UPPER EAST COAST

WATER SUPPLY PLAN

Appendices

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Upper East Coast Water Supply Plan

Appendices

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List of Appendices

Upper East Coast Water Supply Plan

APPENDIX A

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187.201 State Comprehensive Plan Adopted

(8) Water Resources

(a) Goal. --Florida shall assure the availability of an adequate supply of water for all competing uses deemed reasonable and beneficial and shall maintain the functions of natural systems and the overall present level of surface and ground water quality. Florida shall improve and restore the quality of waters not presently meeting water quality standards.

(b) Policies. --

1. Ensure the safety and quality of drinking water supplies and promote the development of reverse osmosis and desalinization technologies for developing water supplies.
2. Identify and protect the functions of water recharge area and provide incentives for their conservation.
3. Encourage the development of local and regional water supplies within water management districts instead of transporting surface water across district boundaries.
4. Protect and use natural water systems in lieu of structural alternatives and restore modified systems.
5. Ensure that new development is compatible with existing local and regional water supplies.
6. Establish minimum seasonal flows and levels for surface watercourses with primary consideration given to the protection of natural resources, especially marine, estuarine, and aquatic ecosystems.
7. Discourage the channelization, diversion, or damming of natural riverine systems.
8. Encourage the development of a strict floodplain management program by state and local governments designed to preserve hydrologically significant wetlands and other natural floodplain features.
9. Protect aquifers from depletion and contamination through appropriate regulatory programs and through incentives.
10. Protect surface and ground water quality and quantity in the state.
11. Promote water conservation as an integral part of water management programs as well as the use and reuse of water of the lowest acceptable quality for the purposes intended.
12. Eliminate the discharge of inadequately treated wastewater and stormwater runoff into the waters of the state.
13. Identify and develop alternative methods of wastewater treatment, disposal, and reuse of wastewater to reduce degradation of water resources.
14. Reserve from use that water necessary to support essential non-withdrawal demands, including navigation, recreation, and the protection of fish and wildlife.

History. --+ s.2, ch. 85-57; s. 1, ch. 87-354; s. 47, ch. 88-130; s. 4, ch. 89-279; s.85, ch. 90-201; s. 28, ch. 91-5; s. 103, ch. 91-282.

SELECTED PASSAGES FROM SECTIONS 373.016 - 373.62, F.S.

Part I State Water Resource Plan

373.016 Declaration of Policy

(1) The waters in the state are among its basic resources. Such waters have not heretofore been conserved or fully controlled so as to realize their full beneficial use.

(2) The department and the governing board shall take into account cumulative impacts on water resources and manage those resources in a manner to ensure their sustainability.

(3) It is further declared to be the policy of the Legislature:

(a) To provide for the management of water and related land resources;

(b) To promote the conservation, replenishment, recapture, enhancement, development, and proper utilization of surface and ground water;

(c) To develop and regulate dams, impoundments, reservoirs, and other works and to provide water storage for beneficial purposes;

(d) To promote the availability of sufficient water for all existing and future reasonable-beneficial uses and natural systems;

(e) To prevent damage from floods, soil erosion, and excessive drainage;

(f) To minimize degradation of water resources caused by the discharge of stormwater;

(g) To preserve natural resources, fish, and wildlife;

(h) To promote the public policy set forth in s. 403.021;

(i) To promote recreational development, protect public lands, and assist in maintaining the navigability of rivers and harbors; and

(j) Otherwise to promote the health, safety, and general welfare of the people of this state.

In implementing this chapter, the department and the governing board shall construe and apply the policies in this subsection as a whole, and no specific policy is to be construed or applied in isolation from the other policies in this subsection.

(4) The Legislature recognizes that the water resource problems of the state vary from region to region, both in magnitude and complexity. It is therefore the intent of the Legislature to vest in the Department of Environmental Protection or its successor agency the power and

responsibility to accomplish the conservation, protection, management, and control of the waters of the state and with sufficient flexibility and discretion to accomplish these ends through delegation of appropriate powers to the various water management districts. The department may exercise any power herein authorized to be exercised by a water management district; however, to the greatest extent practicable, such power should be delegated to the governing board of a water management district.

(5) It is further declared the policy of the Legislature that each water management district, to the extent consistent with effective management practices, shall approximate its fiscal and budget policies and procedures to those of the state.

History.--s. 2, part I, ch. 72-299; s. 36, ch. 79-65; s. 70, ch. 83-310; s. 5, ch. 89-279; s. 20, ch. 93-213; s. 250, ch. 94-356; s. 1, ch. 97-160.

373.019 Definitions.—
When appearing in this chapter or in any rule, regulation, or order adopted pursuant thereto, the following words shall, unless the context clearly indicates otherwise, mean:

(1) “Coastal waters” means waters of the Atlantic Ocean or the Gulf of Mexico within the jurisdiction of the state.

(2) “Department” means the Department of Environmental Protection or its successor agency or agencies.

(3) “District water management plan” means the regional water resource plan developed by a governing board under s. 373.036.

(4) “Domestic use” means the use of water for the individual personal household purposes of drinking, bathing, cooking, or sanitation. All other uses shall not be considered domestic.

(5) “Florida water plan” means the state-level water resource plan developed by the department under s. 373.036.

(6) “Governing board” means the governing board of a water management district.

(7) “Ground water” means water beneath the surface of the ground, whether or not flowing through known and definite channels.

(8) “Impoundment” means any lake, reservoir, pond, or other containment of surface water occupying a bed or depression in the earth's surface and having a discernible shoreline.

(9) “Independent scientific peer review” means the review of scientific data,

theories, and methodologies by a panel of independent, recognized experts in the fields of hydrology, hydrogeology, limnology, and other scientific disciplines relevant to the matters being reviewed under s. 373.042.

(10) "Nonregulated use" means any use of water which is exempted from regulation by the provisions of this chapter.

(11) "Other watercourse" means any canal, ditch, or other artificial watercourse in which water usually flows in a defined bed or channel. It is not essential that the flowing be uniform or uninterrupted.

(12) "Person" means any and all persons, natural or artificial, including any individual, firm, association, organization, partnership, business trust, corporation, company, the United States of America, and the state and all political subdivisions, regions, districts, municipalities, and public agencies thereof. The enumeration herein is not intended to be exclusive or exhaustive.

(13) "Reasonable-beneficial use" means the use of water in such quantity as is necessary for economic and efficient utilization for a purpose and in a manner which is both reasonable and consistent with the public interest.

(14) "Regional water supply plan" means a detailed water supply plan developed by a governing board under s. 373.036[1].

(15) "Stream" means any river, creek, slough, or natural watercourse in which water usually flows in a defined bed or channel. It is not essential that the flowing be uniform or uninterrupted. The fact that some part of the bed or channel has been dredged or improved does not prevent the watercourse from being a stream.

(16) "Surface water" means water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs shall be classified as surface water when it exits from the spring onto the earth's surface.

(17) "Water" or "waters in the state" means any and all water on or beneath the surface of the ground or in the atmosphere, including natural or artificial watercourses, lakes, ponds, or diffused surface water and water percolating, standing, or flowing beneath the surface of the ground, as well as all coastal waters within the jurisdiction of the state.

(18) "Water management district" means any flood control, resource management, or water management district operating under the authority of this chapter.

(19) "Water resource development" means the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and ground water data; structural and

nonstructural programs to protect and manage water resources; the development of regional water resource implementation programs; the construction, operation, and maintenance of major public works facilities to provide for flood control, surface and underground water storage, and ground water recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities.

(20) "Water resource implementation rule" means the rule authorized by s. 373.036, which sets forth goals, objectives, and guidance for the development and review of programs, rules, and plans relating to water resources, based on statutory policies and directives. The waters of the state are among its most basic resources. Such waters should be managed to conserve and protect water resources and to realize the full beneficial use of these resources.

(21) "Water supply development" means the planning, design, construction, operation, and maintenance of public or private facilities for water collection, production, treatment, transmission, or distribution for sale, resale, or end use.

(22) For the sole purpose of serving as the basis for the unified statewide methodology adopted pursuant to s. 373.421(1), as amended,"wetlands" means those areas that are inundated or saturated by surface water or ground water at a frequency and a duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Soils present in wetlands generally are classified as hydric or alluvial, or possess characteristics that are associated with reducing soil conditions. The prevalent vegetation in wetlands generally consists of facultative or obligate hydrophytic macrophytes that are typically adapted to areas having soil conditions described above. These species, due to morphological, physiological, or reproductive adaptations, have the ability to grow, reproduce, or persist in aquatic environments or anaerobic soil conditions. Florida wetlands generally include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps and marshes, hydric seepage slopes, tidal marshes, mangrove swamps and other similar areas. Florida wetlands generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto. Upon legislative ratification of the methodology adopted pursuant to s. 373.421(1), as amended, the limitation contained herein regarding the purpose of this definition shall cease to be effective.

(23) "Works of the district" means those projects and works, including, but not limited to, structures, impoundments, wells, streams, and other watercourses, together with the appurtenant facilities and accompanying lands, which have been officially adopted by the governing board of the district as works of the district.

History.--s. 3, part I, ch. 72-299; s. 37, ch. 79-65; s. 1, ch. 80-259; s. 5, ch. 82-101; s.

6, ch. 89-279; s. 21, ch. 93-213; s. 15, ch. 94-122; s. 251, ch. 94-356; s. 1, ch. 96-339; s. 1, ch. 96-370; s. 2, ch. 97-160.

373.033 Saltwater Barrier Line

(1) The department may, at the request of the board of county commissioners of any county, at the request of the governing board of any water management district, or any municipality or water district responsible for the protection of a public water supply, or, having determined by adoption of an appropriate resolution that saltwater intrusion has become a matter of emergency proportions, by its own initiative, establish generally along the seacoast, inland from the seashore and within the limits of the area within which the petitioning board has jurisdiction, a saltwater barrier line inland of which no canal shall be constructed or enlarged, and no natural stream shall be deepened or enlarged, which shall discharge into tidal waters without a dam, control structure or spillway at or seaward of the saltwater barrier line, which shall prevent the movement of salt water inland of the saltwater barrier line. Provided, however, that the department is authorized, in cases where saltwater intrusion is not a problem, to waive the requirement of a barrier structure by specific permit to construct a canal crossing the saltwater barrier line without a protective device and provided, further that the agency petitioning for the establishment of the saltwater barrier line shall concur in the waiver.

(2) Application by a board of county commissioners or by the governing board of a water management district, a municipality or a water district for the establishment of a saltwater barrier line shall be made by adoption of an appropriate resolution, agreeing to:

(a) Reimburse the department the cost of necessary investigation, including, but not limited to, subsurface exploration by drilling, to determine the proper location of the saltwater barrier line in that county or in all or part of the district over which the applying agency has jurisdiction.

(b) Require compliance with the provisions of this law by county or district forces under their control; by those individuals or corporations filing plats for record and by individuals, corporations or agencies seeking authority to discharge surface or subsurface drainage into tidal waters.

(3) The board of county commissioners of any county or the governing board of any water management district, municipality or water district desiring to establish a saltwater barrier line is authorized to reimburse the department for any expense entailed in making an investigation to determine the proper location of the saltwater barrier line, from any funds available to them for general administrative purposes.

(4) The department, any board of county commissioners, and the governing board of any water management district, municipality, or water district having competent jurisdiction over an area in which a saltwater barrier is established shall be charged with the enforcement of the provisions of this

section, and authority for the maintenance of actions set forth in s. 373.129 shall apply to this section.

(5) The provisions of s. 373.191 shall apply specifically to the authority of the board of county commissioners, or to the governing board of a water management district, a municipality, or a water district having jurisdiction over an area in which a saltwater barrier line is established, to expend funds from whatever source may be available to them for the purpose of constructing saltwater barrier dams, dikes, and spillways within existing canals and streams in conformity with the purpose and intent of the board in establishing the saltwater barrier line.

History.--s. 2, ch. 63-210; ss. 25, 35, ch. 69-106; s. 25, ch. 73-190; s. 14, ch. 78-95; s. 40, ch. 79-65; s. 85, ch. 79-164.

Note.--Former s. 373.194.

373.036 Florida water plan; district water management plans.--

(1) FLORIDA WATER PLAN.--In cooperation with the water management districts, regional water supply authorities, and others, the department shall develop the Florida water plan. The Florida water plan shall include, but not be limited to:

(a) The programs and activities of the department related to water supply, water quality, flood protection and floodplain management, and natural systems.

(b) The water quality standards of the department.

(c) The district water management plans.

(d) Goals, objectives, and guidance for the development and review of programs, rules, and plans relating to water resources, based on statutory policies and directives. The state water policy rule, renamed the water resource implementation rule pursuant to s. 373.019(20), shall serve as this part of the plan. Amendments or additions to this part of the Florida water plan shall be adopted by the department as part of the water resource implementation rule. In accordance with s. 373.114, the department shall review rules of the water management districts for consistency with this rule. Amendments to the water resource implementation rule must be adopted by the secretary of the department and be submitted to the President of the Senate and the Speaker of the House of Representatives within 7 days after publication in the Florida Administrative Weekly. Amendments shall not become effective until the conclusion of the next regular session of the Legislature following their adoption.

(2) DISTRICT WATER MANAGEMENT PLANS.--

(a) Each governing board shall develop a district water management plan for water resources within its region, which plan addresses water supply, water quality, flood protection and floodplain management, and natural systems. The district water management plan shall be based on at least a 20-year planning period, shall be developed and revised in cooperation with other agencies, regional water supply authorities, units of government, and interested parties, and shall be updated at least once every 5 years. The governing board shall hold a public hearing at least 30 days in advance of completing the development or revision of the district water management plan.

(b) The district water management plan shall include, but not be limited to:

1. The scientific methodologies for establishing minimum flows and levels under s. 373.042, and all established minimum flows and levels.

2. Identification of one or more water supply planning regions that singly or together encompass the entire district.

3. Technical data and information prepared under ss. 373.0391 and 373.0395.

4. A districtwide water supply assessment, to be completed no later than July 1, 1998, which determines for each water supply planning region:

   a. Existing legal uses, reasonably anticipated future needs, and existing and reasonably anticipated sources of water and conservation efforts; and

   b. Whether existing and reasonably anticipated sources of water and conservation efforts are adequate to supply water for all existing legal uses and reasonably anticipated future needs and to sustain the water resources and related natural systems.

5. Any completed regional water supply plans.

(c) If necessary for implementation, the governing board shall adopt by rule or order relevant portions of the district water management plan, to the extent of its statutory authority.

(d) In the formulation of the district water management plan, the governing board shall give due consideration to:

1. The attainment of maximum reasonable-beneficial use of water resources.

2. The maximum economic development of the water resources consistent with other uses.

3. The management of water resources for such purposes as environmental protection, drainage, flood control, and water storage.

4. The quantity of water available for application to a reasonable-beneficial use.

5. The prevention of wasteful, uneconomical, impractical, or unreasonable uses of water resources.

6. Presently exercised domestic use and permit rights.

7. The preservation and enhancement of the water quality of the state.

8. The state water resources policy as expressed by this chapter.

(3) The department and governing board shall give careful consideration to the requirements of public recreation and to the protection and procreation of fish and wildlife. The department or governing board may prohibit or restrict other future uses on certain designated bodies of water which may be inconsistent with these objectives.

(4) The governing board may designate certain uses in connection with a particular source of supply which, because of the nature of the activity or the amount of water required, would constitute an undesirable use for which the governing board may deny a permit.

(5) The governing board may designate certain uses in connection with a particular source of supply which, because of the nature of the activity or the amount of water required, would result in an enhancement or improvement of the water resources of the area. Such uses shall be preferred over other uses in the event of competing applications under the permitting systems authorized by this chapter.

(6) The department, in cooperation with the Executive Office of the Governor, or its successor agency, may add to the Florida water plan any other information, directions, or objectives it deems necessary or desirable for the guidance of the governing boards or other agencies in the administration and enforcement of this chapter.

History.--s. 6, part I, ch. 72-299; ss. 2, 3, ch. 73-190; s. 122, ch. 79-190; s. 3, ch. 97-160.

373.0361 Regional water supply planning.--

(1) By October 1, 1998, the governing board shall initiate water supply planning for each water supply planning region identified in the district water management plan under s. 373.036, where it determines that sources

of water are not adequate for the planning period to supply water for all existing and projected reasonable-beneficial uses and to sustain the water resources and related natural systems. The planning must be conducted in an open public process, in coordination and cooperation with local governments, regional water supply authorities, government-owned and privately owned water utilities, self-suppliers, and other affected and interested parties. A determination by the governing board that initiation of a regional water supply plan for a specific planning region is not needed pursuant to this section shall be subject to s. 120.569. The governing board shall reevaluate such a determination at least once every 5 years and shall initiate a regional water supply plan, if needed, pursuant to this subsection.

(2) Each regional water supply plan shall be based on at least a 20-year planning period and shall include, but not be limited to:

(a) A water supply development component that includes:

1. A quantification of the water supply needs for all existing and reasonably projected future uses within the planning horizon. The level-of-certainty planning goal associated with identifying the water supply needs of existing and future reasonable-beneficial uses shall be based upon meeting those needs for a 1-in-10-year drought event.

2. A list of water source options for water supply development, including traditional and alternative sources, from which local government, government-owned and privately owned utilities, self-suppliers, and others may choose, which will exceed the needs identified in subparagraph 1.

3. For each option listed in subparagraph 2., the estimated amount of water available for use and the estimated costs of and potential sources of funding for water supply development.

4. A list of water supply development projects that meet the criteria in s. 373.0831(4).

(b) A water resource development component that includes:

1. A listing of those water resource development projects that support water supply development.

2. For each water resource development project listed:

a. An estimate of the amount of water to become available through the project.

b. The timetable for implementing or constructing the project and the estimated costs for implementing, operating, and maintaining the project.

c. Sources of funding and funding needs.

d. Who will implement the project and how it will be implemented.

(c) The recovery and prevention strategy described in s. 373.0421(2).

(d) A funding strategy for water resource development projects, which shall be reasonable and sufficient to pay the cost of constructing or implementing all of the listed projects.

(e) Consideration of how the options addressed in paragraphs (a) and (b) serve the public interest or save costs overall by preventing the loss of natural resources or avoiding greater future expenditures for water resource development or water supply development. However, unless adopted by rule, these considerations do not constitute final agency action.

(f) The technical data and information applicable to the planning region which are contained in the district water management plan and are necessary to support the regional water supply plan.

(g) The minimum flows and levels established for water resources within the planning region.

(3) Regional water supply plans initiated or completed by July 1, 1997, shall be revised, if necessary, to include a water supply development component and a water resource development component as described in paragraphs (2)(a) and (b).

(4) Governing board approval of a regional water supply plan shall not be subject to the rulemaking requirements of chapter 120. However, any portion of an approved regional water supply plan which affects the substantial interests of a party shall be subject to s. 120.569.

(5) By November 15, 1997, and annually thereafter, the department shall submit to the Governor and the Legislature a report on the status of regional water supply planning in each district. The report shall include:

(a) A compilation of the estimated costs of and potential sources of funding for water resource development and water supply development projects, as identified in the water management district regional water supply plans.

(b) A description of each district's progress toward achieving its water resource development objectives, as directed by s. 373.0831(3), including the district's implementation of its 5-year water resource development work program.

(6) Nothing contained in the water supply development component of the district water management plan shall be construed to require local governments, government-owned or privately owned water utilities, self-suppliers, or other water suppliers to select a water supply development option identified in the component merely because it is identified in the plan. However, this subsection shall not be construed to limit the authority of the department or governing board under part II.

History.--s. 4, ch. 97-160.

373.0391 Technical Assistance to Local Governments

(1) The water management districts shall assist local governments in the development and future revision of local government comprehensive plan elements or public facilities report as required by s. 189.415, related to water resource issues.

(2) By July 1, 1991, each water management district shall prepare and provide information and data to assist local governments in the preparation and implementation of their local government comprehensive plans or public facilities report as required by s. 189.415, whichever is applicable. Such information and data shall include, but not be limited to:

(a) All information and data required in a public facilities report pursuant to s. 189.415.

(b) A description of regulations, programs, and schedules implemented by the district.

(c) Identification of regulations, programs, and schedules undertaken or proposed by the district to further the State Comprehensive Plan.

(d) A description of surface water basins, including regulatory jurisdictions, flood-prone areas, existing and projected water quality in water management district operated facilities, as well as surface water runoff characteristics and topography regarding flood plains, wetlands, and recharge areas.

(e) A description of ground water characteristics, including existing and planned wellfield sites, existing and anticipated cones of influence, highly productive ground water areas, aquifer recharge areas, deep well injection zones, contaminated areas, an assessment of regional water resource needs and sources for the next 20 years, and water quality.

(f) The identification of existing and potential water management district land acquisitions.

(g) Information reflecting the minimum flows for surface watercourses to avoid harm to water resources or the ecosystem and information reflecting the minimum water levels for aquifers to avoid harm to water resources or the ecosystem.

History.--s. 55, ch. 89-169; s. 8, ch. 89-279.

373.0395 Ground water basin resource availability inventory.—
Each water management district shall develop a ground water basin resource availability inventory covering those areas deemed appropriate by the governing board. This inventory shall include, but not be limited to, the following:

(1) A hydrogeologic study to define the ground water basin and its associated recharge areas.

(2) Site specific areas in the basin deemed prone to contamination or overdraft resulting from current or projected development.

(3) Prime ground water recharge areas.

(4) Criteria to establish minimum seasonal surface and ground water levels.

(5) Areas suitable for future water resource development within the ground water basin.

(6) Existing sources of wastewater discharge suitable for reuse as well as the feasibility of integrating coastal wellfields.

(7) Potential quantities of water available for consumptive uses.

Upon completion, a copy of the ground water basin availability inventory shall be submitted to each affected municipality, county, and regional planning agency. This inventory shall be reviewed by the affected municipalities, counties, and regional planning agencies for consistency with the local government comprehensive plan and shall be considered in future revisions of such plan. It is the intent of the Legislature that future growth and development planning reflect the limitations of the available ground water or other available water supplies.

History.--s. 6, ch. 82-101.

373.0397 Floridan and Biscayne aquifers; designation of prime ground water recharge areas.—
Upon preparation of an inventory of prime ground water recharge areas for the Floridan or Biscayne aquifers as a part of the requirements of s. 373.0395(3), but prior to adoption by the governing board, the water management district shall publish a legal notice of public hearing on the designated areas for the Floridan and Biscayne aquifers, with a map delineating the boundaries of the areas, in newspapers defined in chapter 50 as having general circulation within the area to be affected. The notice shall be at least one-fourth page and shall read as follows:

NOTICE OF PRIME RECHARGE
AREA DESIGNATION

The (name of taxing authority) proposes to designate specific land areas as areas of prime recharge to the (name of aquifer)Aquifer.

All concerned citizens are invited to attend a public hearing on the proposed designation to be held on (date and time) at (meeting place).

A map of the affected areas follows.

The governing board of the water management district shall adopt a designation of prime ground water recharge areas to the Floridan and Biscayne aquifers by rule within 120 days after the public hearing, subject to the provisions of chapter 120.

History.--s. 2, ch. 85-42.

373.042 Minimum Flows and Levels

(1) Within each section, or the water management district as a whole, the department or the governing board shall establish the following:

(a) Minimum flow for all surface watercourses in the area. The minimum flow for a given watercourse shall be the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area.

(b) Minimum water level. The minimum water level shall be the level of ground water in an aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources of the area.

The minimum flow and minimum water level shall be calculated by the department and the governing board using the best information available. When appropriate, minimum flows and levels may be calculated to reflect seasonal variations. The department and the governing board shall also consider, and at their discretion may provide for, the protection of nonconsumptive uses in the establishment of minimum flows and levels.

(4)

(a) Upon written request to the department or governing board by a substantially affected person, or by decision of the department or governing board, prior to the establishment of a minimum flow or level and prior to the filing of any petition for administrative hearing related to the minimum flow or level, all scientific or technical data, methodologies, and models, including all scientific and technical assumptions employed in each model, used to establish a minimum flow or level shall be subject to independent scientific peer review. Independent scientific peer review means review by a panel of independent, recognized experts in the fields of hydrology, hydrogeology, limnology, biology, and other scientific disciplines, to the extent relevant to the establishment of the minimum flow or level.

(b) If independent scientific peer review is requested, it shall be initiated at an appropriate point agreed upon by the department or governing board and the person or persons requesting the peer review. If no agreement is reached, the department or governing board shall determine the appropriate point at which to initiate peer review. The members of the peer review panel shall be selected within 60 days of the point of initiation by agreement of the department or governing board and the person or persons requesting the peer review. If the panel is not selected within the 60-day period, the time limitation may be waived upon the agreement of all parties. If no waiver occurs, the department or governing board may proceed to select the peer review panel. The cost of the peer review shall be borne equally by the district and each party requesting the peer review, to the extent economically feasible. The panel shall submit a final report to the governing board within 120 days after its selection unless the deadline is waived by agreement of all parties. Initiation of peer review pursuant to this paragraph shall toll any applicable deadline under chapter 120 or other law or district rule regarding permitting, rulemaking, or administrative hearings, until 60 days following submittal of the final report. Any such deadlines shall also be tolled for 60 days following withdrawal of the request or following agreement of the parties that peer review will no longer be pursued. The department or the governing board shall give significant weight to the final report of the peer review panel when establishing the minimum flow or level.

(c) If the final data, methodologies, and models, including all scientific and technical assumptions employed in each model upon which a minimum flow or level is based, have undergone peer review pursuant to this subsection, by request or by decision of the department or governing board, no further peer review shall be required with respect to that minimum flow or level.

(d) No minimum flow or level adopted by rule or formally noticed for adoption on or before May 2, 1997, shall be subject to the peer review provided for in this subsection.

(5) If a petition for administrative hearing is filed under chapter 120 challenging the establishment of a minimum flow or level, the report of an independent scientific peer review conducted under subsection (4) is admissible as evidence in the final hearing, and the administrative law judge must render the order within 120 days after the filing of the petition. The time limit for rendering the order shall not be extended except by agreement of all the parties. To the extent that the parties agree to the

findings of the peer review, they may stipulate that those findings be incorporated as findings of fact in the final order.

History.--s. 6, part I, ch. 72-299; s. 2, ch. 73-190; s. 2, ch. 96-339; s. 5, ch. 97-160.

373.0421 Establishment and implementation of minimum flows and levels.--

(1) ESTABLISHMENT.--

(a) Considerations.--When establishing minimum flows and levels pursuant to s. 373.042, the department or governing board shall consider changes and structural alterations to watersheds, surface waters, and aquifers and the effects such changes or alterations have had, and the constraints such changes or alterations have placed, on the hydrology of an affected watershed, surface water, or aquifer, provided that nothing in this paragraph shall allow significant harm as provided by s. 373.042(1) caused by withdrawals.

(b) Exclusions.--

1. The Legislature recognizes that certain water bodies no longer serve their historical hydrologic functions. The Legislature also recognizes that recovery of these water bodies to historical hydrologic conditions may not be economically or technically feasible, and that such recovery effort could cause adverse environmental or hydrologic impacts. Accordingly, the department or governing board may determine that setting a minimum flow or level for such a water body based on its historical condition is not appropriate.

2. The department or the governing board is not required to establish minimum flows or levels pursuant to s. 373.042 for surface water bodies less than 25 acres in area, unless the water body or bodies, individually or cumulatively, have significant economic, environmental, or hydrologic value.

3. The department or the governing board shall not set minimum flows or levels pursuant to s. 373.042 for surface water bodies constructed prior to the requirement for a permit, or pursuant to an exemption, a permit, or a reclamation plan which regulates the size, depth, or function of the surface water body under the provisions of this chapter, chapter 378, or chapter 403, unless the constructed surface water body is of significant hydrologic value or is an essential element of the water resources of the area.

The exclusions of this paragraph shall not apply to the Everglades Protection Area, as defined in s. 373.4592(2)(h).

(2) If the existing flow or level in a water body is below, or is projected to fall within 20 years below, the applicable minimum flow or level established pursuant to s. 373.042, the department or governing board, as part of the

regional water supply plan described in s. 373.036[1], shall expeditiously implement a recovery or prevention strategy, which includes the development of additional water supplies and other actions, consistent with the authority granted by this chapter, to:

(a) Achieve recovery to the established minimum flow or level as soon as practicable; or

(b) Prevent the existing flow or level from falling below the established minimum flow or level.

