8.14		8.14	
Stuart	43-00053-W	Average - 2.97; Maximum - 4.53	3.32	3.32		6.00	6.00		
Martin County Subtotals			18.33	13.86	4.47	32.21	14.06	16.11	2.04

Table B-1. Potable Water Treatment Facilities in the UEC – 2003 (Continued).

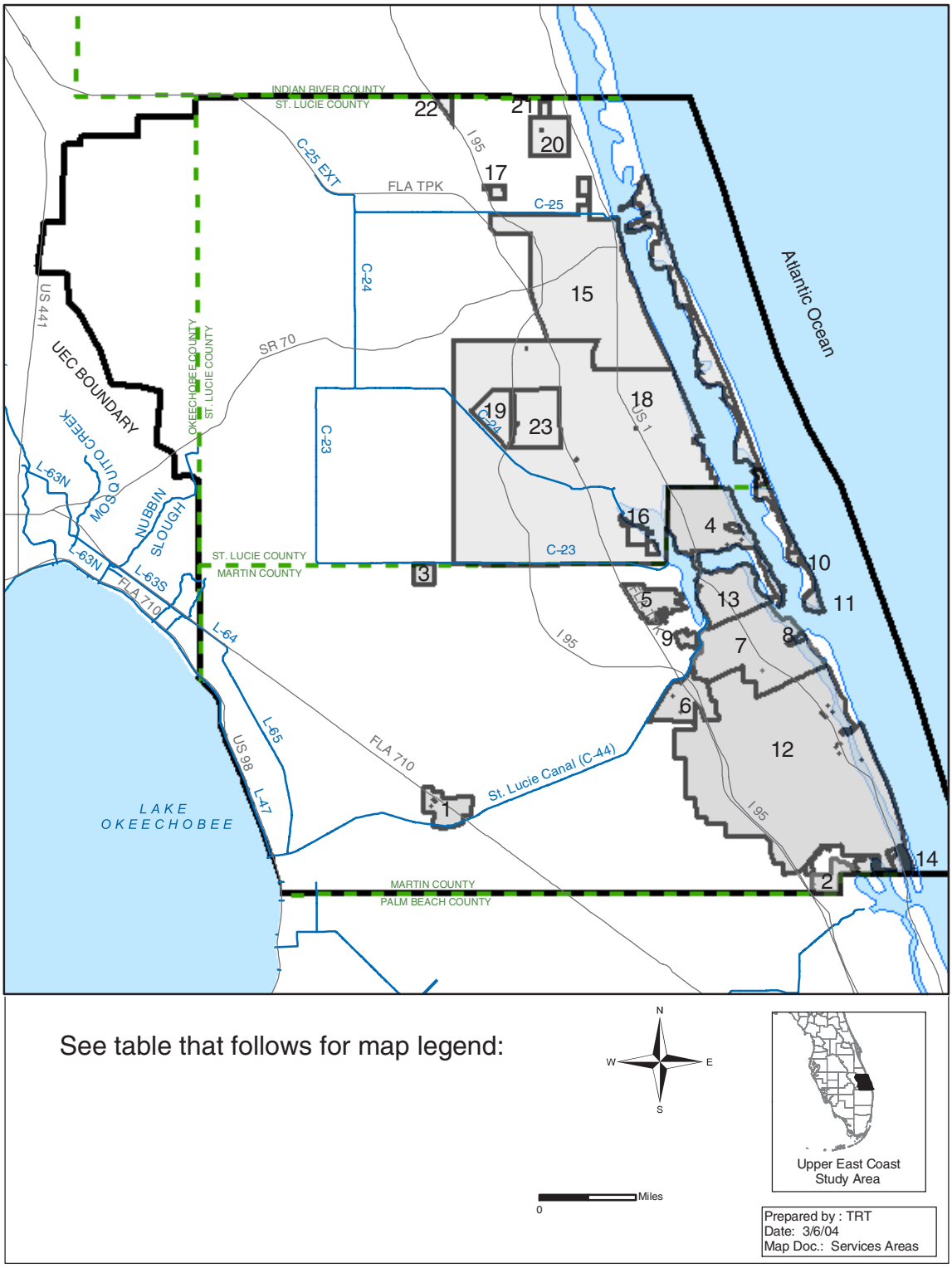
Facility	SFWMD		2003 Total Raw Water Pumped (MGD)[a]	Withdrawal Source		FDEP Rated Capa-city (MGD)	Treatment Method		
	Permit Number	Annual Allocation (MGD)		Surficial Aquifer System	Floridan Aquifer System		Lime Softening	Membrane Technology	Aeration
St. Lucie County									
Ft. Pierce[c]	56-00085-W	Average - 10.98; Maximum - 14.6	9.15	3.15	6.00	20.00	14.70	5.30	
Harbour Ridge	56-00449-W	Average - 0.144; Maximum - 0.20	0.13	0.13		0.36	0.36		
Meadowood /Panther Woods	56-00462-W	Average - .183; Maximum - .323	0.05	0.05		0.20	0.20		
Port St. Lucie[c]	56-00142-W	Average - 14.07; Maximum - 19.56	9.29	4.22	5.07	18.00	6.85	10.00	
Reserve[d]	56-00552-W	Average - 0.413; Maximum - .410	0.24	0.24		0.41	0.41		
Spanish Lakes Fairways	56-00401-W	Average - 0.38; Maximum - 0.73	0.24	0.24		0.57		0.57	
St. Lucie County – North (Holiday Pines)	56-00406-W	Average - .419; Maximum - .58	0.12	0.12		0.24		0.24	
St. Lucie West[d]	56-00614-W	Average - 2.68; Maximum - 4.03	1.20	1.20		2.00		2.00	
St. Lucie County Subtotals			20.42	9.35	11.07	41.78	22.52	18.11	0.00
UEC Planning Totals			38.75	23.21	15.54	73.99	36.58	34.22	2.04

a. Average withdrawal from October 2002 to September 2003.

b. Leilani Heights, Fisherman's Haven, Fox Run and Pinelake Village have been connected to Martin County North. All of the wells will be de-commissioned, with the exception of Leilani Heights, which will be kept as reserve wells.

c. The 2003 raw water figure represents the combined total for both Surficial and Floridan Aquifers.

d. The Reserve Utility is under contract to receive 50,000 gallons per day from St. Lucie West and will receive all of its water and sewer service from St. Lucie West Service District.



See table that follows for map legend:

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Prepared by : TRT
Date: 3/6/04
Map Doc.: Services Areas

Figure B-1. Potable Water Treatment Facility Service Areas – 2003.

Table B-2. Potable Water Treatment Facility Service Areas Map Legend – 2003.

Martin County	**2003 Service Area Map Number**
Indiantown Company	1
Jupiter	2
Martin County Correctional	3
Martin County – Martin Downs	4
Martin County – North	5
Martin County – Port Salerno	6
Martin County – Tropical Farms	7
Miles Grant	8
Piper's Landing	9
Plantation Utilities	10
Sailfish Point	11
South Martin Regional	12
Stuart	13
Tequesta	14
St. Lucie County	
Fort Pierce	15
Harbour Ridge	16
Panther Woods	17
Port St. Lucie	18
Reserve	19
St. Lucie County – North	20
Spanish Lakes Country Club	21
Spanish Lakes Fairways	22
St. Lucie West	23

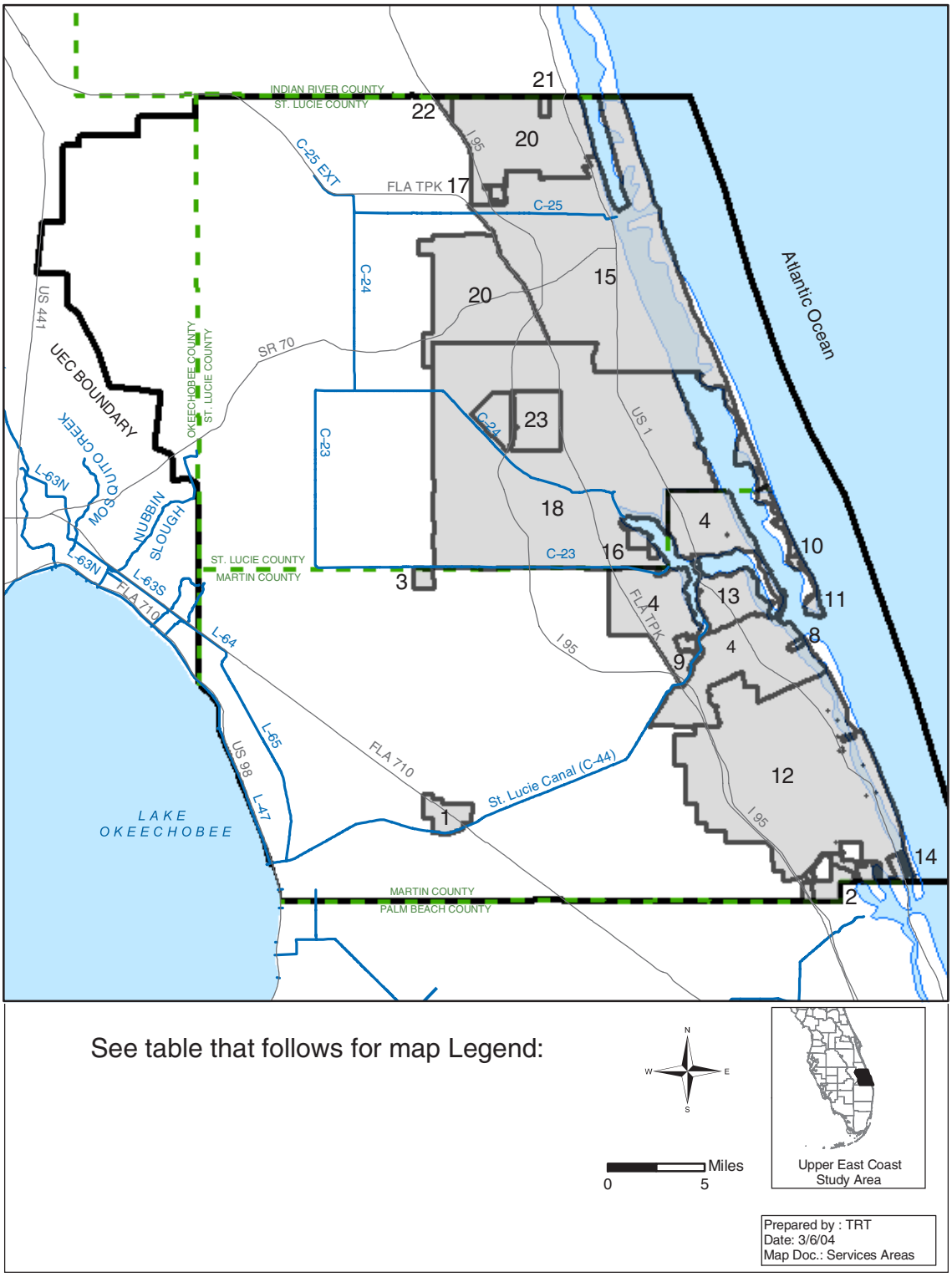

Figure B-2. Potable Water Treatment Facility Service Areas – 2025.

Table B-3. Potable Water Treatment Facility Service Areas Map Legend – 2025

Martin County	2025 Service Area Map Number
Indiantown Company	1
Jupiter	2
Martin County Correctional	3
Martin County Consolidated	4
Miles Grant	8
Piper's Landing	9
Plantation Utilities	10
Sailfish Point	11
South Martin Regional	12
Stuart	13
Tequesta	14
St. Lucie County	
Fort Pierce	15
Harbour Ridge	16
Panther Woods	17
Port St. Lucie	18
St. Lucie County – North	20
Spanish Lakes Country Club	21
Spanish Lakes Fairways	22
St. Lucie West	23

WASTEWATER TREATMENT FACILITIES

There are 29 wastewater treatment facilities (WWTFs) with a capacity of 0.10 MGD or greater in the UEC Planning Area as indicated in **Table B-4**. These facilities have a total capacity of 34.34 MGD and treated 20.20 MGD in 2003. The location of these and their associated service areas are shown in **Figure B-3**. Disposal methods used in 2003 included reuse, discharge to the ocean and deep well injection. Over 49 percent of the wastewater was reused via irrigation of golf courses, residential lots and other green space and groundwater recharge through rapid infiltration basins (RIBS).

The primary means of wastewater treatment in the UEC Planning Area is through regional wastewater treatment facilities, smaller "package plants" and septic tanks. This plan focuses on the regional facilities because they are large enough to allow economy of operation, have sufficient flows that could have a positive impact on the water resources through reuse, and support for a regional reuse program. Many are also located in areas close to potential reclaimed water users.

These wastewater facilities and proposed/future facilities are located in most of the urbanized areas throughout the UEC Planning Area as indicated in **Figure B-3**. Most of the facilities are municipally owned, and all use the activated sludge treatment process. General descriptions of the disposal methods follow.

Wastewater Management Methods

Three wastewater management methods are used in the UEC Planning Area: surface water discharge, deep well injection and reuse.

Surface Water Discharge

This method of wastewater management consists of disposing of the effluent through a pipeline to a receiving surface water. Prior to disposal, effluent is required to receive at least secondary treatment (20 mg/L carbonaceous biochemical oxygen demand, 20 mg/L total suspended solids or 90 percent removal, whichever is more stringent) and basic level disinfection. Additional levels of treatment may be required and are based on the characteristics of the effluent and the receiving water, as well as other regulatory requirements and standards. Effluent standards from this method are known as water quality based effluent limitations (WQBELs). The WQBELs are a means of determining the available assimilative capacity of a water body and setting effluent limits utilizing appropriate procedures for simulation and prediction of water quality impacts.

As regulatory requirements become more stringent, many of the discharges may choose to find alternative means for effluent disposal. In addition, any new discharge or expansion of an existing discharge must justify compliance with the state's anti-

degradation requirements prior to issuance of a permit for such a discharge. The anti-degradation rule requires a utility proposing to construct a new discharge, or expanding an existing discharge, to demonstrate that an alternate disposal method, such as reuse is not feasible in lieu of a discharge to surface water, and that such a discharge is clearly in the public interest. Only St. Lucie County South Hutchinson Island uses surface water discharge for effluent disposal, via discharge to the Florida Power & Light cooling canal to the ocean when wastewater flows exceed reclaimed water demand.

Deep Well Injection Class I Wells

This method of wastewater management consists of injecting secondary treated effluent (no disinfection required) through a casing to the boulder zone, a fractured carbonate sequence formation found at depths ranging from 1,900 to 3,600 feet below the ground surface. Deep wells also serve as an alternative means of disposal for a reuse system. Five wastewater facilities in the UEC Planning Area used deep well injection for all or part of their disposal needs in 2003.

Reuse

Reuse consists of utilizing treated wastewater (reclaimed water) for a beneficial purpose. Reclaimed water is utilized for irrigation of golf courses, residential lawns, park and other green space, and for groundwater recharge via RIBS. Some of the facilities utilize reclaimed water for plant process water, and some for irrigation of the utility site, which also could be considered reuse.

Twenty-three of the facilities use reuse for all or a portion their wastewater management needs. About 52 percent (9.40 MGD) of the wastewater treated in the planning area in 2002 was reused for a beneficial purpose with over 6.70 MGD used for irrigation. In 2002, reclaimed water was used for irrigation of 5,362 residential lots, 20 golf courses, three parks, five schools and a citrus grove (FDEP, 2003). About 1.60 MGD was used for groundwater recharge and the remainder was used for industrial and toilet flushing purposes. The results of the Plan analysis indicates that current reuse in the UEC Planning Area, primarily irrigation of golf courses, has contributed to reduced potential resource impacts.

Summary Descriptions of Existing Wastewater Facilities

Summary descriptions for each of the wastewater treatment facilities (equal to or greater than 0.10 MGD) located in the UEC Planning Area, from which the previously summarized information was obtained, are presented in the following section. Each utility capsule contains the follow information:

Treatment/Disposal – This section presents the current FDEP-rated capacity, the method of treatment and disposal, the average daily flow (ADF) (October 2002 – September 2003), and the reclaimed water/effluent chloride concentration.

Proposed/Future – This section states any current construction or permitting that is underway and known future treatment facility expansions and plans, including new additional facilities.

Martin County Wastewater Treatment Facilities

Indiantown Company

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.75-MGD FDEP-rated facility with reuse via public access irrigation and RIBS. The Indiantown Company operates the facility. The 2003 average daily flow was 0.579 MGD. The maximum month average daily flow was 0.883 MGD and the minimum average daily flow was 0.480 MGD.

Proposed/Future

The Indiantown Company proposes to start design and permitting of a plant expansion to 2.0 MGD after the year 2010.

Information Source

Information was provided by the Indiantown Company.

Leilani Heights

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.15-MGD FDEP-rated extended-aeration wastewater treatment plant with reuse via RIBS. The 2003 average daily flow was 0.061 MGD.

Proposed/Future

The plant will be de-commissioned with connection to Martin County in the future.

Information Source

Information was obtained from FDEP files.

Martin County Correctional Institute

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.60-MGD FDEP-rated capacity activated sludge wastewater treatment plant with reuse via irrigation of citrus groves; reclaimed water is also used for toilet flushing. The facility is operated by Martin County Corrections.

The 2002 average daily flow was 0.21 MGD.

Future/Proposed

There are no plans for expansion of this facility.

Information Source

Information was obtained from the FDEP.

Martin County – Martin Downs

Treatment/Disposal

The wastewater treatment facility consists of an existing 1.75-MGD FDEP-rated capacity activated sludge wastewater treatment plant with reuse by golf course irrigation and RIBS. The facility is operated by Martin County. Irrigation with reclaimed water is implemented at the following locations:

Site	Type	2003 ADF (MGD)
Crane Creek	Golf Course	0.18
Towers	Golf Course	0.276

The 2003 average daily wastewater flow was 1.263 MGD, of which 0.456 MGD was utilized for irrigation and 0.807 MGD for RIBS. The maximum month average daily flow was 1.43 MGD and the minimum month average daily flow was 0.888 MGD. The typical average reclaimed water chloride concentration is 133 mg/L.

Proposed/Future

This facility will be abandoned in 2005 and flows diverted to Martin County's Tropical Farms WWTF.

Information Source

Information was provided by Martin County Utilities.

Martin County – North

Treatment/Disposal

The wastewater treatment facility consists of an existing 1.38-MGD FDEP-rated capacity activated sludge wastewater treatment plant with disposal by reuse and deep well injection. The facility is operated by Martin County. Irrigation with reclaimed water is performed at the following locations:

Site	Type	2003 ADF (MGD)
Eagle Marsh	Golf Course & Residential	0.50
Pineapple Park Plantation	Residential	0.25
West Jensen Development	Residential	0.75

The 2003 average daily flow was 0.92 MGD. The maximum month average daily flow was 1.09 and the minimum month average daily flow was 0.759 MGD. The typical effluent chloride concentration is 130 mg/L.

Future/Proposed

This facility is currently being expanded to 2.76 MGD, which should be completed in 2004. The reclaimed water distribution system is also being expanded to serve new developments in the vicinity of the plant, as well as serving several existing commercial properties. Martin County – North currently uses potable water for irrigation.

Information Source

Information was provided by Martin County Utilities.

Martin County – Port Salerno

Treatment/Disposal

The facility consists of an existing 1.50-MGD FDEP-rated activated sludge wastewater treatment plant with reuse via spray irrigation and RIBS. The facility is operated by Martin County. Irrigation with reclaimed water is implemented at the following locations:

Site	Type	2003 ADF (MGD)
Heritage Ridge	Golf Course	0.35
Double Tree	Golf Course	0.35

In addition, Heritage Ridge can percolate an additional 0.5 MGD of reclaimed water in their lake system. Excess reclaimed water is conveyed to the county's Tropical Farms facility.

The 2003 average daily flow was 0.886 MGD. The maximum average daily flow was 0.945 MGD and the minimum month average daily flow was 0.807 MGD. The typical reclaimed water chloride concentration is 130 mg/L.

Future/Proposed

This facility will be abandoned in 2005 and flows diverted to Martin County's Tropical Farms WWTF.

Information Source

Information was provided by Martin County Utilities.

Martin County – Tropical Farms

Treatment/Disposal

The wastewater treatment facility is permitted as a 0.94-MGD FDEP-rated conventional activated sludge secondary domestic wastewater treatment plant. The average daily flow was 0.696 MGD with reuse via public access spray irrigation.

Reuse is accomplished via the Martin County Consolidated Reuse System. The consolidated reuse system is permitted to receive reclaimed water from the Tropical Farms, Port Salerno and Martin Downs WWTFs. Currently, only the interconnection between the Tropical Farms WWTF and Port Salerno WWTF exists. The common reclaimed water main to connect all three facilities is scheduled to be constructed in 2011.

The Martin County Consolidated Reuse System is permitted to provide reclaimed water to the following users:

Site	Permitted Application Volume
Heritage Ridge Golf Course Lost Lake Course Tower Golf Course Crane Creek Golf Course Florida Club Golf Course	2.54 MGD, Annual Average Daily Flow
Halipatioke Park	0.29 MGD, Annual Average Daily Flow
Five Percolation Ponds at the Port Salerno WWTF and a Percolation Pond at Heritage Ridge	0.88 MGD, Annual Average Daily Flow
Seven Percolation Ponds at the Martin Downs WWTF	0.85 MGD, Annual Average Daily Flow

Future/Proposal

This facility will be expanded in two phases. The first phase will expand the current facility from 0.94 MGD to 5.0 MGD, and should be completed in 2005. The Martin Downs and Port Salerno WWTFs will be abandoned at that time and their wastewater flows diverted to Tropical Farms. The second phase expansion will expand the WWTF from 5.0 MGD to 7.5 MGD, and is planned to go online in 2009.

Reuse via public access spray irrigation will be the primary means of disposal with deep well injection as a backup.

Information Source

Information was provided by Martin County.

Miles Grant

Treatment/Disposal: The wastewater treatment facility consists of an existing 0.30-MGD FDEP-rated activated sludge wastewater treatment plant with reuse by golf course irrigation.

Site	Type	2003 ADF (MGD)
Miles Grant	Golf Course	0.112

The 2003 average daily wastewater flow was 0.112 MGD, of which 0.112 MGD was utilized for irrigation. The maximum month average daily flow was 0.126 MGD and the minimum month daily flow was 0.098 MGD.

Proposed/Future

There are no plans for future expansion of this facility.

Information Source

Information was provided by Utilities Inc., of Florida.

Piper's Landing

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.10-MGD FDEP-rated activated sludge wastewater treatment plant with reuse via golf course irrigation at the Piper's Landing Golf Course.

The 2003 average daily wastewater flow was 0.072 MGD.

Proposed/Future

The community is about 95 percent built-out and there are no plans to expand their service area.

Plantation – Martin County

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.30-MGD activated sludge wastewater treatment plant with reuse via golf course irrigation and the Plantation Golf Course. The 2002 average daily flow was 0.15 MGD.

Proposed/Future

There are no plans for future expansion of this facility.

Information Source

Information was provided by the Plantation utility.

Sailfish Point

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.250 MGD FDEP-rated extended-aeration wastewater treatment plant with reuse by golf course irrigation at the Sailfish Point Country Club Golf Course.

The 2003 average daily wastewater flow was 0.100 MGD. The maximum month average daily flow was 0.192 MGD.

Proposed/Future Use

The utility service area has reached build-out. There are no plans for expansion.

Information Source

Information was provided by the Sailfish Point Utility Corporation.

South Martin Regional Utility (SMRU)

This facility was formerly known as Hydratech Wastewater Treatment Facility in the 1998 Plan. The utility was purchased by the Town of Jupiter Island and is operating under the authority of the SMRU.

Treatment/Disposal

The wastewater treatment facility consists of an existing 1.20-MGD activated sludge (contact stabilization) wastewater treatment plant with reuse by golf course irrigation and RIBS. The facility is operated by SMRU. Irrigation with reclaimed water is implemented at the following locations:

Site	Type	2003* ADF (MGD)
Loblolly Pines	Golf Course	0.15
McArthur Golf Club	Golf Course	0.20
The Medalist	Golf Course	0.20

The 2003 average daily wastewater flow was 0.64 MGD. The maximum month average daily flow was 0.75 MGD in March and the minimum month average daily flow was 0.54 MGD in June. The typical reclaimed water chloride concentration is 76 mg/L.

Proposed/Future

This facility has existing capacity to produce 1.2 MGD of reclaimed water for public access irrigation. This system will be expanded accordingly as flows increase, with the intention of reusing all wastewater treated at this facility via public access irrigation. Eaglewood Country Club and Hobe Sound Golf Club will have reclaimed water available by the end of 2004. Discussions are taking place with the Jupiter Island Club on the potential of using reclaimed water. Existing groundwater wells being used as the irrigation source for Eaglewood Country Club will be converted to a supplemental source to the reuse system. Also, plans are being considered to build a new regional facility west on Bridge Road.

Information Source

Information was supplied by the South Martin Regional Utility.

*Note: September 2002 to October 2003

Stuart

Treatment/Disposal

The wastewater treatment facility consists of an existing 4.00-MGD FDEP-rated activated sludge treatment plant with effluent disposal via deep injection wells with a rated capacity of 13.5 MGD. The 2003 average daily flow was 1.70 MGD. The 2003 maximum daily was 2.16 MGD.

Proposed/Future

At this time, the City of Stuart Wastewater Treatment Plant is running a 2.11-MGD 3-maximum month average daily flow. The current remaining plant capacity is 1.89 MGD. Based on the projected future flow rates for the wastewater treatment plant, no future plant expansion will be required. Based on city data, if the city were to continue on its present course, the wastewater plant would reach a build-out annual average daily flow of 3.05 MGD and a 3-maximum month average daily flow of 3.42 MGD in 2038.

The City of Stuart is initiating a feasibility study and master plan to identify opportunities for reuse, with a focus on reducing groundwater withdrawals for irrigation in the vicinity of its wellfields.

Information Source

Information was supplied by the City of Stuart.

St. Lucie County Wastewater Treatment Facilities

Fort Pierce Utilities Authority

Treatment/Disposal

The wastewater treatment facility consists of an existing 10.0-MGD FDEP-rated activated sludge wastewater treatment plant with disposal via deep well injection.

The 2003 average daily wastewater flow was 5.62 MGD. The maximum month average daily flow was 6.37 MGD and the minimum month average daily flow was 5.52 MGD.

Proposed/Future

Fort Pierce Utilities Authority (FPUA) recently began planning construction for reuse. A 20-inch reclaimed water line to cross the Indian River Lagoon was constructed for this purpose. Several customers have been identified for reuse. The deep well will serve in conjunction with the reuse system once it is implemented.

The FPUA is designing a 1.0-MGD reclaimed water treatment system to provide reclaimed water to a proposed Harbour Isle development and other city properties in the vicinity of the WWTF.

The FPUA Water and Wastewater Master Plan projects future annual wastewater flows of 13.8 MGD and maximum month average daily demand wastewater flows of 17.4 MGD for the ultimate service area in the year 2025. These flows are greater than the capacity of the existing wastewater treatment plant. A 25-acre site in Fort Pierce has been purchased for a mainland wastewater treatment facility. Phase 1 is expected to go on line in late 2010. The proposed plant will incorporate reclaimed water treatment processes.

Information Source

Information was provided by the City of Fort Pierce Utilities.

Harbour Ridge

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.120-MGD FDEP-rated extended-aeration wastewater treatment with reuse by public access irrigation at the Harbour Ridge Golf Course and by RIBS.

The 2003 average daily wastewater flow was 0.07 MGD, all of which was used to irrigate the golf course.

Future/Proposed

Harbour Ridge reached build-out in 1996 with 695 housing units and a population of approximately 1,573 persons. There are no plans to modify the existing permit.

Information Source

Information was provided by Harbour Ridge Property Owners Association.

Meadowood/Panther Woods

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.150-MGD FDEP-rated activated sludge wastewater treatment plant with reuse via irrigation of the Panther Woods Golf Course. The 2003 average daily flow was 0.04. The maximum month average daily flow was 0.050 MGD and the minimum month average daily flow was 0.033 MGD.

Proposed/Future

No expansions are planned for Harbour Ridge...

Information Source

Information was provided by Walsh Environmental Services, Inc.

Port St. Lucie

Port St. Lucie – Glades (Proposed)

Port St. Lucie operates three wastewater treatment facilities: Northport, Southport and Westport. They are currently designing a western "Glades" wastewater treatment facility that will replace the Northport facility. In addition, the Westport facility is being expanded and flows from the Southport facility will be diverted to this facility.

Treatment/Disposal

The wastewater treatment facility will consist of a 6.0-MGD FDEP-rated activated sludge wastewater treatment plant in late 2006. Once the Glades plant is operational, inflow from the Port St. Lucie Northport plant will be diverted to the Glades plant where reuse/irrigation quality water will be produced. The Northport facility will be inactivated in 2007, and held available should additional treatment capacity be needed.

An expansion of this facility to 12.0 MGD is planned by 2001.

Information Source

Information was provided by the City of Port St. Lucie and the *Annual Wastewater Capacity Analysis Report*.

Port St. Lucie Northport Plant

Treatment/Disposal

The wastewater treatment facility consists of an existing 2.5-MGD FDEP-rated activated sludge wastewater treatment plant, with effluent disposal via a 3.53-MGD deep injection well. Construction of an interconnection between the Northport and the Westport wastewater treatment facilities in 2003 provided the utility with valuable options for redirecting wastewater flows for treatment.

The 2003 average daily wastewater flow was 1.39 MGD.

Proposed/Future

The city plans to construct an additional wastewater treatment facility, known as the "Glades Wastewater Treatment Plant" on recently purchased land in the northwest portion of the city's utility service area. The Glades plant is expected to be on-line at 6.0-MGD in late 2006, at which time, inflow from the Northport plant will be diverted to the Glades plant, where reuse/irrigation quality will be produced. The city plans to increase the Glades plant to 12.0 MGD around 2011. The Northport facility will be inactivated in 2007, and held available should additional treatment capacity be needed.

Information Source

Information was provided by the City of Port St. Lucie and the *Annual Wastewater Capacity Analysis Report*.

Port St. Lucie Southport

Treatment/Disposal

Treatment is provided via a 2.8-MGD FDEP-rated activated sludge effluent disposal facility. Reclaimed water/effluent disposal by Southport WWTF is by deep well injection, and spray irrigation at the nearby Ballantrae Golf Course.

The 2003 average daily wastewater flow was 2.01 MGD.

Proposed/Future

The current utility is to phase-out the Southport Wastewater Treatment Plant by 2012. Currently, the design of a force main to divert the effluent from the Southport plant to the Westport WWTF is in progress. Flows exceeding 2.0 MGD will be diverted to the Westport facility. The city is planning to provide a reuse return line from the Westport wastewater plant to the Ballantrae golf course for irrigation purposes.

Information Source

Information was provided by the City of Port St. Lucie and the *Annual Wastewater Capacity Analysis Report*.

Port St. Lucie – Westport

Treatment/Disposal

The wastewater facility consists of a 1.38-MGD FDEP-rated activated sludge wastewater treatment facility with reuse via nine acres of RIBS. A newly constructed 12.0 MGD deep injection well was put in service in 2003, and the facility was re-rated to 1.38 MGD.

The 2003 average daily flow was 0.322 MGD.

Construction of an interconnection from the city's Northport Wastewater Treatment Plant was completed in 2003, thereby creating the possibility that a portion of the Northport plant's flows could be diverted to the Westport plant, if necessary.

Proposed/Future

Facilities are under construction to provide 2.0 MGD of reclaimed/irrigation quality water in late 2004. The nearby upscale Tesoro Development has already submitted an irrigation quality water application to the city and service contract negotiations are well underway so that irrigation quality water will be supplied to the development, as soon as it is available from Westport WWTF. Until Westport WWTF's flows are sufficient to meet Tesoro's anticipated 2.0 MGD irrigation demands, the city will rely on its permitted ability to supplement reclaimed water flows with surface water from adjacent canals and lakes.

An expansion of the Westport WWTF to 4.0 MGD is underway and scheduled for completion in February 2005. Reuse will be the primary means of disposal. Once the expansion is completed, the Southport facility will divert flows exceeding 2.0 MGD until 2012, when the plant will be abandoned and flows diverted to the Westport facility.

A second 2.0-MGD expansion is planned for Westport in 2008 to bring the facility's capacity to 6.0 MGD. Another 2.0-MGD expansion is planned in 2011, and a 12.0-MGD expansion is planned for 2015, bringing the facility's capacity to 20.0 MGD.

Information Source

Information was provided by the City of Port St. Lucie and the *Annual Wastewater Capacity Analysis Report*.

Reserve

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.175-MGD FDEP-rated activated sludge wastewater treatment plant, with reuse via RIBS. The Reserve Community Development District (CDD) operates the facility.

The 2003 average daily wastewater flow was 0.131 MGD, with a maximum daily flow of 0.190 MGD.

Proposed/Future

The utility has been approved to transfer excess wastewater to St. Lucie West wastewater facility thru a 12-inch force main. Future plans involve increasing the raw water transfer to St. Lucie West on an as needed basis.

***Note:** St. Lucie West is under contract to provide water and sewer service to the Reserve Utility.

Information Source

Information was supplied by the Reserve Utility Corporation.

St. Lucie County – North (Holiday Pines)

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.21-MGD FDEP-rated activated sludge wastewater treatment plant with reuse via RIBS. The 2003 average daily flow was 0.122 MGD. The maximum month average daily flow was 0.129 MGD and the minimum month average daily flow was 0.114 MGD.

Proposed/Future

Negotiations are taking place with Fort Pierce Utilities for the City of Fort Pierce to receive of the North Utility District's wastewater. When this document was prepared, the North Utility District was conducting a site analysis study for the possibility of building a regional wastewater facility for the North County Area.

Information Source

Information was provided by St. Lucie County Utilities.

St. Lucie County – North Hutchinson Island

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.50-MGD FDEP-rated WWTF with reclaimed water public access spray irrigation consisting of 0.281 MGD on a 25-acre irrigation site at Pepper Park (a public park), 0.031 MGD on 3.5 acres of on-site irrigation and 0.188 MGD on 25 acres of irrigation for residential developments.

The 2003 average daily flow was 0.282 MGD. The maximum month average daily flow was 0.358 MGD and the minimum month average daily flow was 0.226 MGD.

Proposed/Future

There are no proposed or future expansion plans for this facility.

Information Source

Information was provided by St. Lucie County Utilities.

St. Lucie County – South Hutchinson Island

Treatment/Disposal

The wastewater treatment facility consists of an existing 1.60-MGD FDEP-rated extended-aeration facility. Disposal is via public access irrigation of condominium and other green space on the island. Surplus reclaimed water is discharged to the Florida Power & Light (FPL) St. Lucie Nuclear Power Plant cooling water discharge canal, which goes to the Atlantic Ocean.

The 2003 average daily flow was 0.448 MGD. The maximum month average daily flow was 0.723 MGD and the minimum month daily flow was 0.260 MGD.

Proposed/Future

There are no plans for expansion at this facility.

Information Source

Information was provided by St. Lucie County Utilities.

Savanna Club

Treatment/Disposal

The wastewater treatment facility consists of an existing 0.15-MGD FDEP-rated extended-aeration wastewater treatment plant with reuse via RIBS. The 2003 average daily flow was 0.084 MGD.

Proposed/Future

There are no plans for expansion of this facility.

Information Source

Information was obtained from FDEP files.

Spanish Lakes Country Club Village

Treatment/Disposal

Treatment is provided via a 0.160-MGD FDEP-rated activated sludge wastewater treatment facility with reuse via RIBS and absorption fields.

The 2003 average daily wastewater flow was 0.090 MGD.

Proposed/Future

There are no plans for expansion of this facility.

Information Source

Information was provided by Spanish Lakes Country Club.

Spanish Lakes Fairways

Treatment/Disposal

The facility is an existing 0.250-MGD FDEP-rated activated sludge wastewater treatment plant, with reuse via golf irrigation and RIBS on the Spanish Lakes Fairway Golf Course.

In 2003, the average daily flow was 0.145 MGD; the maximum daily flow was 0.172 MGD.

Proposed/Future

There are no plans for expansion of this facility.

Information Source

Information was supplied by Spanish Lakes Fairways Utilities staff.

St. Lucie West Services District

Treatment/Disposal

The wastewater treatment facility consists of an existing 2.0-MGD FDEP-rated activated sludge wastewater treatment plant, limited to 2.0 MGD, with reuse by irrigation of all landscape areas within the development, including residential areas, via a dual water system. Reclaimed water is used to irrigate the St. Lucie County Stadium, a 100-acre golf course, 1,200 acres of residential home sites, a 6-acre clubhouse and 30 acres of medium strips with 650 acres of additional residential irrigable acres available as new homes are built. Emergency discharge is to a man-made lake located east of the plant site.

The 2003 average daily wastewater flow was 1.02 MGD. The maximum month average daily flow was 1.10 MGD and minimum month average daily flow was 0.80 MGD. Reclaimed water supplies are supplemented with water from the developments' stormwater management system. An average of 2.15-MGD was withdrawn for on-site lakes to supplement reclaimed water flows. The typical average reclaimed water chloride concentration is 137 mg/L.

Proposed/Future

The projected build-out wastewater flows are estimated at 1.70 MGD, to be reached around 2014. The ultimate irrigation demand is projected to be about 7.0 MGD. Excess flows from the Reserve Community Development District will be diverted to St. Lucie West.

***Note:** St. Lucie West is under contract to provide water and sewer service to the Reserve Utility.

Information Source

Information was supplied by St. Lucie West.

Table B-4. Wastewater Treatment Facilities in the UEC Planning Area – 2003.

Facility	FDEP Rated Capacity (MGD)	2003 Average Daily Flow (MGD)[a]	Disposal Method				
			Deep Well (MGD)	Surface Water Discharge (MGD)	Reuse		
					Public Access Irrigation (MGD)	Rapid Infiltration Basins (MGD)	Other (MGD)[b]
Martin County							
Indiantown	0.75	0.58			0.13	0.45	
Leilani	0.15	0.06				0.06	
Martin County Correctional	0.60	0.21			0.19		0.02
Martin County - Martin Downs	1.75	1.26			0.46	0.81	
Martin County - North	1.38	0.92	0.31		0.61		
Martin County – Port Salerno	1.50	0.89			0.83	0.06	
Martin County - Tropical Farms	0.94	0.68			0.61	0.07	
Miles Grant	0.30	0.11			0.11		
Piper's Landing	0.10	0.07			0.07		
Plantation Utilities	0.30	0.15			0.15		
Sailfish Point	0.25	0.10			0.10		
South Martin Regional Utility	1.20	0.64			0.64		
Stuart	4.00	1.70	1.70				
Martin County Subtotal	13.22	7.37	2.01	0	3.90	1.44	0.02

a. Average withdrawal from October 2002 to September 2003.

b. Other reuse includes use of reclaimed water for use at wastewater treatment facilities and for toilet flushing.

c. Reuse at the wastewater treatment facility.

d. This figure includes the average daily flow figure plus reuse figure for public irrigation.

e. The Spanish Lakes Riverfront and Spanish Lakes East facilities were decommissioned in 2003 and connected to the City of Port St. Lucie.

Table B-4. Wastewater Treatment Facilities in the UEC Planning Area – 2003 (Continued).

Facility	FDEP Rated Capacity (MGD)	2003 Average Daily Flow (MGD)[a]	Disposal Method				
			Deep Well (MGD)	Surface Water Discharge (MGD)	Reuse		
					Public Access Irrigation (MGD)	Rapid Infiltration Basins (MGD)	Other (MGD)[b]
St. Lucie County							
Fort Pierce	10.00	5.62	5.17				0.45[c]
Harbour Ridge	0.12	0.07				0.07	
Panther Woods	0.15	0.04			0.04		
Port St. Lucie - Northport	2.50	1.39	2.44[d]		0.05	0.01	
Port St. Lucie - Southport	2.80	2.01	1.52		0.49		
Port St. Lucie - Westport	1.38	0.32				0.32	
Reserve	0.18	0.13				0.13	
Savanna Club	0.15	0.08				0.08	
Spanish Lakes Country Club	0.16	0.09				0.09	
Spanish Lakes East[e]	See footnote below						
Spanish Lakes Fairways	0.25	0.15			0.10	0.05	
Spanish Lakes Riverfront[e]	See footnote below						
St. Lucie County - North (Holiday Pines)	0.21	0.12			0.12		
St. Lucie County - North Hutchinson	0.50	0.28			0.28		
St. Lucie County - South Hutchinson Island	1.60	0.45			0.45		
St. Lucie West	2.00	1.02			3.17[d]		
St. Lucie County Subtotal	22.00	11.77	9.12	0	1.53	0.75	0.45
UEC Planning Area Total	35.22	19.14	11.13	0	5.43	2.20	0.47

a. Average daily flow from October 2002 to September 2003.

b. Other reuse includes use of reclaimed water at the wastewater treatment facility and for toilet flushing.

c. Reuse at the wastewater treatment facility.

d. This figure includes the average daily wastewater flow figure plus water from supplemental sources.

e. The Spanish Lakes Riverfront and Spanish Lakes East facilities were decommissioned in 2003 and connected to the City of Port St. Lucie.