The recovery or prevention strategy shall include phasing or a timetable which will allow for the provision of sufficient water supplies for all existing and projected reasonable-beneficial uses, including development of additional water supplies and implementation of conservation and other efficiency measures concurrent with, to the extent practical, and to offset, reductions in permitted withdrawals, consistent with the provisions of this chapter.

(3) The provisions of this section are supplemental to any other specific requirements or authority provided by law. Minimum flows and levels shall be reevaluated periodically and revised as needed.

History.--s. 6, ch. 97-160.

373.0831 Water resource development; water supply development.--

(1) The Legislature finds that:

(a) The proper role of the water management districts in water supply is primarily planning and water resource development, but this does not preclude them from providing assistance with water supply development.

(b) The proper role of local government, regional water supply authorities, and government-owned and privately owned water utilities in water supply is primarily water supply development, but this does not preclude them from providing assistance with water resource development.

(c) Water resource development and water supply development must receive priority attention, where needed, to increase the availability of sufficient water for all existing and future reasonable-beneficial uses and natural systems.

(2) It is the intent of the Legislature that:

(a) Sufficient water be available for all existing and future reasonable-beneficial uses and the natural systems, and that the adverse effects of competition for water supplies be avoided.

(b) Water management districts take the lead in identifying and implementing water resource development projects, and be responsible for securing necessary funding for regionally significant water resource development projects.

(c) Local governments, regional water supply authorities, and government-owned and privately owned water utilities take the lead in securing funds for and implementing water supply development projects. Generally, direct beneficiaries of water supply development projects should pay the costs of the projects from which they benefit, and water supply development projects should continue to be paid for through local funding sources.

(d) Water supply development be conducted in coordination with water management district regional water supply planning and water resource development.

(3) The water management districts shall fund and implement water resource development as defined in s. 373.019. Each governing board shall include in its annual budget the amount needed for the fiscal year to implement water resource development projects, as prioritized in its regional water supply plans.

(4)

(a) Water supply development projects which are consistent with the relevant regional water supply plans and which meet one or more of the following criteria shall receive priority consideration for state or water management district funding assistance:

1. The project supports establishment of a dependable, sustainable supply of water which is not otherwise financially feasible;

2. The project provides substantial environmental benefits by preventing or limiting adverse water resource impacts, but requires funding assistance to be economically competitive with other options; or

3. The project significantly implements reuse, storage, recharge, or conservation of water in a manner that contributes to the sustainability of regional water sources.

(b) Water supply development projects which meet the criteria in paragraph (a) and also bring about replacement of existing sources in order to help implement a minimum flow or level shall be given first consideration for state or water management district funding assistance.

History.--s. 11, ch. 97-160.

373.086 Providing for District Works

(1) In order to carry out the works for the district, and for effectuating the purposes of this chapter, the governing board is authorized to clean out, straighten, enlarge, or change the course of any waterway, natural or artificial, within or without the district; to provide such canals, levees, dikes, dams, sluiceways, reservoirs, holding basins, floodways, pumping stations, bridges, highways, and other works and facilities which the board may deem necessary; to establish, maintain, and regulate water levels in all canals, lakes, rivers, channels, reservoirs, streams, or other bodies of water owned or maintained by the district; to cross any highway or railway with works of the district and to hold, control, and acquire by donation, lease, or purchase, or to condemn any land, public or private, needed for rights-of-way or other purposes, and may remove any building or other obstruction necessary for the construction, maintenance, and operation of the works; and to hold and have full control over the works and rights-of-way of the district.

(2) The works of the district shall be those adopted by the governing board of the district. The district may require or take over for operation and maintenance such works of other districts as the governing board may deem advisable under agreement with such districts.

(3)

(a) Notwithstanding the provisions of chapter 120, the temporary construction, operation, or maintenance of water supply backpumping facilities to be used for storage of surplus water shall not require a permit under this chapter, chapter 253, or chapter 403 from the Department of Environmental Protection if the governing board issues an order declaring a water emergency which order is approved by the Secretary of Environmental Protection. Such approval may be given by telephone and confirmed by appropriate order at a later date. The temporary construction, operation, or maintenance of the facilities shall cease when the governing board or the secretary issues an order declaring that the emergency no longer exists. If the district intends to operate any such facilities permanently under nonemergency conditions, it shall apply for the appropriate required permits from the Department of Environmental Protection within 30 days of rescinding the emergency order.

(b) Notwithstanding the provisions of chapter 120, emergency orders issued pursuant to this subsection shall be valid for a period of 90 days and may be renewed for a single 90-day period.

History.--s. 16, ch. 25209, 1949; s. 2, ch. 29790, 1955; s. 1, ch. 61-147; s. 3, ch. 61-497; s. 2, ch. 63-224; s. 1, ch. 67-206; s. 1, part VI, ch. 72-299; s. 25, ch. 73-190; s. 1, ch. 82-46; s. 4, ch. 82-101; s. 25, ch. 88-242; ss. 1, 2, ch. 89-279; ss. 11, 12, ch. 90-217; s. 255, ch. 94-356.

Note.--Former s. 378.16.

373.087 District works using aquifer for storage and supply.—
The governing board may establish works of the district for the purpose of introducing water into, or drawing water from, the underlying aquifer for storage or supply. However, only water of a compatible quality shall be introduced directly into such aquifer.

History.--s. 1, ch. 72-318; s. 1, ch. 82-46; s. 25, ch. 88-242; ss. 1, 2, ch. 89-279; ss. 11, 12, ch. 90-217.

373.106 Permit Required for Construction Involving Underground Formation

(1) No construction may be begun on a project involving artificial recharge or the intentional introduction of water into any underground formation except as permitted in chapter 377, without the written permission of the governing board of any water management district within which the construction will take place. Such application shall contain the detailed plans and specifications for the construction of the project.

(2) Each water management district has the exclusive authority to process and issue permits under this section and permits and licenses delegated under s. 403.812, except permits required by the department pursuant to 42 U.S.C. s. 300h until delegated by the department to the districts.

(3) A water management district may do any act necessary to replenish the ground water of the district. The district may, among other things, for the purposes of replenishing the ground water supplies within the district:

(a) Buy water;

(b) Exchange water;

(c) Distribute water to persons in exchange for ceasing or reducing ground water extractions;

(d) Spread, sink, and inject water into the underground;

(e) Store, transport, recapture, reclaim, purify, treat, or otherwise manage and control water for the beneficial use of persons or property within the district; and

(f) Build the necessary works to achieve ground water replenishment.

History.--s. 18, part I, ch. 72-299; s. 14, ch. 78-95; s. 71, ch. 83-310; s. 2, ch. 84-338; s. 1, ch. 84-341.

373.171 Rules and Regulations

(1) In order to obtain the most beneficial use of the water resources of the state and to protect the public health, safety, and welfare and the interests of the

water users affected, governing boards, by action not inconsistent with the other provisions of this law and without impairing property rights, may:

(a) Establish rules, regulations, or orders affecting the use of water, as conditions warrant, and forbidding the construction of new diversion facilities or wells, the initiation of new water uses, or the modification of any existing uses, diversion facilities, or storage facilities within the affected area.

(b) Regulate the use of water within the affected area by apportioning, limiting, or rotating uses of water or by preventing those uses which the governing board finds have ceased to be reasonable or beneficial.

(c) Make other rules, regulations, and orders necessary for the preservation of the interests of the public and of affected water users.

(2) In promulgating rules and regulations and issuing orders under this law, the governing board shall act with a view to full protection of the existing rights to water in this state insofar as is consistent with the purpose of this law.

(3) No rule, regulation or order shall require any modification of existing use or disposition of water in the district unless it is shown that the use or disposition proposed to be modified is detrimental to other water users or to the water resources of the state.

(4) All rules and regulations adopted by the governing board shall be filed with the Department of State as provided in chapter 120. An information copy will be filed with the Department of Environmental Protection.

History.--s. 11, ch. 57-380; s. 8, ch. 63-336; ss. 10, 25, 35, ch. 69-106; s. 8, ch. 76-243; s. 1, ch. 77-117; s. 14, ch. 78-95; s. 256, ch. 94-356.

373.175 Declaration of Water Shortage; Emergency Orders

(1) The governing board of the district may by order declare that a water shortage exists within all or part of the district when insufficient ground or surface water is available to meet the needs of the users or when conditions are such as to require temporary reduction in total use within the area to protect water resources from serious harm.

(2) The governing board may impose such restrictions on one or more users of the water resource as may be necessary to protect the water resources of the area from serious harm.

(3) When a water shortage is declared, the governing board shall cause notice thereof to be published in a prominent place within a newspaper of general circulation throughout the area. Publication of such notice shall serve as notice to all users in the area of the condition of water shortage.

(4) If an emergency condition exists due to a water shortage within any area of the district and the executive director of the district, with the concurrence of the governing board, finds that the exercise of powers under this section is not sufficient to protect the public health, safety, or welfare, the health of animals, fish, or aquatic life, a public water supply, or recreational, commercial, industrial, agricultural, or other reasonable uses, the executive director may, pursuant to the provisions of chapter 120, issue emergency orders reciting the existence of such an emergency and requiring that such action, including, but not limited to, apportioning, rotating, limiting, or prohibiting the use of the water resources of the district, be taken as the executive director, with the concurrence of the governing board, deems necessary to meet the emergency.

History.--s. 1, ch. 72-730; s. 25, ch. 73-190; s. 1, ch. 73-295; s. 14, ch. 78-95; s. 35, ch. 83-218; s. 597, ch. 95-148.

Note.--Former s. 378.152.

373.185 Local Xeriscape ordinances.--

(1) As used in this section, the term:

(a) "Local government" means any county or municipality of the state.

(b) "Xeriscape" means a landscaping method that maximizes the conservation of water by the use of site-appropriate plants and an efficient watering system. The principles of Xeriscape include planning and design, appropriate choice of plants, soil analysis which may include the use of solid waste compost, efficient irrigation, practical use of turf, appropriate use of mulches, and proper maintenance.

(2) Each water management district shall design and implement an incentive program to encourage all local governments within its district to adopt new ordinances or amend existing ordinances to require Xeriscape landscaping for development permitted after the effective date of the new ordinance or amendment. Each district shall adopt rules governing the implementation of its incentive program and governing the review and approval of local government Xeriscape ordinances or amendments which are intended to qualify a local government for the incentive program. Each district shall assist the local governments within its jurisdiction by providing a model Xeriscape code and other technical assistance. A local government Xeriscape ordinance or amendment, in order to qualify the local government for a district's incentive program, must include, at a minimum:

(a) Landscape design, installation, and maintenance standards that result in water conservation. Such standards shall address the use of plant groupings, soil analysis including the promotion of the use of solid waste compost, efficient irrigation systems, and other water-conserving practices.

(b) Identification of prohibited invasive exotic plant species.

(c) Identification of controlled plant species, accompanied by the conditions under which such plants may be used.

(d) A provision specifying the maximum percentage of turf and the maximum percentage of impervious surfaces allowed in a xeriscaped area and addressing the practical selection and installation of turf.

(e) Specific standards for land clearing and requirements for the preservation of existing native vegetation.

(f) A monitoring program for ordinance implementation and compliance.

The districts also shall work with local governments to promote, through educational programs and publications, the use of Xeriscape practices, including the use of solid waste compost, in existing residential and commercial development. This section may not be construed to limit the authority of the districts to require Xeriscape ordinances or practices as a condition of any consumptive use permit.

History.--s. 3, ch. 91-41; s. 3, ch. 91-68.

373.191 County water conservation projects.—
The several counties of the state may cooperate with the [1]division by engaging in county water development and conservation projects and may use county funds and equipment for this purpose and to do all other things necessary in connection with the development and conservation of the county's water resources consistent with the provisions of this law and the rules and regulations adopted pursuant thereto.

History.--s. 13, ch. 57-380; ss. 25, 35, ch. 69-106.

[1] Note.--Former s. 373.081(1), which defined the word"division" as the Division of Interior Resources of the Department of Natural Resources, was repealed by s. 1, pt. VI, ch. 72-299.

373.196 Legislative findings.--

(1) It is the finding of the Legislature that cooperative efforts between municipalities, counties, water management districts, and the Department of Environmental Protection are mandatory in order to meet the water needs of rapidly urbanizing areas in a manner which will supply adequate and dependable supplies of water where needed without resulting in adverse effects upon the areas from whence such water is withdrawn. Such efforts should utilize all practical means of obtaining water, including, but not limited to, withdrawals of surface water and ground water, recycling of waste water, and desalinization, and will necessitate not only cooperation but also well-coordinated activities. The purpose of this act is to provide additional statutory authority for such cooperative and coordinated efforts.

(2) Municipalities and counties are encouraged to create regional water supply authorities as authorized herein. It is further the intent that

municipalities, counties, and regional water supply authorities are to have the primary responsibility for water supply, and water management districts and their basin boards are to engage only in those functions that are incidental to the exercise of their flood control and water management powers.

(3) Nothing herein shall be construed to preclude the various municipalities and counties from continuing to operate existing water production and transmission facilities or to enter into cooperative agreements with other municipalities and counties for the purpose of meeting their respective needs for dependable and adequate supplies of water, provided the obtaining of water through such operations shall not be done in a manner which results in adverse effects upon the areas from whence such water is withdrawn.

History.--s. 1, ch. 74-114; s. 43, ch. 79-65; s. 257, ch. 94-356.

373.1961 Water production.--

(1) In the performance of, and in conjunction with, its other powers and duties, the governing board of a water management district existing pursuant to this chapter:

(a) Shall engage in planning to assist counties, municipalities, private utilities, or regional water supply authorities in meeting water supply needs in such manner as will give priority to encouraging conservation and reducing adverse environmental effects of improper or excessive withdrawals of water from concentrated areas. As used in this section, regional water supply authorities are regional water authorities created under s. 373.1962 or other laws of this state.

(b) Shall assist counties, municipalities, private utilities, or water supply authorities in meeting water supply needs in such manner as will give priority to encouraging conservation and reducing adverse environmental effects of improper or excessive withdrawals of water from concentrated areas.

(c) May establish, design, construct, operate, and maintain water production and transmission facilities for the purpose of supplying water to counties, municipalities, private utilities, or regional water supply authorities. The permit required by part II of this chapter for a water management district engaged in water production and transmission shall be granted, denied, or granted with conditions by the department.

(d) Shall not engage in local distribution.

(e) Shall not deprive, directly or indirectly, any county wherein water is withdrawn of the prior right to the reasonable and beneficial use of water which is required to supply adequately the reasonable and beneficial needs of the county or any of the inhabitants or property owners therein.

(f) May provide water and financial assistance to regional water supply authorities, but may not provide water to counties and municipalities which are located within the area of such authority without the specific approval of the authority or, in the event of the authority's disapproval, the approval of the Governor and Cabinet sitting as the Land and Water Adjudicatory Commission. The district may supply water at rates and upon terms mutually agreed to by the parties or, if they do not agree, as set by the governing board and specifically approved by the Governor and Cabinet sitting as the Land and Water Adjudicatory Commission.

(g) May acquire title to such interest as is necessary in real property, by purchase, gift, devise, lease, eminent domain, or otherwise, for water production and transmission consistent with this section. However, the district shall not use any of the eminent domain powers herein granted to acquire water and water rights already devoted to reasonable and beneficial use or any water production or transmission facilities owned by any county, municipality, or regional water supply authority. The district may exercise eminent domain powers outside of its district boundaries for the acquisition of pumpage facilities, storage areas, transmission facilities, and the normal appurtenances thereto, provided that at least 45 days prior to the exercise of eminent domain, the district notifies the district where the property is located after public notice and the district where the property is located does not object within 45 days after notification of such exercise of eminent domain authority.

(h) In addition to the power to issue revenue bonds pursuant to s. 373.584, may issue revenue bonds for the purposes of paying the costs and expenses incurred in carrying out the purposes of this chapter or refunding obligations of the district issued pursuant to this section. Such revenue bonds shall be secured by, and be payable from, revenues derived from the operation, lease, or use of its water production and transmission facilities and other water-related facilities and from the sale of water or services relating thereto. Such revenue bonds may not be secured by, or be payable from, moneys derived by the district from the Water Management Lands Trust Fund or from ad valorem taxes received by the district. All provisions of s. 373.584 relating to the issuance of revenue bonds which are not inconsistent with this section shall apply to the issuance of revenue bonds pursuant to this section. The district may also issue bond anticipation notes in accordance with the provisions of s. 373.584.

(i) May join with one or more other water management districts, counties, municipalities, private utilities, or regional water supply authorities for the purpose of carrying out any of its powers, and may contract with such other entities to finance acquisitions, construction, operation, and maintenance. The contract may provide for contributions to be made by each party thereto, for the division and apportionment of the expenses of acquisitions, construction, operation, and maintenance, and for the division and apportionment of the benefits, services, and products therefrom. The contracts may contain other covenants and agreements necessary and appropriate to accomplish their purposes.

(2) The Legislature finds that, due to a combination of factors, vastly increased demands have been placed on natural supplies of fresh water, and that, absent increased development of alternative water supplies, such demands may increase in the future. The Legislature also finds that potential exists in the state for the production of significant quantities of alternative water supplies, including reclaimed water, and that water production includes the development of alternative water supplies, including reclaimed water, for appropriate uses. It is the intent of the Legislature that utilities develop reclaimed water systems, where reclaimed water is the most appropriate alternative water supply option, to deliver reclaimed water to as many users as possible through the most cost-effective means, and to construct reclaimed water system infrastructure to their owned or operated properties and facilities where they have reclamation capability. It is also the intent of the Legislature that the water management districts which levy ad valorem taxes for water management purposes should share a percentage of those tax revenues with water providers and users, including local governments, water, wastewater, and reuse utilities, municipal, industrial, and agricultural water users, and other public and private water users, to be used to supplement other funding sources in the development of alternative water supplies. The Legislature finds that public moneys or services provided to private entities for such uses constitute public purposes which are in the public interest. In order to further the development and use of alternative water supply systems, including reclaimed water systems, the Legislature provides the following:

(a) The governing boards of the water management districts where water resource caution areas have been designated shall include in their annual budgets an amount for the development of alternative water supply systems, including reclaimed water systems, pursuant to the requirements of this subsection. Beginning in 1996, such amounts shall be made available to water providers and users no later than December 31 of each year, through grants, matching grants, revolving loans, or the use of district lands or facilities pursuant to the requirements of this subsection and guidelines established by the districts.

(b) It is the intent of the Legislature that for each reclaimed water utility, or any other utility, which receives funds pursuant to this subsection, the appropriate rate-setting authorities should develop rate structures for all water, wastewater, and reclaimed water and other alternative water supply utilities in the service area of the funded utility, which accomplish the following:

1. Provide meaningful progress toward the development and implementation of alternative water supply systems, including reclaimed water systems;

2. Promote the conservation of fresh water withdrawn from natural systems;

3. Provide for an appropriate distribution of costs for all water, wastewater, and alternative water supply utilities, including reclaimed water utilities, among all of the users of those utilities; and

4. Prohibit rate discrimination within classes of utility users.

(c) In order to be eligible for funding pursuant to this subsection, a project must be consistent with a local government comprehensive plan and the governing body of the local government must require all appropriate new facilities within the project's service area to connect to and use the project's alternative water supplies. The appropriate local government must provide written notification to the appropriate district that the proposed project is consistent with the local government comprehensive plan.

(d) Any and all revenues disbursed pursuant to this subsection shall be applied only for the payment of capital or infrastructure costs for the construction of alternative water supply systems that provide alternative water supplies for uses within one or more water resource caution areas.

(e) By January 1 of each year, the governing boards shall make available written guidelines for the disbursal of revenues pursuant to this subsection. Such guidelines shall include at minimum:

1. An application process and a deadline for filing applications annually.

2. A process for determining project eligibility pursuant to the requirements of paragraphs (c) and (d).

3. A process and criteria for funding projects pursuant to this subsection that cross district boundaries or that serve more than one district.

(f) The governing board of each water management district shall establish an alternative water supplies grants advisory committee to recommend to the governing board projects for funding pursuant to this subsection. The advisory committee members shall include, but not be limited to, one or more representatives of county, municipal, and investor-owned private utilities, and may include, but not be limited to, representatives of agricultural interests and environmental interests. Each committee member shall represent his or her interest group as a whole and shall not represent any specific entity. The committee shall apply the guidelines and project eligibility criteria established by the governing board in reviewing proposed projects. After one or more hearings to solicit public input on eligible projects, the committee shall rank the eligible projects and shall submit them to the governing board for final funding approval. The advisory committee may submit to the governing board more projects than the available grant money would fund.

(g) All revenues made available annually pursuant to this subsection must be disbursed annually by the governing board if it approves projects sufficient to expend the available revenues.

(h) For purposes of this subsection, alternative water supplies are supplies of water that have been reclaimed after one or more public supply, municipal, industrial, commercial, or agricultural uses, or are supplies of stormwater, or brackish or salt water, that have been treated in accordance with applicable rules and standards sufficient to supply the intended use.

(i) This subsection shall not be subject to the rulemaking requirements of chapter 120.

(j) By January 30 of each year, each water management district shall submit an annual report to the Governor, the President of the Senate, and the Speaker of the House of Representatives which accounts for the disbursal of all budgeted amounts pursuant to this subsection. Such report shall describe all projects funded and shall account separately for moneys provided through grants, matching grants, revolving loans, and the use of district lands or facilities.

History.--s. 2, ch. 74-114; s. 14, ch. 76-243; s. 7, ch. 82-101; s. 2, ch. 87-347; s. 7, ch. 95-323.

373.1962 Regional water supply authorities.--

(1) By agreement between local governmental units created or existing pursuant to the provisions of Art. VIII of the State Constitution, pursuant to the Florida Interlocal Cooperation Act of 1969, s. 163.01, and upon the approval of the Secretary of Environmental Protection to ensure that such agreement will be in the public interest and complies with the intent and purposes of this act, regional water supply authorities may be created for the purpose of developing, recovering, storing, and supplying water for county or municipal purposes in such a manner as will give priority to reducing adverse environmental effects of excessive or improper withdrawals of water from concentrated areas. In approving said agreement the Secretary of Environmental Protection shall consider, but not be limited to, the following:

(a) Whether the geographic territory of the proposed authority is of sufficient size and character to reduce the environmental effects of improper or excessive withdrawals of water from concentrated areas.

(b) The maximization of economic development of the water resources within the territory of the proposed authority.

(c) The availability of a dependable and adequate water supply.

(d) The ability of any proposed authority to design, construct, operate, and maintain water supply facilities in the locations, and at the times necessary, to ensure that an adequate water supply will be available to all citizens within the authority.

(e) The effect or impact of any proposed authority on any municipality, county, or existing authority or authorities.

(f) The existing needs of the water users within the area of the authority.

(2) In addition to other powers and duties agreed upon, and notwithstanding the provisions of s. 163.01, such authority may:

(a) Upon approval of the electors residing in each county or municipality within the territory to be included in any authority, levy ad valorem taxes, not to exceed 0.5 mill, pursuant to s. 9(b), Art. VII of the State Constitution. No tax authorized by this paragraph shall be levied in any county or municipality without an affirmative vote of the electors residing in such county or municipality.

(b) Acquire water and water rights; develop, store, and transport water; provide, sell and deliver water for county or municipal uses and purposes; provide for the furnishing of such water and water service upon terms and conditions and at rates which will apportion to parties and nonparties an equitable share of the capital cost and operating expense of the authority's work to the purchaser.

(c) Collect, treat, and recover wastewater.

(d) Not engage in local distribution.

(e) Exercise the power of eminent domain in the manner provided by law for the condemnation of private property for public use to acquire title to such interest in real property as is necessary to the exercise of the powers herein granted, except water and water rights already devoted to reasonable and beneficial use or any water production or transmission facilities owned by any county or municipality.

(f) Issue revenue bonds in the manner prescribed by the Revenue Bond Act of 1953, as amended, part I, chapter 159, to be payable solely from funds derived from the sale of water by the authority to any county or municipality. Such bonds may be additionally secured by the full faith and credit of any county or municipality, as provided by s. 159.16 or by a pledge of excise taxes, as provided by s. 159.19. For the purpose of issuing revenue bonds, an authority shall be considered a "unit" as defined in s. 159.02(2) and as that term is used in the Revenue Bond Act of 1953, as amended. Such bonds may be issued to finance the cost of acquiring properties and facilities for the production and transmission of water by the authority to any county or municipality, which cost shall include the acquisition of real property and easements therein for such purposes. Such bonds may be in the form of refunding bonds to take up any outstanding bonds of the authority or of any county or municipality where such outstanding bonds are secured by properties and facilities for production and transmission of water, which properties and facilities are being acquired by the authority. Refunding bonds may be issued to take up and refund all outstanding bonds of said authority that are subject to call and termination, and all bonds of said authority that are not subject to call or redemption, when the surrender of said bonds can be procured from the holder thereof at prices satisfactory to the authority. Such refunding bonds may be issued at any time when, in the judgment of the authority, it will be to the best interest of the authority financially or economically by securing a lower rate of interest on said bonds or by extending the time of maturity of said bonds or, for any other reason, in the judgment of the authority, advantageous to said authority.

(g) Sue and be sued in its own name.

(h) Borrow money and incur indebtedness and issue bonds or other evidence of such indebtedness.

(i) Join with one or more other public corporations for the purpose of carrying out any of its powers and for that purpose to contract with such other public corporation or corporations for the purpose of financing such acquisitions, construction, and operations. Such contracts may provide for contributions to be made by each party thereto, for the division and apportionment of the expenses of such acquisitions and operations, and for the division and apportionment of the benefits, services, and products therefrom. Such contract may contain such other and further covenants and agreements as may be necessary and convenient to accomplish the purposes hereof.

(3) A regional water supply authority is authorized to develop, construct, operate, maintain, or contract for alternative sources of potable water, including desalinated water, and pipelines to interconnect authority sources and facilities, either by itself or jointly with a water management district; however, such alternative potable water sources, facilities, and pipelines may also be privately developed, constructed, owned, operated, and maintained, in which event an authority and a water management district

are authorized to pledge and contribute their funds to reduce the wholesale cost of water from such alternative sources of potable water supplied by an authority to its member governments.

(4) When it is found to be in the public interest, for the public convenience and welfare, for a public benefit, and necessary for carrying out the purpose of any regional water supply authority, any state agency, county, water control district existing pursuant to chapter 298, water management district existing pursuant to this chapter, municipality, governmental agency, or public corporation in this state holding title to any interest in land is hereby authorized, in its discretion, to convey the title to or dedicate land, title to which is in such entity, including tax-reverted land, or to grant use-rights therein, to any regional water supply authority created pursuant to this section. Land granted or conveyed to such authority shall be for the public purposes of such authority and may be made subject to the condition that in the event said land is not so used, or if used and subsequently its use for said purpose is abandoned, the interest granted shall cease as to such authority and shall automatically revert to the granting entity.

(5) Each county or municipality which is a party to an agreement pursuant to subsection (1) shall have a preferential right to purchase water from the regional water supply authority for use by such county or municipality.

(6) In carrying out the provisions of this section, any county wherein water is withdrawn by the authority shall not be deprived, directly or indirectly, of the prior right to the reasonable and beneficial use of water which is required adequately to supply the reasonable and beneficial needs of the county or any of the inhabitants or property owners therein.

(7) Upon a resolution adopted by the governing body of any county or municipality, the authority may, subject to a majority vote of its voting members, include such county or municipality in its regional water supply authority upon such terms and conditions as may be prescribed.

(8) The authority shall design, construct, operate, and maintain facilities in the locations and at the times necessary to ensure that an adequate water supply will be available to all citizens within the authority.

History.--s. 7, ch. 74-114; s. 1, ch. 77-174; s. 35, ch. 79-5; s. 1, ch. 86-22; s. 258, ch. 94-356; s. 29, ch. 97-160.

Part II Permitting Consumptive Uses Water

373.207 Abandoned Artesian Well--

(1) Each water management district shall develop a work plan which identifies the location of all known abandoned artesian wells within its jurisdictional boundaries and defines the actions which the district must take in order to

ensure that each such well is plugged on or before January 1, 1992. The work plan shall include the following:

(a) An initial inventory which accounts for all known abandoned artesian wells in the district.

(b) The location and owner of each known abandoned well.

(c) The methodology proposed by the district to accomplish the plugging of all known abandoned wells within the district on or before January 1, 1992.