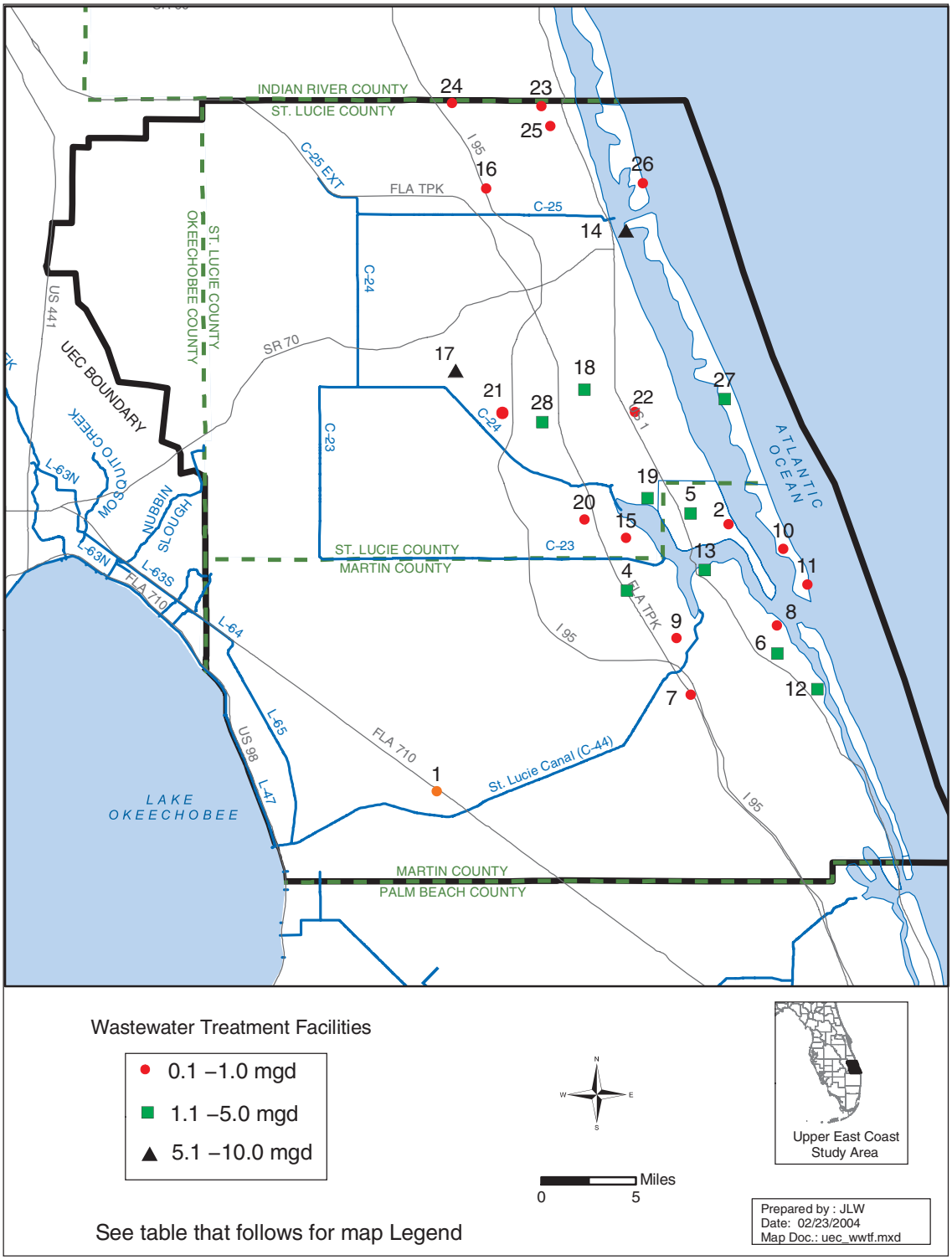

Figure B-3. Wastewater Treatment Facilities in the UEC Planning Area.

Table B-5. Wastewater Treatment Facility Service Areas Map Legend – 2003.

Martin County	**2003 Service Area Map Number**
Indiantown Company	1
Leilani Heights	2
Martin County Correctional	3
Martin County – Martin Downs	4
Martin County – North	5
Martin County – Port Salerno	6
Martin County – Tropical Farms	7
Miles Grant	8
Piper's Landing	9
Plantation Utilities	10
Sailfish Point	11
South Martin Regional	12
Stuart	13
St. Lucie County	
Fort Pierce	14
Harbour Ridge	15
Panther Woods	16
Port St. Lucie – Glades	17
Port St. Lucie – Northport	18
Port St. Lucie – Southport	19
Port St. Lucie – Westport	20
Reserve	21
Savanna Club	22
Spanish Lakes Country Club	23
Spanish Lakes Fairways	24
St. Lucie County – North	25
St. Lucie County – North Hutchinson Island	26
St. Lucie County – South Hutchinson Island	27
St. Lucie West	28

REFERENCES CITED

Florida Department of Environmental Protection. 2003. *Florida Department of Environmental Protection Reuse Inventory*. Tallahassee, FL. vari. pag.

APPENDIX C

Water Supply Cost and Funding Information

INTRODUCTION

This Appendix provides supplemental and supporting information to the water supply cost and funding information presented in the planning and support documents.

Water Supply Cost

This section contains information on the origination of several of the cost estimations for the water source options and treatment technologies presented in this plan.

Cost Estimating and Economic Criteria

In this portion of the appendix, a memo (**Exhibit C-1**) summarizing the approach on the origination and updated cost information presented in Chapters 3 and 5 of the UEC Planning Document is presented. The approach discussed in this consultants memo was supported by the Florida Department of Environmental Protection (FDEP) and water management districts in updating costs to 2005 dollars from the St. John's River Water Management District's (SJRWMD) Special Publication SJ97-SP3 titled, *Water Supply Needs and Sources Assessment – Alternative Water Supply Strategies Investigation – Water Supply and Wastewater Systems Component Cost Information*. The cost information provides a consistent set of definitions and criteria for the development of comparable planning level, life cycle, cost estimates for water supply and wastewater treatment alternatives.

Aquifer Storage and Recovery

The section provides a table containing the assumptions used in developing cost information regarding aquifer storage and recovery.

Water Supply Funding

UEC Alternative Water Supply Funding

A table is provided in this section itemizing UEC projects that have received funding from the Districts Alternative Water Supply Funding Program between Fiscal Year (FY) 1997 and FY 2004.

WATER SUPPLY COST

Cost Estimating and Economic Criteria

Please refer to the following memo (**Exhibit C-1**), which summarizes cost information.

Exhibit C-1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan and East Central Florida Water Supply Initiative (Third Draft).

TECHNICAL MEMORANDUM CH2MHILL

Cost Estimating and Economic Criteria for 2005 District Water Supply Plan and East Central Florida Water Supply Planning Initiative (third draft)

PREPARED FOR:	Patrick Burger/SJRWMD Beth Wilder/SJRWMD
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COPIES:	Barbara Vergara/ SJRWMD Jerry Salsano/TAURANT
DATE:	April 3, 2003 (Revised June 6, 2003, and September 8, 2003)

Purpose

This technical memorandum (TM) provides cost definitions and cost estimating and economic criteria to be used in the development of water supply facilities costing for the 2005 District Water Supply Plan (DWSP). These criteria are developed in support of SJRWMD's optimization and decision models and will be applied to all cost estimates and economic comparisons developed as part of the 2005 DWSP to ensure that all costs are directly comparable.

These criteria are also being be applied (with some modifications) to the ongoing East-central Florida Water Supply Planning Initiative (ECFWSPI) projects cost estimates. The ECFWSPI will conclude in early 2004 and the resulting report will update the 2000 DWSP.

This TM provides a consistent set of definitions and criteria for the development of comparable planning level life cycle cost estimates for all water supply alternatives.

Definitions

The following definitions will be used in the 2005 DWSP project and should be adhered to when applicable. For the most part, these definitions are the same as used by SJRWMD, as well as by Southwest Florida Water Management District (SWFWMD), in the development of the initial DWSPs.

Construction Cost

The construction cost is the total amount expected to be paid to a qualified contractor to build the required facilities at peak design capacity.

COST ESTIMATING CRITERIA TM 09082003.DOC 1

Exhibit C-1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan and East Central Florida Water Supply Initiative (Continued).

Non-construction Capital Cost

Non-construction capital cost is an allowance for construction contingency, engineering design, permitting and administration associated with the constructed facilities.

Land Cost

The market value of the land required to implement the water supply option.

Land Acquisition Cost

The estimated cost of acquiring the required land, exclusive of the land cost.

Total Capital Cost

Total capital cost is the sum of construction cost, non-construction capital cost, land cost, and land acquisition cost.

Operation and Maintenance Cost

The estimated annual cost of operating and maintaining the water supply option when operated at average day capacity.

Equivalent Annual Cost

Total annual life cycle cost of the water supply option based on service life and time value of money criteria established for this project. Equivalent Annual Cost accounts for Total Capital Cost and O&M costs with facility operating at average day design capacity.

Present Worth

The equivalent present value of current and future expenditures for a specified planning period.

Unit Production Cost

Equivalent Annual Cost divided by annual water production. The Unit Production Cost will be expressed in terms of dollars per 1,000 gallons.

Criteria

Cost estimating and economic criteria are guidelines for estimating costs associated with water supply options.

Peak Flow Ratio

Capital cost of water supply facilities will be based on maximum installed capacity designed to accommodate peak or maximum daily flow (MDF) requirements. O&M costs and annual water production are based on the average daily flow (ADF) produced. The peak flow ratio (MDF/ADF) for an individual water supply system depends on the demand characteristics of the service area. For public supply systems the peak ratio is generally at least 1.25 for large systems and can be greater than 2.0 for small systems.

Exhibit C-1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan and East Central Florida Water Supply Initiative (Continued).

For water supply options where the service area peak flow ratio is known, the known value can and should be used in the cost estimating and economic calculations. For regional planning applications, including application of SJRWMD's decision model, a peak ratio of 1.5 will be used. This MDF/ADF ratio was applied in the 2000 DWSP.

Cost Index

Engineering News Record (ENR) publishes a Construction Cost Index (CCI) that can be used to adjust the cost basis of a given construction project for past and future times. The ENRCCI is based on the following construction items: 200 hours of common labor at the 20-city average of common labor rates, plus 2,500 pounds of standard structural steel shapes at the mill price prior to 1996 and the fabricated 20-city price from 1996, plus 1.128 tons of Portland cement at the 20-city price, plus 1,088 board-ft of 2 x 4 lumber at the 20-city price.

Because much of the work associated with development of the 2005 DWSP will be completed in the coming years and reported in 2005, all cost estimates, for the 2005 DWSP, will be expressed in estimated year 2005 dollars. Estimating year 2005 costs involves the projection of the year 2002 ENRCCI (2002 mean annual ENRCCI = 6,538) to year 2005 ENRCCI. Exhibit 1 shows the recent historic ENRCCI trend, as well as, ENRCCI projections for years 2003, 2004, and 2005. The projected ENRCCI for year 2005 is approximately 7,000. This projection is based on the historically observed 2.34% mean annual growth rate for the period 1997 to 2002.

EXHIBIT 1
ENRCCI Projection to 2005
Cost Estimating & Economic Evaluation Criteria

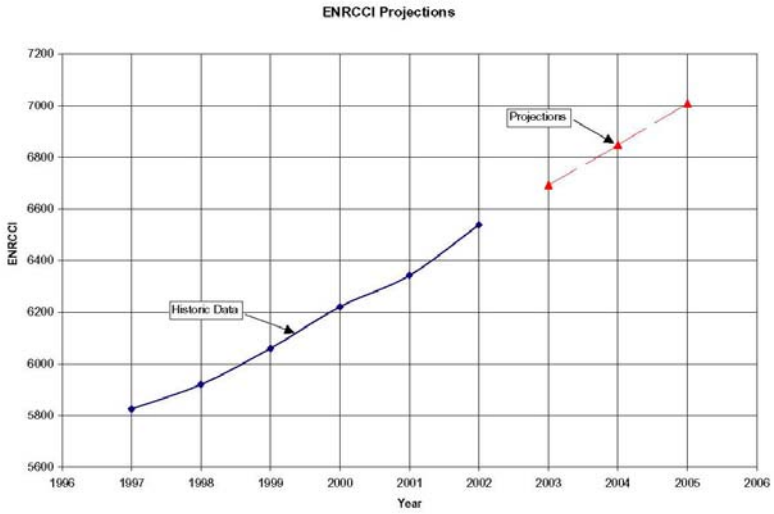

Exhibit C-1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan and East Central Florida Water Supply Initiative (Continued).

The cost basis for the 2000 DWSP was March 1996 with a corresponding ENRCCI value of 5537. Using the projected year 2005 ENRCCI value of 7000 represents an increase in the cost basis of about 26 percent.

The estimated 2005 ENRCCI will be applied to all 2005 DWSP cost estimates. However, the conceptual planning level cost estimates currently being prepared for the ECFWSPI projects will be expressed in current dollars. The cost basis for the ECFWSPI estimates is April 2003, with a corresponding ENRCCI value of 6635.

Non-construction Capital Cost

Non-construction capital cost will equal 45% of the planning level estimated construction cost. This includes a 20% allowance for construction contingency and a 25% allowance for engineering design, permitting, and administration. This value is unchanged from the 2000 DWSP.

Land Cost

Unit land cost ($/acre) for each parcel are based upon land use classification and size as supplied by SJRWMD land acquisition staff for the 2000 DWSP. An evaluation of current land values, as per recent SJRWMD land purchases, did not provide an adequate basis for revising the 2000 DWSP values. If actual site-specific land values are available for a given parcel and water supply option the site specific value should be used in lieu of these typical regional values.

General land use classifications include urban, suburban, and rural. Size is based on acreage, where *small* refers to parcels 50 acres or less in size and *large* refers to parcels greater than 50 acres in size. Exhibit 2 provides the unit land cost matrix for parcels located within SJRWMD.

EXHIBIT 2
Unit Land Cost for Parcels
Cost Estimating & Economic Evaluation Criteria

Land Use Classification	Parcel Size	
	Small (< or = 50 acres) ($/acre)	Large (> 50 acres) ($/acre)
Urban	$ 100,000	N/A
Suburban	$ 20,000	$ 10,000
Rural	$ 5,000	$ 3,000

Unit land costs ($/ft²) for pipeline corridors vary based on the land use classification and whether or not the parcel is adjacent to public right of way (ROW) or in an undeveloped (new) area, and whether an easement or full ROW is required. Exhibit 3 provides the unit

Exhibit C-1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan and East Central Florida Water Supply Initiative (Continued).

cost matrix for pipeline corridors located within SJRWMD. These values are the same as used in the 2000 DWSP.

EXHIBIT 3
Unit Land Cost for Pipeline Corridors
Cost Estimating & Economic Evaluation Criteria

Land Use Classification	Adjacent to Public ROW		New Area	
	Easement ($/ft2)	ROW ($/ft2)	Easement ($/ft2)	ROW ($/ft2)
Urban	$ 4.00	$ 6.00	$ 3.00	$ 5.00
Suburban	$ 1.50	$ 3.00	$ 1.00	$ 2.00
Rural	$ 0.75	$ 1.00	$ 0.50	$ 0.75

Land Acquisition Cost

Land acquisition cost estimates will vary as a function of condemnation requirements, as follows:

- 12% of land value for known non-condemnation parcels
- 25% of land value for know condemnation parcels
- 18% of land value where condemnation status is unknown

In most case, at the conceptual regional planning level of analysis, it is anticipated that condemnation status will be unknown and therefore the 18% value will apply. A single value of 25% was used in the 2000 DWSP.

Interest Rate

SJRWMD recently conducted an analysis of the potential financial impacts of alternative water supply development. This analysis conducted by Burton and Associates produced a final report entitled , *Financial Impact of Alternative Water Supply*. The financial impacts analysis project employed an interest rate of 6% per year in all water rates calculations. Current AAA rated, long term municipal bond interest rates (approximately 5% per year) are lower than the value chosen for the water rates impact analysis. However, the 6% was chosen by SJRWMD based on the expectation than the current very low municipal bond interest rates are not likely representative of future rates, but also recognizing that rates are unlikely to rise excessively in the foreseeable future.

In order to maintain compatibility among the existing ongoing SJRWMD water supply related projects, an interest rate of 6% is being used for all ECFWSPI projects.

For the 2005 DWSP, the interest rate to be used in all economic analysis calculations will be based on the current (FY03) federal water resources planning rate. This rate is set annually, by the US Bureau of Reclamation for use by all federal agencies, is based on US Treasury Bond rates. Although it is adjusted annually, it cannot be changed by more than ¼ percent

Exhibit C-1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan and East Central Florida Water Supply Initiative (Continued).

in any single year. The current (FY03) federal planning rate, as published in the Federal Register (December 13, 2002) , is 5.875%. This value will be used in all economic calculations for the 2005 DWSP.

Economic Life of Facilities

The economic service life of facilities is based on the criteria adopted for the 2000 DWSP. Exhibit 4 provides the economic service life, in years based on component type. These values will be used in all annual cost and present worth calculations.

In all cases, land is considered a permanent resources and therefore has an infinite service life.

EXHIBIT 4
Economic Service Life
Cost Estimating & Economic Evaluation Criteria

Component Type	Service Life (years)
Water Conveyance Structures	40
(pipelines, collection and distribution systems)	
Other Structures	35
(buildings, tankage, site improvements, etc.)	
Wells	30
Process and Auxiliary Equipment	20
(treatment equipment, pumps motors, mechanical equipment, etc.)	
Reverse Osmosis Membranes	5

The non-construction capital costs associated with a given project, or major project component, will also be distributed in proportion to expected service life of the project. For example, if a given project, or major project component, has an economic service life of 20 years then the non-construction capital cost for that project, or major project component, also has an economic service life of 20 years.

Present Worth

A 20-year planning period will be used in present worth calculations. This present worth planning period was also used in the 2000 DWSP.

Summary

Generally, definitions and cost estimating and economic criteria applied to the 2005 DWSP will be the same as those applied to the 2000 DWSP. The main exceptions are the cost basis, the land acquisition cost factor and the interest rate.

Exhibit C-1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan and East Central Florida Water Supply Initiative (Continued).

All 2005 DWSP costs will be estimated year 2005 costs; whereas, the 2000 DWSP was developed using March 1996 costs. The cost basis for the ECFWSPI projects and resulting update to the 2000 DWSP is April 2003.

The second change is the land acquisition factor. Land acquisition costs were estimated as 25% of land value for the 2000 DWSP. For the 2005 DWSP, this factor will vary depending upon condemnation status.

The final change is the interest rate used in the economic calculations. An interest rate of 7% was used for the 2000 DWSP and an interest rate of 6% is currently being used for the ECFWSPI and associated DWSP update. An interest rate of 5.875% will be used for the 2005 DWSP. The 2005 DWSP interest rate is equal to the current (FY03) federal water resources planning rate.

All other definitions and criteria remain unchanged.

Aquifer Storage and Recovery

Please refer to the following table (**Table C-1**) for Aquifer Storage and Recovery (ASR) Estimates.

Table C-1. Aquifer Storage and Recovery Estimates.

ASR Cost Estimate		
ASR Item	**2 MGD Potable Water ASR System**	**5 MGD Surface Water ASR System**
Construction		
ASR Well	$450,000	$650,000
Monitor Well	$-	$450,000
Surface Facilities	$350,000	$500,000
Piping	$25,000	$250,000
Discharge Structure	$-	$100,000
Water Treatment Facilities	$-	$3,500,000
Subtotal	$825,000	$5,450,000
Permitting/Design/CM	$165,000	$1,090,000
Total Construction Cost	$990,000	$6,540,000
Construction Cost per mgd	$495,000	$1,308,000
Annualized Costs	$28,300	$74,781
1+ie = 1 + effective rate	1.02960	1.02960
P/A	17.49	17.49
Operations & Maintenance		
Well	$10,000	$10,000
Water Quality Monitoring	$20,000	$100,000
Operators, Chemicals, etc.	$-	$100,000
Pumping/Electrical	$25,000	$80,000
O&M Cost (Annual)	$55,000	$290,000
O&M Cost (Annual) per mgd	$27,500	$58,000
Cost per 1,000 gallons	$0.44	$1.05
Assumptions		
Location	Co-located at Existing WTP	Remote from Existing WTP
Monitor Wells (Floridan)	None	One
Water Treatment (Recharge Only)	None additional	Micro filtration
Capacity (mgd)	2	5
Recoverability	70%	70%
Recharge (days)	180	180
Recovery (days)	126	126
Surface Facilities	Wellhead, pumps, valves, instrumentation, electrical	Wellhead, pumps, valves, instrumentation, electrical
Permitting/Design/CM	20% of construction cost	20% of construction cost
Facility Life Span (yrs)	25	25
Discount Rate	5.50%	5.50%
Inflation Rate	2.54%	2.54%

Notes:
Assumes seasonal operation of a south Florida-based ASR system (i.e., treat and store water during the wet season, pump it out in the dry season
CM = construction management
mgd = million gallons per day
WTP = Water Treatment Plant

WATER SUPPLY FUNDING

UEC Alternative Water Supply Funding

Please refer to the following table (**Table C-2**) for Alternative Water Supply (AWS) Grant Funding.

Table C-2. Alternative Water Supply Grant Funding.

Year	Applicant	Project	Approved Funding Amount	New Water (mgd)	Type
FY 1996-97	St. Lucie County	Reclaimed Water Ext - N. Hutchinson Island	$50,200	N/A	Reuse
	St. Lucie County	Reclaimed Water Ext - S. Hutchinson Island	$300,000	N/A	Reuse
FY 1997-98	Port St. Lucie	Concentrate Disposal Main	$300,000	N/A	Floridan
	Port St. Lucie	Floridan Wellfield & Raw Water Main	$300,000	N/A	Floridan
FY 1998-99	Jupiter Island	Stormwater Reuse	$200,000	0.10	Stormwater
	Port St. Lucie	Westport Reuse	$200,000	0.50	Reuse
	Martin County	Tropical Farms Ranney Collector Test Wells	$57,500	3.00	Floridan
	Martin County	N. Facility Floridan Well Equipment	$62,500	1.80	Floridan
	Fort Pierce	Floridan Aquifer Production Wells	$200,000	4.00	Floridan
	Port St. Lucie	Northport Reuse	$200,000	1.50	Reuse
FY 1999-00	Ft. Pierce	Reverse Osmosis Treatment Facility	$200,000	5.33	Floridan
	Martin County	N. Martin Floridan Well No. 4	$200,000	1.78	Floridan
	South Martin Regional	Two (2) Floridan Aquifer Supply Wells	$200,000	2.00	Floridan
	Jupiter Island Holdings	Irrigation Water Supply & Treatment	$200,000	0.25	Stormwater
FY 2001-02	South Martin Regional	Reverse Osmosis Treatment Facility	$300,000	2.00	Floridan
	Martin County	N. Martin Floridan Well 4 Wellhead	$300,000	0.00	Floridan
	St. Lucie County	Reclaimed Water Ext - N. Hutchinson Island	$82,800	0.17	Reuse
FY 2002-03	South Martin Regional	Ocean Outfall for RO By-product	$150,000	1.00	Floridan
FY 2003-04	Ft. Pierce	Reclaimed Water System	$100,000	1.00	Reuse
	Port St. Lucie	Westport Reclaimed Water System	$100,000	3.00	Reuse
	Martin County	North Reclaimed Water System Exp	$100,000	0.33	Reuse
	South Martin Regional	Reclaimed Water System Exp	$100,000	0.10	Reuse
	Martin County	Tropical Farms Floridan Wellheads	$100,000	3.90	Floridan
		TOTAL (FY 1997 – FY 2004)	$4,003,000	31.76	

REFERENCES CITED

St. Johns River Water Management District. 1997. *Water Supply Needs and Sources Assessment: Alternative Water Supply Strategies Investigation, Water Supply and Wastewater Systems Component Cost Information*. Technical Publication SJ97-SP3. Law Engineering and Environmental Services, Inc. for SJRWMD, Palatka, FL.

St. Johns River Water Management District. 2003. *Cost Estimating and Economic Criteria for 2005 District Water Supply Plan and East Central Florida Water Supply Initiative (Third Draft) – Technical Memorandum*. CH2M Hill. Palatka, FL.

APPENDIX D
Rainfall Analysis

A primary goal of the Upper East Coast (UEC) Water Supply Plan is to identify areas of expected water supply shortage and the frequency with which those shortages may occur. Rainfall is responsible for nearly all surface water inflows and outflows in the planning area and is the single most important source of recharge to the Surficial Aquifer. Rainfall is also the single most important variable controlling the occurrence of water shortages in the planning area.

RAINFALL DISTRIBUTION

Rainfall varies from county to county within the UEC Planning Area. Rainfall data has been broken down for seven selected rainfall stations throughout the planning area. The average annual rainfall for the planning area is 55.12 inches. There is a wet period from June through October, and a dry period from November through May (**Figure D-l**). Abtew and Ali (1999) have completed the most recent Districtwide analysis of rainfall distribution.

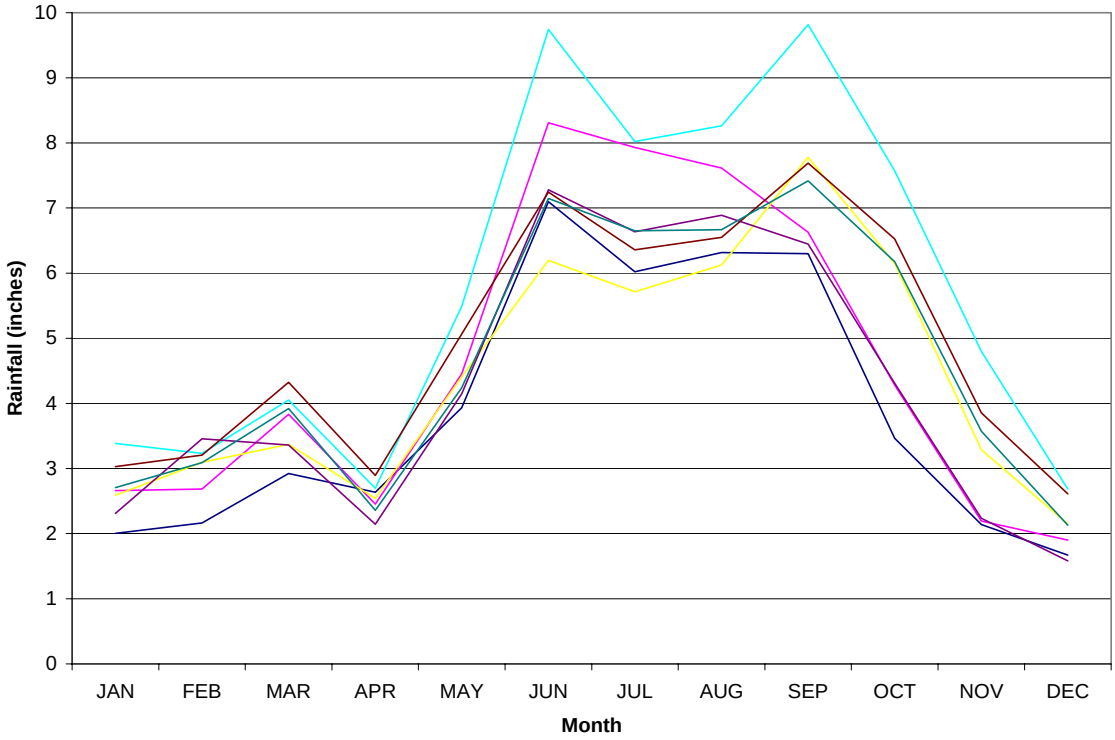

Figure D-1. Average Monthly Distribution of Rainfall at Stations in the UEC Planning Area.

The heaviest rainfall usually occurs in September or June, averaging 8.02 inches for the month, and the lightest rain month is usually December, averaging 2.06 inches for the month (**Table D-l**). The locations of these stations are shown in **Figure D-2**.

Table D-1. Average Rainfall Data for Rainfall Stations in the UEC Planning Area.

County	Rainfall Station	Average Annual Rainfall	Years and Period of Record	Maximum Monthly Rainfall		Minimum Monthly Rainfall		% Rain Falling in Wet Season	Primary DBKEY[a]
				in	mo	in	mo		
Indian River	Vero	56.08	36 1965-2000	7.42	Sep	2.13	Dec	68%	06262
Martin	S308	50.79	36 1965-2000	7.28	Jun	1.58	Dec	70%	06239
	Stuart	59.35	36 1965-2000	7.69	Sep	2.61	Dec	66%	PT389, PT390, PT391
Palm Beach	Pratt	69.75	36 1965-2000	9.81	Sep	2.69	Dec	70%	06122
Okeechobee	Fort Drum	54.95	36 1965-2000	8.31	Jun	1.90	Dec	71%	PT218, PT219
St. Lucie	Cow Creek	46.67	30 1971-2000	7.10	Jun	1.67	Dec	71%	05848, JG320
	Fort Pierce	53.41	36 1965-2000	7.78	Sep	2.15	Dec	68%	PT240, PT241, PT242
Overall Average		55.86		7.91		2.11		69%	

a. For those interested in accessing DBHYDRO. Missing daily data replaced by weighted averages of neighboring stations.

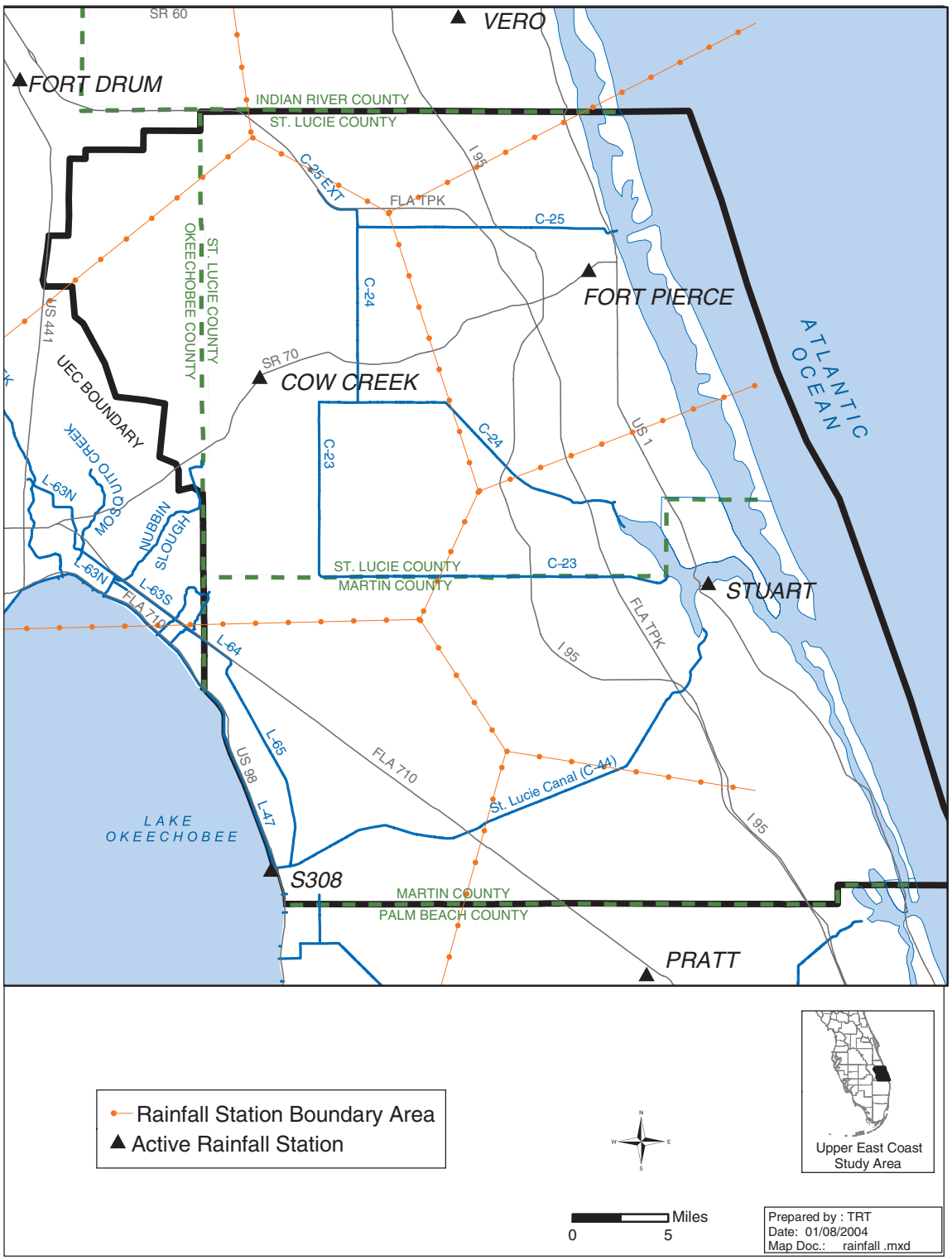

Figure D-2. Rainfall Stations in the UEC Planning Area.

RAINFALL DATA PREPARATION

The SFWMD has a network of rainfall stations that provides historical rainfall data. Long-term data were obtained from seven rainfall stations with relatively long and reliable records. These data are maintained in the District's environmental database, DBHYDRO. The DBHYDRO database key (DBKEY) values for these stations are listed in **Table D-l**. The period of record for each rainfall station is shown in **Table D-l**. **Tables D-2** through **D-8** show the monthly rainfall for each rainfall station during the entire period of record. The inverse distance squared method was used to fill in daily missing values in each data set before calculating monthly averages.

Table D-2. Monthly and Mean Rainfall (inches) at Cow Creek Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1971	0.31	2.00	1.74	1.70	5.05	7.63	9.12	1.52	3.80	3.15	0.06	0.92	37.01
1972	0.28	0.83	4.07	0.81	5.55	10.01	3.53	9.49	1.87	2.20	2.20	0.75	41.60
1973	2.72	1.70	3.65	1.59	5.05	5.19	7.90	2.34	5.53	3.23	0.15	1.15	40.20
1974	1.51	0.67	0.17	1.87	1.92	11.66	12.92	7.34	3.80	2.83	2.50	1.20	48.39
1975	0.15	3.83	0.00	1.25	7.03	9.25	7.81	8.55	4.55	2.77	0.40	0.97	46.55
1976	0.37	1.50	0.62	1.81	11.82	9.53	5.70	0.90	6.64	0.10	0.34	2.51	41.84
1977	1.60	0.97	0.30	0.28	3.11	6.34	6.87	8.68	6.55	1.93	4.09	3.02	43.73
1978	2.05	1.55	3.50	1.72	3.12	10.66	5.57	2.55	6.34	3.33	1.00	4.45	45.84
1979	4.12	0.04	1.46	1.81	10.46	2.20	3.11	6.65	25.33	0.90	1.77	1.28	59.13
1980	3.08	2.16	2.50	4.48	2.90	3.42	4.21	4.90	1.92	1.16	2.87	0.66	34.26
1981	0.35	2.10	0.64	0.15	3.67	5.25	1.71	9.95	6.04	2.39	0.85	0.23	33.33
1982	1.02	2.79	9.95	6.34	4.47	8.28	6.90	7.17	4.28	2.18	1.85	0.50	55.73
1983	2.66	6.12	2.82	0.65	2.12	6.04	4.24	8.45	5.84	5.53	0.77	3.79	49.03
1984	0.18	3.48	2.68	0.92	2.76	2.35	6.17	4.53	7.79	0.44	4.34	0.73	36.37
1985	0.24	0.10	2.09	4.05	2.92	6.25	10.08	6.77	9.35	2.08	2.12	1.05	47.09
1986	1.67	1.83	2.95	0.19	3.26	9.66	3.97	9.32	3.14	5.94	1.09	3.63	46.65
1987	1.21	1.72	4.09	0.00	2.17	5.80	4.09	1.67	2.88	4.31	7.32	0.00	35.26
1988	2.26	1.66	3.09	2.06	4.72	4.18	6.04	8.38	1.52	1.32	2.58	1.81	39.63
1989	2.11	0.32	2.78	3.77	0.78	5.53	3.06	4.37	5.20	3.73	0.40	2.83	34.88
1990	1.11	2.70	0.53	0.77	3.24	7.41	3.72	6.59	13.88	2.86	1.22	0.39	44.42
1991	5.37	1.74	3.63	5.65	2.98	5.66	12.08	4.62	6.48	4.38	1.67	0.42	54.68
1992	1.38	2.59	1.47	3.43	0.91	15.92	5.72	9.69	5.71	0.85	5.29	1.25	54.21
1993	8.05	3.43	6.80	1.58	3.08	3.34	6.80	4.43	3.33	6.46	2.75	0.83	50.87
1994	3.46	5.91	3.07	7.65	5.22	11.08	3.42	6.71	6.19	3.87	4.68	6.91	68.17
1995	1.46	3.33	2.71	2.51	2.19	5.87	8.02	12.68	5.78	12.07	0.54	0.70	57.86
1996	1.83	1.36	10.01	1.20	6.04	6.08	4.31	1.84	5.14	8.02	1.63	2.14	49.60
1997	2.26	1.12	2.80	9.45	3.71	8.72	8.62	10.17	4.18	1.03	1.95	3.68	57.69
1998	2.52	5.95	4.60	5.23	2.32	2.77	4.54	7.60	10.22	0.58	5.64	0.43	52.40
1999	2.47	0.42	1.21	3.03	5.25	12.39	3.72	7.13	9.11	10.52	1.90	1.19	58.34
2000	2.30	1.03	1.83	3.15	0.24	4.40	6.70	4.50	6.54	3.71	0.29	0.66	35.36
Mean	2.00	2.16	2.93	2.64	3.94	7.10	6.02	6.32	6.30	3.46	2.14	1.67	46.67

Table D-3. Monthly and Mean Rainfall (inches) at Fort Drum Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.38	3.55	4.71	0.64	0.05	4.55	8.13	5.72	5.94	7.77	0.69	1.61	43.74
1966	4.34	4.10	0.85	2.01	7.37	8.24	4.59	6.95	5.71	3.29	0.82	0.39	48.66
1967	0.31	3.88	1.10	0.00	0.47	8.98	12.18	5.13	6.31	1.30	0.77	2.20	42.63
1968	0.93	1.82	0.63	0.25	3.63	14.21	12.68	2.28	2.36	7.46	2.27	0.46	48.98
1969	2.63	1.46	7.11	3.84	4.89	2.42	3.88	10.72	4.00	11.09	2.89	2.08	57.01
1970	4.74	3.52	4.93	0.07	2.21	3.62	4.82	3.51	4.57	2.96	0.11	0.86	35.92
1971	0.11	3.38	1.62	0.53	5.28	12.60	10.44	5.14	6.90	4.27	0.41	1.40	52.08
1972	1.09	4.59	3.17	1.60	6.95	8.66	4.41	9.02	2.09	1.73	3.10	1.68	48.09
1973	4.97	2.52	2.83	2.24	6.41	10.40	13.83	7.07	7.81	2.89	1.24	1.70	63.91
1974	1.02	1.83	0.08	2.50	3.63	10.63	10.54	10.90	8.09	2.46	0.78	1.48	53.94
1975	0.18	1.89	2.22	1.24	10.66	4.71	15.95	4.22	6.39	5.43	1.31	1.00	55.20
1976	0.35	0.62	1.08	3.03	14.52	7.05	7.39	4.44	10.16	0.65	1.48	3.49	54.26
1977	1.10	1.23	0.53	0.55	3.14	6.41	6.24	8.62	7.13	0.84	5.00	4.29	45.08
1978	1.19	2.80	3.34	0.14	6.36	12.09	9.98	5.34	7.96	1.83	2.83	3.34	57.20
1979	6.82	0.77	0.98	2.91	14.33	1.74	5.69	3.80	22.40	0.77	0.89	1.80	62.89
1980	2.52	2.92	3.89	3.36	2.76	6.13	4.38	3.18	2.92	0.79	2.66	2.02	37.53
1981	0.33	3.35	1.85	0.20	1.54	4.29	4.08	8.82	3.54	2.43	1.52	0.79	32.74
1982	1.12	2.92	6.86	5.47	5.55	8.42	8.80	9.20	5.76	2.44	2.93	1.79	61.26
1983	4.02	7.60	5.20	1.15	1.48	10.85	7.20	10.68	4.65	4.46	2.38	4.62	64.29
1984	0.45	4.24	2.41	1.78	5.23	4.53	9.35	9.08	5.63	0.57	3.81	1.52	48.60
1985	0.53	0.40	2.99	2.49	1.75	5.11	7.48	7.38	14.89	2.38	1.17	1.18	47.75
1986	2.97	0.46	2.92	0.00	1.94	12.48	8.15	5.63	2.99	9.09	0.98	2.63	50.23
1987	4.82	0.68	11.61	0.38	3.79	6.82	5.20	1.66	8.14	3.45	6.77	0.01	53.34
1988	2.95	2.98	4.86	1.10	1.81	8.05	7.33	6.52	2.00	0.84	2.95	0.60	41.99
1989	2.98	1.05	5.27	3.22	1.07	6.96	3.16	9.58	9.12	8.25	1.10	3.06	54.83
1990	0.00	4.35	1.10	2.02	4.20	10.65	10.93	6.97	6.37	5.07	0.00	0.00	51.67
1991	4.86	3.27	5.73	9.60	7.55	14.26	13.17	6.43	6.13	2.62	0.00	0.00	73.62
1992	2.31	3.49	1.34	3.87	0.33	23.50	6.10	11.79	6.26	5.33	5.12	2.17	71.60
1993	8.75	2.19	9.00	3.78	4.30	4.68	5.59	6.60	3.94	10.24	2.80	3.60	65.46
1994	4.35	4.61	0.82	7.07	1.50	10.69	4.79	8.22	7.00	2.57	6.43	3.53	61.60
1995	4.15	4.24	5.13	3.10	2.85	6.55	10.04	14.31	8.35	9.11	1.20	0.67	69.70
1996	4.56	1.90	17.96	2.41	9.32	8.78	5.16	14.02	1.65	6.85	1.26	2.68	76.55
1997	3.98	0.75	1.90	6.67	4.45	11.20	5.80	13.91	7.23	1.73	2.70	7.92	68.23
1998	4.35	5.88	10.18	3.00	1.78	2.05	17.22	8.85	10.69	5.39	6.75	0.30	76.45
1999	2.15	1.15	0.25	2.55	6.94	13.49	4.02	9.69	8.62	13.88	1.90	0.70	65.35
2000	3.50	0.30	1.52	3.52	0.30	3.27	6.80	8.74	4.92	1.90	0.00	0.93	35.70
Mean	2.66	2.69	3.83	2.45	4.45	8.31	7.93	7.61	6.63	4.28	2.19	1.90	54.95