(d) Data relating to costs to be incurred for the plugging of all wells, including the per-well cost and personnel costs.

(e) A schedule of priority for the plugging of wells, which schedule is established to mitigate damage to the ground water resource due to water quality degradation.

(2) Each water management district shall submit an annual update of its work plan to the Secretary of Environmental Protection by January 1 of each year, until all wells identified by the plan are plugged.

History.--s. 8, ch. 83-310; s. 263, ch. 94-356.

373.217 Superseded Laws and Regulations

(1) It is the intent of the Legislature to provide a means whereby reasonable programs for the issuance of permits authorizing the consumptive use of particular quantities of water may be authorized by the Department of Environmental Protection, subject to judicial review and also subject to review by the Governor and Cabinet, sitting as the Land and Water Adjudicatory Commission as provided in s. 373.114.

(2) It is the further intent of the Legislature that Part II of the Florida Water Resources Act of 1972, as amended, as set forth in ss. 373.203-373.249, shall provide the exclusive authority for requiring permits for the consumptive use of water and for authorizing transportation thereof pursuant to s. 373.223(2).

(3) If any provision of Part II of the Florida Water Resources Act of 1972, as amended, as set forth in ss. 373.203-373.249, is in conflict with any other provision, limitation, or restriction which is now in effect under any law or ordinance of this state or any political subdivision or municipality, or any rule or regulation promulgated thereunder, Part II shall govern and control, and such other law or ordinance or rule or regulation promulgated thereunder shall be deemed superseded for the purpose of regulating the consumptive use of water. However, this section shall not be construed to supersede the provisions of the Florida Electrical Power Plant Siting Act.

(4) Other than as provided in subsection (3) of this section, Part II of the Florida Water Resources Act of 1972, as amended, preempts the regulation of the consumptive use of water as defined in this act.

History.--s. 9, ch. 76-243; s. 1, ch. 77-174; s. 265, ch. 94-356.

373.219 Permits required.--

(1) The governing board or the department may require such permits for consumptive use of water and may impose such reasonable conditions as are necessary to assure that such use is consistent with the overall objectives of the district or department and is not harmful to the water resources of the area. However, no permit shall be required for domestic consumption of water by individual users.

(2) In the event that any person shall file a complaint with the governing board or the department that any other person is making a diversion, withdrawal, impoundment, or consumptive use of water not expressly exempted under the provisions of this chapter and without a permit to do so, the governing board or the department shall cause an investigation to be made, and if the facts stated in the complaint are verified the governing board or the department shall order the discontinuance of the use.

History.--s. 2, part II, ch. 72-299; s. 9, ch. 73-190.

373.223 Conditions for a permit.--

(1) To obtain a permit pursuant to the provisions of this chapter, the applicant must establish that the proposed use of water:

(a) Is a reasonable-beneficial use as defined in [1] s. 373.019(4);

(b) Will not interfere with any presently existing legal use of water; and

(c) Is consistent with the public interest.

(2) The governing board or the department may authorize the holder of a use permit to transport and use ground or surface water beyond overlying land, across county boundaries, or outside the watershed from which it is taken if the governing board or department determines that such transport and use is consistent with the public interest, and no local government shall adopt or enforce any law, ordinance, rule, regulation, or order to the contrary.

(3) The governing board or the department, by regulation, may reserve from use by permit applicants, water in such locations and quantities, and for such seasons of the year, as in its judgment may be required for the protection of fish and wildlife or the public health and safety. Such reservations shall be subject to periodic review and revision in the light of changed conditions. However, all presently existing legal uses of water shall be protected so long as such use is not contrary to the public interest.

History.--s. 3, part II, ch. 72-299; s. 10, ch. 73-190; s. 10, ch. 76-243; s. 35, ch. 85-81.

[1] Note.--Redesignated as s. 373.019(13) by s. 2, ch. 97-160.

373.224 Existing Permits

Any permits or permit agreements for consumptive use of water executed or issued by an existing flood control, water management, or water regulatory district pursuant to this chapter or chapter 378 prior to December 31, 1976, shall remain in full force and effect in accordance with their terms until otherwise modified or revoked as authorized herein.

History.--s. 11, ch. 73-190; s. 3, ch. 75-125.

373.226 Existing uses.--

(1) All existing uses of water, unless otherwise exempted from regulation by the provisions of this chapter, may be continued after adoption of this permit system only with a permit issued as provided herein.

(2) The governing board or the department shall issue an initial permit for the continuation of all uses in existence before the effective date of implementation of this part if the existing use is a reasonable-beneficial use as defined in [1]s. 373.019(13) and is allowable under the common law of this state.

(3) Application for permit under the provisions of subsection (2) must be made within a period of 2 years from the effective date of implementation of these regulations in an area. Failure to apply within this period shall create a conclusive presumption of abandonment of the use, and the user, if he or she desires to revive the use, must apply for a permit under the provisions of s. 373.229.

History.--s. 4, part II, ch. 72-299; s. 12, ch. 73-190; s. 598, ch. 95-148.

[1] Note.--Substituted by the editors for a reference to s. 373.019(5) to conform to the redesignation of subunits by s. 37, ch. 79-65, and the further redesignation of subunits by s. 2, ch. 97-160.

373.2295 Interdistrict Transfers of Ground water

(1) As used in this section, “interdistrict transfer and use” means a consumptive water use which involves the withdrawal of ground water from a point within one water management district for use outside the boundaries of that district.

(2) To obtain a permit for an interdistrict transfer and use of ground water, an applicant must file an application in accordance with s. 373.229 with the water management district having jurisdiction over the area from which the applicant proposes to withdraw ground water and submit a copy of the application to the water management district having jurisdiction over the area where the water is to be used.

(3) The governing board of the water management district where the ground water is proposed to be withdrawn shall review the application in accordance with this part, the rules of the district which relate to consumptive water use permitting, and other applicable provisions of this chapter.

(4) In determining if an application is consistent with the public interest as required by s. 373.223, the projected populations, as contained in the future land use elements of the comprehensive plans adopted pursuant to chapter 163 by the local governments within which the withdrawal areas and the proposed use areas are located, will be considered together with other evidence presented on future needs of those areas. If the proposed interdistrict transfer of ground water meets the requirements of this chapter, and if the needs of the area where the use will occur and the specific area from which the ground water will be withdrawn can be satisfied, the permit for the interdistrict transfer and use shall be issued.

(5) In addition to other requirements contained in this part, the water management district where the ground water is proposed to be withdrawn shall:

(a) Furnish copies of any application, information, correspondence, or other related material to the water management district having jurisdiction over the area where the water is to be used; and

(b) Request comments on the application and the future water needs of the proposed use area from the water management district having jurisdiction over the area where the water is to be used. If comments are received, they must be attached to the preliminary notice of intended agency action and may not create a point of entry for review whether issued by the governing board or district staff.

(6) Upon completion of review of the application, the water management district where the ground water is proposed to be withdrawn shall prepare a notice of preliminary intended agency action which shall include an evaluation of the application and a recommendation of approval, denial, or approval with conditions. The notice shall be furnished to the district where the water is to be used, the applicant, the Department of Environmental Protection, the local governments having jurisdiction over the area from which the ground water is to be withdrawn and where the water is to be used, and any person requesting a copy of the notice.

(a) Any interested person may, within the time specified in the notice, notify in writing the district from where the ground water is to be withdrawn of such person's position and comments or objections, if any, to the preliminary intended action.

(b) The filing of the notice of intended agency action shall toll the time periods contained in s. 120.60 for the granting or denial of a permit for an interdistrict transfer and use of ground water.

(c) The preliminary intended agency action and any comments or objections of interested persons made pursuant to paragraph (a) shall be considered by the governing board of the water management district where the ground water is proposed to be withdrawn. Following such consideration, the governing board shall issue a notice of intended agency action.

(d) Any substantially affected person who submitted a notification pursuant to paragraph (a) may request review by the department within 14 days after the filing of the notice of intended agency action. If no request for review is filed, the notice of intended agency action shall become the final order of the governing board.

(7) Notwithstanding the provisions of chapter 120, the department shall, within 30 days after its receipt of a request for review of the water management district's action, approve, deny, or modify the water management district's action on the proposed interdistrict transfer and use of ground water. The department shall issue a notice of its intended action. Any substantially affected person who requested review pursuant to paragraph (6)(a) may request an administrative hearing pursuant to chapter 120 within 14 days after notice of the department's intended action. The parties to such proceeding shall include, at a minimum, the affected water management districts and the applicant. The proceedings initiated by a petition under ss. 120.569 and 120.57, following the department's issuance of a notice of intended agency action, is the exclusive proceeding authorized for the review of agency action on the interdistrict transfer and use of ground water. This procedure is to give effect to the legislative intent that this section provide a single, efficient, simplified, coordinated permitting process for the interdistrict transfer and use of ground water.

(8) The department shall issue a final order which is subject to review pursuant to s. 120.68 or s. 373.114.

(9) In administering this part, the department or the water management districts may enter into interagency agreements. However, such agreements are not subject to the provisions of s. 373.046 and chapter 120.

(10) The state hereby preempts any regulation of the interdistrict transfer and use of ground water. If any provision of this section is in conflict with any other provision or restriction under any law, administrative rule, or ordinance, this section shall govern and such law, rule, or ordinance shall be deemed superseded for the purposes of this section. A water management district or the department may not adopt special rules which prohibit or restrict interdistrict transfer and use of ground water in a manner inconsistent with this section.

(11) Any applicant who has submitted an application for interdistrict transfer and use of ground water which is pending on July 11, 1987, may have the application considered pursuant to this section. New permits are not required for interdistrict transfers existing on July 11, 1987, for the duration of the permits issued for such uses.

(12) If, after the final order of the department or final agency action under this section, the proposed use of the site designated in the application for ground water production, treatment, or transmission facilities does not conform with the existing zoning ordinances, a rezoning application may be submitted. If local authorities deny the application for rezoning, the applicant may appeal this decision to the Land and Water Adjudicatory Commission, which shall authorize a variance or nonconforming use to the existing comprehensive plan and zoning ordinances, unless the commission determines after notice and hearing that such variance or nonconforming use is contrary to the public interest.

(13) The permit required under this section and other sections of this chapter and chapter 403 are the sole permits required for interdistrict transfer and use of ground water, and such permits are in lieu of any license, permit, or similar document required by any state agency or political subdivision pursuant to chapter 163, chapter 380, or chapter 381, and the Florida Transportation Code.

(14) When a consumptive use permit under this section is granted for water use beyond the boundaries of a local government from which or through which the ground water is withdrawn or transferred and a local government denies a permit required under chapter 125 or chapter 153 for a facility or any infrastructure which produces, treats, transmits, or distributes such ground water, the person or unit of government applying for the permit under chapter 125 or chapter 153 may appeal the denial to the Land and Water Adjudicatory Commission. The commission shall review the local government action for consistency with this chapter and the interdistrict ground water transfer permit and may reverse, modify, or approve the local government's action.

History.--s. 1, ch. 87-347; s. 266, ch. 94-356; s. 99, ch. 96-410.

373.233 Competing applications.--

(1) If two or more applications which otherwise comply with the provisions of this part are pending for a quantity of water that is inadequate for both or all, or which for any other reason are in conflict, the governing board or the department shall have the right to approve or modify the application which best serves the public interest.

(2) In the event that two or more competing applications qualify equally under the provisions of subsection (1), the governing board or the department shall give preference to a renewal application over an initial application.

History.--s. 6, part II, ch. 72-299.

373.236 Duration of permits; compliance reports.--

(1) Permits shall be granted for a period of 20 years, if requested for that period of time, if there is sufficient data to provide reasonable assurance that the conditions for permit issuance will be met for the duration of the permit; otherwise, permits may be issued for shorter durations which reflect the period for which such reasonable assurances can be provided. The governing board or the department may base the duration of permits on a reasonable system of classification according to source of supply or type of use, or both.

(2) The governing board or the department may authorize a permit of duration of up to 50 years in the case of a municipality or other governmental body or of a public works or public service corporation where such a period is required to provide for the retirement of bonds for the construction of waterworks and waste disposal facilities.

(3) Where necessary to maintain reasonable assurance that the conditions for issuance of a 20-year permit can continue to be met, the governing board or department, in addition to any conditions required pursuant to s. 373.219, may require a compliance report by the permittee every 5 years during the term of a permit. This report shall contain sufficient data to maintain reasonable assurance that the initial conditions for permit issuance are met. Following review of this report, the governing board or the department may modify the permit to ensure that the use meets the conditions for issuance. Permit modifications pursuant to this subsection shall not be subject to competing applications, provided there is no increase in the permitted allocation or permit duration, and no change in source, except for changes in source requested by the district. This subsection shall not be construed to limit the existing authority of the department or the governing board to modify or revoke a consumptive use permit.

History.--s. 7, part II, ch. 72-299; s. 13, ch. 97-160.

373.239 Modification and renewal of permit terms.--

(1) A permittee may seek modification of any terms of an unexpired permit.

(2) If the proposed modification involves water use of 100,000 gallons or more per day, the application shall be treated under the provisions of s. 373.229 in the same manner as the initial permit application. Otherwise, the governing board or the department may at its discretion approve the proposed modification without a hearing, provided the permittee establishes that:

(a) A change in conditions has resulted in the water allowed under the permit becoming inadequate for the permittee's need, or

(b) The proposed modification would result in a more efficient utilization of water than is possible under the existing permit.

(3) All permit renewal applications shall be treated under this part in the same manner as the initial permit application.

History.--s. 8, part II, ch. 72-299; s. 14, ch. 73-190.

373.243 Revocation of permits.—
The governing board or the department may revoke a permit as follows:

(1) For any material false statement in an application to continue, initiate, or modify a use, or for any material false statement in any report or statement of fact required of the user pursuant to the provisions of this chapter, the governing board or the department may revoke the user's permit, in whole or in part, permanently.

(2) For willful violation of the conditions of the permit, the governing board or the department may permanently or temporarily revoke the permit, in whole or in part.

(3) For violation of any provision of this chapter, the governing board or the department may revoke the permit, in whole or in part, for a period not to exceed 1 year.

(4) For nonuse of the water supply allowed by the permit for a period of 2 years or more, the governing board or the department may revoke the permit permanently and in whole unless the user can prove that his or her nonuse was due to extreme hardship caused by factors beyond the user's control.

(5) The governing board or the department may revoke a permit, permanently and in whole, with the written consent of the permittee.

History.--s. 9, part II, ch. 72-299; s. 14, ch. 78-95; s. 600, ch. 95-148.

373.246 Declaration of Water Shortage or Emergency

(1) The governing board or the department by regulation shall formulate a plan for implementation during periods of water shortage. Copies of the water shortage plan shall be submitted to the Speaker of the House of Representatives and the President of the Senate no later than October 31, 1983. As a part of this plan the governing board or the department shall adopt a reasonable system of water-use classification according to source of water supply; method of extraction, withdrawal, or diversion; or use of water or a combination thereof. The plan may include provisions for variances and alternative measures to prevent undue hardship and ensure equitable distribution of water resources.

(2) The governing board or the department by order may declare that a water shortage exists for a source or sources within all or part of the district when insufficient water is or will be available to meet the present and anticipated requirements of the users or when conditions are such as to require temporary reduction in total use within the area to protect water resources from serious harm. Such orders will be final agency action.

(3) In accordance with the plan adopted under subsection (1), the governing board or the department may impose such restrictions on one or more classes of water uses as may be necessary to protect the water resources of the area from serious harm and to restore them to their previous condition.

(4) A declaration of water shortage and any measures adopted pursuant thereto may be rescinded by the governing board or the department.

(5) When a water shortage is declared, the governing board or the department shall cause notice thereof to be published in a prominent place within a newspaper of general circulation throughout the area. Publication of such notice will serve as notice to all users in the area of the condition of water shortage.

(6) The governing board or the department shall notify each permittee in the district by regular mail of any change in the condition of his or her permit or any suspension of his or her permit or of any other restriction on the permittee's use of water for the duration of the water shortage.

(7) If an emergency condition exists due to a water shortage within any area of the district, and if the department, or the executive director of the district with the concurrence of the governing board, finds that the exercise of powers under subsection (1) is not sufficient to protect the public health, safety, or welfare; the health of animals, fish, or aquatic life; a public water supply; or recreational, commercial, industrial, agricultural, or other reasonable uses, it or he or she may, pursuant to the provisions of s. 373.119, issue emergency orders reciting the existence of such an emergency and requiring that such action, including, but not limited to, apportioning, rotating, limiting, or prohibiting the use of the water resources of the district, be taken as the department or the executive director deems necessary to meet the emergency.

(8) An affected party to whom an emergency order is directed under subsection (7) shall comply immediately, but may challenge such an order in the manner set forth in s. 373.119.

History.--s. 10, part II, ch. 72-299; s. 14, ch. 78-95; s. 11, ch. 82-101; s. 10, ch. 84-341; s. 601, ch. 95-148.

373.250 Reuse of reclaimed water.--

(1) The encouragement and promotion of water conservation and reuse of reclaimed water, as defined by the department, are state objectives and considered to be in the public interest. The Legislature finds that the use of reclaimed water provided by domestic wastewater treatment plants permitted and operated under a reuse program approved by the department is environmentally acceptable and not a threat to public health and safety.

(2)

(a) For purposes of this section, “uncommitted” means the average amount of reclaimed water produced during the three lowest-flow months minus the amount of reclaimed water that a reclaimed water provider is contractually obligated to provide to a customer or user.

(b) Reclaimed water may be presumed available to a consumptive use permit applicant when a utility exists which provides reclaimed water, which has uncommitted reclaimed water capacity, and which has distribution facilities, which are initially provided by the utility at its cost, to the site of the affected applicant's proposed use.

(3) The water management district shall, in consultation with the department, adopt rules to implement this section. Such rules shall include, but not be limited to:

(a) Provisions to permit use of water from other sources in emergency situations or if reclaimed water becomes unavailable, for the duration of the emergency or the unavailability of reclaimed water. These provisions shall also specify the method for establishing the quantity of water to be set aside for use in emergencies or when reclaimed water becomes unavailable. The amount set aside is subject to periodic review and revision. The methodology shall take into account the risk that reclaimed water may not be available in the future, the risk that other sources may be fully allocated to other uses in the future, the nature of the uses served with reclaimed water, the extent to which the applicant intends to rely upon reclaimed water and the extent of economic harm which may result if other sources are not available to replace the reclaimed water. It is the intent of this paragraph to ensure that users of reclaimed water have the same access to ground or surface water and will otherwise be treated in the same manner as other users of the same class not relying on reclaimed water.

(b) A water management district shall not adopt any rule which gives preference to users within any class of use established under s. 373.246 who do not use reclaimed water over users within the same class who use reclaimed water.

(4) Nothing in this section shall impair a water management district's authority to plan for and regulate consumptive uses of water under this chapter.

(5) This section applies to new consumptive use permits and renewals of existing consumptive use permits.

(6) Each water management district shall submit to the Legislature, by June 1 of each year, an annual report which describes the district's progress in promoting the reuse of reclaimed water. The report shall include, but not be limited to:

(a) The number of permits issued during the year which required reuse of reclaimed water and, by categories, the percentages of reuse required.

(b) The number of permits issued during the year which did not require the reuse of reclaimed water and, of those permits, the number which reasonably could have required reuse.

(c) In the second and subsequent annual reports, a statistical comparison of reuse required through consumptive use permitting between the current and preceding years.

(d) A comparison of the volume of reclaimed water available in the district to the volume of reclaimed water required to be reused through consumptive use permits.

(e) A comparison of the volume of reuse of reclaimed water required in water resource caution areas through consumptive use permitting to the volume required in other areas in the district through consumptive use permitting.

(f) An explanation of the factors the district considered when determining how much, if any, reuse of reclaimed water to require through consumptive use permitting.

(g) A description of the district's efforts to work in cooperation with local government and private domestic wastewater treatment facilities to increase the reuse of reclaimed water. The districts, in consultation with the department, shall devise a uniform format for the report required by this subsection and for presenting the information provided in the report.

History.--s. 2, ch. 94-243; s. 35, ch. 97-160; s. 18, ch. 97-164.

Part V Finance and Taxation

373.536 District budget and hearing thereon.--

(1) The fiscal year of districts created under the provisions of this chapter shall extend from October 1 of one year through September 30 of the following year. The budget officer of the district shall, on or before July 15 of each year, submit for consideration by the governing board of the district a tentative budget for the district covering its proposed operation and requirements for the ensuing fiscal year. Unless alternative notice requirements are otherwise provided by law, notice of all budget hearings conducted by the governing board or district staff must be published in a newspaper of general circulation in each county in which the district lies not less than 5 days nor more than 15 days before the hearing. Budget workshops conducted for the public and not governed by s. 200.065 must be advertised in a newspaper of general circulation in the community or area in which the workshop will occur not less than 5 days nor more than 15 days before the workshop. The tentative budget shall be adopted in accordance with the provisions of s. 200.065; however, if the mailing of the notice of proposed property taxes is delayed beyond September 3 in any county in which the district lies, the district shall advertise its intention to adopt a tentative budget and millage rate, pursuant to s. 200.065(3)(g), in a newspaper of general paid circulation in that county. The budget shall set forth, classified by object and purpose, and by fund if so designated, the proposed expenditures of the district for bonds or other debt, for construction, for acquisition of land, for operation and maintenance of the district works, for the conduct of the affairs of the district generally, and for other purposes, to which may be added an amount to be held as a reserve. District administrative and operating expenses must be identified in the budget and allocated among district programs.

(2) The budget shall also show the estimated amount which will appear at the beginning of the fiscal year as obligated upon commitments made but uncompleted. There shall be shown the estimated unobligated or net balance which will be on hand at the beginning of the fiscal year, and the estimated amount to be raised by district taxes and from other sources for meeting the requirements of the district.

(3) As provided in s. 200.065(2)(d), the board shall publish one or more notices of its intention to finally adopt a budget for the district for the ensuing fiscal year. The notice shall appear adjacent to an advertisement which shall set forth the tentative budget in full. The notice and advertisement shall be published in one or more newspapers having a combined general circulation in the counties having land in the district. Districts may include explanatory phrases and examples in budget advertisements published under s. 200.065 to clarify or illustrate the effect that the district budget may have on ad valorem taxes.

(4) The hearing to finally adopt a budget and millage rate shall be by and before the governing board of the district as provided in s. 200.065 and may

be continued from day to day until terminated by the board. The final budget for the district will thereupon be the operating and fiscal guide for the district for the ensuing year; however, transfers of funds may be made within the budget by action of the governing board at a public meeting of the governing board. Should the district receive unanticipated funds after the adoption of the final budget, the final budget may be amended by including such funds, so long as notice of intention to amend is published one time in one or more newspapers qualified to accept legal advertisements having a combined general circulation in the counties in the district. The notice shall set forth the proposed amendment and shall be published at least 10 days prior to the public meeting of the board at which the proposed amendment is to be considered. However, in the event of a disaster or of an emergency arising to prevent or avert the same, the governing board shall not be limited by the budget but shall have authority to apply such funds as may be available therefor or as may be procured for such purpose.

(5)

(a) The Executive Office of the Governor is authorized to approve or disapprove, in whole or in part, the budget of each water management district and shall analyze each budget as to the adequacy of fiscal resources available to the district and the adequacy of district expenditures related to water supply, including water resource development projects identified in the district's regional water supply plans; water quality; flood protection and floodplain management; and natural systems. This analysis shall be based on the particular needs within each water management district in those four areas of responsibility.

(b) The Executive Office of the Governor and the water management districts shall develop a process to facilitate review and communication regarding water management district budgets, as necessary. Written disapproval of any provision in the tentative budget must be received by the district at least 5 business days prior to the final district budget adoption hearing conducted under s. 200.065(2)(d). If written disapproval of any portion of the budget is not received at least 5 business days prior to the final budget adoption hearing, the governing board may proceed with final adoption. Any provision rejected by the Governor shall not be included in a district's final budget.

1(c) Each water management district shall, by August 1 of each year, submit for review a tentative budget to the Governor, the President of the Senate, the Speaker of the House of Representatives, the chairs of all legislative committees and subcommittees with substantive or fiscal jurisdiction over water management districts, the secretary of the department, and the governing body of each county in which the district has jurisdiction or derives any funds for the operations of the district. The tentative budget[2] must include, but is not limited to, the following information for the preceding fiscal year and the current fiscal year, and the proposed amounts for the upcoming fiscal year, in a standard format prescribed by the Executive Office of the Governor which is generally consistent with the format prescribed by legislative budget instructions for state agencies and the format requirements of s. 216.031:

1. The millage rates and the percentage increase above the rolled-back rate, together with a summary of the reasons the increase is required, and the percentage increase in taxable value resulting from new construction;

2. The salary and benefits, expenses, operating capital outlay, number of authorized positions, and other personal services for the following program areas, including a separate section for lobbying, intergovernmental relations, and advertising:

   a. District management and administration;

   b. Implementation through outreach activities;

   c. Implementation through regulation;

   d. Implementation through acquisition, restoration, and public works;

   e. Implementation through operations and maintenance of lands and works;

   f. Water resources planning and monitoring; and

   g. A full description and accounting of expenditures for lobbying activities relating to local, regional, state, and federal governmental affairs, whether incurred by district staff or through contractual services and all expenditures for public relations, including all expenditures for public service announcements and advertising in any media.

In addition to the program areas reported by all water management districts, the South Florida Water Management District shall include in its budget document a separate section on all costs associated with the Everglades Construction Project.

3. The total amount in the district budget for each area of responsibility listed in paragraph (a) and for water resource development projects identified in the district's regional water supply plans.

4. A 5-year capital improvements plan.

5. A description of each new, expanded, reduced, or eliminated program.

6. A proposed 5-year water resource development work program, that describes the district's implementation strategy for the water resource development component of each approved regional water supply plan developed or revised pursuant to s. 373.0361. The work program shall address all the elements of the water resource development component in the district's approved regional water supply plans. The office of the Governor, with the assistance of the department, shall review the proposed work program. The review shall include a written evaluation of its consistency with and furtherance of the district's approved regional water supply plans, and adequacy of proposed expenditures. As part of the review, the Executive Office of the Governor and the department shall afford to all interested parties the opportunity to provide written comments on each district's proposed work program. At least 7 days prior to the adoption of its final budget, the governing board shall state in writing to the Executive Office of the Governor which changes recommended in the evaluation it will incorporate into its work program, or specify the reasons for not incorporating the changes. The office of the Governor shall include the district's responses in the written evaluation and shall submit a copy of the evaluation to the Legislature; and

7. The funding sources, including, but not limited to, ad valorem taxes, Surface Water Improvement and Management Program funds, other state funds, federal funds, and user fees and permit fees for each program area.

(d) By September 5 of the year in which the budget is submitted, the House and Senate appropriations chairs may transmit to each district comments and objections to the proposed budgets. Each district governing board shall include a response to such comments and objections in the record of the governing board meeting where final adoption of the budget takes place, and the record of this meeting shall be transmitted to the Executive Office of the Governor, the department, and the chairs of the House and Senate appropriations committees.

(e) The Executive Office of the Governor shall annually, on or before December 15, file with the Legislature a report that summarizes the expenditures of the water management districts by program area and identifies the districts that are not in compliance with the reporting requirements of this section. State funds shall be withheld from a water management district that fails to comply with these reporting requirements.

History.--s. 28, ch. 25209, 1949; s. 3, ch. 29790, 1955; s. 4, ch. 61-497; s. 1, ch. 65-432; s. 1, ch. 67-74; s. 25, ch. 73-190; s. 18, ch. 74-234; s. 46, ch. 80-274; s. 230, ch. 81-259; s. 3, ch. 84-164; s. 2, ch. 86-190; s. 9, ch. 91-288; s. 24, ch. 93-213; s. 276, ch. 94-356; s. 1012, ch. 95-148; s. 5, ch. 96-339; s. 16, ch. 97-160.

[1]Note.--Section 16, ch. 97-160, purported to amend paragraph (c) of subsection (5), but did not set out in full the amended paragraph to include subparagraph 4. Absent affirmative evidence that the Legislature intended to repeal the omitted material, it is set out here pending clarification by the Legislature.

[2] Note.--The word “which” preceding the word “must” was deleted by the editors to improve clarity.

Note.--Former s. 378.28.

373.59 Water Management Lands Trust Fund.--

(1) There is established within the Department of Environmental Protection the Water Management Lands Trust Fund to be used as a nonlapsing fund for the purposes of this section. The moneys in this fund are hereby continually appropriated for the purposes of land acquisition, management, maintenance, capital improvements, payments in lieu of taxes, and administration of the fund in accordance with the provisions of this section.

(2)

(a) By January 15 of each year, each district shall file with the Legislature and the Secretary of Environmental Protection a report of acquisition activity together with modifications or additions to its 5-year plan of acquisition. Included in the report shall be an identification of those lands which require a full fee simple interest to achieve water management goals and those lands which can be acquired using alternatives to fee simple acquisition techniques and still achieve such goals. In their evaluation of which lands would be appropriate for acquisition through alternatives to fee simple, district staff shall consider criteria including, but not limited to, acquisition costs, the net present value of future land management costs, the net present value of ad valorem revenue loss to the local government, and the potential for revenue generated from activities compatible with acquisition objectives. The report shall also include a description of land management activity. Expenditure of moneys from the Water Management Lands Trust Fund shall be limited to the costs for acquisition, management, maintenance, and capital improvements of lands included within the 5-year plan as filed by each district and to the department's costs of administration of the fund. The department’s costs of administration shall be charged proportionally against each district’s allocation using the formula provided in [1]subsection (7). However, no acquisition of lands shall occur without a public hearing similar to those held pursuant to the provisions set forth in s. 120.54. In the annual update of its 5-year plan for acquisition, each district shall identify lands needed to protect or recharge ground water and shall establish a plan for their acquisition as necessary to protect potable water supplies. Lands which serve to protect or recharge ground water identified pursuant to this paragraph shall also serve to protect other valuable natural resources or provide space for natural resource based recreation.

(b) Moneys from the fund shall be used for continued acquisition, management, maintenance, and capital improvements of the following lands and lands set forth in the 5-year land acquisition plan of the district:

1. By South Florida Water Management District--lands in the water conservation areas and areas adversely affected by raising water levels of Lake Okeechobee in accordance with present regulation schedules, and the Savannahs Wetland area in Martin County and St. Lucie County.

2. Each district shall remove the property of an unwilling seller from its plan of acquisition at the next scheduled update of the plan, if in receipt of a request to do so by the property owner.

(4)

(a). Moneys from the Water Management Lands Trust Fund shall be used for acquiring the fee or other interest in lands necessary for water management, water supply, and the conservation and protection of water resources, except that such moneys shall not be used for the acquisition of rights-of-way for canals or pipelines. Such moneys shall also be used for management, maintenance, and capital improvements. Interests in real property acquired by the districts under this section may be used for permittable water resource development and water supply development purposes under the following conditions: the minimum flows and levels of priority water bodies on such lands have been established; the project complies with all conditions for issuance of a permit under part II of this chapter; and the project is compatible with the purposes for which the land was acquired. Lands acquired with moneys from the fund shall be managed and maintained in an environmentally acceptable manner and, to the extent practicable, in such a way as to restore and protect their natural state and condition.

(b). The Secretary of Environmental Protection shall release moneys from the Water Management Lands Trust Fund to a district for preacquisition costs within 30 days after receipt of a resolution adopted by the district's governing board which identifies and justifies any such preacquisition costs necessary for the purchase of any lands listed in the district's 5-year plan. The district shall return to the department any funds not used for the purposes stated in the resolution, and the department shall deposit the unused funds into the Water Management Lands Trust Fund.

(c). The Secretary of Environmental Protection shall release acquisition moneys from the Water Management Lands Trust Fund to a district following receipt of a resolution adopted by the governing board identifying the lands being acquired and certifying that such acquisition is consistent with the plan of acquisition and other provisions of this act. The governing board shall also provide to the Secretary of Environmental Protection a copy of all certified appraisals used to determine the value of the land to be purchased. Each parcel to be acquired must have at least one appraisal. Two appraisals are required when the estimated value of the parcel exceeds $500,000. However, when both appraisals exceed $500,000 and differ significantly, a third appraisal may be obtained. If the purchase price is greater than the appraisal price, the governing board shall submit written justification for the increased price. The Secretary of Environmental Protection may withhold moneys for any purchase that is not consistent with the 5-year plan or the intent of this act or that is in excess of appraised value. The governing board may appeal any denial to the Land and Water Adjudicatory Commission pursuant to s. 373.114.

(d). The Secretary of Environmental Protection shall release to the districts moneys for management, maintenance, and capital improvements following receipt of a resolution and request adopted by the governing board which specifies the designated managing agency, specific management activities, public use, estimated annual operating costs, and other acceptable documentation to justify release of moneys.

(5) Water management land acquisition costs shall include payments to owners and costs and fees associated with such acquisition.

(6) If a district issues revenue bonds or notes under s. 373.584, the district may pledge its share of the moneys in the Water Management Lands Trust Fund as security for such bonds or notes. The Department of Environmental Protection shall pay moneys from the trust fund to a district or its designee sufficient to pay the debt service, as it becomes due, on the outstanding bonds and notes of the district; however, such payments shall not exceed the district's cumulative portion of the trust fund. However, any moneys remaining after payment of the amount due on the debt service shall be released to the district pursuant to [2]subsection (3).

(7) Any unused portion of a district's share of the fund shall accumulate in the trust fund to the credit of that district. Interest earned on such portion shall also accumulate to the credit of that district to be used for land acquisition, management, maintenance, and capital improvements as provided in this section. The total moneys over the life of the fund available to any district under this section shall not be reduced except by resolution of the district governing board stating that the need for the moneys no longer exists.

(8) Moneys from the Water Management Lands Trust Fund shall be allocated to the five water management districts in the following percentages:

(a) Thirty percent to the South Florida Water Management District.

(b) Twenty-five percent to the Southwest Florida Water Management District.

(c) Twenty-five percent to the St. Johns River Water Management District.

(d) Ten percent to the Suwannee River Water Management District.

(e) Ten percent to the Northwest Florida Water Management District.

(9) Each district may use its allocation under subsection (8) for management, maintenance, and capital improvements. Capital improvements shall include, but need not be limited to, perimeter fencing, signs, firelanes, control of invasive exotic species, controlled burning, habitat inventory and restoration, law enforcement, access roads and trails, and minimal public accommodations, such as primitive campsites, garbage receptacles, and toilets.

(10) Moneys in the fund not needed to meet current obligations incurred under this section shall be transferred to the State Board of Administration, to the credit of the fund, to be invested in the manner provided by law. Interest received on such investments shall be credited to the fund.

(11) Lands acquired for the purposes enumerated in this section shall also be used for general public recreational purposes. General public recreational purposes shall include, but not be limited to, fishing, hunting, horseback riding, swimming, camping, hiking, canoeing, boating, diving, birding, sailing, jogging, and other related outdoor activities to the maximum extent possible considering the environmental sensitivity and suitability of those lands. These public lands shall be evaluated for their resource value for the purpose of establishing which parcels, in whole or in part, annually or seasonally, would be conducive to general public recreational purposes. Such findings shall be included in management plans which are developed for such public lands. These lands shall be made available to the public for these purposes, unless the district governing board can demonstrate that such activities would be incompatible with the purposes for which these lands were acquired. For any fee simple acquisition of a parcel which is or will be leased back for agricultural purposes, or for any acquisition of a less-than-fee interest in land that is or will be used for agricultural purposes, the district governing board shall first consider having a soil and water conservation district created pursuant to chapter 582 manage and monitor such interest.

(12) A district may dispose of land acquired under this section, pursuant to s. 373.056 or s. 373.089. However, revenue derived from such disposal may

not be used for any purpose except the purchase of other lands meeting the criteria specified in this section or payment of debt service on revenue bonds or notes issued under s. 373.584, as provided in this section.

(13) No moneys generated pursuant to this act may be applied or expended subsequent to July 1, 1985, to reimburse any district for prior expenditures for land acquisition from ad valorem taxes or other funds other than its share of the funds provided herein or to refund or refinance outstanding debt payable solely from ad valorem taxes or other funds other than its share of the funds provided herein.

(14)

(a) Beginning in fiscal year 1992-1993, not more than one-fourth of the land management funds provided for in subsections (1) and (9) in any year shall be reserved annually by a governing board, during the development of its annual operating budget, for payment in lieu of taxes to qualifying counties for actual ad valorem tax losses incurred as a result of lands purchased with funds allocated pursuant to s. 259.101(3)(b). In addition, the Northwest Florida Water Management District, the South Florida Water Management District, the Southwest Florida Water Management District, the St. Johns River Water Management District, and the Suwannee River Water Management District shall pay to qualifying counties payments in lieu of taxes for district lands acquired with funds allocated pursuant to subsection (8). Reserved funds that are not used for payment in lieu of taxes in any year shall revert to the fund to be used for management purposes or land acquisition in accordance with this section.

(b) Payment in lieu of taxes shall be available to counties for each year in which the levy of ad valorem tax is at least 8.25 mills or the amount of the tax loss from all completed Preservation 2000 acquisitions in the county exceeds 0.01 percent of the county's total taxable value, and the population is 75,000 or less and to counties with a population of less than 100,000 which contain all or a portion of an area of critical state concern designated pursuant to chapter 380.

(c) If insufficient funds are available in any year to make full payments to all qualifying counties, such counties shall receive a pro rata share of the moneys available.

(d) The payment amount shall be based on the average amount of actual taxes paid on the property for the 3 years immediately preceding acquisition. For lands purchased prior to July 1, 1992, applications for payment in lieu of taxes shall be made to the districts by January 1, 1993. For lands purchased after July 1, 1992, applications for payment in lieu of taxes shall be made no later than January 31 of the year following acquisition. No payment in lieu of taxes shall be made for properties which were exempt from ad valorem taxation for the year immediately preceding acquisition. Payment in lieu of taxes shall be limited to a period of 10 consecutive years of annual payments.

(e) Payment in lieu of taxes shall be made within 30 days after: certification by the Department of Revenue that the amounts applied for are appropriate, certification by the Department of Environmental Protection that funds are available, and completion of any fund transfers to the district. The governing board may reduce the amount of a payment in lieu of taxes to any county by the amount of other payments, grants, or in-kind services provided to that county by the district during the year. The amount of any reduction in payments shall remain in the Water Management Lands Trust Fund for purposes provided by law.

(f) If a district governing board conveys to a local government title to any land owned by the board, any payments in lieu of taxes on the land made to the local government shall be discontinued as of the date of the conveyance.

(15) Each district is encouraged to use volunteers to provide land management and other services. Volunteers shall be covered by liability protection and workers' compensation in the same manner as district employees, unless waived in writing by such volunteers or unless such volunteers otherwise provide equivalent insurance.

(16) Each water management district is authorized and encouraged to enter into cooperative land management agreements with state agencies or local governments to provide for the coordinated and cost-effective management of lands to which the water management districts, the Board of Trustees of the Internal Improvement Trust Fund, or local governments hold title. Any such cooperative land management agreement must be consistent with any applicable laws governing land use, management duties, and responsibilities and procedures of each cooperating entity. Each cooperating entity is authorized to expend such funds as are made available to it for land management on any such lands included in a cooperative land management agreement.

History.—ss. 3, 5, ch. 81-33; s. 36, ch. 83-218; s. 5, ch. 85-347; s. 4, ch. 86-22; s. 8, ch. 86-294; s. 13, ch. 90-217; s. 11, ch. 91-288; s. 13, ch. 92-288; s. 277, ch. 94-356; s. 1, ch. 95-311; s. 6, ch. 95-349; s. 21, ch. 95-430; s. 17, ch. 96-389; s. 25, ch. 97-94; s. 17, ch. 97-160; s. 14, ch. 97-164.

[1]Note.—Redesignated as subsection (8) by s. 17, ch. 96-389.

[2]Note.—Redesignated as subsection (4) by s. 17, ch. 96-389.

Part VI Miscellaneous Provisions

373.619 Recognition of Water and Sewer-Saving Devices

The Legislature urges all public-owned or investor-owned water and sewerage systems to reduce connection fees and regular service charges for customers who utilize water or sewer-saving devices, including, but not limited to, individual graywater disposal systems.

History.--s. 2, ch. 82-10.

373.62 Water conservation; automatic sprinkler systems.—

Any person who purchases and installs an automatic lawn sprinkler system after May 1, 1991, shall install a rain sensor device or switch which will override the irrigation cycle of the sprinkler system when adequate rainfall has occurred.

History.--s. 7, ch. 91-41; s. 7, ch. 91-68.

SELECTED PASSAGES FROM CHAPTER 62-40, F.A.C.

Part I General Water Policy Part I General Water

62-40.110 Declaration and Intent

(1) The waters of the state are among its basic resources. Such waters should be managed to conserve and protect natural resources and scenic beauty and to realize the full beneficial use of the resource. Recognizing the importance of water to the state, the Legislature passed the Water Resources Act, Chapter 373, Florida Statutes, and the Air and Water Pollution Control Act, Chapter 403, Florida Statutes. Additionally, numerous goals and policies within the State Comprehensive Plan, Chapter 187, Florida Statutes, address water resources and natural systems protection.

(2) This Chapter is intended to provide water policy goals, objectives, and guidance for the development and review of programs, rules, and plans relating to water resources, as expressed in Chapters 187, 373, and 403, Florida Statutes.

(3) These policies shall be construed as a whole and no individual policy shall be construed or applied in isolation from other policies. All constructions of this Chapter shall give meaning to all parts of the rule when possible.

(4) Notwithstanding the incorporation of other Department rules in Rule 62-40.120, F.A.C., this Chapter shall not constitute standards or criteria for decisions on individual permits.

(5) A goal of this Chapter is to coordinate the management of water and related land resources. Local governments shall consider state water policy in the development of their comprehensive plans as required by Chapter 163, Florida Statutes, and as required by Section 403.0891(3)(a), F.S. Special districts which manage water shall consider state water policy in the development of their plans and programs. The Legislature has also expressed its intent, in Section 373.0395, F.S., that future growth and development planning reflect the limitations of available ground water and other water supplies.

(6) It is an objective of the State to protect the functions of entire ecological systems, as developed and defined in the programs, rules, and plans of the Department and water management districts.

(7) Government services should be provided efficiently. Inefficiency resulting from duplication of permitting shall be eliminated where appropriate, including water quality and water quantity permitting functions.

(8) Public education, awareness, and participation shall be encouraged. The Department and Districts should assist educational institutions in the development of educational curricula and research programs which meet Florida’s present and future water management needs.

(9) This Chapter does not repeal, amend or otherwise alter any rule now existing or later adopted by the Department or Districts. However, procedures are included in this Chapter which provide for the review of Department and District plans, programs, and rules to assure consistency with the provisions of this Chapter. The procedure for modification of District rules as requested by the Department shall be as prescribed in Section 373.114, F.S. and applicable provisions of this Chapter.

(10) It is the intent of the Department, in cooperation with the Water Management Districts, to seek adequate sources of funding to supplement District ad valorem taxes to implement the provisions of this Chapter.

62-40.120 Department Rules

State water policy shall also include the following Department rules:

(1) Water Quality Standards, Chapter 62-3, F.A.C.
(2) Surface Water Quality Standards, Chapter 62-302, F.A.C.
(3) Surface Water Improvement and Management, Chapter 62-43, F.A.C.
(4) Ground Water Classes, Standards, and Exemptions, Chapter 62-520, F.A.C.
(5) Drinking Water Standards, Monitoring, and Reporting, Chapter 62-550, F.A.C.

Part II Definitions

62-40.210 Definitions

When used in this Chapter and in the review of rules of the Districts pursuant to Section 373.114(2), F.S., unless the context or content of such District rule requires a narrower, more specific meaning, the following words shall mean:

(1) "Aquifer" shall mean a geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield useful quantities of ground water to wells, springs or surface water.
(2) "Consumptive use" means any use of water which reduces the supply from which it is withdrawn or diverted.
(3) "Department" means the Department of Environmental Protection.
(4) "Detention" means the delay of stormwater runoff prior to its discharge.
(5) "District" means a Water Management District created pursuant to Chapter 373, Florida Statutes.
(6) "District Water Management Plan" means the long-range comprehensive water resource management plan prepared by a District.
(7) "Drainage basin" means a subdivision of a watershed.
(8) "Effluent", unless specifically stated otherwise, means water that is not reused after flowing out of any wastewater treatment facility or other works used for the purpose of treating, stabilizing, or holding wastes.
(9) "Floodplain" means land area subject to inundation by flood waters from a river, watercourse, lake, or coastal waters. Floodplains are delineated according to their estimated frequency of flooding.
(10) "Florida Water Plan" means the State Water Use Plan, together with the water quality standards and water classifications adopted by the Department.
(11) "Governing Board" means the governing board of a water management district.
(12) "Ground water" means water beneath the surface of the ground, whether or not flowing through known and definite channels.
(13) "Ground water availability" means the potential quantity of ground water which can be withdrawn without resulting in significant harm to the water resources or associated natural systems.

(14) "Ground water basin" means a ground water flow system that has defined boundaries and may include permeable materials that are capable of storing or furnishing a significant water supply. The basin includes both the surface area and the permeable materials beneath it.

(15) "High recharge areas" means areas contributing significant volumes of water which add to the storage and flow of an aquifer through vertical movement from the land surface. The term significant will vary geographically depending on the hydrologic characteristics of that aquifer.

(16) "Natural systems" for the purpose of this rule means an ecological system supporting aquatic and wetland-dependent natural resources, including fish and aquatic and wetland-dependent wildlife habitat.

(17) "Nutrient limitations" means those numeric values which establish a maximum or minimum allowable nutrient loading or concentration, as appropriate, for a specific nutrient. Nutrient limitations are established through an individual permit or other action within the regulatory authority of the Department or a District. These limitations serve to implement state water quality standards.

(18) "Pollutant load reduction goal" means estimated numeric reductions in pollutant loadings needed to preserve or restore designated uses of receiving bodies of water and maintain water quality consistent with applicable state water quality standards.

(19) "Prime recharge areas" means areas that are generally within high recharge areas and are significant to present and future ground water uses including protection and maintenance of natural systems and water supply.

(20) "Reasonable-beneficial use" means the use of water in such quantity as is necessary for economic and efficient utilization for a purpose and in a manner which is both reasonable and consistent with the public interest.

(21) "Reclaimed water" means water that has received at least secondary treatment and is reused after flowing out of a domestic wastewater treatment facility.

(22) "Retention" means the prevention of stormwater runoff from direct discharge.

(23) "Reuse" means the deliberate application of reclaimed water, in compliance with Department and District rules, for a beneficial purpose.

(a) For example, said uses may encompass:

1. Landscape irrigation (such as irrigation of golf courses, cemeteries, highway medians, parks, playgrounds, school yards, retail nurseries, and residential properties);
2. Agricultural irrigation (such as irrigation of food, fiber, fodder and seed crops, wholesale nurseries, sod farms, and pastures);
3. Aesthetic uses (such as decorative ponds and fountains);
4. Ground water recharge (such as slow rate, rapid-rate, and absorption field land application systems) but not including disposal methods described in Rule 62-40.210(23)(b), F.A.C.;
5. Industrial uses (such as cooling water, process water, and wash waters);
6. Environmental enhancement of surface waters resulting from discharge of reclaimed water having received at least advanced

wastewater treatment or from discharge of reclaimed water for wetlands restoration;

7. Fire protection; or
8. Other useful purpose.

(b) Overland flow land application systems, rapid-rate land application systems providing continuous loading to a single percolation cell, other land application systems involving less than secondary treatment prior to application, septic tanks, and ground water disposal systems using Class I wells injecting effluent or wastes into Class G-IV waters shall be excluded from the definition of reuse.

(24) "Secretary" means the Secretary of the Department of Environmental Protection.

(25) "State water quality standards" means water quality standards adopted by the Environmental Regulations Commission pursuant to Chapter 403, Florida Statutes, including standards composed of designated most beneficial uses (classification of waters), the numerical and narrative criteria applied to the specific water use or classification, the Florida anti-degradation policy, and the moderating provisions contained in Rules 62-3, 62-4, 62-302, 62-520, and 62-550, F.A.C.

(26) "State Water Use Plan" means the plan formulated pursuant to Section 373.036, Florida Statutes, for the use and development of waters of the State.

(27) "Stormwater" means the water which results from a rainfall event.

(28) "Stormwater management program" means the institutional strategy for stormwater management, including urban, agricultural, and other stormwater.

(29) "Stormwater management system" means a system which is designed and constructed or implemented to control stormwater, incorporating methods to collect, convey, store, absorb, inhibit, treat, use, or reuse stormwater to prevent or reduce flooding, over-drainage, environmental degradation and water pollution or otherwise affect the quantity and quality of discharges from the system.

(30) "Stormwater utility" means the entity through which funding for a stormwater management program is obtained by assessing the cost of the program to the beneficiaries based on their relative contribution to its need. It is operated as a typical utility which bills services regularly, similar to water and wastewater services.

(31) "Surface water" means water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs shall be classified as surface water when it exits from the spring onto the earth's surface.

(32) "Surface water availability" means the potential quantity of surface water that can be removed or retained without significant harm to the water resources or associated natural systems.

(33) "Water resource caution area" means a geographic area identified by a water management district as having existing water resource problems or an area in which water resource problems are projected to develop during the next twenty years. A critical water supply problem area, as described in Section 403.064, F.S., is an example of a water resource caution area.

(34) "Water" or "waters in the state" means any and all water on or beneath the surface of the ground or in the atmosphere, including natural or artificial watercourses, lakes, ponds, or diffused surface water and water percolating, standing, or flowing beneath the surface of the ground, as well as all coastal waters within the jurisdiction of the state.

(35) "Watershed" means the land area which contributes to the flow of water into a receiving body of water.

(36) "Watershed management goal" means an overall goal for the management of water resources within a watershed.

(37) "Wetlands" means those areas that are inundated or saturated by surface or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that requires saturated or seasonably saturated soil conditions for growth and reproduction, such as swamps, marshes, bayheads, cypress ponds, sloughs, wet prairies, wet meadows, river overflows, mud flats and natural ponds. This definition does not alter the Department's jurisdiction over dredging and filling activities in wetlands as defined in Section 403.911(7), F.S.

Part III General Provisions

62-40.310 General Policies

The following statement of general water policy shall guide Department review of water management programs, rules, and plans. Water management programs, rules and plans, where economically and environmentally feasible, not contrary to the public interest, and consistent with Florida law, shall seek to:

(1) Water Supply

(a) Assure availability of an adequate and affordable supply of water for all reasonable-beneficial uses. Uses of water authorized by a permit shall be limited to reasonable-beneficial uses.

(b) Reserve from use that water necessary to support essential non-withdrawal demands, including navigation, recreation, and the protection of fish and wildlife.

(c) Champion and develop sound water conservation practices and public information programs.

(d) Advocate and direct the reuse of reclaimed water as an integral part of water and wastewater management programs, rules, and plans consistent with protection of the public health and surface and ground water quality.

(e) Encourage the use of water of the lowest acceptable quality for the purpose intended.

(f) Encourage the development of local and regional surface and ground water supplies within districts rather than transfer water across District boundaries.

(g) Encourage demand management and the development of alternative water supplies, including water conservation, reuse of reclaimed water, desalination, stormwater and industrial wastewater reuse, recharge, and aquifer storage and recovery.

(h) Protect aquifers from depletion through water conservation and preservation of the functions of high recharge areas.

(2) Water Quality Protection and Management

(a) Restore and protect the quality of ground and surface water by solving current problems and ensuring high quality treatment for stormwater and wastewater.

(b) Identify existing and future public water supply areas and protect them from contamination.

(3) Flood Protection and Floodplain Protection

(a) Encourage nonstructural solutions to water resource problems and give adequate consideration to nonstructural alternatives whenever structural works are proposed.

(b) Manage the construction and operation of facilities which dam, divert, or otherwise alter the flow of surface waters to minimize damage from flooding, soil erosion or excessive drainage.

(c) Encourage the management of floodplains and other flood hazard areas to prevent or reduce flood damage, consistent with establishment and maintenance of desirable hydrologic characteristics and associated natural systems.

(d) Encourage the development and implementation of a strict floodplain management program by state, regional, and local governments designed to preserve floodplain functions and associated natural systems.

(e) Avoid the expenditure of public funds that encourage or subsidize incompatible new development or significant expansion of existing development in high-hazard flood areas.

(f) Minimize flood-related emergencies, human disasters, loss of property, and other associated impacts.

(4) Natural Systems Protection and Management

(a) Establish minimum flows and levels to protect water resources and the environmental values associated with marine, estuarine, freshwater, and wetlands ecology.

(b) Mitigate adverse impacts resulting from prior alteration of natural hydrologic patterns and fluctuations in surface and ground water levels.

(c) Utilize, preserve, restore, and enhance natural water management systems and discourage the channelization or other alteration of natural rivers, streams and lakes.

(5) Management Policies

(a) Protect the water storage and water quality enhancement functions of wetlands, floodplains, and aquifer recharge areas through acquisition, enforcement of laws, and the application of land and water management practices which provide for compatible uses.

(b) Emphasize the prevention of pollution and other water resource problems.

(c) Develop interstate agreements and undertake cooperative programs with Alabama and Georgia to provide for coordinated management of surface and ground waters.

Part IV Resource Protection and Management

62-40.410 Water Supply Protection and Management

The following shall apply to those areas where the use of water is regulated pursuant to Part II of Chapter 373, Florida Statutes:

(1) No permit shall be granted to authorize the use of water unless the applicant establishes that the proposed use is a reasonable-beneficial use, will not interfere with presently existing legal uses of water and is consistent with the public interest.

(2) In determining whether a water use is a reasonable-beneficial use, the following factors will be considered:
  - (a) The quantity of water requested for the use;
  - (b) The demonstrated need for the use;
  - (c) The suitability of the use to the source of water;
  - (d) The purpose and value of the use;
  - (e) The extent and amount of harm caused;
  - (f) The practicality of mitigating any harm by adjusting the quantity or method of use;
  - (g) Whether the impact of the withdrawal extends to land not owned or legally controlled by the user;
  - (h) The method and efficiency of use;
  - (i) Water conservation measures taken or available to be taken;
  - (j) The feasibility of alternative sources such as reclaimed water, stormwater, brackish water and salt water;
  - (k) The present and projected demand for the source of water;
  - (l) The long term yield available from the source of water;
  - (m) The extent of water quality degradation caused;
  - (n) Whether the proposed use would cause or contribute to flood damage;
  - (o) Whether the proposed use would significantly induce saltwater intrusion;
  - (p) The amount of water which can be withdrawn without causing harm to the resource;
  - (q) Whether the proposed use would adversely affect public health; and
  - (r) Whether the proposed use would significantly affect natural systems.

(3) Water may be reserved from permit use in such locations and quantities, and for such seasons of the year, as is required for the protection of fish and wildlife or the public health or safety. Such reservations shall be subject to periodic review and revision in light of changed conditions. However, all presently existing legal users of water shall be protected so long as such use is not contrary to the public interest.

(4) Water use shall not be allowed to exceed ground water availability or surface water availability. If either is exceeded, the Districts shall expeditiously implement a remedial program. The remedial program shall consider options such as designation of a water resource caution area, declaration of a water shortage, development of water resource projects, regulation of consumptive water users, or other options consistent with this chapter and Chapter 373, F.S.

(5) In implementing consumptive use permitting programs, the Department and the Districts shall recognize the rights of property owners, as limited by law, to make consumptive uses of water from their land, and the rights of other

users, as limited by law, to make consumptive uses of water, for reasonable-beneficial uses in a manner consistent with the public interest that will not interfere with any presently existing legal use of water.

(6) Permits authorizing consumptive uses of water which cause unanticipated significant adverse impacts on off-site land uses existing at the time of permit application, or on legal uses of water existing at the time of permit application, should be considered for modification, to curtail or abate the adverse impacts, unless the impacts can be mitigated by the permittee.

(7) The Districts shall determine whether Section 373.233, F.S., entitled "Competing Applications", and implementing rules, are applicable to pending applications.

(8) Any reallocation of an existing permitted quantity of water shall be reviewed by the District and shall be subject to full compliance with the applicable permitting criteria of the District.