Table D-4. Monthly and Mean Rainfall (inches) at Fort Pierce Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.45	5.61	3.40	2.52	0.66	5.52	5.90	1.37	3.28	7.10	1.42	1.52	38.75
1966	3.73	7.60	2.29	3.01	6.57	11.26	4.96	2.72	6.76	4.52	2.28	1.31	57.01
1967	1.29	2.69	1.66	0.34	0.37	8.57	5.20	5.03	5.32	6.92	0.27	1.81	39.47
1968	0.48	2.08	0.87	0.87	3.80	15.84	6.61	6.91	7.87	7.06	1.97	0.13	54.49
1969	2.29	1.05	7.78	1.18	8.27	3.45	4.99	8.94	9.81	11.41	5.67	3.10	67.94
1970	3.92	2.60	7.26	0.45	7.81	3.20	3.81	4.92	12.32	9.67	1.41	1.13	58.50
1971	0.46	3.57	1.55	1.67	2.18	6.82	9.43	3.78	4.87	6.19	1.78	4.29	46.59
1972	2.37	4.55	2.69	4.31	5.21	10.11	5.33	4.60	2.04	5.37	4.03	1.77	52.38
1973	3.37	2.61	2.18	2.06	5.49	7.95	5.16	6.55	9.11	6.47	1.49	1.38	53.82
1974	2.66	0.86	0.48	2.07	4.93	8.08	12.62	4.48	6.21	3.62	2.10	1.82	49.93
1975	0.19	2.21	1.91	1.44	7.82	5.16	5.70	3.19	8.43	2.62	3.38	1.35	43.40
1976	0.40	1.52	0.72	4.51	7.74	7.70	2.68	4.44	5.45	0.66	2.87	3.47	42.16
1977	2.03	1.76	0.70	1.03	5.54	3.63	2.69	4.89	10.22	4.47	2.48	5.12	44.56
1978	3.21	2.93	2.95	1.96	5.48	5.67	9.37	5.33	4.94	8.00	2.28	7.25	59.37
1979	5.39	0.93	1.13	1.90	5.56	5.22	7.92	3.97	14.22	1.44	2.10	1.66	51.44
1980	3.12	2.79	2.15	2.90	2.54	4.65	6.59	1.31	6.30	6.94	4.78	1.97	46.04
1981	0.57	2.16	1.04	0.35	4.84	0.78	5.72	12.25	5.84	4.05	2.21	0.38	40.19
1982	1.39	3.63	7.48	4.10	12.97	8.31	5.64	5.24	4.86	2.76	8.70	1.79	66.87
1983	4.35	8.21	5.51	1.70	1.66	3.96	1.53	10.74	8.18	10.82	0.91	3.94	61.51
1984	0.94	2.77	4.05	0.76	7.85	4.15	3.80	7.41	6.93	1.34	9.33	0.86	50.19
1985	0.68	0.24	3.31	3.68	4.30	5.05	6.45	6.21	17.50	4.29	3.77	1.50	56.98
1986	3.40	1.80	8.94	0.17	2.43	7.45	6.06	9.21	7.29	6.11	3.21	4.05	60.12
1987	1.57	1.51	4.93	0.32	3.45	2.87	3.49	3.89	4.98	11.36	6.16	0.27	44.80
1988	2.85	2.91	3.43	1.49	2.73	1.54	5.90	4.35	1.46	2.33	2.19	1.48	32.66
1989	3.34	0.27	3.05	2.77	2.88	2.77	1.21	5.83	3.58	6.52	0.93	3.36	36.51
1990	1.65	2.34	0.71	0.65	4.33	3.14	8.13	4.54	11.27	3.71	2.40	0.44	43.31
1991	4.36	6.46	4.42	6.70	6.46	6.49	13.17	3.41	6.05	4.58	1.20	1.73	65.03
1992	0.94	3.33	1.12	4.34	1.00	14.13	1.33	7.48	7.50	1.38	7.74	2.00	52.29
1993	9.46	4.28	6.44	2.17	4.12	5.81	6.98	5.31	7.31	12.83	5.93	0.99	71.63
1994	3.97	9.70	2.34	5.39	4.21	5.33	5.96	6.35	14.19	9.98	5.77	7.42	80.61
1995	2.73	6.50	2.13	3.39	1.13	5.16	8.43	17.66	14.01	13.04	0.80	0.69	75.67
1996	2.83	1.15	12.46	0.83	4.95	5.19	4.28	3.40	9.75	7.49	2.64	1.50	56.47
1997	5.31	1.70	3.35	10.37	2.26	5.68	6.04	12.16	5.01	2.21	3.46	3.68	61.23
1998	2.40	5.23	3.98	3.15	2.75	6.00	3.31	9.17	11.61	2.93	8.05	0.28	58.86
1999	2.64	0.30	0.57	3.29	4.10	10.45	0.82	9.38	11.06	14.29	2.04	1.23	60.17
2000	2.47	1.59	2.39	3.67	0.36	5.94	8.58	4.01	4.56	6.90	0.59	0.78	41.84
Mean	2.59	3.10	3.37	2.54	4.41	6.20	5.72	6.12	7.78	6.15	3.29	2.15	53.41

Table D-5. Monthly and Mean Rainfall (inches) at Pratt Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.90	3.32	2.45	0.20	1.40	4.59	6.25	7.00	5.80	10.90	0.20	0.00	43.01
1966	9.78	3.66	1.80	1.99	4.90	13.13	5.00	8.01	6.56	8.85	1.66	1.78	67.11
1967	1.55	3.25	3.10	0.00	0.60	9.35	10.55	6.65	8.36	9.15	1.23	1.05	54.83
1968	0.42	2.55	0.90	0.40	8.00	22.12	9.50	10.40	10.80	7.77	3.03	0.01	75.89
1969	2.05	1.35	7.12	2.35	6.94	7.64	2.92	9.42	7.87	10.95	1.95	1.39	61.96
1970	2.85	2.48	13.50	1.64	7.00	8.06	11.54	6.19	6.56	3.40	0.00	0.31	63.54
1971	0.80	3.10	1.00	0.35	3.63	6.85	9.86	8.55	7.15	10.61	6.76	4.95	63.60
1972	1.77	2.20	3.67	6.81	8.34	19.56	5.94	7.24	3.42	6.00	4.15	2.39	71.49
1973	3.41	3.62	1.42	1.55	4.75	10.20	7.70	7.08	5.20	8.95	1.08	3.91	58.87
1974	8.69	0.62	3.00	0.40	3.14	18.55	15.39	10.82	8.70	5.10	5.41	0.85	80.67
1975	0.89	4.70	1.25	1.75	7.57	11.93	8.58	3.07	10.55	5.95	1.65	0.61	58.52
1976	0.26	4.10	0.07	3.74	11.60	7.18	5.11	9.32	15.17	0.50	2.26	1.99	61.30
1977	3.62	0.82	0.76	0.00	5.63	5.27	5.05	6.85	15.05	0.58	6.43	5.16	55.21
1978	2.30	2.26	3.70	1.21	6.49	24.35	12.60	7.40	8.60	9.20	7.75	5.70	91.57
1979	4.20	0.30	3.27	2.28	5.23	7.00	6.74	2.54	14.88	9.86	4.55	1.35	62.19
1980	1.60	1.90	1.85	2.80	6.66	5.00	8.55	3.61	6.16	6.00	1.95	1.52	47.61
1981	0.60	2.00	0.80	0.20	3.64	6.20	5.85	14.18	12.37	3.25	3.20	1.75	54.04
1982	1.50	3.60	14.65	2.63	10.16	7.82	13.00	6.30	9.95	6.10	16.25	2.10	94.06
1983	5.20	10.97	4.95	4.45	3.00	9.05	5.45	7.26	16.90	15.30	3.40	12.45	98.38
1984	0.40	2.53	4.58	1.55	6.73	3.56	2.95	4.45	14.79	2.86	14.60	0.00	59.00
1985	0.78	0.00	3.00	5.74	1.18	8.45	8.42	5.07	12.70	4.95	1.16	3.15	54.60
1986	4.64	1.70	7.85	0.15	1.45	16.64	10.02	4.47	6.94	6.14	4.45	4.26	68.71
1987	0.72	0.21	4.10	0.75	2.65	3.85	6.02	2.20	8.90	8.25	12.10	0.73	50.48
1988	3.20	3.19	3.60	1.40	6.52	4.48	9.94	11.25	0.90	0.84	1.80	0.50	47.62
1989	0.70	0.60	4.19	4.50	0.60	7.90	9.43	9.09	5.75	8.56	3.35	2.75	57.42
1990	1.63	4.35	4.65	4.30	5.63	1.55	8.79	14.37	10.10	3.62	2.64	2.23	63.86
1991	9.28	6.25	2.67	9.50	7.32	7.45	12.44	12.33	8.09	10.42	4.54	1.55	91.83
1992	0.45	4.98	1.90	2.99	1.35	21.89	2.57	22.81	17.29	2.35	16.49	1.30	96.37
1993	17.20	5.12	11.44	2.58	8.18	8.48	7.57	8.83	9.39	10.51	4.65	0.70	94.65
1994	8.12	8.05	2.70	4.90	6.99	12.64	12.35	14.12	21.45	8.75	11.51	12.00	123.58
1995	3.64	5.45	3.50	1.85	2.53	8.08	10.24	18.02	8.63	22.75	1.20	0.95	86.84
1996	1.03	0.31	9.50	1.35	13.55	8.76	3.34	1.65	7.04	7.96	3.55	1.28	59.32
1997	4.58	6.58	2.30	8.34	11.39	10.12	10.23	11.84	11.38	0.73	4.80	7.89	90.18
1998	6.65	8.34	6.25	4.90	3.18	5.20	8.97	6.21	14.28	3.88	11.23	3.66	82.75
1999	5.44	0.20	0.54	1.20	7.80	13.89	3.11	5.42	9.00	22.63	0.93	2.99	73.15
2000	1.01	1.74	3.86	6.39	1.89	3.87	6.70	3.47	6.60	9.00	0.82	1.52	46.87
Mean	3.39	3.23	4.05	2.70	5.49	9.74	8.02	8.26	9.81	7.57	4.80	2.69	69.75

Table D-6. Monthly and Mean Rainfall (inches) at S308 Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.23	4.61	1.94	0.22	1.42	11.40	8.30	9.43	4.23	10.78	0.16	1.07	53.75
1966	4.33	3.96	0.85	4.86	4.76	12.73	5.72	5.70	5.01	9.93	0.36	0.61	58.79
1967	0.92	3.33	1.09	0.04	3.70	12.71	6.76	8.63	8.27	6.57	0.16	1.64	53.80
1968	0.27	2.56	0.99	0.22	8.89	15.86	6.20	4.07	6.20	8.78	2.31	0.01	56.33
1969	1.62	2.18	7.50	1.66	5.83	9.33	4.99	6.33	9.21	11.98	1.92	3.66	66.18
1970	3.23	3.92	15.73	0.03	9.93	7.71	7.58	9.11	2.71	2.93	0.10	0.20	63.15
1971	0.20	2.22	0.81	0.18	6.10	3.78	9.16	5.73	4.24	9.25	2.42	2.14	46.20
1972	1.75	1.30	2.38	4.23	3.58	10.89	10.59	4.93	2.86	1.49	1.87	2.46	48.29
1973	1.69	1.84	3.16	0.92	3.89	8.69	13.65	6.75	2.23	4.92	0.10	1.43	49.25
1974	1.24	0.21	0.19	2.21	1.74	11.44	3.65	7.65	9.03	2.20	1.68	0.97	42.19
1975	0.93	2.23	1.93	0.28	4.63	3.61	15.82	3.56	7.13	3.77	0.60	0.34	44.81
1976	0.16	2.02	0.09	1.15	10.13	6.07	2.88	9.91	3.51	1.74	2.90	1.06	41.61
1977	4.53	0.66	1.24	0.73	2.75	1.90	7.32	8.51	10.79	2.85	5.32	4.57	51.15
1978	2.96	1.35	3.08	1.41	3.89	8.92	8.01	6.06	9.37	3.48	3.14	4.30	55.94
1979	6.17	0.13	2.29	1.52	5.53	3.54	3.32	3.62	14.96	2.98	2.07	1.44	47.55
1980	2.97	1.72	1.11	2.74	5.87	1.20	4.72	4.63	9.70	2.26	1.81	1.12	39.84
1981	1.08	1.16	1.07	0.11	2.00	0.86	4.03	12.10	4.25	0.87	0.92	0.09	28.51
1982	0.46	2.91	8.00	4.10	7.64	5.22	7.34	4.07	5.88	2.59	1.97	0.81	50.95
1983	6.91	11.45	6.12	3.40	2.78	6.45	2.66	3.91	4.02	6.21	1.74	2.78	58.43
1984	0.89	4.09	4.51	1.17	7.53	7.47	8.47	3.32	8.52	0.48	4.67	0.07	51.17
1985	0.60	0.13	2.15	3.07	1.60	7.02	9.54	0.54	7.63	3.36	0.05	1.80	37.47
1986	3.23	1.21	3.33	0.15	2.02	10.40	8.47	4.98	7.74	2.98	2.66	3.36	50.50
1987	1.46	1.06	4.30	0.61	2.89	5.79	6.84	1.13	3.44	7.18	6.13	0.04	40.85
1988	1.99	2.85	2.35	1.30	3.48	3.97	8.75	13.56	1.12	0.82	4.75	0.84	45.76
1989	0.67	0.53	4.21	2.67	1.06	3.64	3.48	6.61	4.02	4.38	0.50	2.20	33.95
1990	1.91	1.75	0.75	1.62	4.63	4.71	5.18	8.08	6.07	7.01	0.45	0.26	42.42
1991	4.03	2.59	6.36	7.31	3.32	8.21	6.01	6.06	5.74	3.52	2.30	0.19	55.61
1992	4.00	5.01	2.80	6.10	3.63	12.91	6.35	9.88	6.01	0.78	1.66	0.51	59.62
1993	6.52	2.66	3.42	1.24	1.91	5.10	2.96	3.63	4.87	2.74	1.86	0.29	37.19
1994	5.14	2.66	2.25	6.46	2.83	5.20	4.15	6.57	8.37	4.25	6.69	6.68	61.22
1995	3.18	1.29	7.00	3.24	3.83	6.26	7.88	9.05	2.99	9.86	1.98	0.26	56.79
1996	3.11	38.41	6.21	1.17	5.04	7.42	3.87	2.32	3.60	4.29	1.58	2.87	79.89
1997	1.43	0.21	2.70	4.70	4.84	5.75	2.12	4.37	7.74	0.56	2.62	4.38	41.42
1998	0.71	8.06	4.92	0.60	0.85	7.40	9.14	27.68	12.31	1.34	10.05	1.48	84.53
1999	1.98	1.15	1.03	0.70	4.65	9.36	6.29	8.04	7.22	4.28	0.40	0.82	45.91
2000	0.75	1.10	3.20	5.11	0.20	9.23	6.70	7.52	11.14	1.74	0.68	0.32	47.65
Mean	2.31	3.46	3.36	2.14	4.15	7.28	6.63	6.89	6.45	4.31	2.24	1.58	50.79

Table D-7. Monthly and Mean Rainfall (inches) at Stuart Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.61	4.28	2.27	1.10	0.65	7.13	7.69	3.51	5.36	6.47	1.62	0.77	41.46
1966	6.36	3.86	3.37	4.12	3.69	15.48	3.70	5.66	8.11	6.91	1.20	1.27	63.73
1967	1.09	1.86	2.56	0.11	0.33	9.90	7.66	7.99	4.95	9.25	2.84	1.11	49.65
1968	0.52	2.22	0.93	1.78	8.38	13.72	8.29	6.15	6.57	6.39	2.65	0.12	57.72
1969	2.02	1.28	5.52	1.17	7.12	3.31	3.45	8.54	6.79	6.82	2.41	3.45	51.88
1970	4.94	4.56	18.12	0.00	5.31	7.59	2.40	1.50	8.12	9.37	0.40	0.28	62.59
1971	0.46	2.33	1.68	1.98	6.75	4.14	7.01	2.87	8.44	5.43	4.21	4.72	50.02
1972	1.67	1.85	3.68	6.45	7.37	11.12	11.14	3.30	3.60	2.49	4.61	2.63	59.91
1973	4.51	6.03	2.07	0.89	4.30	7.92	5.56	6.94	6.82	6.87	0.91	1.48	54.30
1974	1.87	0.80	1.40	1.36	3.47	8.30	12.44	5.06	3.59	4.40	3.22	2.04	47.95
1975	0.16	1.53	1.59	1.46	8.82	7.48	4.55	1.97	6.04	3.04	0.90	1.30	38.84
1976	0.46	2.63	0.03	2.57	9.17	6.68	3.15	4.92	6.53	2.82	4.08	5.94	48.98
1977	3.52	0.68	0.59	0.21	3.37	3.56	5.49	3.96	12.40	6.99	3.65	4.46	48.88
1978	3.10	2.19	2.28	2.61	4.99	3.92	6.14	3.42	3.22	4.25	3.08	7.23	46.43
1979	7.03	0.66	1.05	4.08	6.38	3.84	3.07	5.36	15.61	2.70	5.42	1.95	57.15
1980	3.42	3.30	1.41	1.42	5.01	5.17	9.26	3.26	4.71	2.47	4.20	0.30	43.93
1981	0.67	1.82	0.65	0.71	4.21	1.89	2.72	8.72	10.86	3.39	1.93	0.45	38.02
1982	0.81	7.28	13.01	3.56	13.50	9.07	8.74	5.17	6.63	2.41	12.71	2.35	85.24
1983	3.83	13.47	5.72	2.85	2.32	6.79	6.89	9.97	6.73	12.69	2.20	5.49	78.95
1984	0.88	5.77	3.59	1.07	11.13	4.80	3.98	4.39	13.80	1.65	11.01	0.42	62.49
1985	1.54	0.16	5.01	5.94	0.67	5.95	12.23	6.36	12.55	4.18	2.45	3.98	61.02
1986	4.90	1.99	9.17	1.28	4.58	5.86	6.71	7.39	2.97	7.39	2.03	6.41	60.68
1987	2.95	1.62	6.42	0.83	3.33	4.95	5.78	1.88	6.99	7.87	4.65	0.40	47.67
1988	2.70	3.39	4.41	2.78	5.08	4.12	6.98	10.72	1.55	4.84	3.45	1.35	51.37
1989	1.74	0.32	4.07	3.83	4.37	2.85	7.40	6.03	6.32	7.01	0.81	3.38	48.13
1990	2.45	2.21	2.66	0.66	3.77	4.98	10.22	8.35	15.01	3.58	1.99	0.66	56.54
1991	6.83	5.83	6.37	7.92	7.68	10.22	7.17	10.04	6.90	4.56	0.87	1.76	76.15
1992	1.15	2.70	4.16	2.98	2.14	16.80	3.95	15.21	6.29	6.26	10.71	0.53	72.88
1993	11.44	2.27	6.15	3.22	6.49	5.92	2.77	5.14	10.54	17.95	9.16	3.28	84.33
1994	5.31	6.81	4.84	6.89	4.73	9.62	8.56	11.48	13.80	9.35	10.17	8.37	99.93
1995	2.56	2.25	3.48	3.49	2.27	6.15	3.47	14.71	3.81	24.48	0.24	0.66	67.57
1996	1.02	0.34	11.84	2.60	8.15	4.05	4.42	2.62	3.84	6.91	1.63	2.44	49.86
1997	3.85	1.89	3.20	8.61	3.81	7.00	6.42	10.17	5.73	1.54	5.44	5.12	62.78
1998	5.75	10.68	5.99	4.06	5.32	4.88	6.05	10.24	12.00	2.92	7.40	2.77	78.06
1999	5.05	2.32	1.20	4.29	3.27	20.28	4.87	7.95	13.12	13.48	2.34	3.42	81.59
2000	1.92	2.22	5.18	5.26	0.41	5.43	8.55	4.85	6.45	5.77	2.09	1.70	49.84
Mean	3.03	3.21	4.32	2.89	5.07	7.25	6.36	6.55	7.69	6.52	3.85	2.61	59.35