62-40.412 Water Conservation

The overall water conservation goal of the state shall be to prevent and reduce wasteful, uneconomical, impractical, or unreasonable use of water resources. Conservation of water shall be required unless not economically or environmentally feasible. The Districts shall accomplish this goal by:

(1) Assisting local and regional governments and other parties in formulating plans and programs to conserve water to meet their long-term needs, including incentives such as longer term or more flexible permits, economic incentives, and greater certainty of supply during water shortages;

(2) Establishing efficiency standards for urban, industrial, and agricultural demand management which may include the following:
   - (a) Restrictions against inefficient irrigation practices;
   - (b) If a District imposes year-round restrictions, which may include variances or exemptions, on particular irrigation activities or irrigation sources, using a uniform time period of 10:00 a.m. to 4:00 p.m.;
   - (c) Minimizing unaccounted for water losses;
   - (d) Promoting water conserving rate structures;
   - (e) Water conserving plumbing fixtures, xeriscape, and rain sensors.

(3) Maintaining public information and education programs for long- and short-term water conservation goals;

(4) Executing provisions to implement the above criteria and to consistently apply water shortage restrictions between those Districts whose boundaries contain political jurisdictions located in more than one District.

62-40.416 Water Reuse

(1) As required by Section 373.0391(2)(e), F.S., the Districts shall designate areas that have water supply problems which have become critical or are anticipated to become critical within the next 20 years. The Districts shall identify such water resource caution areas during preparation of a District Plan pursuant to Rule 62-40.520, F.A.C., and shall adopt and amend these designations by rule.

(2) In implementing consumptive use permitting programs, a reasonable amount of reuse of reclaimed water shall be required within designated water

resource caution areas, unless objective evidence demonstrates that such reuse is not economically, environmentally, or technically feasible.

(3) The Districts shall periodically update their designations of water resource caution areas by rule. Such updates shall occur within one year after updates of the District Plan prepared pursuant to Rule 62-40.520, F.A.C. After completion of the District Plan or updates pursuant to Rule 62-40.520, F.A.C., the Districts may limit areas where reuse shall be required to areas where reuse is specified as a remedial or preventive action pursuant to Rule 62-40.520, F.A.C. Any such limitation of areas where reuse shall be required shall be designated by rule.

(4) In implementing consumptive use permitting programs, a reasonable amount of reuse of reclaimed water from domestic wastewater treatment facilities may be required outside of areas designated pursuant to Rule 62-40.416(1), F.A.C., as subject to water supply problems, provided:
   (a) Reclaimed water is readily available;
   (b) Objective evidence demonstrates that such reuse is economically, environmentally, and technically feasible; and
   (c) The District has adopted rules for reuse in these areas.

(5) The Department encourages local governments to implement programs for reuse of reclaimed water. The Districts are encouraged to establish incentives for local governments and other interested parties to implement programs for reuse of reclaimed water. These rules shall not be deemed to pre-empt any such local reuse programs.

62-40.422 Interdistrict Transfer

The following shall apply to the transfers of surface and ground water where such transfers are regulated pursuant to Part II of Chapter 373, Florida Statutes:

(1) The transfer or use of surface water across District boundaries shall require approval of each involved District. The transfer or use of ground water across District boundaries shall require approval of the District where the withdrawal of ground water occurs.

(2) In deciding whether the transfer and use of surface water across District boundaries is consistent with the public interest pursuant to Section 373.223, Florida Statutes, the Districts should consider the extent to which:
   (a) Comprehensive water conservation and reuse programs are implemented and enforced in the area of need;
   (b) The major costs, benefits, and environmental impacts have been adequately determined including the impact on both the supplying and receiving areas;
   (c) The transfer is an environmentally and economically acceptable method to supply water for the given purpose;
   (d) The present and projected water needs of the supplying area are reasonably determined and can be satisfied even if the transfer takes place;
   (e) The transfer plan incorporates a regional approach to water supply and distribution including, where appropriate, plans for eventual interconnection of water supply sources; and
   (f) The transfer is otherwise consistent with the public interest based upon evidence presented.

(3) The interdistrict transfer and use of ground water must meet the requirements of Section 373.2295, Florida Statutes.

62-40.430 Water Quality

(1) Water quality standards shall be enforced pursuant to Chapter 403, Florida Statutes, to protect waters of the State from point and non-point sources of pollution.

(2) State water quality standards adopted by Department rule shall be a part of the Florida Water Plan.

62-40.432 Surface Water Protection and Management

(1) Surface Water Protection and Management Goals.
The following goals are established to provide guidance for Department, District and local government storm water management programs:

(a) It shall be a goal of surface water management programs to protect, preserve and restore the quality, quantity and environmental values of water resources. A goal of surface water management programs includes effective storm water management for existing and new systems which shall seek to protect, maintain and restore the functions of natural systems and the beneficial uses of waters.

(b) The primary goals of the state's storm water management program are to maintain, to the maximum extent practicable, during and after construction and development, the pre-development storm water characteristics of a site; to reduce stream channel erosion, pollution, siltation, sedimentation and flooding; to reduce storm water pollutant loadings discharged to waters to preserve or restore beneficial uses; to reduce the loss of fresh water resources by encouraging the reuse of storm water; to enhance ground water recharge by promoting infiltration of storm water in areas with appropriate soils and geology; to maintain the appropriate salinity regimes in estuaries needed to support the natural flora and fauna; and to address storm water management on a watershed basis to provide cost effective water quality and water quantity solutions to specific watershed problems.

(c) Inadequate management of storm water throughout a watershed increases storm water flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and other conveyances, disrupts the functions of natural systems, undermines floodplain management and flood control efforts in downstream communities, reduces ground water recharge, threatens public health and safety, and is the primary source of pollutant loading entering Florida's rivers, lakes and estuaries, thus causing degradation of water quality and a loss of beneficial uses. Accordingly, it is a goal to eliminate the discharge of inadequately managed storm water into waters and to minimize other adverse impacts on natural systems, property and public health, safety and welfare caused by improperly managed storm water.

(d) It shall be a goal of storm water management programs to reduce unacceptable pollutant loadings from older storm water management systems, constructed before the adoption of Chapter 62-25, F.A.C., (February 1, 1982), by developing watershed management and storm water master plans or District-wide or basin specific rules.

(e) The concept of developing comprehensive watershed management plans in designated watersheds is intended not only to prevent existing environmental, water quantity, and water quality problems from becoming worse but also to reduce existing flooding problems, to improve existing water quality, and to preserve or restore the values of natural systems.

(2) Watershed management goals shall be developed by the District for all watersheds within the boundaries of each District and shall be consistent with the Surface Water Improvement and Management (SWIM) program and the EPA National Pollution Discharge Elimination System (NPDES) program. Watershed management goals shall be included in the District Water Management Plans.

(3) Storm Water Management Program Implementation.

As required by Section 403.0891, F.S., the Department, Districts and local governments shall cooperatively implement on a watershed basis a comprehensive storm water management program designed to minimize the adverse effects of storm water on land and water resources. All such programs shall be mutually compatible with the State Comprehensive Plan (Chapter 187, Florida Statutes), the Local Government Comprehensive Planning and Land Development Regulation Act (Chapter 163, Florida Statutes), the Surface Water Improvement and Management Act (Sections 373.451-.4595, F.S.), Chapters 373 and 403, F.S., and this chapter. Programs shall be implemented in a manner that will improve and restore the quality of waters that do not meet state water quality standards and maintain the water quality of those waters which meet or exceed state water quality standards.

(a) The Department shall be the lead agency responsible for coordinating the statewide storm water management program by establishing goals, objectives and guidance for the development and implementation of storm water management programs by the Districts and local governments. The Department shall implement the state storm water management program in Districts which do not have the economic and technical resources to implement a comprehensive storm water and surface water management program.

(b) The Districts which have implemented a comprehensive storm water and surface water management program shall be the chief administrators of the state storm water management program. The Department or the Districts, where appropriate, shall set regional storm water management goals and policies on a watershed basis, including watershed storm water pollutant load reductions necessary to preserve or restore beneficial uses of receiving waters. For water bodies which fully attain their designated use and meet the applicable state water quality standards, the pollutant load reduction goal shall be zero. Such goals and policies shall be implemented through District SWIM plans, through preparation of watershed management plans in other designated priority watersheds and through appropriate regulations.

(c) Local governments shall establish storm water management programs which are in accordance with the state and District storm water quality and quantity goals. Local governments may establish a storm water utility or other dedicated source of funding to implement a local storm water management program which shall include the development and implementation of a storm water master plan and provisions, such as an operating permit system, to ensure that storm water systems are properly operated and maintained.

(d) Any water control district created pursuant to Chapter 298, F.S., or special act, and other special districts as defined in Section 189.403(1), F.S., which have water management powers shall:

1. Be consistent with the applicable local comprehensive plan adopted under Part II, Chapter 163, F.S., and state and district storm water quality and quantity goals, for the construction and expansion of water control and related facilities.
2. Operate existing water control and related facilities consistent with applicable state and district storm water quality and quantity goals. Any modification or alteration of existing water control and related facilities shall be consistent with the applicable local government comprehensive plan and state and district storm water quality and quantity goals.

(4) Surface Water Management.

The following shall apply to the regulation of surface water pursuant to Part IV, Chapter 373, Florida Statutes.

(a) The construction and operation of facilities which manage or store surface waters, or other facilities which drain, divert, impound, discharge into, or otherwise impact waters in the state, and the improvements served by such facilities, shall not be harmful to water resources or inconsistent with the objectives of the Department or District.

(b) In determining the harm to water resources and consistency with the objectives of the Department or District, consideration should be given to:

1. The impact of the facilities on:
   a. water quality;
   b. fish and wildlife;
   c. wetlands, floodplains, estuaries, and other environmentally sensitive lands;
   d. reasonable-beneficial uses of water;
   e. recreation;
   f. navigation;
   g. saltwater or pollution intrusion, including any barrier line established pursuant to Section 373.033, F.S.;
   h. minimum flows and levels established pursuant to Section 373.042, F.S.; and
   i. other factors relating to the public health, safety, and welfare;
2. Whether the facilities meet applicable design or performance standards;
3. Whether adequate provisions exist for the continued satisfactory operation and maintenance of the facilities; and

4. The ability of the facilities and related improvements to avoid increased damage to off-site property, water resources, natural systems or the public caused by:
   a. floodplain development, encroachment or other alteration;
   b. retardance, acceleration or diversion of flowing water;
   c. reduction of natural water storage areas;
   d. facility failure; or
   e. other actions adversely affecting off-site water flows or levels.

(5) Minimum Stormwater Treatment Performance Standards.

(a) When a storm water management system complies with rules establishing the design and performance criteria for storm water management systems, there shall be a rebuttable presumption that such systems will comply with state water quality standards. The Department and the Districts, pursuant to Section 373.418, F.S., shall adopt rules that specify design and performance criteria for new storm water management systems which:
1. Shall be designed to achieve at least 80 percent reduction of the average annual load of pollutants that would cause or contribute to violations of state water quality standards.
2. Shall be designed to achieve at least 95 percent reduction of the average annual load of pollutants that would cause or contribute to violations of state water quality standards in Outstanding Florida Waters.
3. The minimum treatment levels specified in subparagraphs 1 and 2 above may be replaced by basin specific design and performance criteria adopted by a District in order to achieve the pollutant load reduction goals established in paragraph (c).

(b) Erosion and sediment control plans detailing appropriate methods to retain sediment on-site shall be required for land disturbing activities.

(c) The pollutant loading from older storm water management systems shall be reduced as necessary to restore or maintain the beneficial uses of waters. The Districts shall establish pollutant load reduction goals and adopt them as part of a SWIM plan, other watershed management plan, or District-wide or basin specific rules.

(d) Watershed specific storm water pollutant load reduction goals shall be developed for older storm water management systems on a priority basis as follows:
1. The Districts shall include in adopted SWIM Plans numeric estimates of the level of pollutant load reduction goals anticipated to result from planned corrective actions included in the plan.
   a. For SWIM water bodies with plans originally adopted before January 1, 1992, these estimates shall be established before December 31, 1994.
   b. For SWIM water bodies with plans originally adopted after January 1, 1992, these estimates shall be established within three years of the plan's original adoption date.
2. Each District shall develop water body specific pollutant load reduction goals for non-SWIM water bodies on a priority basis according to a schedule provided in the District Water Management

Plan. The list of water bodies and the schedule shall be developed by each District, giving priority consideration to water bodies that receive discharges from storm water management systems that are required to obtain a NPDES municipal storm water discharge permit.

3. The Districts shall consider economic, environmental, and technical factors in implementing programs to achieve pollutant load reduction goals. These goals shall be considered in local comprehensive plans submitted or updated in accordance with Section 403.0891(3)(a), F.S.

62-40.450 Flood Protection

Flood protection shall be implemented within the context of other interrelated water management responsibilities. Florida will continue to be dependent on some structural water control facilities constructed in the past, and new structural facilities may sometimes be unavoidable in addressing existing and future flooding or other water-related problems. The Department and the Districts shall promote nonstructural flood protection strategies.

(1) Flood Protection Responsibilities

(a) Local governments have the primary responsibility for regulating land use, enforcing construction criteria for flood prone areas, establishing local storm water management levels of service, constructing and maintaining local flood control facilities, and otherwise preventing flood damages to new and existing development.

(b) District flood protection responsibilities relate primarily to serving regional water conveyance and storage needs. Districts have the authority to plan, construct, and operate water control facilities, as well as regulate discharges into works of the District or facilities controlled by the District.

(c) Rules adopted under Part IV of Chapter 373, F.S., shall require that appropriate precautions be taken to protect public health and safety in the event of failure of any water control structures, such as pumps and levees.

(d) Department and District programs shall discourage siting of incompatible public facilities in floodplains and flood prone areas wherever possible. Where no feasible alternative exists to siting an incompatible public facility in a floodplain or flood prone Area, the facility shall be designed to minimize flood damage risks and adverse impacts on natural flood detention and conveyance capabilities.

(e) Each District shall clearly define in its District Water Management Plan, in basin specific plans, or rules, the District's responsibilities related to flood emergencies, including its mechanisms for coordinating with emergency response agencies.

(2) District Facilities

(a) District water control facilities shall be operated and maintained in accordance with established plans or schedules.

(b) Districts shall assess the design characteristics and operational practices of existing District water control facilities to ascertain opportunities for minimizing adverse impacts on water resources and associated natural systems. Where feasible, facility design modifications or operational changes shall be implemented to enhance natural systems or fulfill other water management responsibilities.

62-40.458 Floodplain Protection

(1) The Department and the Districts shall provide leadership to protect and enhance the beneficial values of floodplains. This shall include active coordination with local governments, special districts, and related programs of federal agencies, the Department of Community Affairs, and the Department of Health and Rehabilitative Services. Nothing in this section is intended to diminish the Department's and District's responsibilities regarding flood protection.

(a) The Department and the Districts shall pursue development of adequate floodplain protection information, including:

1. District determination of flood levels for priority floodplains. At a minimum, this shall include the 100-year flood level, with other flood levels to be determined where needed for watershed-specific management purposes. Districts are encouraged to determine the 10-year flood level for the purpose of assisting the Department of Health and Rehabilitative Services to regulate septic tanks in floodplains pursuant to Section 10D-6.0471, F.A.C.
2. Identification of floodplains with valuable natural systems for potential acquisition.
3. Identification of floodplain areas having potential for restoration of natural flow regimes.

(b) The Department and the Districts shall develop jointly a comprehensive system of coordinated planning, management, and acquisition to protect and, where feasible, enhance floodplain functions and associated natural systems in floodplains. This system shall include implementation of policies and programs to:

1. Acquire and maintain valuable natural systems in floodplains.
2. Protect the natural water storage and water conveyance capabilities of floodplains.
3. Where feasible, enhance or restore natural flow regimes of rivers and watercourses that have been altered for water control purposes.

(c) District regulatory programs shall minimize incompatible activities in floodplains. For regulated floodplains, each District, at a minimum, shall ensure that such activities:

1. Will not result in significant adverse effects on surface and ground water levels and surface water flows.
2. Will not result in significant adverse impacts to existing surface water storage and conveyance capabilities of the floodplain.
3. Will not result in significant adverse impacts to the operation of District facilities.
4. Will assure that any surface water management facilities associated with the proposed activity will be capable of being effectively operated and maintained.
5. Will not cause violations of water quality standards in receiving waters.
6. Will not otherwise be harmful to water resources.

(2) Each District shall provide to local governments and water control districts available information regarding floodplain delineation and floodplain functions and associated natural systems, and assist in developing effective measures to manage floodplains consistently with this Chapter.

62-40.470 Natural Systems Protection and Management
Programs, plans, and rules to accomplish natural systems protection and management shall include rules to address adverse cumulative impacts, the establishment of minimum flows and levels (Rule 62-40.473, F.A.C.) and may include protection measures for surface water resources (Rule 62-40.475, F.A.C.).

62-40.473 Minimum Flows and Levels

(1) In establishing minimum flows and levels pursuant to Section 373.042, consideration shall be given to the protection of water resources, natural seasonal fluctuations in water flows or levels, and environmental values associated with coastal, estuarine, aquatic, and wetlands ecology, including:
  (a) Recreation in and on the water;
  (b) Fish and wildlife habitats and the passage of fish;
  (c) Estuarine resources;
  (d) Transfer of detrital material;
  (e) Maintenance of freshwater storage and supply;
  (f) Aesthetic and scenic attributes;
  (g) Filtration and absorption of nutrients and other pollutants;
  (h) Sediment loads;
  (i) Water quality; and
  (j) Navigation.

(2) Established minimum flows and levels shall be protected where relevant to:
  (a) The construction and operation of water resource projects;
  (b) The issuance of permits pursuant to Part II, Part IV, and Section 373.086, Florida Statutes; and
  (c) The declaration of a water shortage pursuant to Section 373.175 or Section 373.246, Florida Statutes.

(3) Each water management district shall advise the Secretary by January 1, 1995 of the date by which each District shall establish minimum flows and levels for surface waterbodies within the District. Priority shall be given to establishment of minimum flows and levels on waters which are located within:
  (a) an Outstanding Florida Water;
  (b) an Aquatic Preserve;
  (c) an Area of Critical State Concern; or
  (d) an area subject to Chapter 380 Resource Management Plans adopted by rule by the Administration Commission, when the plans for an area include waters that are particularly identified as needing additional protection, which provisions are not inconsistent with applicable rules adopted for the management of such areas by the Department and the Governor and Cabinet.

62-40.475 Protection Measures for Surface Water Resources

(1) As part of SWIM Plans or basin-specific management plans, programs, or rules, the Districts are encouraged to implement protection measures as appropriate to enhance or preserve surface water resources. Protection measures shall be based on scientific evaluations of particular surface waters and the need for enhancement or preservation of these surface water resources.

(2) In determining if basin-specific rules should be adopted to establish protection areas, due consideration shall be given to surface waters with the following special designations:
   (a) an Outstanding Florida Water,
   (b) an Aquatic Preserve,
   (c) an Area of Critical State Concern, or
   (d) an area subject to Chapter 380 Resource Management Plans adopted by rule by the Administration Commission, when the plans for an area include waters that are particularly identified as needing additional protection, which provisions are not inconsistent with applicable rules adopted for the management of such areas by the Department and the Governor and Cabinet.

62-40.510 Florida Water Plan

(1) The Department shall formulate an integrated, coordinated Florida Water Plan for the management of Florida's water resources. The scope of the plan shall include the State Water Use Plan and all other water-related activities of the Department and the Districts. It shall give due consideration to the factors in Section 373.036(2), F.S.

(2) The Florida Water Plan shall be developed in coordination with District Water Management Plans and include, at a minimum:
   (a) Department overview, including a discussion of the interrelationships of Department and District programs;
   (b) Water management goals and responsibilities, including the following areas of responsibilities:
      1. water supply protection and management,
      2. flood protection and management,
      3. water quality protection and management, and
      4. natural systems protection and management;
   (c) Statewide water management implementation strategies for each area of responsibility;
   (d) Intergovernmental coordination, including the Department's processes for general supervision of the water management districts;
   (e) Procedures for plan development, including public participation;
   (f) Methods for assessing program effectiveness and the Department's progress toward implementation of the Plan;
   (g) Linkages to Department rulemaking, budgeting, program development, and legislative proposals;
   (h) Strategies to identify the amount and sources of supplemental funding to implement the programs identified in Chapter 373, District Water Management Plans, this Chapter, and any delegated programs;
   (i) Chapter 62-40, F.A.C., State Water Policy;

(j) Appropriate sections of the District Water Management Plans;
(k) State water quality standards.

(3) The Florida Water Plan shall be developed expeditiously and may be phased. It shall be completed by November 1, 1995.

(4) At a minimum, the Florida Water Plan shall be updated every five years after the initial plan development. Annual status reports on the Plan shall also be prepared by the Department.

Part V Water Program Development

62-40.520 District Water Management Plans

(1) As required by Section 373.036(4), F.S., a long range comprehensive water management plan shall be prepared by each District which is consistent with the provisions of this Chapter and Section 373.036, Florida Statutes. District Water Management Plans are comprehensive guides to the Districts in carrying out all their water resource management responsibilities, including water supply, flood protection, water quality management, and protection of natural systems. The plans shall provide general directions and strategies for District activities, programs, and rules. They will be implemented by a schedule of specific actions of the District, which may include program development, water resource projects, land acquisition, funding, technical assistance, facility operations, and rule development.

(2) The District Plan shall include an assessment of water needs and sources for the next 20 years. The District Plan shall identify specific geographical areas that have water resource problems which have become critical or are anticipated to become critical within the next 20 years to be called water resource caution areas. Identification of water resource caution areas needed for imposition of reuse requirements pursuant to Rule 62-40.416, F.A.C., may be accomplished before publication of the complete District Plan.

(3) Based on economic, environmental, and technical analyses, a course of remedial or preventive action shall be specified for each current and anticipated future problem.

(4) Remedial or preventive measures may include, but are not limited to, water resource projects; water resources restoration projects pursuant to Section 403.0615, Florida Statutes; purchase of lands; conservation of water; reuse of reclaimed water; enforcement of Department or District rules; and actions taken by local government pursuant to a local government comprehensive plan, local ordinance, or zoning regulation.

(5) District Plans shall also provide for identifying areas where collection of data, water resource investigations, water resource projects, or the implementation of regulatory programs are necessary to prevent water resource problems from becoming critical.

(6) District plans shall address, at a minimum, the following subjects:
(a) District overview;
(b) Water management goals;
(c) Water management responsibilities, including:
1. Water supply protection and management, to include needs and

sources, source protection, and a schedule for recharge mapping and recharge area designation.

2. Flood protection and floodplain management. This shall include the District's strategies and priorities for managing facilities and floodplains, and a schedule for District mapping of floodplains.
3. Water quality protection and management for both surface water and ground water. This shall include the District's strategies, priorities, and schedules to develop pollutant load reduction goals; and
4. Natural systems protection and management. This shall include a schedule for establishing minimum flows and levels for a priority selection of surface waters and ground waters in the District, considering ground water availability and surface water availability, and a schedule for establishing protection areas for surface waters in the District, where appropriate.

(d) For each water management responsibility, the following shall be included:

1. Resource assessments, including identification of regionally significant water resource issues and problems, and determinations of the need for ground water basin resource availability inventories in various portions of the District;
2. Evaluation of options;
3. Water management policies for identified issues and problems;
4. Implementation strategies for each issue and problem, including tasks, schedules, responsible entities, and measurable benchmarks.

(e) Integrated plan, describing how the water problems of each county in the District are identified and addressed;

(f) Intergovernmental coordination, including measures to implement the plan through coordination with the plans and programs of local, regional, state and federal agencies and governments; and

(g) Procedures for plan development, including definitions and public participation.

(7) District Plans shall be developed expeditiously and may be phased. All District Plans shall be accepted by the Governing Board no later than November 1, 1994. A District Water Management Plan is intended to be a planning document and is not self-executing.

(8) At a minimum, District Plans shall be updated and progress assessed every five years after the initial plan development. Each District shall include in the Plan a procedure for evaluation of the District's progress towards implementing the Plan. Such procedure shall occur at least annually and a copy of the evaluation shall be provided to the Department each year by November 15 for review and comment.

(9) Plan development shall include adequate opportunity for participation by the public and governments. The Districts shall initiate public workshops at least four months before Plan acceptance by the Governing Board. At the workshops, a preliminary list of schedules to be included in the Plan shall be presented.

62-40.530 Department Review of District Water Management Plans

(1) After acceptance by the District Governing Board, District Water Management Plans shall be submitted to the Department.

(2) Within sixty days after receipt of a Plan for review, the Department shall review each Plan for consistency with this Chapter and recommend any changes to the Governing Board.

(3) After consideration of the comments and recommendations of the Department, the Governing Board shall, within sixty days, either incorporate the recommended changes into the Plan or state in the Plan, with specificity, the reasons for not incorporating the changes.

(4) Plan amendments shall follow the same process as for initial Plan acceptance.

62-40.540 Water Data-40.540 Water Data

(1) All local governments, water management districts, and state agencies are directed by Section 373.026(2), F.S., to cooperate with the Department in making available to the Department such scientific or factual data as they may possess. The Department shall prescribe the format and ensure the quality control for all water quality data collected or submitted.

(2) The Department is the state's lead water quality monitoring agency and central repository for surface water and ground water information. The Department shall coordinate Department, District, state agency, and local government water quality monitoring activities to improve data and reduce costs.

(3) The U.S. Environmental Protection Agency water quality data base (STORET) shall be the central repository of the state's water quality data. All appropriate water quality data collected by the Department, Districts, local governments, and state agencies shall be placed in the STORET system within one year of collection.

(4) The Department's biennial state water quality assessment (the "305(b) Report") shall be the state's general guide to water quality assessment and should be used as the basis for assessments unless more recent, more accurate, or more detailed information is available.

(5) Appropriate monitoring of water quality and water withdrawal shall be required of permittees.

(6) The Districts shall implement a strategy for measuring, estimating, and reporting withdrawal and use of water by permitted and exempted users. Thresholds for measurement requirements and reporting applicable to permittees shall be established and adopted by rule.

(7) The Department and the Districts shall coordinate in the development and implementation of a standardized computerized statewide data base and methodology to track activities authorized by environmental resource permits in wetlands and waters of the state. The data base will be designed to provide for the rapid exchange of information between the Department and the Districts. The Department will serve as the central repository for environmental resource permit data and shall specify the data base organization and electronic format in which the data are to be provided by the Districts.

Part VI Water Program Administration and Evaluation

62-40.610 Review and Application

(1) This Chapter shall be reviewed periodically, but in no case less frequently than once every four years. Revisions, if any, shall be adopted by rule.

(2) Within 12 months after adoption or revision of this Chapter, the Districts shall have revised their rules and reviewed their programs to be consistent with the provisions contained herein.

(3) District rules adopted after this Chapter takes effect shall be reviewed by the Department for consistency with this Chapter.

(4) At the request of the Department, each District shall initiate rulemaking pursuant to Chapter 120, Florida Statutes, to consider changes the Department determines to be necessary to assure consistency with this Chapter. The Department shall be made a party to the proceeding.

(5) District water policies may be adopted which are consistent with this Chapter, but which take into account differing regional water resource characteristics and needs.

(6) A District shall initiate rulemaking or program review to consider implementation of programs pursuant to Sections 373.033, 373.042, 373.106, Part III, or Part IV of Chapter 373, Florida Statutes, where the Department or District determines that present or projected conditions of water shortages, saltwater intrusion, flooding, drainage, or other water resource problems, prevent or threaten to prevent the achievement of reasonable-beneficial uses, the protection of fish and wildlife, or the attainment of other water policy directives.

(7) The Department and Districts shall assist other governmental entities in the development of plans, ordinances, or other programs to promote consistency with this Chapter and District water management plans.

APPENDIX B

Land Use Maps

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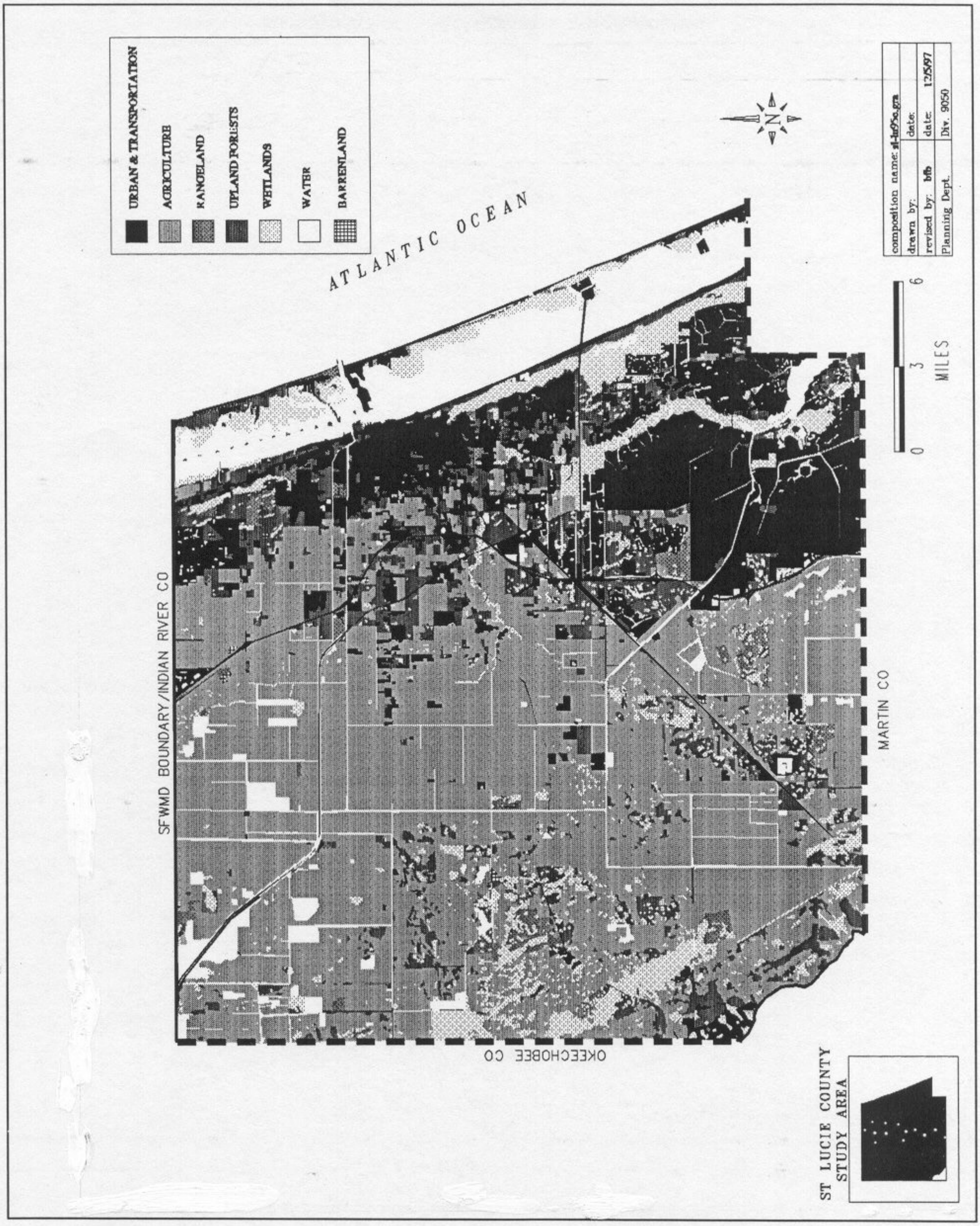

Figure B-1. Land Use in the St. Lucie County Area.
Source: 1995 SFWMD land use/land cover GIS data base.

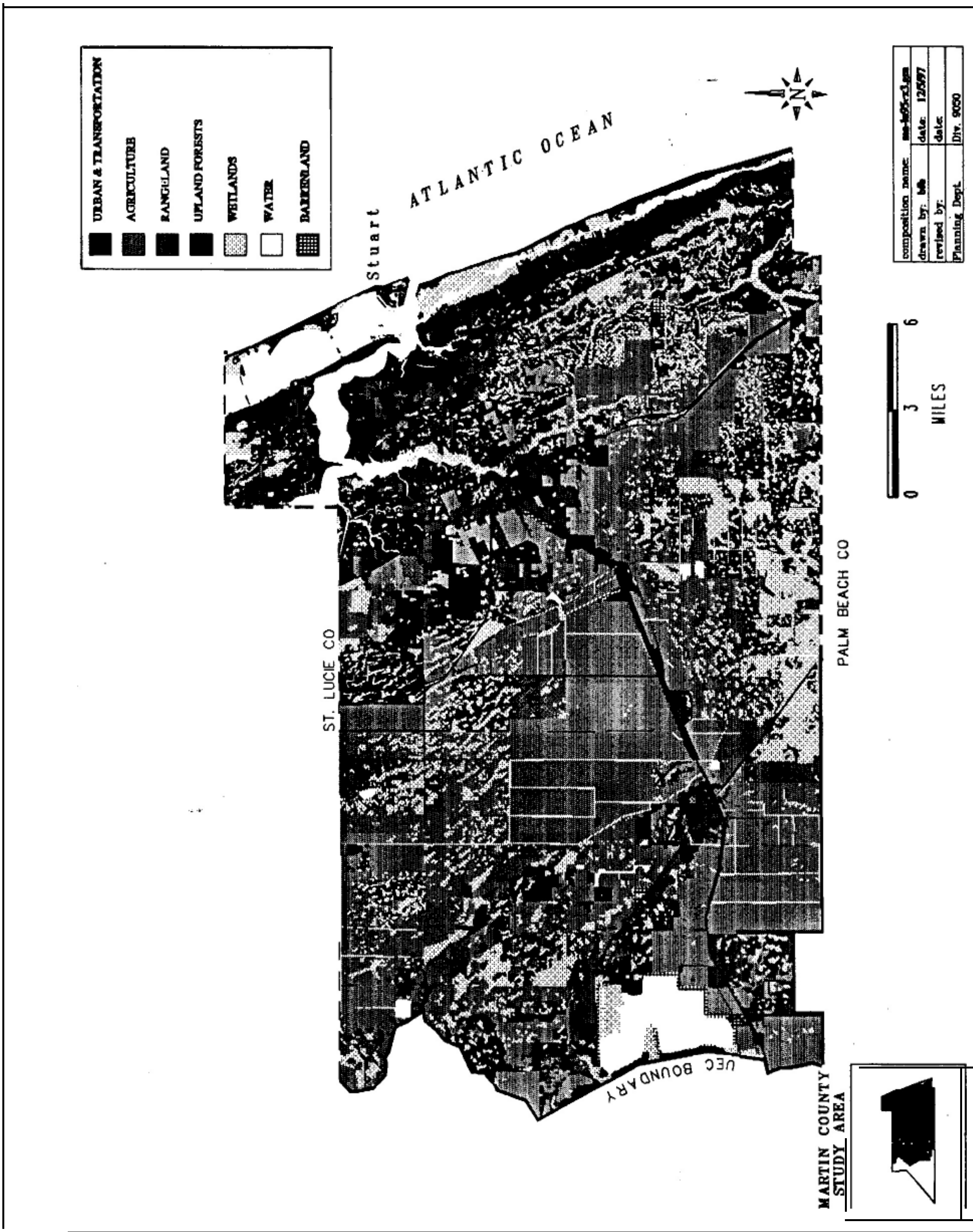

Figure B-2. Land Use in the Martin County Area.
Source: 1995 SFWMD land use/land cover GIS data base.

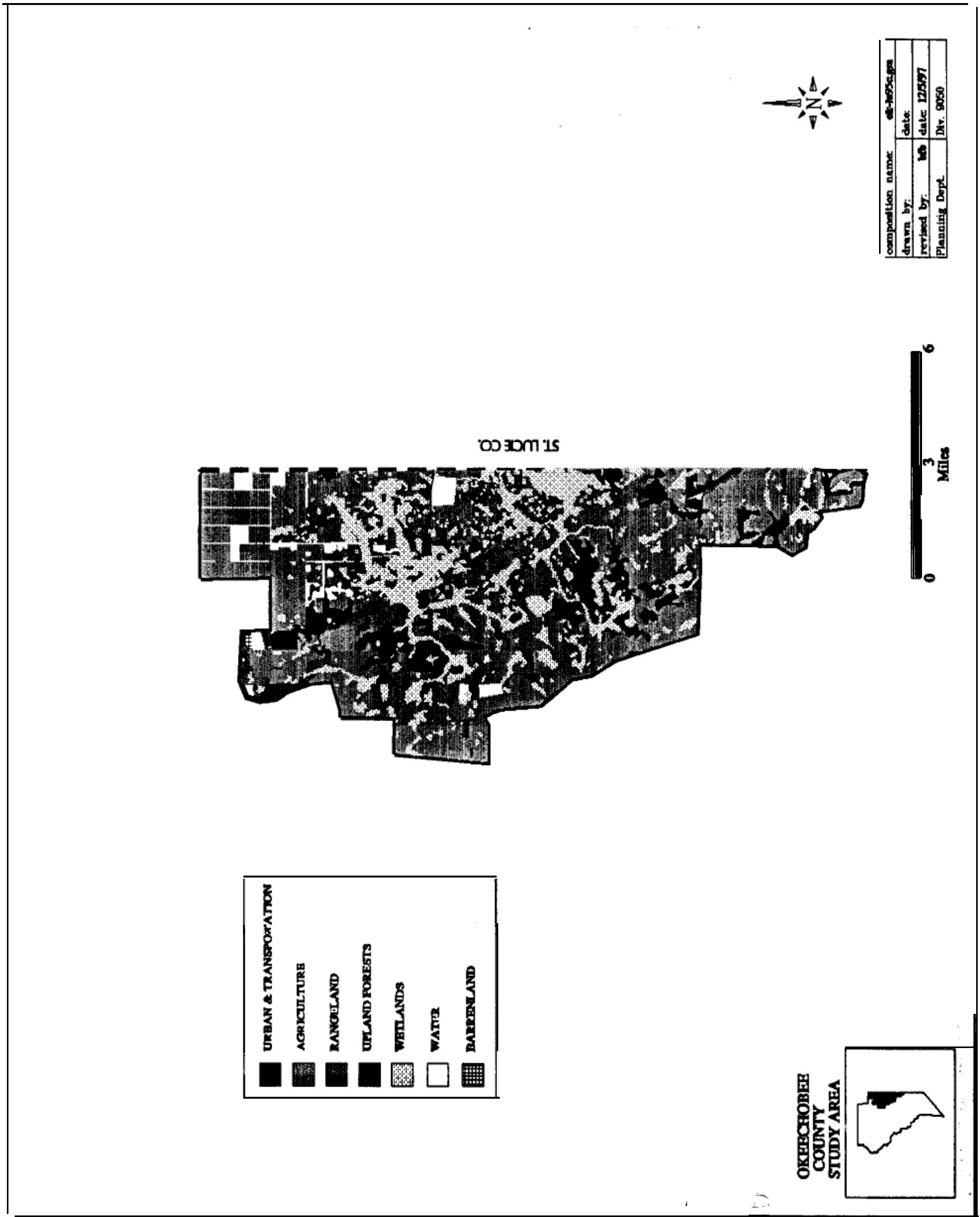

Figure B-3. Land Use in the Okeechobee County Area.
Source: 1995 SFWMD land use/land cover GIS data base.

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APPENDIX C

Rainfall Frequency Analysis

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RAINFALL ANALYSIS

A primary goal of the 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 is variable from county to county within the UEC Planning Area. To provide more precise input into the county-level ground water models, the rainfall data was broken down for seven selected rainfall stations. The average annual rainfall for the planning area is 51.6 inches. There is a wet period from June through October, and a dry period from November through May (Figure C-l).

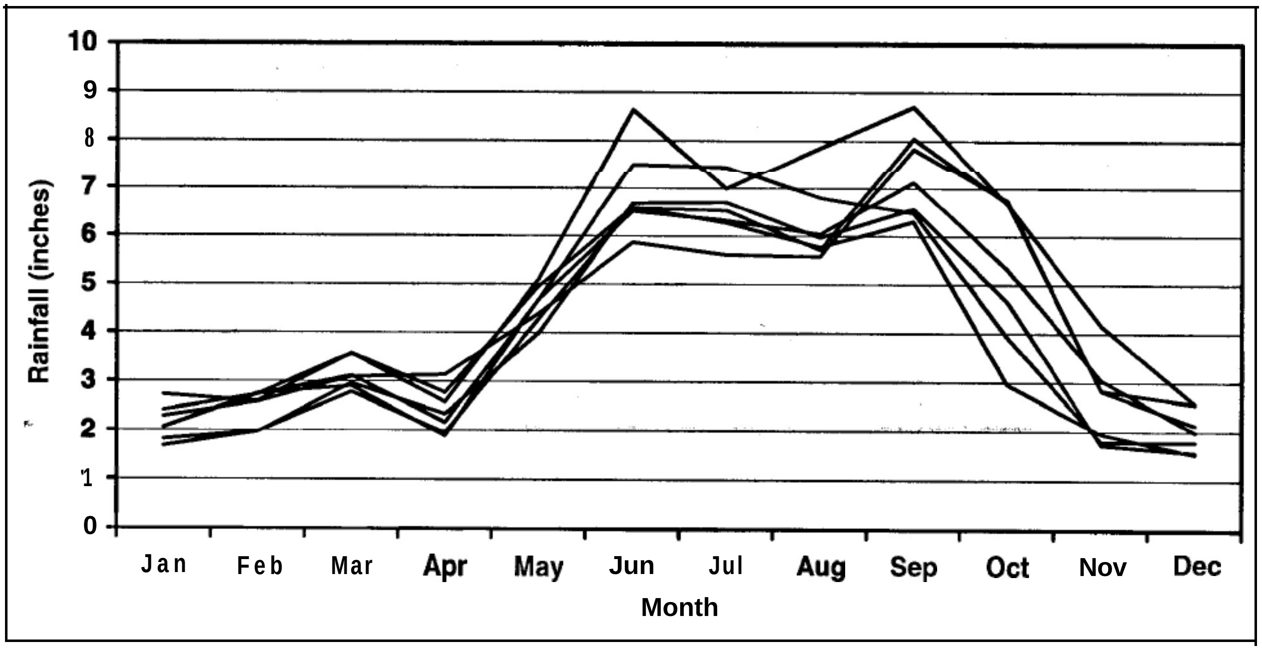

FIGURE C-l. Average Monthly Distribution of Rainfall at Seven Stations in the UEC Planning Area.

The heaviest rainfall usually occurs in September or June, averaging 7.42 inches for the month, and the lightest rain month is usually December, averaging 1.98 inches for the month (Table C-l). The locations of these stations are shown in Figure C-2.

TABLE C-l. Average Rainfall Data for Rainfall Stations in the UEC Planning Area.

County	Rainfall Station	Average Annual Rainfall	Years POR*	Maximum Monthly Rainfall		Minimum Monthly Rainfall		% Rain Falling in Wet Season	Primary DBKEY*'
				in	mo	in	mo		
Indian River	Vero	50.60	26 1965-1990	6.51	Jun	1.88	Apr	71.1	06262
Martin	S308	46.76	51 1940-1990	6.70	Jul	1.57	Dec	73.9	06239
	Stuart	55.37	56 1936-1991	8.05	Sep	2.40	Jan	69.6	08187
Palm Beach	Pratt	62.10	36 1957-1992	8.70	Sep	2.57	Dec, Apr	70.8	06122
Okeechobee	Fort Drum	50.45	36 1956-1991	7.52	Jun	1.78	Dec	73.1	06141
St. Lucie	Cow Creek	44.14	22 1970-1991	6.59	Jun	1.54	Dec	72.9	05848
	Fort Pierce	52.02	79 1914-1992	7.84	Sep	2.13	Dec	69.2	06151
Overall Average		51.63		7.42		1.98		71.5	

Period of Record

**For those interested in accessing DBHYDRO. Missing data were replaced with county-wide average data.

RAINFALL DATA PREPARATION

The District 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. This data is maintained in the District's DBHYDRO database. The DBHYDRO dbkey values for these stations are listed in Table C-l. Tables C-2 through C-8 show the monthly rainfall for each rainfall station for the entire period of record. The period of record varies from table to table, as shown in Table C-l.

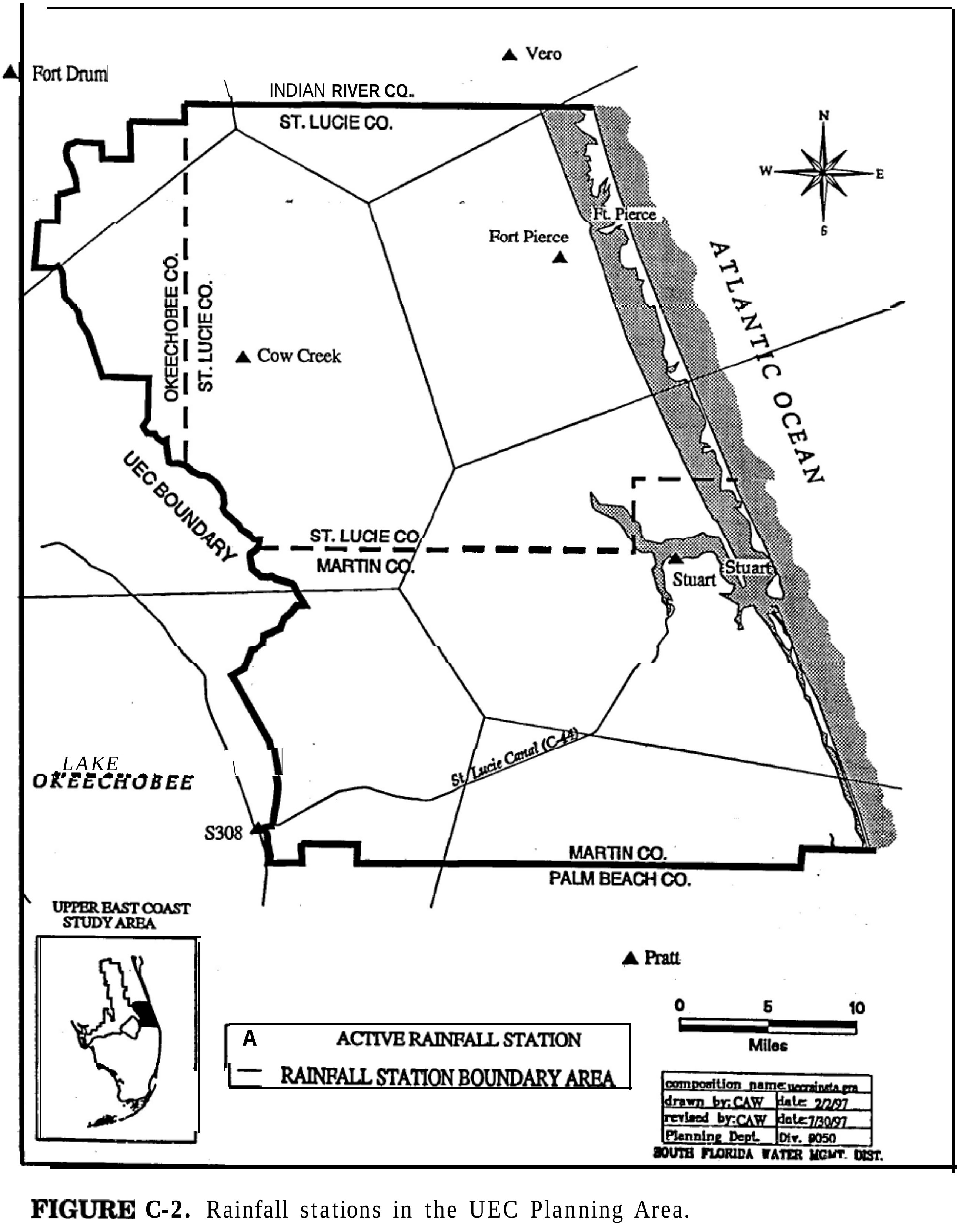

FIGURE C-2. Rainfall stations in the UEC Planning Area.

TABLE C-2. Monthly and Mean Rainfall (inches) at Cow Creek Rainfall Station.

Cow Creek Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1970	4.23	3.09	8.07	0.17	4.79	5.75	4.90	4.21	7.94	6.94	0.76	0.59	51.44
1971	0.37	2.66	1.37	1.70	5.05	8.20	9.12	1.52	5.84	3.15	0.06	0.92	39.96
1972	0.28	0.83	4.07	0.82	5.66	10.00	4.71	9.49	1.87	2.20	2.20	0.75	42.88
1973	2.72	1.70	3.65	1.59	5.05	5.19	7.90	2.34	5.53	3.24	0.15	1.15	40.21
1974	1.51	0.67	0.17	1.87	1.92	10.40	11.40	7.34	3.80	2.83	2.50	1.20	45.61
1975	0.15	3.83	0.00	1.25	7.03	9.25	7.41	8.55	4.55	3.14	0.40	0.97	46.53
1976	0.37	1.22	0.62	1.81	11.80	8.10	5.70	0.90	6.64	0.10	2.66	2.51	42.43
1977	1.60	0.97	0.30	0.87	3.66	6.07	5.27	6.62	6.55	1.93	4.09	3.02	40.95
1978	2.05	1.55	3.50	1.72	3.12	10.50	7.68	2.55	6.34	3.34	1.00	5.49	48.84
1979	5.29	0.04	1.46	1.81	10.10	2.20	3.11	6.65	18.60	0.90	1.77	1.28	53.21
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	6.82	2.30	0.85	0.23	34.02
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	6.13	2.82	0.65	2.12	6.33	4.24	8.45	5.84	5.53	0.77	3.96	49.50
1984	0.18	3.49	2.68	0.92	2.76	2.35	5.98	4.53	7.79	0.44	4.34	0.73	36.19
1985	0.24	0.10	2.09	4.05	2.92	6.25	10.00	6.77	9.35	2.97	2.10	1.05	47.89
1986	1.67	1.83	2.95	0.22	3.26	9.66	6.48	9.32	4.95	5.94	1.09	3.63	51.00
1987	1.21	1.72	4.10	0.00	2.17	5.80	4.09	2.36	2.88	4.31	7.32	0.00	35.96
1988	2.26	1.66	3.09	2.06	4.72	4.67	8.35	7.83	1.52	1.32	2.86	1.51	41.85
1989	2.11	0.32	2.78	3.77	0.78	5.54	3.06	4.37	5.20	3.73	0.40	2.83	34.89
1990	1.11	2.70	0.53	0.77	3.24	6.11	3.72	6.59	13.80	2.86	1.22	0.39	43.04
1991	5.37	1.74	3.63	5.65	2.98	5.66	12.00	4.62	6.48	4.38	1.67	0.42	54.60
Mean	1.81	1.97	2.77	1.94	4.28	6.59	6.27	5.77	6.30	2.95	1.95	1.54	44.14

TABLE C-3. Monthly and Mean Rainfall (inches) at Fort Drum Rainfall Station.

Fort Drum Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1956	1.10	2.26	0.55	2.92	3.44	7.15	5.92	6.77	6.23	11.28	0.61	0.16	48.39
1957	0.88	2.35	5.47	6.60	4.82	4.08	9.51	8.78	9.84	3.51	1.25	3.36	60.45
1958	6.52	1.98	4.60	2.67	3.37	8.39	5.34	5.85	1.48	2.93	0.47	2.36	45.96
1959	2.68	1.62	7.41	4.90	5.92	9.42	5.37	6.11	5.51	12.06	1.55	1.34	63.89
1960	0.40	5.05	6.20	2.68	2.26	6.28	8.41	3.66	13.85	3.93	0.46	0.78	53.96
1961	2.27	0.95	2.13	2.09	4.12	4.17	3.51	9.72	0.68	4.14	1.44	0.16	35.38
1962	0.53	1.52	2.83	1.55	4.38	13.92	5.55	14.04	7.83	0.34	3.43	0.36	56.28
1963	1.90	5.36	1.28	1.38	5.35	6.65	2.68	2.99	7.57	2.27	4.28	3.72	45.43
1964	1.65	3.99	1.54	3.58	4.15	2.09	5.09	9.42	8.82	2.64	0.32	3.01	46.30
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	1.45	0.63	0.25	3.63	14.21	12.68	2.28	2.36	7.46	2.27	0.46	48.61
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

Fort Drum Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
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	5.72	7.81	2.89	0.86	1.70	62.18
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	10.59	4.71	15.95	4.22	6.39	5.43	1.31	1.00	55.13
1976	0.35	0.59	1.08	3.03	14.52	7.05	7.39	4.44	10.16	0.65	1.48	3.49	54.23
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	6.80	0.77	0.98	2.91	14.33	1.74	5.69	3.80	20.75	0.77	0.89	1.80	61.23
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	5.04	8.10	7.38	13.01	2.97	1.17	1.18	47.01
1986	3.03	1.36	5.03	0.00	2.72	12.48	7.93	6.74	2.99	8.43	0.98	3.31	55.00
1987	3.83	0.68	10.76	0.24	3.61	6.82	5.20	2.36	6.30	3.45	6.94	0.31	50.50
1988	2.65	2.70	4.05	1.46	3.96	8.05	7.33	6.27	2.00	1.79	2.86	1.51	44.63
1989	2.10	1.05	5.24	3.42	1.07	6.64	4.98	9.30	7.89	8.24	1.10	2.92	53.95
1990	0.00	4.21	1.10	1.95	4.20	5.76	9.22	6.97	4.77	5.07	0.00	0.00	43.25
1991	4.99	3.82	5.35	6.15	6.55	13.38	9.90	5.99	5.82	2.62	0.00	1.01	65.58
Mean	2.05	2.72	3.39	2.16	4.67	7.52	7.46	6.80	6.48	3.92	1.79	1.78	50.73

TABLE C-4. Monthly and Mean Rainfall (inches) at Fort Pierce Rainfall Station.