Table D-8. Monthly and Mean Rainfall (inches) at Vero Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.34	6.72	5.85	0.29	0.10	6.43	7.95	5.02	5.82	7.91	2.89	1.55	50.87
1966	4.23	6.20	2.39	2.14	4.79	11.44	8.73	2.74	6.53	13.06	2.08	1.25	65.58
1967	1.67	3.08	1.43	0.66	0.30	4.74	8.16	4.96	3.42	7.34	0.41	1.69	37.86
1968	1.19	2.23	0.54	2.88	7.36	18.24	10.58	6.50	7.78	7.23	2.33	0.15	67.01
1969	2.52	1.16	8.67	1.96	5.49	1.59	7.08	7.65	10.87	9.93	4.19	1.68	62.79
1970	4.62	2.77	5.93	0.31	2.77	4.74	4.34	3.52	10.27	6.18	0.11	0.40	45.96
1971	0.59	3.01	1.59	0.94	3.57	8.02	12.22	2.55	7.95	7.09	2.15	2.25	51.93
1972	1.34	4.44	1.48	5.65	7.30	11.20	2.31	6.33	2.98	2.54	3.46	1.67	50.70
1973	5.75	2.01	2.25	2.64	9.05	11.90	9.00	8.24	8.58	4.95	2.26	1.68	68.31
1974	2.64	1.91	1.91	2.97	4.35	9.19	7.14	8.48	4.36	3.13	2.94	1.66	50.68
1975	0.21	3.81	2.03	0.62	7.72	7.75	3.69	6.44	5.92	4.73	1.61	1.02	45.55
1976	0.55	0.61	0.52	2.23	8.41	10.29	2.14	5.94	9.02	2.35	2.13	3.29	47.48
1977	2.75	0.69	1.05	1.10	3.12	10.63	2.60	5.86	7.94	2.23	3.21	6.68	47.86
1978	1.67	2.93	3.14	0.67	4.34	5.48	4.63	7.01	3.27	3.20	4.72	5.20	46.26
1979	4.71	1.22	1.06	1.89	12.06	3.77	6.20	5.44	21.92	1.65	4.16	1.47	65.55
1980	2.37	3.46	2.46	3.06	3.38	4.09	5.14	1.22	7.18	1.54	3.52	2.28	39.70
1981	0.17	2.13	1.45	0.37	2.31	3.15	2.17	18.26	7.76	3.07	3.09	0.80	44.73
1982	1.21	4.35	10.73	5.39	7.60	8.54	9.73	9.40	7.39	3.09	11.71	2.60	81.74
1983	4.17	11.42	4.74	2.89	1.15	6.35	4.13	9.07	3.20	15.75	1.59	4.32	68.78
1984	2.02	4.24	2.32	1.02	6.53	2.14	4.54	7.09	12.67	3.64	13.65	2.92	62.78
1985	0.87	0.43	2.41	5.53	1.69	3.67	10.28	6.68	12.13	5.76	2.22	2.63	54.30
1986	4.70	2.29	4.97	0.13	1.88	8.86	11.51	4.37	7.07	14.85	3.01	2.55	66.19
1987	3.20	1.27	5.87	0.23	5.85	4.45	5.73	4.61	5.18	7.89	8.35	0.60	53.24
1988	2.78	1.93	6.56	0.54	5.59	2.58	13.08	4.30	1.37	1.65	2.56	2.89	45.83
1989	2.55	1.25	5.32	3.72	1.80	4.08	5.97	5.13	5.87	7.25	0.33	2.80	46.07
1990	1.33	2.81	0.77	1.81	2.95	6.68	4.77	11.76	7.94	6.06	1.64	0.61	49.14
1991	7.32	6.81	7.05	6.47	5.19	6.02	9.33	11.04	4.12	6.97	1.71	1.13	73.16
1992	1.54	3.42	0.89	3.01	1.18	22.55	2.82	4.43	5.77	3.18	9.22	2.14	60.15
1993	7.30	2.66	13.12	1.79	3.66	1.88	3.29	6.95	6.97	4.67	4.86	1.05	58.20
1994	2.36	4.11	3.43	3.79	3.43	9.43	7.42	8.83	12.85	6.35	9.57	6.29	77.87
1995	1.73	3.02	3.90	2.46	1.65	5.00	7.64	10.48	8.38	10.00	0.50	0.27	55.02
1996	4.42	0.99	11.11	1.90	5.63	11.14	7.71	3.07	3.87	10.36	0.67	2.14	63.01
1997	3.56	2.80	4.18	8.10	2.67	8.03	5.71	8.46	6.41	2.42	3.07	4.81	60.23
1998	4.43	6.96	7.21	1.51	3.94	0.98	7.90	9.54	9.57	4.84	5.46	0.92	63.26
1999	2.18	1.38	0.63	1.93	3.28	7.10	4.10	5.58	5.32	13.50	2.93	0.79	48.73
2000	2.50	0.84	2.28	2.28	0.55	5.11	9.74	3.10	9.32	5.99	0.22	0.52	42.45
Mean	2.71	3.09	3.92	2.36	4.24	7.15	6.65	6.67	7.42	6.18	3.57	2.13	56.08

FREQUENCY ANALYSIS

1-in-10 Year Drought Event

Water supply planning statutory requirements direct water supply plans to identify sufficient sources of water to provide a 1-in-10 level of certainty to all water users. A 1-in-10 level of certainty is the probability that the needs for reasonable-beneficial uses of water will be fully met during a 1-in-10 year drought. A 1-in-10 year drought is defined as a drought of such intensity, that it is expected to have a return frequency of once in 10 years. This means that there is only a 10 percent chance such a small amount of rain will fall in any given year.

Statistical Method

The statistical approach requires selection of the initial month and an analysis of 12 cumulative rainfall data sets. March was chosen as the month to begin the analysis because it marks the time of year when the rainfall-evapotranspiration deficit becomes the greatest. A statistical rainfall frequency analysis was performed on March rainfall data for each station. Similar analyses were performed on historical rainfall data for durations of two months (March through April) through 12 months (March through the following February). Estimates of 10 percent drought frequency rainfall were made for each duration and individual month amounts were obtained by subtraction of consecutive cumulative amounts (e.g., the November rainfall amount was obtained by subtracting the cumulative March–November drought frequency estimate from the cumulative March–October estimate). This analysis produced a set of monthly values that had a constant cumulative drought frequency of 10 percent. The individual month rainfall amounts (other than that of the initial month of March) do not have a prescribed drought frequency.

Each rainfall time series was fitted to the logarithmic-normal probability distribution. The log-normal distribution is useful in defining many hydrologic random variables where the values of the variate are the result of underlying multiplicative factors, and are known to be strictly positive, (Alfredo *et al.*, 1975), and has been previously used to define rainfall. A non-parametric test was performed on each of the time series to assess the goodness-of-fit to the assumed underlying probability distribution.

The statistical 1-in-10 year drought event plots for the seven rainfall stations are shown in **Figure D-3**; while the values for 1-in-10 year drought events are listed in **Table D-9**.

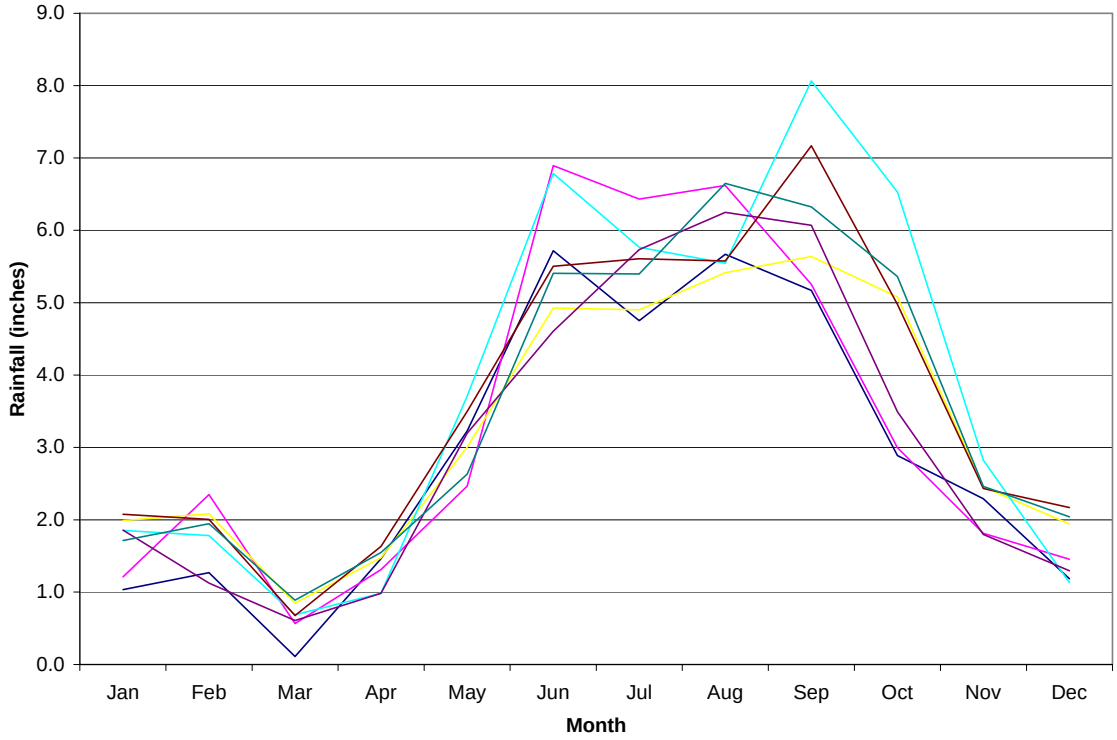

Figure D-3. Statistical 1-in-10 Year Drought Events for Rainfall Stations in the UEC Planning Area.

Table D-9. Statistical 1-in-10 Rainfall (in inches) for Rainfall Stations Based on a Log Normal Distribution.

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Cow Creek[a]	1.0	1.3	0.1	1.5	3.2	5.7	4.8	5.7	5.2	2.9	2.3	1.2	34.8
Fort Drum	1.2	2.3	0.6	1.3	2.5	6.9	6.4	6.6	5.3	3.0	1.8	1.5	39.4
Fort Pierce	2.0	2.1	0.8	1.5	3.0	4.9	4.9	5.4	5.6	5.1	2.5	1.9	39.8
Pratt	1.9	1.8	0.7	1.0	3.7	6.8	5.8	5.5	8.1	6.5	2.8	1.1	45.7
S308	1.9	1.1	0.6	1.0	3.2	4.6	5.7	6.2	6.1	3.5	1.8	1.3	37.0
Stuart	2.1	2.0	0.7	1.6	3.5	5.5	5.6	5.6	7.2	5.0	2.4	2.2	43.3
Vero	1.7	1.9	0.9	1.5	2.6	5.4	5.4	6.7	6.3	5.4	2.5	2.0	42.4

a. Cow Creek 1971–2000.

REFERENCES CITED

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Ali, A. and W. Abtew. 1999. *Regional Rainfall Frequency Analysis for Central and South Florida*. Technical Publication WRE-380. South Florida Water Management District, West Palm Beach, FL. vari. pag.

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APPENDIX E

Upper East Coast Water Source Options

INTRODUCTION

Water Source Options

Several water source options were considered in this water supply plan. This appendix contains additional information for several of these options, including conservation, the Floridan Aquifer and surface water.

Water Conservation

The housing stock analysis by utility service area, used to estimate potential water savings associated with retrofit conservation measures is included in this section. The dates presented represent years when changes were made to the plumbing code as described in the UEC Planning Document.

Floridan Aquifer

This section provides a detailed summary of the comprehensive Floridan Aquifer monitoring well network that was established to monitor the effects of sustained withdrawals on the aquifer pursuant to the recommendations in the 1998 Plan. The purpose of the Floridan Aquifer monitoring network is to provide water level, water quality and water use data in high use areas (citrus groves) to determine statistical trends and relationships between the three data sets. Understanding these relationships will aid in the allocation of water from the Floridan Aquifer, and planning for long-term water supply in the region.

Surface Water

A link to the conceptual drawing of the Ten Mile Creek Critical Restoration Project is provided in this section. The recommended CERP Indian River Lagoon – South Project map is also presented.

WATER CONSERVATION

Housing Stock Analysis

The housing stock analysis includes counts and percentages of units constructed before rain sensor rules and plumbing codes went into effect (pre-1984, 1984–1994, 1994–2000). **Tables E-1** through **E-4** shows the counts and percentages of housing in each age group in each utility service area for Martin and St. Lucie counties.

Plumbing Codes

To determine housing with greater potential for indoor retrofits, unit age of the residential units was compared to years when plumbing code changed (pre-1984, 1984–1994, 1994–2000). **Tables E-1** and **E-2** show the counts and percentages of housing in each age group in each utility service area for Martin and St. Lucie counties.

Table E-1. Analysis of Martin County Housing Stock in Relation to Indoor Plumbing Code Changes.

Utility Service Area	Housing Stock			
	Pre 1984	1985-1994	Post 1994	Total
Indiantown Water Co.	765 87%	61 7%	51 6%	877
Martin County – Martin Downs	413 22%	1,308 69%	188 10%	1,909
Martin County – North	3,027 76%	778 20%	181 5%	3,986
Martin County – Port Salerno	2,814 64%	1,338 30%	279 6%	4,431
Martin County – Tropical Farms	316 72%	99 22%	26 6%	441
Miles Grant/Utility Inc.	50 96%	2 4%	0 0%	52
Piper's Landing	51 47%	55 50%	3 3%	109
Sailfish Point	14 8%	140 78%	26 14%	180
South Martin Regional Utility	2324 50%	1892 40%	477 10%	4693
Stuart	1,625 92%	115 6%	32 2%	1,772
Not in a Service Area	14,036 56%	8,462 34%	2,454 10%	24,952
Martin County Totals	25,435	14,250	3,717	43,402

Source: Year 2000 Martin County Property Appraisers data and District Regulation files.

Table E-2. Analysis of St. Lucie County Housing Stock in Relation to Indoor Plumbing Code Changes.

Utility Service Area	Housing Stock			
	Pre 1984	1985-1994	Post 1994	Total
Ft. Pierce Utilities Authority	13,586 75%	3,675 20%	932 5%	18,193
Harbour Ridge	2 0%	437 94%	28 6%	467
Panther Woods	1 1%	95 84%	17 15%	113
Port St. Lucie	13,456 37%	17,842 49%	5,431 15%	36,729
Spanish Lakes Fairways	536 48%	499 45%	79 7%	1,114
St. Lucie County North/Holiday Pines	0 0%	0 0%	252 100%	252
St. Lucie West	0 0%	271 38%	443 62%	714
Not in a Service Area	3,263 62%	1,655 31%	379 7%	5,297
St. Lucie County Totals	30,844	24,474	7,561	62,879

Source: Year 2000 St. Lucie County Property Appraisers data and District Regulation files.

Rain Sensor Rule

To determine housing with greater potential for outdoor retrofits, the unit age was compared to years when rain sensor law changed (pre-1992 and post-1992). **Tables E-3** and **E-4** show the counts and percentages of units constructed in the two time periods in each county by utility service area.

Table E-3. Analysis of Martin County Housing Stock in Relation to Rain Sensor Rule.

Utility Service Area	Housing Stock		
	Pre 1992	Post 1992	Total
Indiantown Water Co.	805 92%	72 8%	877
Martin County – Martin Downs	1,546 81%	363 19%	1,909
Martin County – North	3,739 94%	247 6%	3,986
Martin County – Port Salerno	4,038 91%	393 9%	4,431
Martin County – Tropical Farms	403 91%	38 9%	441
Miles Grant/Utility Inc.	52 100%	0 0%	52
Piper's Landing	106 97%	3 3%	109
Sailfish Point	139 77%	41 23%	180
South Martin Regional Utility	3,970 85%	723 15%	4,693
Stuart	1,728 98%	44 2%	1,772
Not in a Service Area	21,394 86%	3,558 14%	24,952
Martin County Totals	37,920	5,482	43,402

Source: Year 2000 Martin County Property Appraisers data and District Regulation files.

Table E-4. Analysis of St. Lucie County Housing Stock in Relation to Rain Sensor Rule.

Utility Service Area	Housing Stock		
	Pre 1992	Post 1992	Total
Ft. Pierce Utilities Authority	16,870 93%	1,323 7%	18,193
Harbour Ridge	393 84%	74 16%	467
Panther Woods	92 81%	21 19%	113
Port St. Lucie	29,211 80%	7,518 20%	36,729
Spanish Lakes Fairways	991 89%	123 11%	1,114
St. Lucie County North/Holiday Pines	0 0%	252 100%	252
St. Lucie West	232 32%	482 68%	714
Not in a Service Area	4,751 90%	546 10%	5,297
St. Lucie County Totals	52,540	10,339	62,879

Source: Year 2000 St. Lucie County Property Appraisers data and District Regulation files.

FLORIDAN AQUIFER

Upper East Coast Comprehensive Floridan Aquifer Monitoring Well Network

The Upper East Coast (UEC) Planning Area covers approximately 1,200 square miles and includes Martin and St. Lucie counties, as well as a small portion of eastern Okeechobee County. Agriculture is the major land use in the area with citrus being the dominant crop. Citrus crops are primarily irrigated with surface water from canals. The Floridan Aquifer is used by growers as a supplemental source when surface water availability is limited, and as a primary irrigation source when surface water is not available (SFWMD, 1998). In most cases, water from the Floridan Aquifer has a high salinity (relative to surface water) and has to be blended with surface water or water from the Surficial Aquifer before it is used for irrigation.

The Floridan Aquifer in the UEC Planning Areas is a relatively unused water source for public water supply, as it located approximately 900 feet below land surface. Citrus farmers mainly use water from the Floridan Aquifer as a supplemental source of irrigation in the region. Currently, most of the public water supply for the region comes from the shallower Surficial Aquifer as it has better quality water. However, the use of the Floridan Aquifer by utilities is increasing and most coastal utilities in the region plan to use the Floridan Aquifer to meet their future needs. Utilities either blend the Floridan water with fresh water or treat it using reverse osmosis.

Network Purpose

Preliminary evaluations presented in the UEC Water Supply Plan (SFWMD, 1998) indicated that the Floridan Aquifer could meet current and projected future urban and agricultural water use demands. However, there is little information on long-term ramifications to water quality in the aquifer from sustained withdrawals. The SFWMD recommended establishing a comprehensive Floridan Aquifer monitoring well network, the UECFAS, to evaluate the effects of sustained withdrawals on the aquifer (Recommendation 3.2, SFWMD, 1998).

The purpose of the UECFAS is to provide water level, water quality and water use data across the UEC Planning Area and determine statistical trends and relationships between the three data sets. Understanding these relationships will help the District better allocate and plan for water supply in the region.

Review of Previous Monitoring Well Networks

The UECFAS was designed using wells from two previously established networks in the region: the District's potentiometric network and the U.S. Department of Agriculture–Natural Resource Conservation Service's (USDA–NRCS or NRCS) network established in 1996. The District's potentiometric network was established in the late 1980s and includes wells in Glades, Highlands, Okeechobee, Martin, Palm Beach and St. Lucie counties. Water level measurements are collected twice a year from the wells in this network: during the dry season and the wet season. This water level data is combined with water level data from other water management districts to develop and publish semi-annual potentiometric surface maps of the Floridan Aquifer. The NRCS established their network in 1996 under a cooperative agreement with the District in an effort to determine water use from the Floridan Aquifer wells for citrus crop irrigation. This network was established as part of the *Indian River Lagoon Surface Water Improvement and Management Plan* to document the frequency, quantity and timing of water use from the aquifer. This initial NRCS network consisted of 45 wells at 16 sites and was later expanded to include 57 wells at 21 sites. As previously mentioned, the NRCS network was fully integrated into the comprehensive network under a cooperative agreement in 1999.

The UECFAS selected wells from the two aforementioned sources to establish a comprehensive set of monitoring sites across the UEC Planning Area. Laying the foundation of the UECFAS began in 1999 when potential wells were selected from District and NRCS sites. A cooperative agreement between the two agencies merged the NRCS sites with selected District sites into one monitoring network covering the UEC Planning Area. The agreement directs the District to manage the wells selected from the potentiometric network and the NRCS to manage the wells selected from their network. By the end of 2000, the water use and water quality components of the UECFAS were established. The water level component was not fully implemented until mid-2002, due to several logistical reasons involving the installation of water level recorders on the artesian wells.

Network Design and Composition

This section describes the design and composition of the UECFAS and its primary objectives. Several factors that led to the final design of the network are also discussed, including the data collection methods

The first stage in designing any monitoring well network is to determine the objectives of the monitoring program (Heath, 1976; O'Hearn and Schock, 1984; and Moore, 1983). The main objective of the UECFAS is to collect water level, water quality and water use data from the Floridan Aquifer focusing on areas with relatively high Floridan Aquifer water use. The long-term trends in each data set will be evaluated, as well as any relationships between the three.

The UECFAS was designed to cover Martin and St. Lucie counties. Over 90 percent of the wells are owned by private landowners and are monitored based on the willingness of the owner to participate in this study. The District obtained access agreements for 12 sites in its potentiometric network. The NRCS received permission to monitor all 45 wells in its network. In 2001, the NRCS added 15 wells (at 5 sites) to provide additional sampling points and improve the UECFAS's coverage. The distribution of the monitoring wells across the UEC Planning Area is shown in **Figure E-1**. The sites in **Figure E-1** are identified with a number: the site name corresponding to each number is listed in **Table E-5**.

Twelve of the wells the District monitors tap the upper Floridan Aquifer and two penetrate the lower Floridan Aquifer (SLF-14 and SLF-74). Three monitoring wells, SLF-74, SLF-75 and SLF-76 (location 12 in **Figure E-1**) are located on the District right-of-way adjacent to the C-24 Canal in central St. Lucie County. These three wells were installed by the District as part of a separate hydrogeologic investigation (Lukasiewicz and Smith, 1996) in the UEC Planning Area and are the only dedicated monitoring wells (not used for agriculture) in the network. The locations of the District monitoring wells are identified in **Figure E-1**.

By 2002, NRCS monitored 57 wells at 21 different sites in the UECFAS. These wells are privately owned and the NRCS maintains the wells and collects data from them. All wells monitored by the NRCS are used for citrus grove irrigation and all are completed into the upper Floridan Aquifer. The locations of the NRCS monitored wells are also shown in **Figure E-1. Table E-5** lists the wells currently in the UECFAS.

The UECFAS will allow the District to better assess current and plan for future groundwater conditions in the UEC Planning Area's Floridan Aquifer.

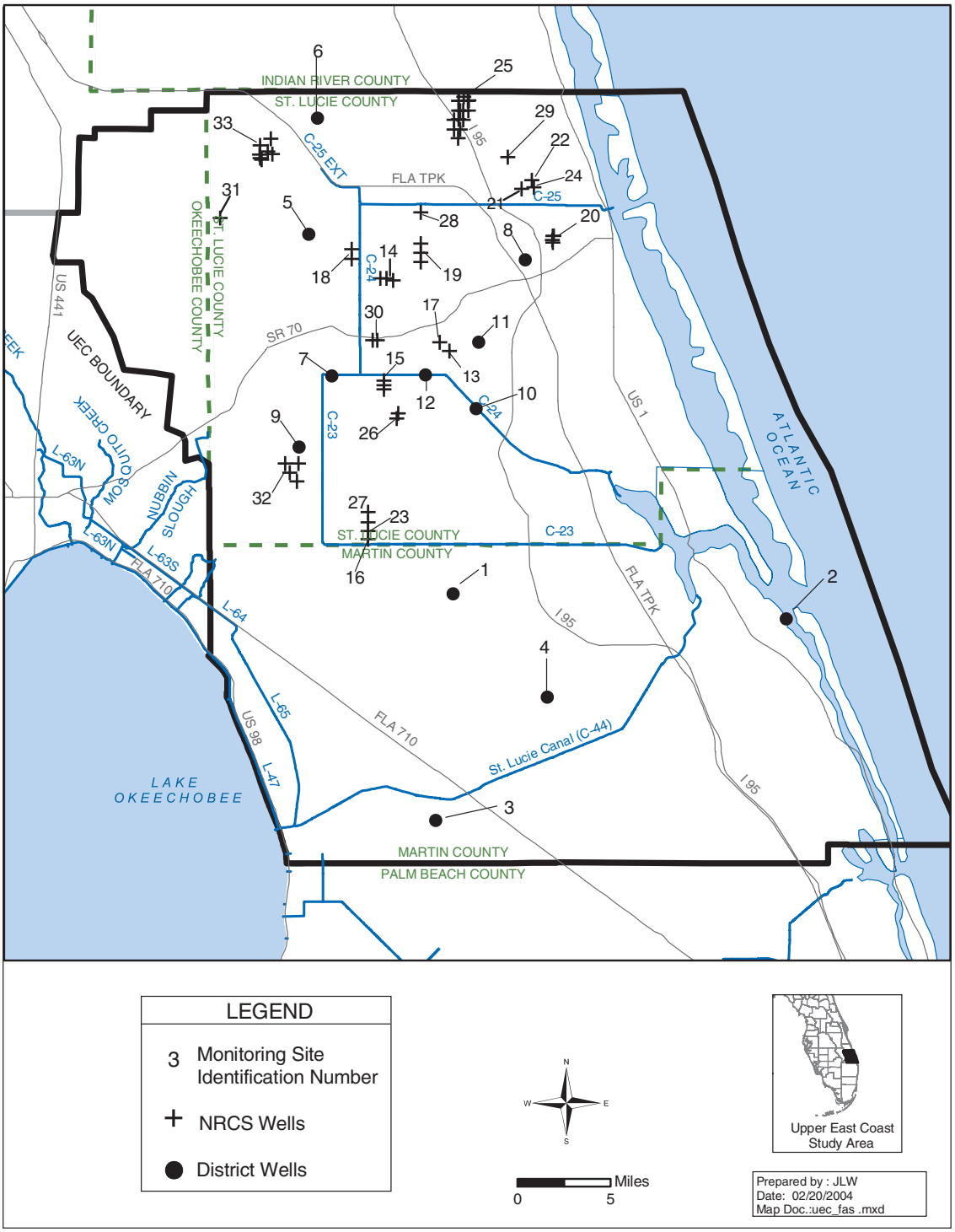

Figure E-1. Distribution of Monitoring Wells in the UECFAS.

Table E-5. Wells in the UEC Comprehensive Floridan Aquifer Monitoring Well Network.

Map Site ID	Site Name	County	Number of Wells at Site	Monitored By	Data Collected
1	MF-9	Martin	1	SFWMD	WQ[b]
2	MF-3	Martin	1	SFWMD	WQ[b]
3	MF-35B	Martin	1	SFWMD	WL[a], WQ[b]
4	MF-52	Martin	1	SFWMD	WL[a], WQ[b]
5	SLF-9	St. Lucie	1	SFWMD	WQ[b]
6	SLF-11	St. Lucie	1	SFWMD	WQ[b]
7	SLF-14	St. Lucie	1	SFWMD	WL[a], WQ[b]
8	SLF-21	St. Lucie	1	SFWMD	WL[a], WQ[b]
9	SLF-60	St. Lucie	1	SFWMD	WQ[b]
10	SLF-62B	St. Lucie	1	SFWMD	WL[a], WQ[b]
11	SLF-69	St. Lucie	1	SFWMD	WL[a], WQ[b]
12	C-24 Site	St. Lucie	3	SFWMD	WL[a], WQ[b]
13	Grove #1	St. Lucie	1	NRCS	WQ[b], WU[c]
14	Grove #2	St. Lucie	3	NRCS	WL[a], WQ[b], WU[c]
15	Grove #3	St. Lucie	3	NRCS	WQ[b], WU[c]
16	Grove #4	St. Lucie	1	NRCS	WQ[b], WU[c]
17	Grove #5	St. Lucie	1	NRCS	WQ[b], WU[c]
18	Grove #6	St. Lucie	2	NRCS	WQ[b], WU[c]
19	Grove #7	St. Lucie	3	NRCS	WQ[b], WU[c]
20	Grove #8	St. Lucie	4	NRCS	WQ[b], WU[c]
21	Grove #11	St. Lucie	1	NRCS	WL[a], WQ[b], WU[c]
22	Grove #12	St. Lucie	1	NRCS	WL[a], WQ[b], WU[c]
23	Grove #13	St. Lucie	1	NRCS	WQ[b], WU[c]
24	Grove #14	St. Lucie	1	NRCS	WQ[b], WU[c]
25	Grove #29	St. Lucie	15	NRCS	WL[a], WQ[b], WU[c]
26	Grove #35	St. Lucie	2	NRCS	WL[a], WQ[b], WU[c]
27	Grove #36	St. Lucie	2	NRCS	WQ[b], WU[c]
28	Grove #121	St. Lucie	1	NRCS	WL[a], WQ[b], WU[c]
29	Grove #201	St. Lucie	1	NRCS	WL[a], WQ[b], WU[c]
30	Grove #202	St. Lucie	2	NRCS	WQ[b], WU[c]
31	Grove #203	St. Lucie	1	NRCS	WL[a], WQ[b], WU[c]
32	Grove #204	St. Lucie	4	NRCS	WL[a], WQ[b], WU[c]
33	Grove #205	St. Lucie	7	NRCS	WL[a], WQ[b], WU[c]

a. WL – Water level data (readings collected every 15 minutes).

b. WQ – Water quality data (monthly specific conductance readings, quarterly chloride and total dissolved solids data).

c. WU – Water use data (collected monthly).

Data Collection Objectives and Methods

This section discusses the different types of data collected from the UECFAS.

Water Level Data Collection

There are currently 18 sites that collect continuous (15 minute interval) water level data in the UECFAS. The District maintains six sites and the NRCS maintains the other 12 sites. Electronically collected water level data will allow for a detailed evaluation of water levels in the Floridan Aquifer because of the high frequency at which they are collected. Hydrographs developed for each well should show water level trends over time. Seasonal variations, as well as long-term water level trends will be recorded. Data from the District maintained sites are stored in DBHYDRO, the District's main database. Plans are underway to upload the data from the NRCS maintained sites into DBHYDRO.

The six sites that the District currently maintains have been equipped with a Campbell Scientific CR10 data logger and a Rittmeyer (Model MPxSGRN) pressure transducer. Each pressure transducer is rated at 30 pounds per square inch (psi) and mounted on top of the wellhead. The water level recorders are connected to a telemetry system that sends data back to the District daily. A water level reading is collected every 15 minutes and stored in the data logger's storage module. Data for these six sites is available from September 2001 to present.

The NRCS has installed electronic water level recorders that consist of In-Situ, Inc., MiniTroll (professional model) data loggers in each well. Each MiniTroll is rated at 30 psi and is set in each well approximately 30 feet from the top of the wellhead. Each MiniTroll collects a water level reading every 15 minutes and stores it in the instruments internal memory. Unlike the District sites, which have telemetry, NRCS personnel visit each well monthly and manually download data from the loggers onto a laptop computer. The water level data is then sent to the District electronically each month.

Water Quality Data Collection

Water quality samples are collected on two separate schedules: monthly specific conductance samples from all NRCS monitored wells, quarterly chloride, total dissolved solids (TDS) samples and specific conductance samples from selected wells that both the District and NRCS monitor.

The NRCS collects specific conductance data monthly from each of the 57 wells they monitor. After purging each well, a specific conductance reading is taken in the field with a handheld water quality probe. The probe is calibrated daily and checked against a known standard. The NRCS sends the specific conductance data and calibration logs to the District in a quarterly report.

Water quality data collected on a quarterly schedule are available from January 2001 to present for selected wells in the UECFAS. The District retained a contractor (GFA International) to collect water quality samples from the wells the District is responsible for. The NRCS collects water quality samples from the wells they monitor. These samples will allow the District to gauge water quality changes in the aquifer on a seasonal, as well as a long-term basis. Before a water sample is collected, each well is allowed to flow (purged) at least three well volumes. This procedure ensures that the water samples are representative of the aquifer and not of water stored in the well bore. Both the District contractor and the NRCS follow the District's quality assurance/quality control (QA/QC) protocol when collecting these water quality samples. Specific conductance samples are collected after purging is complete and are measured in the field with a calibrated handheld water quality probe. All Chloride and TDS samples are collected in the appropriate sample containers, after purging is complete. These samples are sent to a state certified analytical laboratory (US Biosystems) for analysis. Water quality data from the UECFAS are stored in DBHYDRO, the District's primary database. Data collected by the District is stored under the project code "UECF." Data collected by the NRCS is stored under the project code "NRCS."

Water Use Data Collection

As part of the cooperative agreement with the District, the NRCS installed flow meters on the 57 wells they monitor. Water use data is only available for the NRCS portion of the UECFAS. Collecting water use data involves reading each flow meter once a month and recording the amount of water used. The NRCS sends the water use data to the District in a quarterly report along with the monthly water quality data they collect. The water use data will be plotted to reveal any trends. The objective is to discover seasonal variations and long-term trends. In addition, annual water use totals for each grove will show which groves frequently use water from the Floridan Aquifer and if the use is continuous from year to year or only during times of a water shortage.

Rainfall Data Collection

In conjunction with the water level, water quality and water use data, the NRCS also collects rainfall data at each site they monitor. There are 21 rain gauges distributed across St. Lucie County where the NRCS collects rainfall data monthly. Rainfall data is useful in showing when the wet and dry seasons start and the annual rainfall in the region and may relate to detected trends in water use.

Network Maintenance

Currently, most work with the UECFAS involves collecting data from the wells and performing a variety of maintenance tasks. The maintenance tasks are as follows.

Data Logger Maintenance

Data logger maintenance, whether it is a CR10 or a MiniTroll, involves changing desiccant packs, ensuring the internal batteries are charged and checking to ensure that the equipment and protective housing are functional. The maintenance also involves calibrating each data logger and verifying that it is collecting accurate measurements. This maintenance is performed monthly as the desiccant packs require frequent changing due to the high humidity in south Florida.

Wellhead Maintenance

From time to time several wellheads develop leaks and/or rupture, requiring repair. Most of the wells in the UECFAS are over 20 years old, and these problems develop as the highly mineralized water in the Floridan Aquifer corrodes the steel wellheads. Both the District and the NRCS hire certified well drilling companies to repair damaged wellheads.

Flow Meter Maintenance

The NRCS performs routine maintenance on each flow meter to ensure that they remain calibrated and operational. They inspect each meter monthly, while on site collecting flow meter readings. The maintenance also involves calibrating each flow meter as needed and verifying that it is collecting accurate measurements. An independent contractor certified by the flow meter manufacturer performs flow meter calibration. These inspections enable the NRCS to identify faulty meters in a timely manner, have them repaired and minimize any gaps in the data record.

Data Summary

This section presents a summary of the data collected since the network was developed in 1999. Initial data analysis included tabulating and graphing the data to look for trends. A secondary analysis included a correlation between the data sets to see if there were any relationships between them.

Water Level Data

Continuous water level data are available for 18 wells from late 2001 to present. Hydrographs for each well show water levels generally decreased during the dry season, reaching “lows” in May of each year. During the wet season, the water levels generally rise to “highs” in September/October of each year. The hydrograph for some wells show several sharp dips that look like straight lines. Since the wells in the UECFAS are artesian, these dips represent times when the well was used for irrigation and indicate the pressure drop that occurred when the landowner opened the wellhead valve. A more thorough discussion of the water level data will take place in a separate technical report when more data is available to assess seasonal and long-term trends. Additional water

level data will allow for trend comparisons with the water quality and water use data. Hydrographs from two selected wells are presented below. One hydrograph represents a well that is used frequently for citrus irrigation (**Figure E-2**) and the other a well used strictly for monitoring (**Figure E-3**).

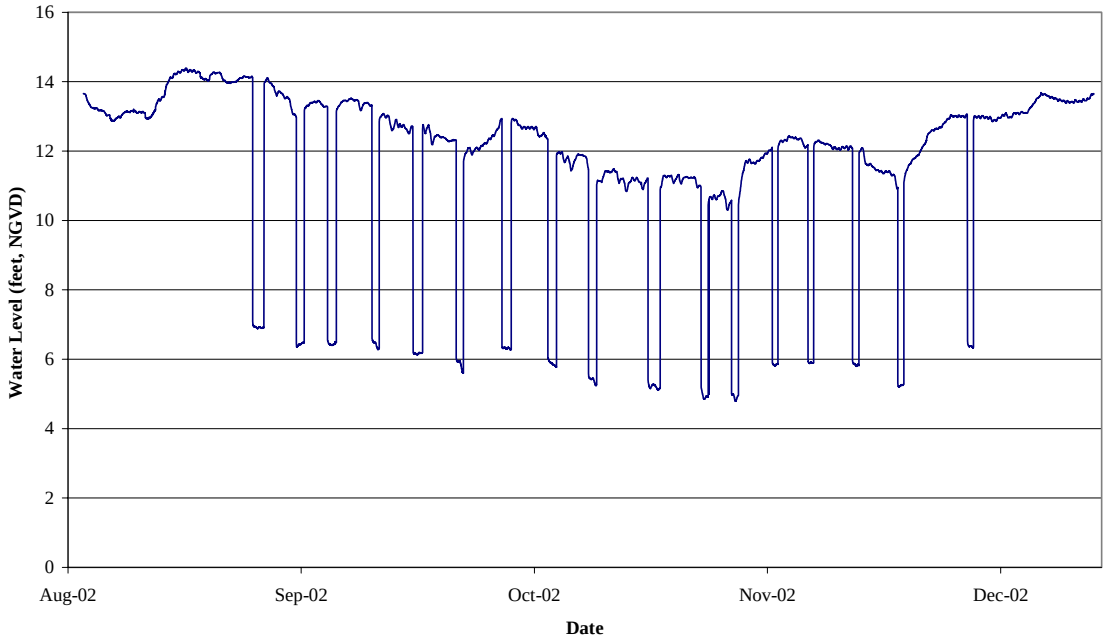

Figure E-2. Hydrograph of Well SLF-21 (Site 8 on **Figure E-1**).

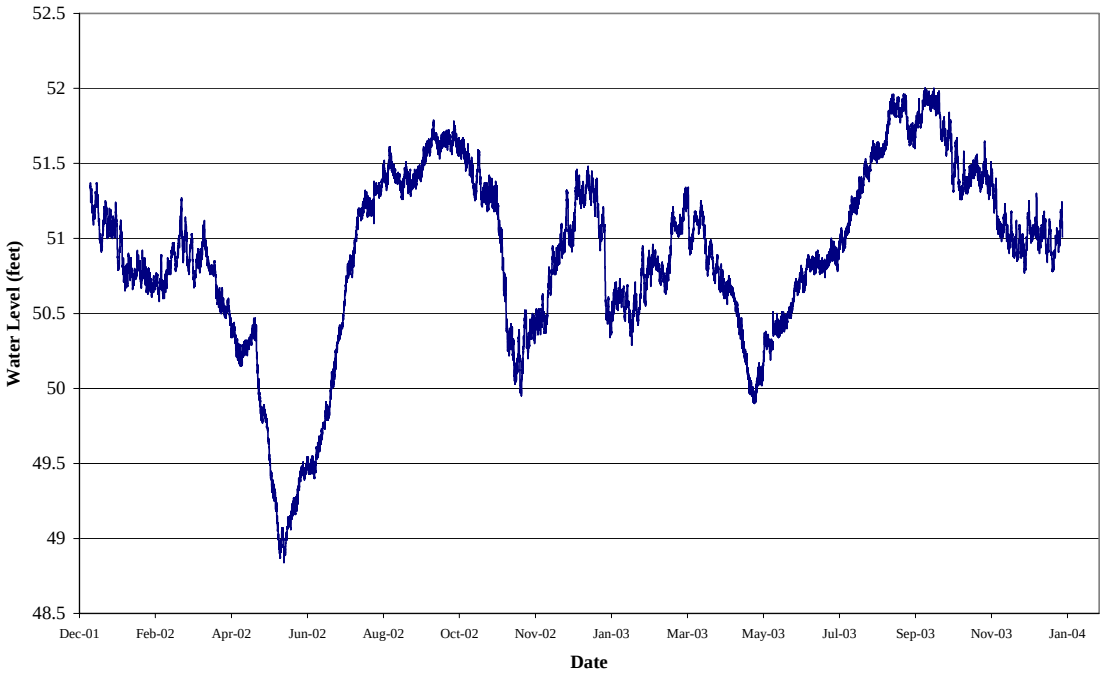

Figure E-3. Hydrograph of Well MF-52 (Site 4 on **Figure E-1**).

Water Quality Data

Water quality data has been collected in various forms from the UECFAS as follows:

- NRCS monthly specific conductance data from 1999
- NRCS quarterly chloride and TDS data from January 2001
- District quarterly chloride and TDS data from January 2001

Specific Conductance Data

Specific conductance data is available from 1999 for 42 wells monitored by the NRCS. Data is available for the remaining 15 NRCS wells, but the period of record is not as extensive (start date of April 2002). Plots of the specific conductance data generally show a sinusoidal trend. The graphs were constructed with the date of data collection on the x-axis and specific conductance on the y-axis. The plots generally show that specific conductance peaks in the mid-to-late dry season (March to April) and was at a low in the early dry season (December) (**Figure E-4**).

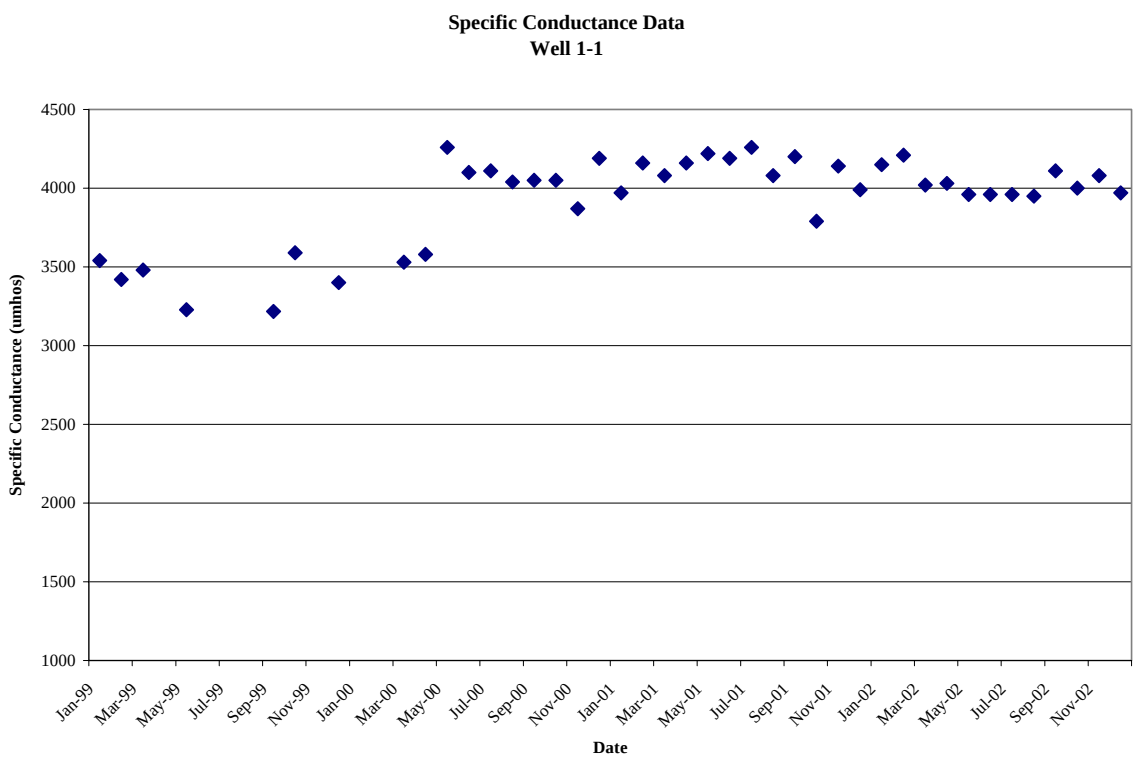

Figure E-4. Specific Conductance Data for Well 1-1.