Fort Pierce Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1914	2.86	2.95	0.62	4.53	3.29	3.05	7.17	4.28	11.13	5.93	4.18	3.44	53.43
1915	9.36	2.24	2.74	1.36	2.25	5.41	8.81	7.91	7.44	10.88	3.35	1.89	63.64
1916	1.83	2.05	0.60	1.84	4.04	5.75	3.53	2.98	8.06	10.34	2.94	1.19	45.15
1917	0.90	3.23	0.19	0.44	1.18	4.66	5.09	3.18	6.67	3.37	0.49	2.65	32.05
1918	3.51	0.69	4.38	6.74	1.35	6.30	8.21	2.74	14.22	6.02	0.89	1.31	56.36
1919	2.16	4.30	5.64	2.15	2.94	4.13	9.43	5.33	2.82	0.60	7.32	2.14	48.96
1920	7.38	1.97	2.13	4.22	4.50	2.83	5.91	5.32	9.67	4.14	3.50	0.78	52.35
1921	0.43	1.99	1.56	1.36	6.26	1.96	6.90	1.63	0.75	11.31	0.98	1.02	36.15
1922	2.18	3.19	0.60	0.65	2.54	2.94	4.34	5.88	8.44	10.46	2.10	0.67	43.99
1923	1.28	0.30	0.79	4.84	7.72	8.40	5.39	1.09	8.50	2.93	0.46	1.12	42.82
1924	5.16	1.47	3.63	2.22	4.42	0.69	7.38	1.41	7.19	19.31	0.38	1.28	54.54
1925	4.99	2.15	3.31	1.75	7.16	5.21	6.44	5.49	1.91	1.79	10.65	6.77	57.62
1926	7.48	1.84	2.40	4.75	0.72	9.52	12.74	7.74	11.07	1.88	0.71	1.03	61.88
1927	0.65	0.78	1.56	1.21	0.92	2.00	4.93	5.13	11.81	10.27	1.95	0.56	41.77
1928	1.04	1.27	3.56	0.25	3.88	3.98	2.84	14.57	4.72	3.50	1.70	0.35	41.66
1929	1.89	0.59	2.32	1.46	11.09	6.85	5.45	3.04	6.97	8.76	1.60	2.51	52.53
1930	1.78	5.28	5.43	7.72	7.41	11.88	2.78	3.84	7.34	4.78	2.90	3.49	64.63
1931	3.27	0.79	3.76	11.16	1.80	1.17	6.39	4.12	6.89	6.37	1.48	1.37	48.57

Fort Pierce Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1932	1.45	1.44	3.04	1.74	4.16	12.90	1.48	6.41	5.44	4.05	6.86	0.94	49.91
1933	1.98	1.18	4.23	9.86	1.65	5.45	2.98	8.87	6.36	12.97	3.62	0.75	59.90
1934	1.49	5.54	2.12	5.44	5.72	4.97	2.89	4.00	3.68	3.09	1.06	1.32	41.32
1935	0.22	1.61	0.27	5.31	3.44	9.15	4.00	3.57	6.53	10.63	0.77	0.99	46.49
1936	1.83	4.94	3.44	2.74	5.87	12.00	3.81	2.60	10.33	6.41	4.54	4.42	62.93
1937	1.60	4.55	9.08	5.09	9.90	2.80	3.32	4.75	7.75	12.46	6.94	0.93	69.17
1938	0.46	1.11	0.49	0.39	3.25	5.72	3.95	2.65	8.42	6.46	4.07	1.25	38.22
1939	0.48	0.46	1.11	5.16	4.61	4.59	6.21	3.30	5.12	10.42	1.55	1.12	44.13
1940	2.98	2.53	4.92	0.96	3.76	6.34	5.16	5.55	12.40	1.95	0.23	3.51	50.29
1941	5.92	5.64	3.03	7.51	3.02	5.73	8.23	3.74	14.19	5.80	6.30	4.32	73.43
1942	2.16	4.24	6.17	1.17	7.94	7.65	1.94	2.43	5.95	1.84	0.87	5.10	47.46
1943	0.29	1.28	5.57	1.11	4.96	5.10	6.65	9.29	6.30	5.84	2.65	0.59	49.63
1944	1.10	0.27	1.73	6.74	2.15	7.46	5.82	4.49	4.90	11.56	1.55	0.57	48.34
1945	1.16	0.37	1.51	1.69	0.98	4.23	4.32	5.38	17.05	6.74	4.28	4.17	51.88
1946	1.20	0.77	2.32	0.42	6.75	3.71	5.23	5.53	6.23	4.75	3.13	3.55	43.59
1947	1.42	3.48	6.75	4.62	5.23	5.58	8.79	6.97	15.22	12.35	6.03	1.32	77.76
1948	5.11	0.58	2.27	5.10	4.27	3.74	5.56	9.70	14.31	4.78	1.43	1.11	57.96
1949	1.01	1.88	0.81	2.97	3.53	6.90	4.67	12.16	8.97	5.80	0.37	5.57	54.64
1950	0.68	1.58	4.04	3.28	3.83	3.68	4.21	12.12	8.59	11.01	2.48	0.72	56.22
1951	0.31	2.21	0.76	10.25	3.84	4.02	3.11	5.21	7.03	10.73	3.28	0.84	51.59
1952	2.45	7.08	2.31	2.11	1.04	1.03	6.96	7.58	5.48	13.50	0.55	1.32	51.41
1953	1.98	1.40	9.83	3.36	1.41	5.81	4.27	6.58	7.16	10.14	4.40	1.32	57.66
1954	2.32	1.92	2.13	10.82	4.91	12.48	5.92	5.81	9.50	7.46	6.08	0.60	69.95
1955	1.64	1.32	2.41	3.26	4.24	7.43	3.35	7.35	4.83	7.67	0.09	4.98	48.57
1956	0.41	2.76	0.53	2.76	2.03	1.58	5.73	4.03	7.82	10.51	0.55	0.90	39.61
1957	0.99	3.87	5.03	5.31	5.22	5.72	10.67	6.77	6.93	7.69	1.96	2.56	62.72
1958	8.39	0.88	3.49	2.00	6.88	5.70	1.79	5.70	3.15	8.94	0.81	4.07	51.80
1959	2.52	0.96	7.76	1.41	4.54	13.51	4.97	5.86	10.55	11.41	3.78	2.92	70.19
1960	0.19	6.13	3.93	5.85	4.30	6.52	6.05	7.78	16.73	4.85	0.84	1.10	64.27
1961	3.24	1.39	3.40	1.14	7.18	5.47	1.25	5.19	3.24	5.09	1.22	0.49	38.30
1962	0.64	0.71	2.82	3.19	2.20	5.11	12.65	8.46	5.19	3.63	1.68	0.28	46.56
1963	0.80	4.82	1.67	0.35	2.71	5.43	5.10	2.66	19.90	7.49	3.05	8.21	62.19
1964	2.16	6.13	1.36	5.44	3.24	2.44	7.16	9.80	6.19	9.96	0.47	1.64	55.99
1965	0.45	5.61	3.40	2.07	0.66	5.52	5.90	1.37	3.28	7.10	1.42	1.52	38.30
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	1.81	0.87	0.87	3.80	15.84	6.61	6.91	7.87	7.06	1.97	0.13	54.22
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	1.51	0.72	4.51	7.74	7.70	2.68	4.44	5.45	0.66	2.87	3.47	42.15

Fort Pierce Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
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	2.89	1.15	6.35	1.53	10.74	8.18	10.82	0.91	3.94	64.58
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	2.77	1.50	55.98
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	1.34	2.45	2.19	1.48	32.66
1989	3.34	0.22	3.08	2.56	2.88	3.00	1.21	5.83	3.58	6.52	0.93	3.36	36.51
1990	1.65	2.33	0.72	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	5.91	4.58	1.20	1.72	64.88
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
Mean	2.28	2.57	3.08	3.13	4.39	5.86	5.61	5.58	7.84	6.74	2.82	2.13	52.02

TABLE C-5. Monthly and Mean Rainfall (inches) at Pratt Rainfall Station.

Pratt Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1957	2.57	2.57	3.40	7.42	6.51	5.59	9.39	4.97	7.75	6.74	0.69	6.41	64.01
1958	13.52	0.44	5.25	2.97	9.01	1.54	3.55	3.84	7.92	4.54	1.98	5.66	60.22
1959	3.10	0.51	7.56	4.49	5.63	4.86	4.02	9.34	9.58	8.35	9.62	4.48	71.54
1960	1.00	4.89	1.40	7.56	4.74	7.77	2.67	9.15	8.55	5.36	0.40	0.32	53.81
1961	2.90	0.95	2.50	1.30	7.60	2.17	5.25	8.50	3.47	6.61	1.18	0.02	42.45
1962	0.33	0.00	2.76	3.40	3.95	8.81	8.24	8.53	6.17	5.05	0.40	0.35	47.99
1963	0.55	2.82	1.10	1.00	5.75	4.70	4.60	9.20	8.37	8.15	2.22	8.85	57.31
1964	1.15	3.30	0.11	1.80	3.86	11.65	7.86	12.51	8.45	13.85	2.86	1.58	68.98
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	3.60	1.80	1.99	4.90	12.95	5.00	7.51	6.56	8.85	1.66	1.65	66.25
1967	1.55	3.25	3.10	0.00	0.60	9.35	10.55	6.65	7.45	9.00	1.20	1.05	53.75
1968	0.35	2.35	0.90	0.40	8.00	21.90	9.50	10.40	10.80	7.75	2.15	0.00	74.50
1969	2.05	1.35	7.05	2.35	6.75	5.70	2.65	9.42	6.25	10.95	1.95	1.25	57.72
1970	2.85	2.45	13.50	1.60	7.00	7.65	10.25	5.55	6.00	2.65	0.00	0.30	59.80
1971	0.80	3.10	1.00	0.35	2.85	6.65	8.80	8.55	7.15	8.05	6.50	4.90	58.70
1972	1.55	2.20	3.65	5.65	8.25	10.62	5.70	5.90	3.20	6.00	3.45	1.10	57.27
1973	3.00	1.20	1.30	1.55	3.25	10.20	7.70	6.95	5.20	8.80	0.65	3.91	53.71
1974	8.69	0.35	3.00	0.40	3.00	16.70	9.54	9.60	5.90	3.65	5.35	0.85	67.03
1975	0.70	4.70	1.25	1.75	6.85	11.55	7.30	2.50	9.05	5.95	1.50	0.61	53.71
1976	0.25	3.90	0.07	2.40	11.60	6.40	4.80	8.40	13.80	0.50	2.20	2.44	56.76
1977	3.55	0.75	0.35	0.00	5.45	4.70	5.05	6.85	15.05	0.58	5.15	5.00	52.48
1978	1.50	1.15	3.70	0.85	6.05	24.35	12.40	7.40	8.60	9.20	7.75	5.70	88.65

Pratt Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1979	4.20	0.30	2.30	2.20	4.74	7.00	3.32	2.54	14.88	9.86	4.55	1.35	57.24
1980	1.60	1.90	1.85	2.80	6.47	5.00	8.55	3.61	6.48	6.00	2.54	1.52	48.32
1981	0.60	2.00	0.80	0.20	3.64	6.20	5.85	14.15	12.37	3.25	3.20	1.75	54.01
1982	1.50	3.60	14.65	2.60	10.16	7.82	13.00	6.30	9.95	6.10	16.25	2.10	94.03
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	14.20	2.84	14.60	0.00	58.39
1985	0.78	0.00	3.00	5.74	1.18	8.45	8.30	4.95	12.70	4.95	1.16	3.15	54.36
1986	4.64	1.70	7.85	0.15	1.45	16.64	10.02	5.80	6.94	6.14	4.45	4.80	70.58
1987	0.72	1.32	4.10	0.75	2.65	3.85	6.02	2.20	8.90	8.25	12.10	0.60	51.46
1988	3.20	3.19	3.60	1.40	6.52	4.48	9.94	11.25	0.90	0.84	1.50	0.50	47.32
1989	0.70	0.60	4.01	4.50	0.60	7.90	9.43	9.09	5.75	8.56	3.35	2.75	57.24
1990	1.63	4.35	4.65	4.30	4.97	1.55	8.79	14.37	10.10	3.62	2.64	2.23	63.20
1991	9.28	6.25	2.67	9.50	7.32	7.08	6.26	5.34	4.87	10.42	4.54	1.55	75.08
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
Mean	2.71	2.58	3.56	2.57	5.10	8.64	6.99	7.86	8.70	6.67	4.16	2.57	62.10

TABLE C-6. Monthly and Mean Rainfall (inches) at S308 Rainfall Station.

S308 Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1940	2.68	2.82	5.95	2.92	2.93	7.44	4.92	8.02	6.71	0.96	0.18	3.13	48.66
1941	4.00	4.41	3.73	9.07	1.89	3.09	10.81	4.42	8.30	5.09	2.53	2.97	60.31
1942	1.40	3.17	5.11	1.79	7.66	7.66	5.25	5.88	1.76	0.40	0.79	1.67	42.54
1943	0.06	0.40	2.12	3.10	1.32	6.91	8.30	5.15	6.78	1.39	2.07	0.19	37.79
1944	1.19	0.08	1.61	3.38	5.27	1.44	6.16	3.46	5.72	7.37	0.27	0.16	36.11
1945	1.05	0.23	0.00	0.69	1.75	5.60	6.58	0.01	11.52	6.59	1.47	1.34	36.83
1946	0.82	1.86	3.27	0.00	5.37	6.09	6.38	2.98	4.98	1.71	4.70	1.63	39.79
1947	0.15	2.16	9.00	2.53	5.82	5.90	8.02	5.74	14.29	10.35	1.44	0.90	66.30
1948	2.99	0.00	1.92	3.97	1.09	2.10	9.51	7.71	10.57	1.75	0.32	0.01	41.94
1949	0.00	0.00	0.04	1.61	1.64	10.09	4.64	10.89	6.76	3.04	0.84	2.79	42.34
1950	0.02	1.64	4.70	0.33	4.65	1.41	7.54	4.90	2.84	9.57	1.47	0.65	39.72
1951	0.00	1.75	0.68	4.72	1.59	10.58	6.78	7.13	3.90	8.78	1.79	0.05	47.75
1952	0.97	4.19	1.24	1.50	3.50	2.71	6.22	5.47	10.36	9.49	0.20	0.46	46.31
1953	1.38	1.59	1.43	3.26	1.25	13.58	9.93	10.22	7.51	6.69	0.98	1.02	58.84
1954	0.00	2.56	2.42	6.88	4.16	10.22	4.95	2.75	7.34	3.29	1.09	1.41	47.07
1955	1.64	0.58	1.48	3.08	1.58	10.02	7.77	7.67	5.86	1.95	0.12	3.02	44.77
1956	0.63	1.16	0.70	3.88	1.93	3.12	1.97	3.57	5.17	8.74	0.19	0.07	31.13
1957	2.42	2.47	3.52	5.55	4.46	2.12	4.87	4.39	7.71	2.43	0.74	5.69	46.37
1958	7.06	0.51	5.85	3.32	6.64	3.33	3.50	4.35	5.52	2.39	0.06	3.45	45.98
1959	1.18	0.32	4.36	1.64	8.88	9.16	6.45	3.42	7.19	6.33	2.42	1.39	52.74
1960	0.00	5.79	0.70	3.97	2.90	4.97	3.01	3.56	11.22	3.20	1.04	0.52	40.88
1961	1.73	0.31	1.98	1.41	4.45	1.95	3.61	5.91	1.15	4.66	1.19	0.03	28.38
1962	0.26	0.92	3.86	4.17	0.45	4.38	7.22	4.07	7.53	3.25	1.87	0.16	38.14
1963	0.86	3.85	0.64	1.37	3.99	7.40	5.34	5.43	3.12	1.31	2.15	5.62	41.08
1964	1.48	2.41	0.74	4.29	3.88	8.16	11.70	9.61	3.54	4.58	0.12	0.98	51.49

S308 Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.21	3.99	1.95	0.19	1.40	10.68	7.73	8.77	3.96	10.26	0.12	1.00	50.26
1966	4.00	3.73	0.80	4.50	4.47	12.05	5.45	5.23	3.50	9.37	0.34	0.40	53.84
1967	0.88	3.19	1.06	0.05	3.44	11.79	6.30	8.03	8.41	6.09	0.16	1.53	50.93
1968	0.25	2.23	0.88	0.20	8.23	14.75	5.67	3.84	5.79	8.26	2.15	0.02	52.27
1969	1.51	2.02	6.53	1.54	5.43	8.08	4.69	5.87	8.67	11.15	1.78	3.38	60.65
1970	3.11	3.64	14.65	0.03	9.24	7.19	6.97	9.04	2.45	2.90	0.09	0.19	59.50
1971	0.19	2.22	0.90	0.17	6.12	6.41	9.11	5.69	4.25	9.25	2.41	2.13	48.85
1972	1.76	1.26	2.38	4.23	3.60	10.98	10.91	5.78	2.95	1.48	1.84	2.46	49.63
1973	1.69	1.83	3.15	0.87	3.86	8.70	11.54	6.14	2.34	4.93	0.10	1.43	46.58
1974	1.29	0.22	0.19	2.20	1.75	11.28	3.67	7.60	9.19	2.17	1.66	0.97	42.19
1975	0.92	2.23	1.93	0.27	4.84	6.72	13.48	3.56	6.33	3.77	0.57	0.34	44.96
1976	0.16	1.79	0.09	1.07	9.10	6.47	3.38	9.86	3.57	1.74	2.87	1.06	41.16
1977	4.53	0.66	1.24	0.73	2.71	2.06	7.33	8.38	11.67	2.84	5.33	4.56	52.04
1978	2.94	1.66	3.07	1.46	3.89	11.64	8.02	6.33	9.34	3.45	3.16	4.32	59.28
1979	6.75	0.14	2.36	1.51	5.55	3.54	3.27	3.64	14.90	2.88	2.12	1.44	48.10
1980	2.98	1.84	1.67	2.77	4.99	4.06	7.05	4.98	6.48	3.06	2.54	1.25	43.67
1981	0.94	1.16	1.00	0.10	2.04	0.98	4.05	9.72	4.23	0.90	0.92	0.17	26.21
1982	0.46	2.35	12.17	3.95	7.63	8.74	7.50	5.86	6.50	1.15	1.90	1.42	59.63
1983	4.47	8.82	4.49	3.41	2.35	7.29	4.84	3.80	8.69	10.15	1.73	2.68	62.72
1984	0.81	3.23	4.19	0.56	7.41	6.11	7.77	3.31	9.19	1.98	7.73	0.26	52.55
1985	0.54	0.12	2.20	2.82	1.99	5.27	7.70	4.58	10.16	3.12	0.00	1.66	40.16
1986	3.64	0.68	5.10	0.09	1.91	9.80	7.32	5.80	7.34	5.11	2.55	3.72	53.06
1987	1.64	1.10	4.81	0.87	3.95	4.53	6.10	2.09	2.82	6.70	7.48	0.03	42.12
1988	2.61	2.83	2.32	0.14	3.69	4.83	9.55	13.58	1.53	0.38	5.38	0.83	47.67
1989	1.15	0.33	3.71	4.31	1.60	3.53	3.48	7.80	5.02	4.29	1.28	2.53	39.03
1990	1.97	1.67	0.75	2.13	3.43	3.59	7.14	8.56	8.40	4.65	1.50	0.75	44.54
Mean	1.67	1.96	2.95	2.33	3.99	6.68	6.70	5.97	6.57	4.65	1.72	1.57	46.76

TABLE C-7. Monthly and Mean Rainfall (inches) at Stuart Rainfall Station.

Stuart Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1936	1.87	4.48	4.15	2.12	5.60	7.26	5.48	4.23	6.39	8.70	4.78	4.56	59.62
1937	1.65	1.88	5.65	8.27	2.94	4.88	3.97	2.99	9.42	18.81	5.92	1.06	67.44
1938	1.00	1.32	0.38	0.08	1.94	7.64	5.64	0.61	6.66	11.14	3.03	2.06	41.50
1939	0.34	0.17	1.33	5.16	8.99	4.50	4.94	12.06	7.19	11.04	0.89	1.67	58.28
1940	2.20	3.48	6.85	1.20	2.50	5.59	3.40	7.56	16.40	3.31	0.15	6.34	58.98
1941	6.27	5.47	2.50	6.38	4.87	9.72	8.56	1.66	9.51	4.71	3.44	1.70	64.79
1942	2.42	3.32	5.50	1.83	6.93	12.82	2.04	4.67	9.42	5.56	0.78	3.25	58.54
1943	0.49	0.67	4.34	1.91	7.05	5.56	8.93	3.66	7.91	2.40	3.25	0.80	46.97
1944	2.31	0.25	0.53	2.18	2.69	4.18	9.80	4.07	8.17	10.11	0.51	0.88	45.68
1945	1.05	2.00	0.02	0.71	1.27	6.05	8.34	0.01	12.84	7.33	2.77	2.12	44.51
1946	2.64	1.45	1.73	0.00	9.19	6.51	8.51	5.42	4.18	2.17	5.86	1.84	49.50
1947	1.29	2.44	3.02	6.62	3.13	9.03	9.11	4.73	17.24	11.85	3.44	1.27	73.17
1948	3.50	0.83	1.87	4.86	3.38	3.29	5.09	4.33	14.86	4.12	1.16	1.30	48.59

Stuart Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1949	0.27	0.87	0.42	0.45	4.07	9.40	4.56	9.53	7.09	5.84	1.05	8.67	52.22
1950	0.49	0.97	3.70	1.14	3.08	3.36	4.52	6.74	7.21	8.33	1.19	0.58	41.31
1951	0.55	2.11	0.28	3.65	5.04	3.73	5.20	8.27	4.97	10.57	2.36	1.23	47.96
1952	1.29	6.62	4.04	1.51	2.30	2.86	7.80	6.39	5.10	17.36	0.58	0.62	56.47
1953	1.97	2.80	4.31	3.92	1.94	8.66	10.77	6.63	14.51	7.83	2.14	5.00	70.48
1954	0.33	3.31	4.37	4.01	6.77	10.38	7.80	8.88	12.27	6.75	4.20	1.01	70.08
1955	2.49	1.93	2.29	5.25	3.51	9.61	3.08	4.06	2.18	5.09	0.17	3.86	43.52
1956	2.17	2.60	1.15	2.75	5.17	2.60	6.55	4.43	5.12	5.66	0.63	1.85	40.68
1957	1.77	4.02	3.43	5.77	5.78	4.76	8.42	7.97	6.14	8.70	1.53	3.67	61.96
1958	10.66	0.69	5.58	2.62	8.35	3.04	4.34	3.30	5.04	9.19	2.30	5.52	60.63
1959	5.14	0.55	8.65	6.30	4.35	11.46	6.86	9.42	13.24	11.86	6.64	3.31	87.78
1960	0.23	4.58	1.74	5.47	1.73	7.71	11.53	4.60	18.45	2.12	1.68	1.06	60.90
1961	4.46	0.76	4.98	1.63	11.02	4.33	1.13	6.32	2.39	4.80	1.80	0.14	43.76
1962	1.39	0.77	3.53	2.56	1.44	8.18	13.12	11.91	6.18	0.89	1.42	0.20	51.59
1963	0.90	4.59	1.54	0.82	2.73	6.10	2.17	2.51	10.05	10.36	2.80	10.06	54.63
1964	2.25	3.95	1.37	2.84	3.85	4.40	6.58	15.11	5.18	11.81	2.38	2.51	62.23
1965	0.61	4.28	2.27	1.10	0.65	7.13	7.69	2.62	5.36	6.47	1.62	0.77	40.57
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	2.15	0.93	1.78	8.38	13.72	8.29	6.15	6.57	6.39	2.65	0.12	57.65
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	8.25	12.44	5.06	3.59	4.40	3.22	2.04	47.90
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	2.44	0.03	2.57	9.17	6.68	3.15	4.92	6.53	2.82	4.08	5.94	48.79
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	14.74	2.70	5.42	1.95	56.28
1980	3.42	3.30	1.41	1.42	5.01	5.17	7.05	3.26	4.71	2.47	4.20	0.30	41.72
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	7.91	6.73	12.69	2.20	5.49	76.89
1984	0.88	5.77	4.79	1.07	11.13	4.80	3.98	4.39	9.19	1.65	11.01	0.42	59.08
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	1.67	6.42	0.83	3.33	4.95	5.78	1.88	6.95	7.87	4.65	0.40	47.68
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	3.11	47.86
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	7.34	6.87	4.56	0.87	1.76	73.42
Mean	2.40	2.72	3.57	2.76	4.95	6.58	6.53	5.71	8.05	6.69	2.83	2.56	55.37

TABLE C-8. Monthly and Mean Rainfall (inches) at Vero Rainfall Station.

Vero Rainfall Station													
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.50	5.22	2.80	1.42	0.46	6.33	8.14	4.96	5.44	7.68	2.46	1.39	46.80
1966	3.97	6.22	2.05	3.06	4.11	11.95	7.76	2.10	6.26	12.41	1.97	1.14	63.00
1967	1.55	2.93	1.29	0.63	0.30	5.06	8.42	5.37	3.45	7.28	0.41	1.64	38.33
1968	1.00	1.98	0.23	2.80	6.80	17.18	9.92	6.11	7.16	6.63	2.31	0.12	62.24
1969	2.27	1.13	8.37	1.97	5.04	1.49	7.04	7.82	9.96	9.90	2.83	1.59	59.41
1970	4.47	2.89	5.68	0.26	2.73	4.33	4.14	3.41	10.12	5.13	0.05	0.66	43.87
1971	0.03	2.94	1.40	0.90	3.50	8.10	12.20	2.50	7.70	6.80	2.00	2.20	50.27
1972	1.10	3.90	0.60	4.70	7.50	11.10	2.20	6.70	2.30	2.50	3.30	2.00	47.90
1973	5.30	1.90	2.20	2.70	9.30	12.20	9.50	8.60	8.30	5.12	0.86	1.60	67.58
1974	2.60	2.00	1.90	2.90	4.30	8.80	6.80	8.30	4.00	3.10	2.90	1.50	49.10
1975	0.10	3.70	1.90	0.60	7.70	6.19	3.10	4.90	5.70	4.60	1.20	0.90	40.59
1976	0.50	0.50	0.40	2.10	10.63	8.30	2.10	5.60	9.60	1.40	2.10	3.70	46.93
1977	1.80	1.10	0.30	1.00	4.40	8.90	2.50	5.60	7.40	2.10	3.00	6.60	44.70
1978	1.50	2.40	3.00	0.50	4.10	4.24	5.40	5.05	3.50	3.20	4.40	4.80	42.09
1979	4.71	1.22	1.06	1.89	12.06	3.77	6.20	5.44	17.42	1.65	3.92	1.47	60.81
1980	3.50	3.10	2.90	2.50	3.05	4.41	6.12	3.97	4.78	2.17	3.47	1.53	41.50
1981	0.20	2.60	1.40	0.20	2.30	3.20	2.50	18.00	6.40	2.60	3.00	0.41	42.81
1982	0.97	3.67	8.84	4.00	7.00	8.20	9.10	7.60	7.20	2.60	10.30	2.40	71.88
1983	3.90	9.80	4.50	2.70	1.00	5.60	3.70	9.50	6.31	15.70	1.20	3.80	67.71
1984	1.80	3.70	1.80	1.34	6.40	2.10	3.80	6.90	11.70	3.10	12.60	1.90	57.14
1985	0.67	0.28	2.20	5.20	1.60	3.30	7.70	6.10	12.20	4.20	1.70	1.68	46.83
1986	3.03	1.36	5.03	0.10	1.70	8.10	6.80	3.40	5.90	7.54	2.70	2.50	48.16
1987	2.80	1.20	5.00	0.60	5.10	3.00	5.30	4.20	4.40	6.90	7.70	0.50	46.70
1988	2.30	1.70	5.20	0.50	5.40	3.50	12.40	3.40	1.10	1.60	0.30	2.40	39.80
1989	2.06	1.20	4.50	3.20	1.60	3.70	4.40	4.10	8.30	7.00	0.78	2.92	43.76
1990	0.94	2.70	0.50	1.21	3.56	6.10	7.20	7.54	8.57	5.32	1.58	0.40	45.62
Mean	2.06	2.74	2.89	1.88	4.68	6.51	6.32	6.04	7.12	5.32	3.04	1.99	50.60

FREQUENCY ANALYSIS

1-in-10 Year Drought Event

Model simulations were used to analyze potential impacts on wetlands and aquifer levels within the UEC under average and drought rainfall conditions. The UEC Water Supply Plan Advisory Committee and staff agreed that a 1-in-10 year drought condition is an appropriate event for the plan to balance the needs of all users, including the environment. This is defined as rainfall with a probability of exceedance of 90 percent for a twelve-month period. This means that there is a 10 percent chance that less than this amount will be received in any given year. In other words, an area receives the 10 percent chance rainfall or less, on average, once every 10 years. Other drought events were considered, such as 1-in-5 and 1-in-20 year drought events, but were not used because it was concluded these were not appropriate events to plan for. The 1-in-10 drought condition was codified by Chapter 373, F.S. during the 1997 legislative session.

Statistical vs. Empirical Rainfall Data

Two approaches or methods, statistical and empirical, were used to select the 1-in-10 year drought events for the seven rainfall stations. In the empirical method, a 12-month period was selected from each station's historical period of record with the period total being approximately equal to that of the respective 10 percent chance amount. This method led to inconsistencies among the stations: sets were chosen without regard to the magnitude and frequency of individual monthly values within each set, as long as the total amount matched the 10 percent drought frequency criterion.

More consistent and meaningful rainfall sets were developed based on further statistical analysis of the monthly data. Unlike their predecessors, the monthly values in these sets have a known cumulative frequency and are not drawn from the historical record. The sets have the statistical property that the initial-month and subsequent *cumulative* amounts (including the 12-month total) have a drought frequency of 10 percent. The advantages of this method are that it:

- eliminates subjectivity,
- minimizes influences of peaks and valleys,
- eliminates inequities between rainfall stations, and
- shows a minimal change in annual allocations.

Figure C-3 illustrates the peaks and valleys in the empirical 1-in-10 year drought event for the Fort Pierce rainfall station. Table C-9 shows the variation in supplemental water requirements for citrus at the seven rainfall stations using the two methods.