Specific conductance values for all the wells ranged from 660 to 7,900 microsiemens per centimeter (µs cm^{-1}) between January 1999 and December 2002. The mean and median of the sample population are 2,934 µs cm^{-1} and 2,780 µs cm^{-1}, respectively. The data was averaged for each year in order to determine trends in each

well. An increasing trend in specific conductance is considered to be a 10 percent increase in the annual average over the period of record for each well.

Reviewing the annual mean revealed some trends in specific conductance in each well. Of the 57 wells with data, 38 showed an increasing trend in specific conductance, while 17 remained constant between 1999 and 2002. Two wells only had one year of data available so a trend could not be established. The mean and median specific conductance values for the region have increased between 1999 and 2002. The mean regional specific conductance value increased from 2,563 to 3,044 $\mu s\ cm^{-1}$. The median regional specific conductance value increased from 2,519 to 2,888 $\mu s\ cm^{-1}$. This increase in specific conductance may be an effect of the water shortage that the District experienced in 2000 and 2001. During these years, lower rainfall in Florida resulted in less recharge to the aquifer probably resulting in higher specific conductance values in the wells.

Chloride Data

Quarterly chloride data from January 2001 to December 2002 were reviewed for this report. Chloride concentrations ranged from 270 and 1,800 milligrams per liter (mg/l) for the total sample population. The mean and median of the sample population are 948 mg/l and 890 mg/l, respectively. Currently, there is insufficient data to perform a temporal trend analysis in each well for chlorides, even to compare it with other data sets.

Total Dissolved Solids Data

Quarterly TDS data is available from January 2001 to December 2002 for this report. TDS concentrations ranged from 410 mg/l to 5,900 mg/l over the UEC Planning Area for the total sample population. The mean and median of the sample population are 2,122 mg/l and 2000 mg/l, respectively. Currently, there is insufficient data to perform a detailed trend analysis in each well for the TDS data. In general, the available data shows that TDS fluctuations are greater in magnitude and occurrence than those for the specific conductance and chloride data.

Water Use Data

Each of the 57 wells that the NRCS monitors is equipped with a flow meter. Totalized flow meter readings (in gallons) are colleted monthly to determine the amount of water used for irrigation. Plots of the water use data show that there was no definitive trend in monthly water use at any of the sites. The plots were constructed with the date of data collection on the x-axis and water use on the y-axis. The only commonality seen in the plots is that most wells were used for irrigation during the early portion of 2000 and 2001 when the District was experiencing a water shortage.

Ranking the top water users shows the sites that use the most water every year. The ranking also reveals water use patterns, e.g. does the same site using the same amount of water every year. The top ten water users over the last four years (1999 to 2002) are listed in **Table E-6**.

Table E-6. Top Ten Water Users from 1999 to 2002.

Rank	Total Water Use 1999 to 2002 (Gallons)	
	Water Use	Well
1	9,908,381	29-14
2	8,490,056	6-2
3	6,234,953	6-1
4	3,745,828	29-11
5	3,102,109	29-5
6	2,943,456	5-1
7	2,759,202	29-9
8	2,654,314	4-1
9	2,479,339	29-2
10	2,063,655	1-1

By the end of 2002, Well 29-14 recorded the highest water use over the last four years. This well has consistently been the highest user since the UECFAS was established. Well 29-14 is located in northeast St. Lucie County away from major surface water sources and relies on water from the Floridan Aquifer as a supplemental irrigation source. The second ranked water user over the same period was Well 6-2. However, approximately 90 percent of this well's water use occurred over a two-year period (2000 and 2001). The two years of high water use for this well coincide with two years when the District was experiencing a water shortage. Well 6-2 is located along the north-south stretch of the C-24 Canal in western St. Lucie County. Ordinarily, this user relies on surface water for irrigation. However, the water use restrictions in place during the 2000 and 2001 water shortages limited the use of surface water for irrigation. As a backup, this user drew water from its wells to supplement irrigation. The remaining top 10 water users had similar patterns of water use: constant high water use over the period of record or two years of high use during the water shortage.

Rainfall Data

Graphs of rainfall data between 1999 and 2002 displayed the distinct wet and dry season pattern attributed to south Florida. Typically, the majority of annual rainfall occurred between May and September. September was frequently the month with the highest precipitation over the four-year period of record.

Correlation Analysis

A correlation analysis was performed to try and determine a statistical relationship between the following data sets:

- Water quality and water use
- Water levels and water use
- Water levels and water quality

The results of the correlation analyses are provided in **Table E-7**.

Table E-7. Summary of Correlation Analyses.

Data Sets Compared	Correlation Coefficient Range
Water Quality and Water Use	-0.32 to 0.51
Water Levels and Water Use	-0.54 to 0.43
Water Levels and Water Quality	-0.07 to 0.45

The analyses yielded correlation coefficients between -0.54 and 0.51. A correlation coefficient of 1.00 represents a perfect relationship. A correlation coefficient of 0.00 represents the absence of a relationship. Similarly, a correlation coefficient of -1.00 represents a perfect inverse relationship. These correlation coefficients show that there is little to no relationship between the aforementioned data sets at this time. Further study is required to determine the relationship between the three data sets.

Conclusions

With only about a two-year period of record, hydrographs for the network wells show a pattern of "low" water levels every May and "high" levels every September/October. There is insufficient data at this time to determine the long-term water level trends in the aquifer.

Specific conductance data in most wells shows a sinusoidal trend with higher values in the mid-to-late dry season (March to April) and lows in the early dry season (December). It appears that recharge from wet season precipitation may reduce the specific conductance in the aquifer. The effect of this recharge is not seen until the early dry season when specific conductance values decrease. Recharge does not occur locally as the Floridan Aquifer is confined and lies approximately 1,000 feet below land surface in the UEC Planning Area. Recharge occurs to the northwest of UEC Planning Area along the Lake Wales Ridge, where the aquifer is unconfined to thinly confined. The calculated mean specific conductance for each well showed that the average specific conductance in 38 wells had an increasing trend (mean specific conductance rose from 2,563 to 3,044 $\mu s\ cm^{-1}$) between 1999 and 2002. Similarly, the average specific conductance in 18 wells remained the same in 34 wells over the same period. These increases in specific conductance may be an effect of the water shortage that the District experienced in 2000 and 2001. During these years, lower rainfall in Florida resulted in less recharge to the aquifer resulting, generally, in higher specific conductance values in the wells.

As with the water level data, it is hard to determine trends in the chlorides and TDS due to the current lack of available data.

There is no specific trend in monthly water use. Landowners use their wells with no specific frequency. The top ten water users between 1999 and 2002 fell into two categories: (1) those that used a constant amount of water and (2) those that had very high

water use in one to two years. The data showed that water use was greatest during 2000 and 2001, the years in which the District was experiencing a water shortage.

At this time, there is no correlation among water level, water quality and water use data in the UEC Planning Area. With the addition of more data every month, another trend and correlation analysis should be completed at the end of each year. This new analysis may reveal relationships between water levels, water quality and water use in the region.

SURFACE WATER

CERP Ten Mile Creek Project

Please see the following map (**Figure E-5**) representing the CERP Ten Mile Creek Project.

Figure E-5. Ten Mile Creek Critical Restoration Project Map.

CERP Indian River Lagoon – South Project

Please see the following map (**Figure E-6**) representing the CERP Indian River Lagoon – South Project.

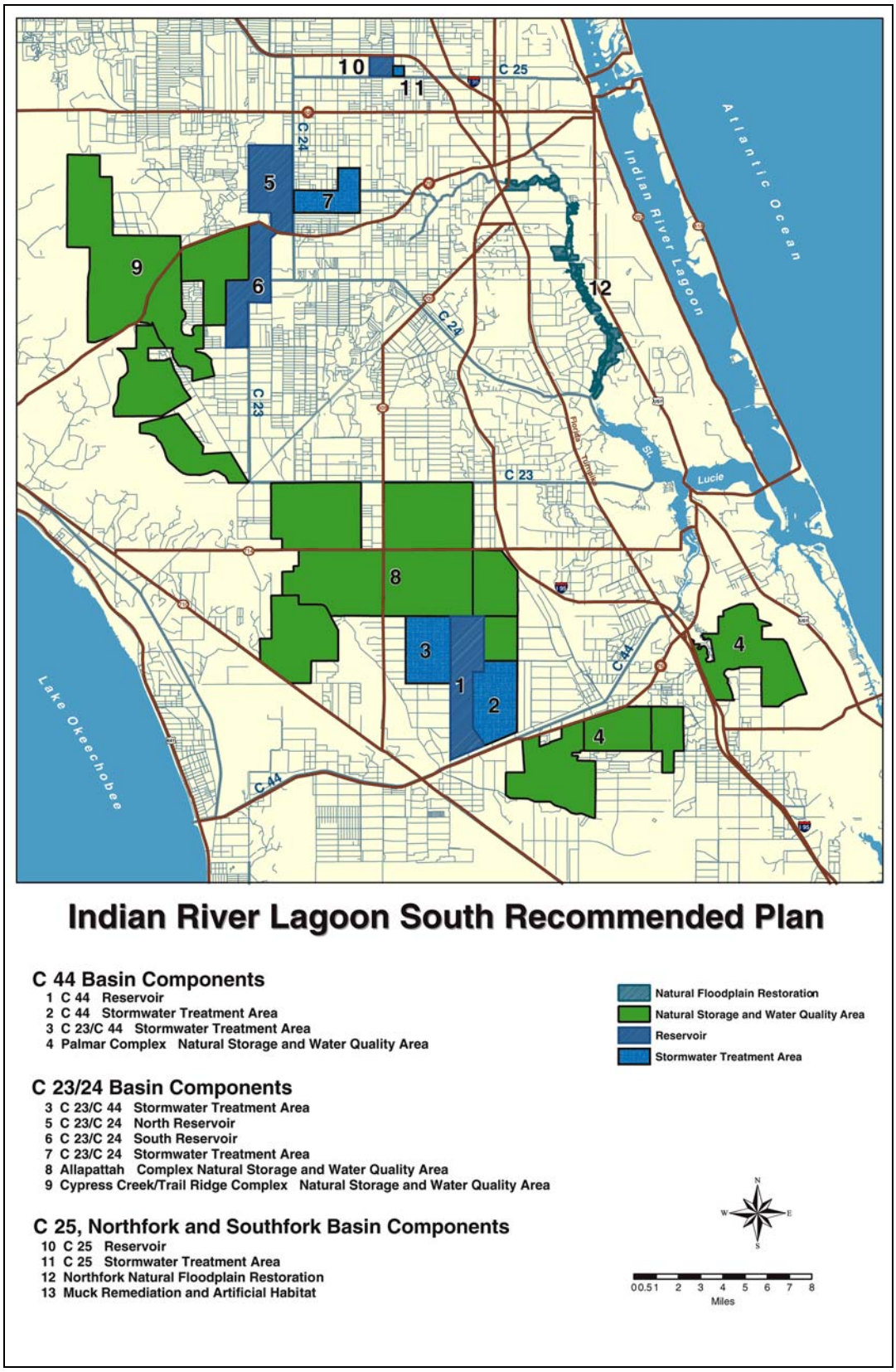

Figure E-6. Indian River Lagoon – South Project Map.

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Glossary

1-in-10 Year Drought A drought of such intensity, that it is expected to have a return frequency of once in 10 years. A drought, in which below normal rainfall, has a 90 percent probability of being exceeded over a twelve-month period. This means that there is only a ten percent chance that less than this amount of rain will fall in any given year.

1-in-10 Year Level of Certainty Probability that the needs for reasonable-beneficial uses of water will be fully met during a 1-in-10 year drought.

Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) A simple water budget model for estimating irrigation demands that estimates demand based on basin specific data.

Agricultural Self-Supplied Water Demand The water used to irrigate crops, to water cattle and for aquaculture (e.g., fish production) that is not supplied by a public water supply utility.

Aquifer A portion of a geologic formation or formations that yield water in sufficient quantities to be a supply source.

Aquifer Storage and Recovery (ASR) The injection of fresh water into a confined saline aquifer during times when supply exceeds demand (wet season), and recovering it during times when there is a supply deficit (dry season).

Aquifer System A heterogeneous body of intercalated permeable and less permeable material that acts as a water-yielding hydraulic unit of regional extent.

Artesian When groundwater is confined under pressure greater than atmospheric pressure by overlying relatively impermeable strata.

Average Daily Demand A water system's average daily use based on total annual water production (total annual gallons or cubic feet divided by 365).

Average Irrigation Requirement Irrigation requirement under average rainfall as calculated by the District's modified Blaney-Criddle model.

Average Rainfall Year A year having rainfall with a 50 percent probability of being exceeded over a twelve-month period.

Basin (Groundwater) A hydrologic unit containing one large aquifer or several connecting and interconnecting aquifers.

Basin (Surface Water) A tract of land drained by a surface water body or its tributaries.

Biochemical Oxygen Demand (BOD) The amount of dissolved oxygen required to meet the metabolic needs of aerobic microorganisms in water rich in organic matter, such as sewage. Also known as Biological Oxygen Demand.

Blaney-Criddle A formula to calculate evapotranspiration (ET) based on mean temperature and number of daylight hours. The Water Supply Department allocates water using a version of the Blaney-Criddle that employs months as time increments. The 'Modified Blaney-Criddle' is a variation of Blaney-Criddle, which multiplies the ET from Blaney-Criddle by a coefficient that relates mean air temperature to the growth stage of a crop. Additionally, effective rainfall is calculated using the mean temperature and hours of daylight, the Blaney-Criddle ET, average monthly rainfall and a soil factor. Further calculations consider average rainfall to drought rainfall (1-in-10 year drought). The difference between monthly drought effective rainfall and monthly ET becomes the basis for water allocations.

Boulder Zone A highly transmissive, cavernous zone of limestone within the lower Floridan Aquifer.

Commercial and Industrial Self-Supplied Water Demand Water used by commercial and industrial operations withdrawing over 0.1 million gallons per day from individual, on-site wells.

Comprehensive Everglades Restoration Plan (CERP) The implementation of recommendations made within the Restudy, that is, structural and operational modifications to the C&SF Project are being further refined and will be implemented through this plan.

Confined Aquifer Water bearing stratum of permeable rock, sand or gravel overlaid by a thick, impermeable stratum.

Consumptive Use Use that reduces an amount of water in the source from which it is withdrawn.

Consumptive Use Permit (CUP) A permit issued by the SFWMD under authority of Chapter 40E-2, F.A.C., allowing withdrawal of water for consumptive use.

Demand The quantity of water needed to be withdrawn to fulfill a requirement.

Desalination A process that treats saline water to remove chlorides and dissolved solids, resulting in the production of fresh water.

Domestic Self-Supplied (DSS) Water Demand The water used by households whose primary source of water is private wells and water treatment facilities with pumpages of less than 0.10 million gallons per day.

Evapotranspiration (ET) Water losses from the surface of water and soils (evaporation) and plants (transpiration).

Fiscal Year (FY) The South Florida Water Management District's fiscal year begins on October 1 and ends on September 30 the following year.

Florida Department of Agricultural and Consumer Services (FDACS) FDACS communicates the needs of the agricultural industry to the Florida Legislature, the FDEP, and the water management districts, and ensures participation of agriculture in the development and implementation of water policy decisions. FDACS also oversees Florida's soil and water conservation districts, which coordinate closely with the federal Natural Resources Conservation Service (NRCS).

Florida Department of Environmental Protection (FDEP) The SFWMD operates under the general supervisory authority of the FDEP, which includes budgetary oversight.

Floridan Aquifer System (FAS) A highly-used aquifer system composed of the Upper Floridan and Lower Floridan Aquifers. It is the principal source of water supply north of Lake Okeechobee and the upper Floridan Aquifer is used for drinking water supply in parts of Martin and St. Lucie Counties. From Jupiter to south Miami, water from the Floridan Aquifer System is mineralized (total dissolved solids are greater than 1,000 mg/L) along coastal areas and in southern Florida.

Geographic Information Systems (GIS) The abstract representation of natural (or cultural) features of a landscape into a digital database, geographic information system.

Groundwater Water beneath the soil surface, whether or not flowing through known and definite channels.

Indian River Lagoon Extending for 156 miles from north of Cape Canaveral to Stuart along the east coast of Florida, this lagoon is America's most diverse estuary, home to more than 4,000 plant and animal species.

Infiltration The movement of water through the soil surface into the soil under the forces of gravity and capillarity.

Institute of Food and Agricultural Sciences (IFAS) Agricultural branch of the University of Florida that performs research, education and extension.

Irrigation The application of water to crops and other plants by artificial means.

Irrigation Efficiency The average percent of total water pumped or delivered for use that is delivered to the root zone of a plant.

Lagoon A body of water separated from the ocean by barrier islands, with limited exchange with the ocean through inlets.

Level of Certainty Probability that the demands for reasonable-beneficial uses of water will be fully met for a specified period of time (generally taken to be one year) and for a specified condition of water availability (generally taken to be a drought event of a specified return frequency).

Marsh A frequently or continually inundated non-forested wetland characterized by emergent herbaceous vegetation adapted to saturated soil conditions.

Natural Resources Conservation Service (NRCS) An agency of the U.S. Department of Agriculture (USDA) that provides technical assistance for soil and water conservation, natural resource surveys and community resource protection. Formerly the U.S. Soil Conservation Service (SCS).

Potable Water Water that is safe for human consumption. The maximum chloride concentration is 250 milligrams/liter.

Potentiometric Surface An imaginary surface representing the total head of groundwater.

Process Water Water used for nonpotable industrial usage, e.g., mixing cement.

Public Water Supply (PWS) Utilities that provide potable water for public use.

Reasonable-Beneficial Use Use of water in such quantity as is necessary for economic and efficient utilization for a purpose and in a manner that is both reasonable and consistent with the public interest.

Reclaimed Water Water that has received at least secondary treatment and basic disinfection and is reused after flowing out of a domestic wastewater treatment facility.

Recreational Self-Supplied Water Demand The water used for landscape and golf course irrigation. The landscape subcategory includes water used for parks, cemeteries and other irrigation applications greater than 0.1 million gallons per day. The golf course subcategory includes those operations not supplied by a public water supply or regional reuse facility.

Regional Water Supply Plan (RWSP) Detailed water supply plan developed by the District under Section 373.0361, F.S. ., providing an evaluation of available water supply and projected demands, at the regional scale. The planning process projects future demand for 20 years and develops strategies to meet identified needs.

Reservoir A man-made or natural water body used for water storage.

Retrofit The replacement of existing equipment with equipment of higher efficiency.

Reuse The deliberate application of water that has received at least secondary treatment for a beneficial purpose, in compliance with the Florida Department of Environmental Protection and water management district rules, for a beneficial purpose.

Reverse Osmosis (RO) A membrane process for desalting water using applied pressure to drive the feedwater (source water) through a semipermeable membrane.

Self-Supplied The water used to satisfy a water need, not supplied by a public water supply utility.

Seepage Irrigation Irrigation that conveys water through open ditches. Water is either applied to the soil surface (possibly in furrows) and held for a period of time to allow infiltration, or is applied to the soil subsurface by raising the water table to wet the root zone.

Sinusoidal The real or complex function $\sin(u)$ or any function with analogous continuous periodic behavior.

Slough A channel in which water moves sluggishly, or a place of deep muck, mud or mire. Sloughs are wetland habitats that serve as channels for water draining off surrounding uplands and/or wetlands.

Storm Water Surface water resulting from rainfall runoff that does not percolate into the ground or evaporate.

Surface Water Water that flows, falls or collects above the soil or substrate surface.

Surface Water Improvement and Management (SWIM) Plan A plan prepared pursuant to Chapter 373, F.S.

Surficial Aquifer System (SAS) Often the principal source of water for urban uses within certain areas of south Florida. This aquifer is unconfined, consisting of varying amounts of limestone and sediments that extend from the land surface to the top of an intermediate confining unit.

Thermoelectric Self-Supplied Water Demand The difference in the amount of water withdrawn by electric power generating facilities for cooling purposes and the water returned to the hydrologic system near the point of withdrawal.

Total Trihalomethane (TTHM) A sum of chloroform, bromodichloromethane, dibromochloromethane and bromoform.

Trihalomethanes (THMs) Any of several synthetic organic compounds formed when chlorine combines with organic materials in water during the disinfection process.

Wastewater The waterborne discharge from residences, commercial buildings, industrial plants and institutions together with any groundwater, surface runoff or leachate that may be present.

Water Conservation Reducing the demand for water through activities that alter water use practices, e.g., improving efficiency in water use, and reducing losses of water, waste of water and water use.

Water Shortage Declaration If there is a possibility that insufficient water will be available within a source class to meet the estimated present and anticipated user demands from that source, or to protect the water resource from serious harm, the governing board may declare a water shortage for the affected source class. (Rule 40E-21.231, F.A.C.) Estimates of the percent reduction in demand required to match available supply is required and identifies which phase of drought restriction is implemented. A gradual progression in severity of restriction is implemented through increasing phases. Once declared, the District is required to notify permitted users by mail of the restrictions and to publish restrictions in area newspapers.

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