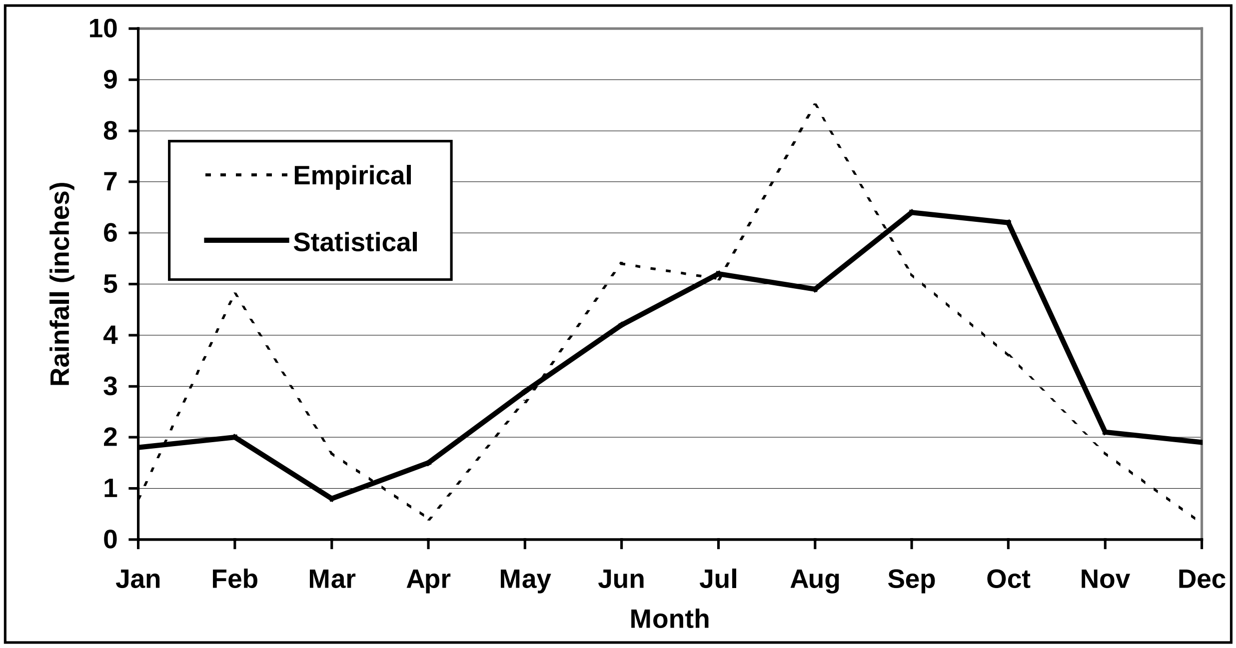

FIGURE C-3. Empirical vs. Statistical 1-in-10 year drought events for the Fort Pierce rainfall station.

TABLE C-9. Empirical vs. Statistical Citrus Supplemental Water Requirements.

	Rainfall Stations						
	Cow Creek	Vero Beach	Pratt	Fort Drum	S-308	Stuart	Fort Pierce
Annual (in) Empirical	32.83	30.62	29.29	29.48	30.40	30.62	30.40
Statistical	32.52	29.77	29.29	29.99	30.92	30.70	30.23
Max Month (in) Empirical	5.06 (July)	4.26 (May)	4.32 (May)	3.80 (April)	4.14 (July)	3.98 (June)	3.98 (April)
Statistical	3.81 (July)	3.66 (May)	3.74 (April)	3.71 (May)	3.53 (May)	3.65 (April)	3.62 (May)

Statistical Method

The statistical approach requires selection of the initial month and an analysis of twelve cumulative rainfall data sets. March was chosen as the month from which 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 for each station. Similar analyses were performed on historical rainfall for durations of two months (March through April) through twelve 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 produces a set of monthly values that has 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 C-4; while the values for 1-in-10 year drought events are listed in Table C-10.

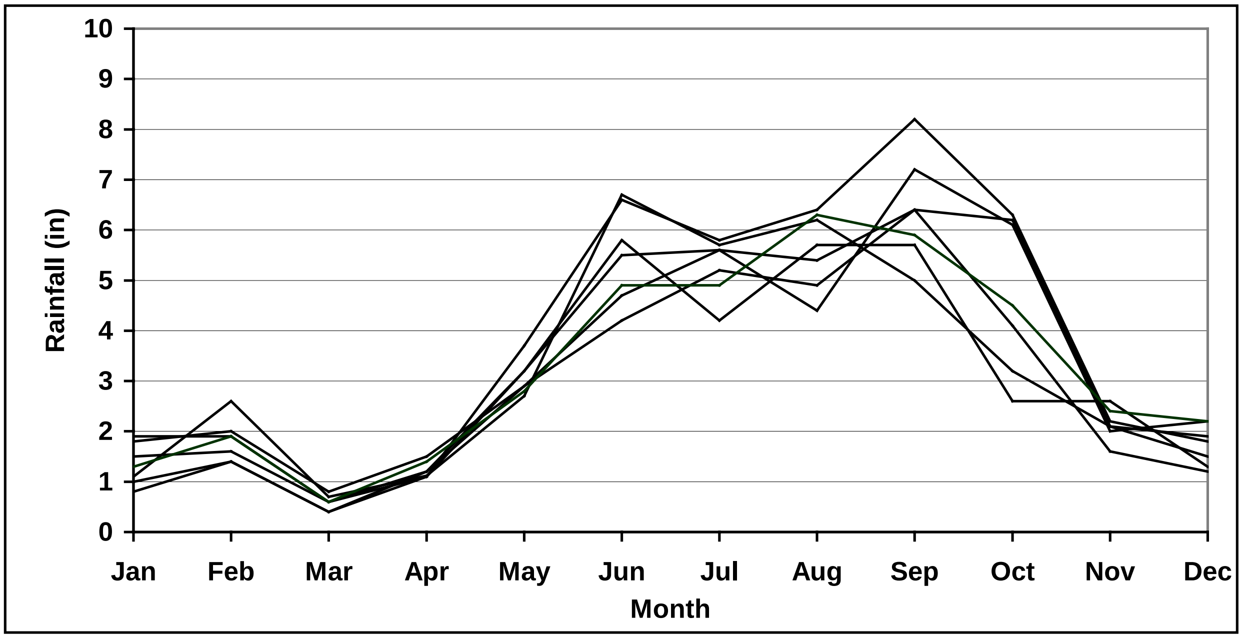

FIGURE C-4. Statistical 1-in-10 year drought events for seven rainfall stations.

TABLE C-10. Statistical 1-in-10 Rainfall (in inches) for Seven Rainfall Stations, Calculations Starting with March.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
Cow Creek	0.8	1.4	0.4	1.1	3.2	5.8	4.2	5.7	5.7	2.6	2.6	1.3	34.8
Fort Drum	1.1	2.6	0.7	1.12	2.7	6.7	5.7	6.2	5.0	3.2	2.1	1.5	38.6
Fort Pierce	1.8	2.0	0.8	1.5	2.9	4.2	5.2	4.9	6.4	6.2	2.1	1.9	39.9
Pratt	1.5	1.6	0.6	1.1	3.7	6.6	5.8	6.4	8.2	6.3	2.2	1.8	45.8
S308	1.0	1.4	0.4	1.2	2.9	4.7	5.6	5.4	6.4	4.1	1.6	1.2	35.9
Stuart	1.9	1.9	0.6	1.2	3.2	5.5	5.6	4.4	7.2	6.1	2.0	2.2	41.8
Vero	1.3	1.9	0.6	1.4	2.8	4.9	4.9	6.3	5.9	4.5	2.4	2.2	39.1

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REFERENCES CITED

Alfredo, H., S. Ang, and W.H. Tang. 1975. *Probability concepts in engineering planning and design.* New York: Wiley and Sons.

Sculley, S. 1986. Frequency analysis of SFWMD Rainfall. Technical Publication 86-6. Water Resources Division, South Florida Water Management District, West Palm Beach, FL. vari. pag.

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APPENDIX D

Ground Water Resources

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LIST OF TABLES

LIST OF FIGURES

Ground Water Resources Graphics

Table D-l. Temporal and Physical Relationship Between Maior Aquifer Systems in the Upper East Coast Planning, Area.

AGE ESTIMATES OF BOUNDARIES (MYBP)	SERIES	STRATIGRAPHIC UNITS	HYDROGEOLOGIC UNITS: SYSTEMS OR UNITS		HYDROGEOLOGIC UNITS: SUBUNITS OR FLOW ZONES
	Holocene	Pamlico Sands	rficial Aquifer System 90'-200' thick	Water Table Aquifer	Surficial Sands
-0.01	Pleistocene	Ft. Thompson Formation (West) / Anastasia Formation (East)			Primary Water Producing Zone
3.2	Pliocene	Caloosahatchee Marl			Non-Production Zone
5	Upper Miocene	Tamiami Formation	ntermediate Confining Unit 450'-650' thick	Upper Confining Unit for the Floridan Aquifer	N/A
	Miocene	Hawthorn Group			
25	Oligocene	Suwannee Limestone	Floridan Aquifer System (FAS) 2800'-3400' thick	Upper Floridan Aquifer	First Continuous Flow Zone
37	Upper Eocene	Ocala Group			Vorious Flow Zones Second Continuous Flow Zone
	Middle Eocene	Avon Park Limestone		Middle Semi-Confining Unit	(Several Permeable Zones)
		Lake City Limestone		Lower Floridan Aquifer (LFA)	*ULFA: Producing Zone Semi-Confining Unit Producing Zone
	Lower Eocene	Oldsmar Limestone			Lower Confining Un
					Boulder Zone
58	Paleocene	Cedar Keys Limestone		Confining Unit for Base of FAS	

*ULFA = Upper part of the Lower Floridan Aqulfar

MYBP = Million years before present.

~~~~~ = Location of FAS Continuous Flow Zones.

Dates are referenced to Decade of North American Geology Geologic Time Scale (Geologic 9-83).
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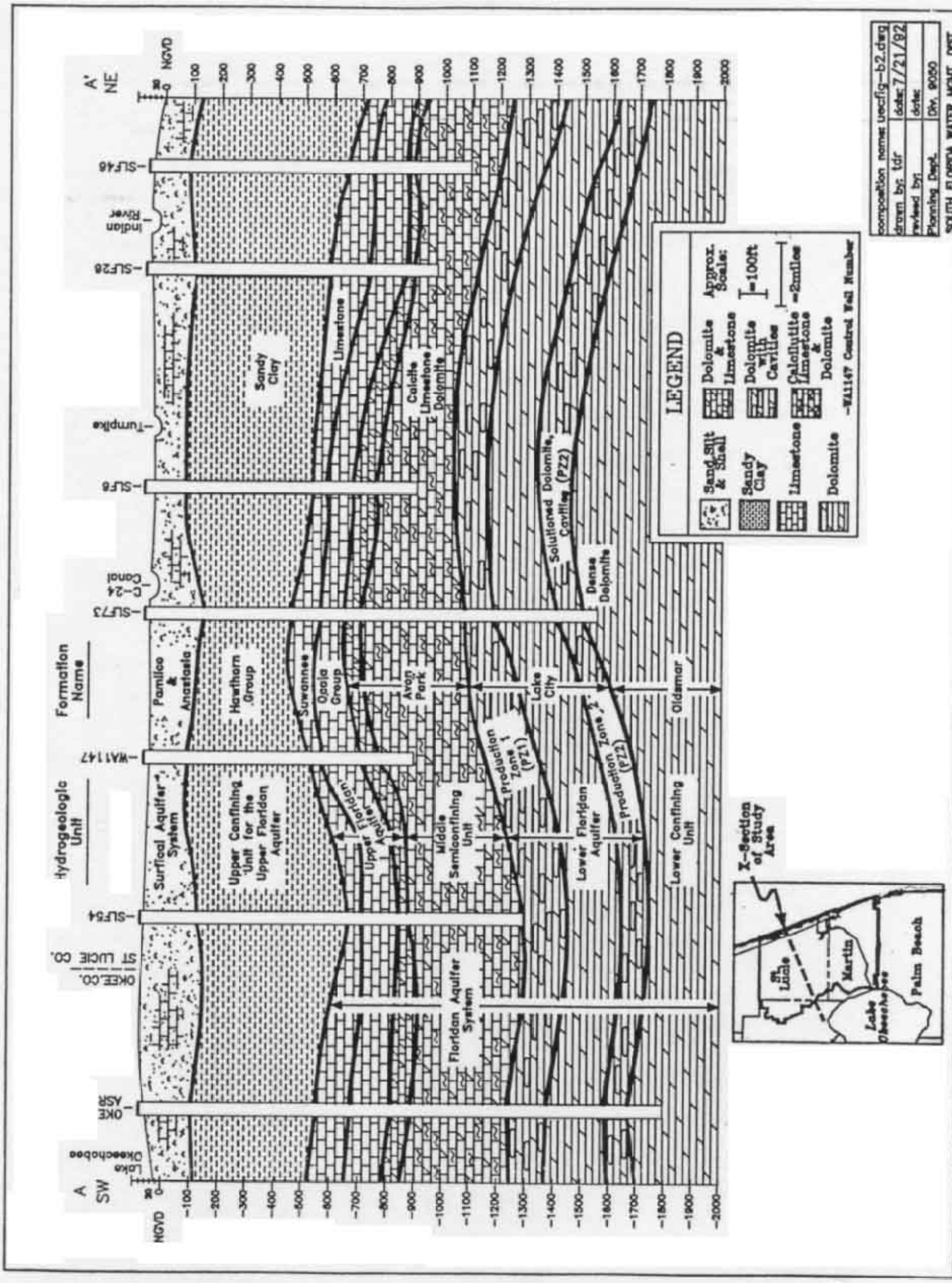

FIGURE D-1. Stratigraphic Cross Section through the UEC Planning Area (After Lukasiewicz, 1992).

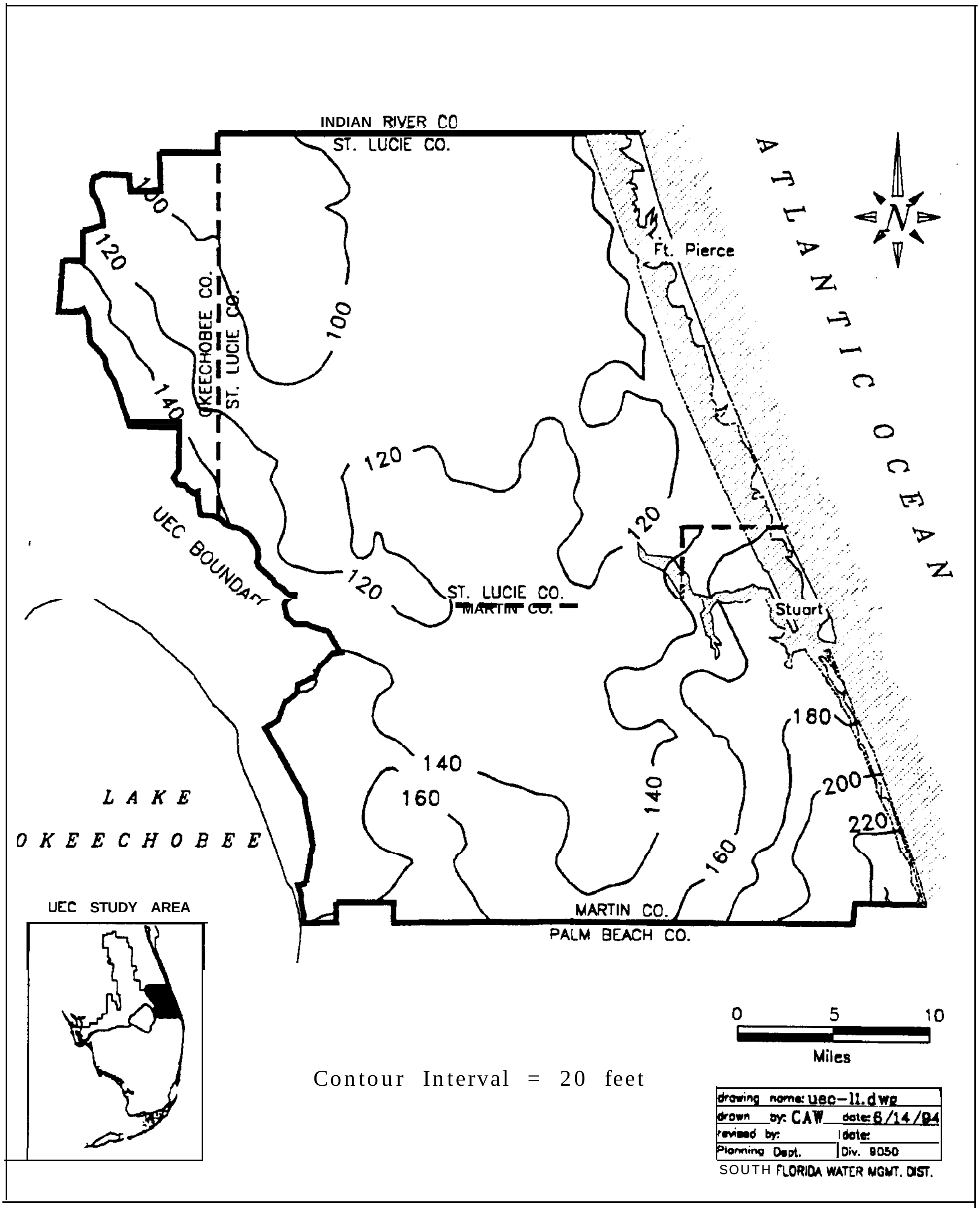

FIGURE D-2. Thickness (in feet) of the Surficial Aquifer System (After Lukasiewicz, 1992).

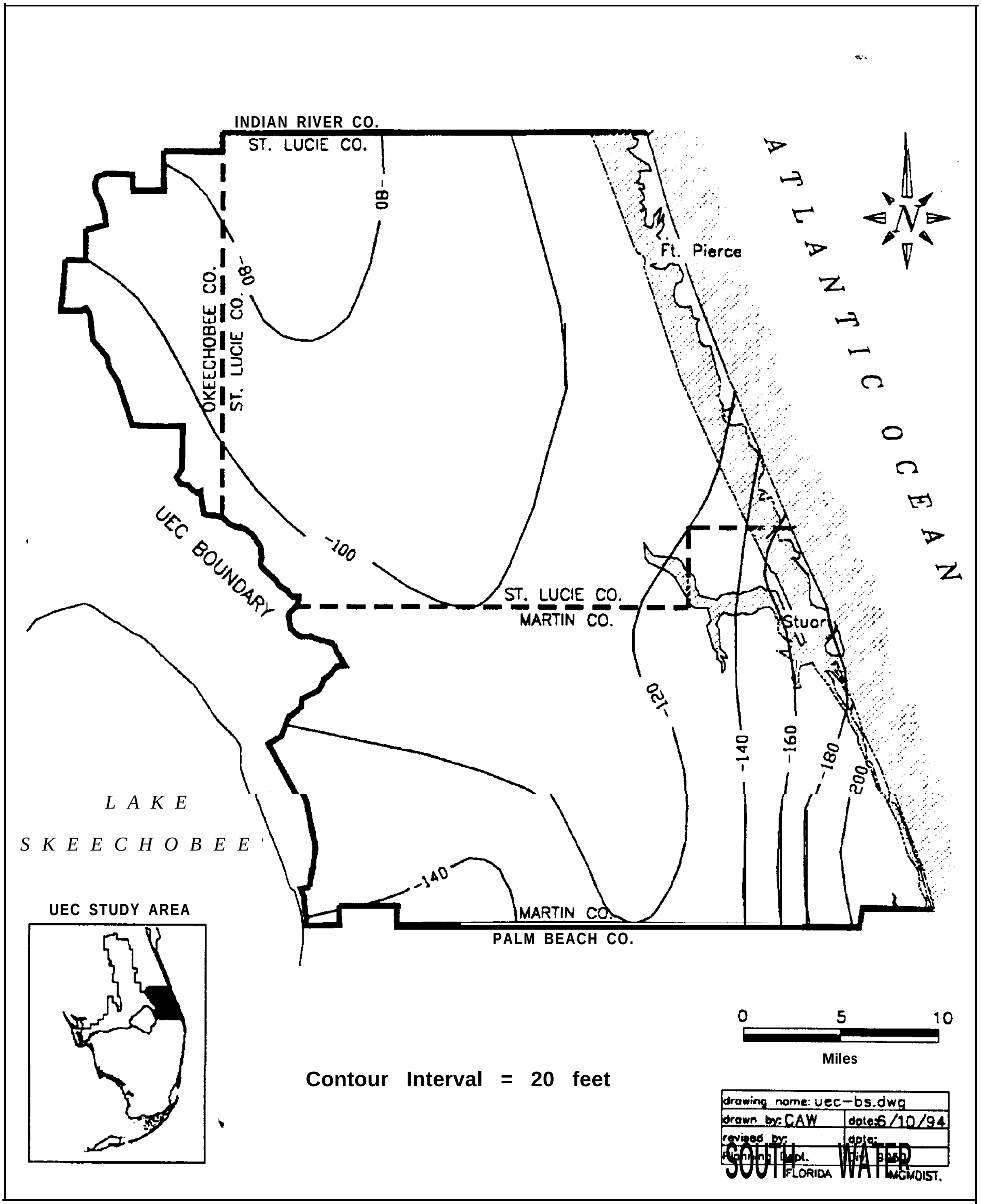

FIGURE D-3. Elevation (in feet NGVD) of the Top of the Upper Confining Unit of the Floridan Aquifer System (After Lukasiewicz, 1992).

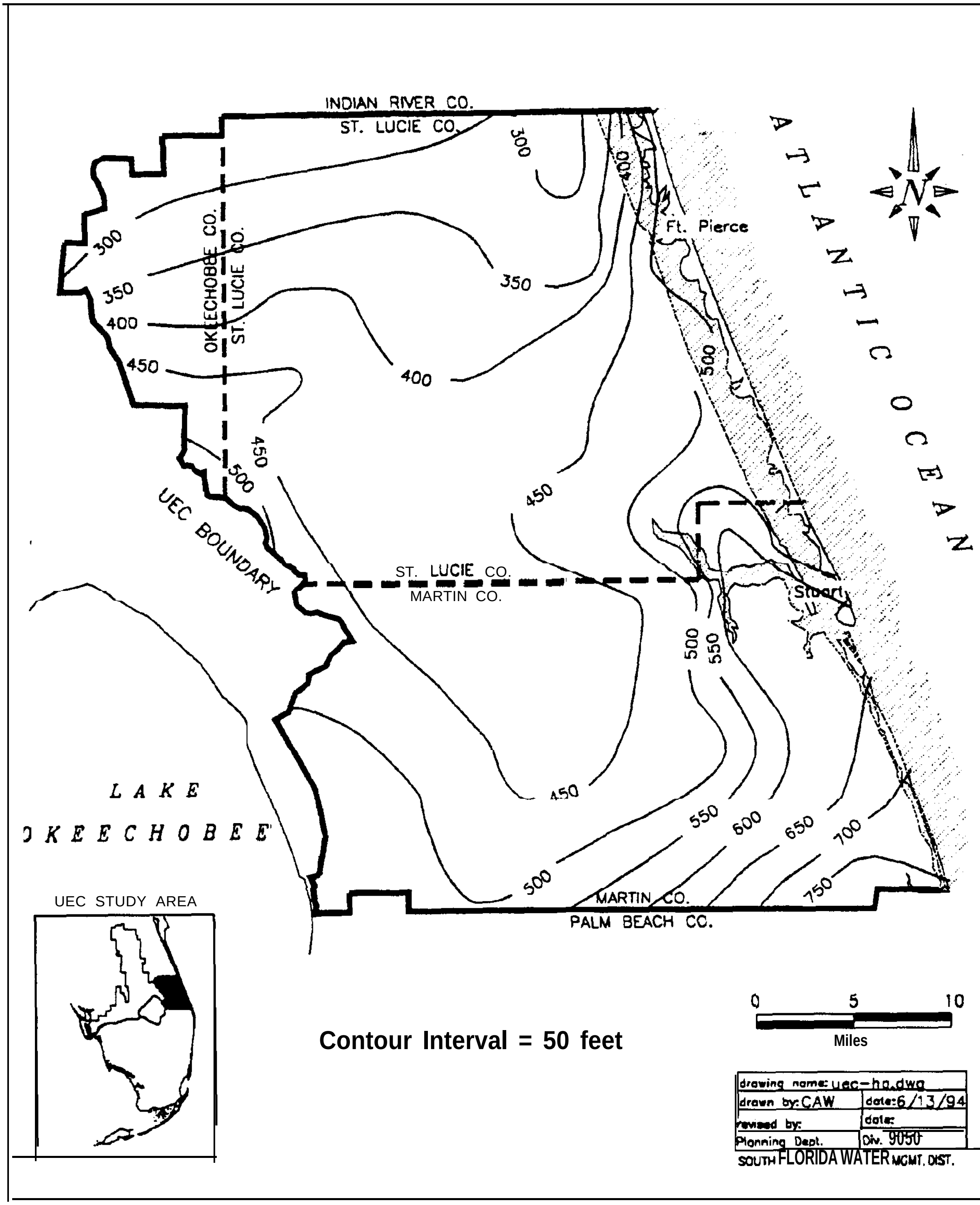

FIGURE D-4. Thickness (in feet) of the Upper Confining Unit for the Floridan Aquifer System (After Lukasiewicz, 1992).

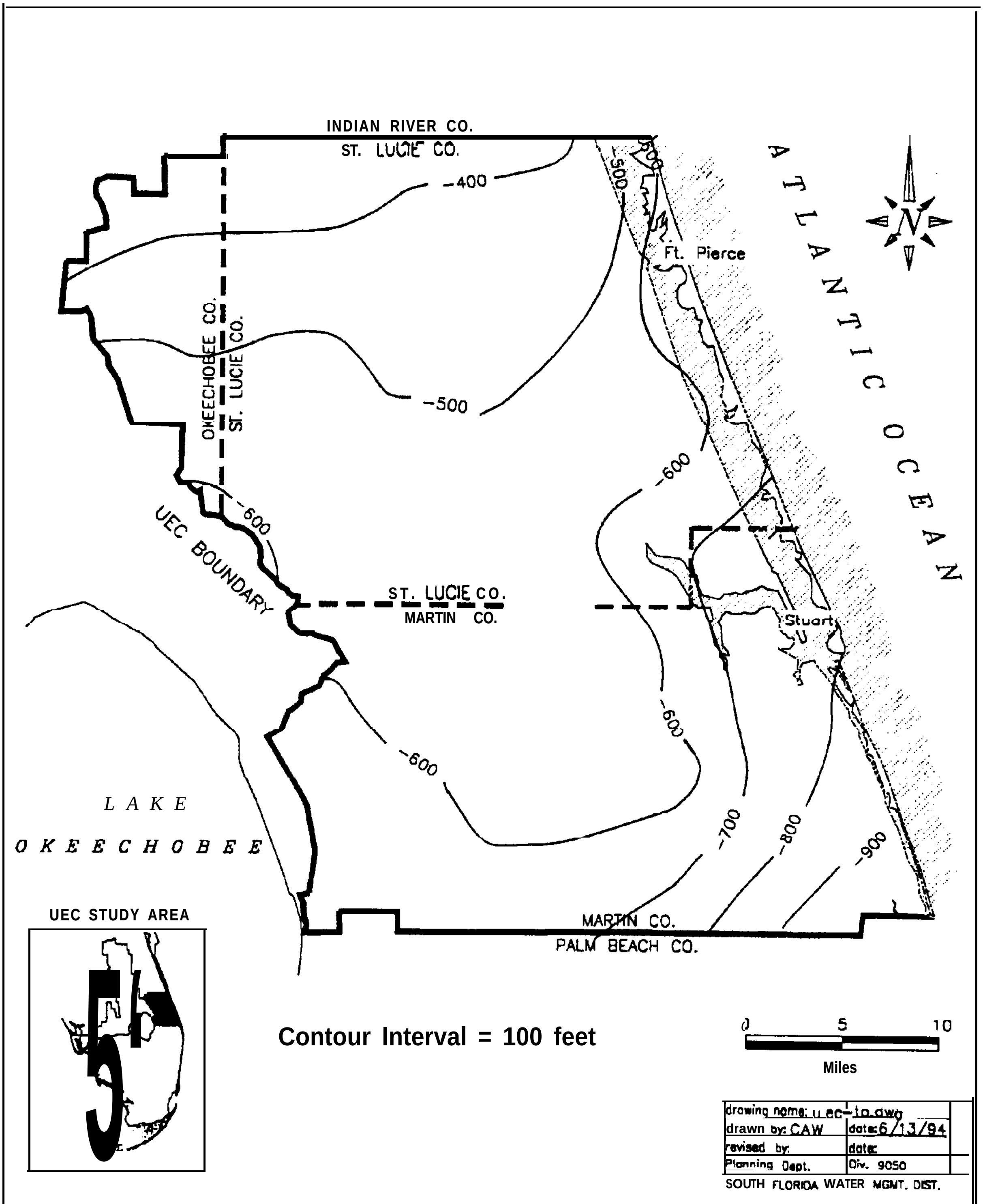

FIGURE D-5. Elevation (in feet NGVD) of the Top of the Floridan Aquifer System (After Lukasiewicz, 1992).

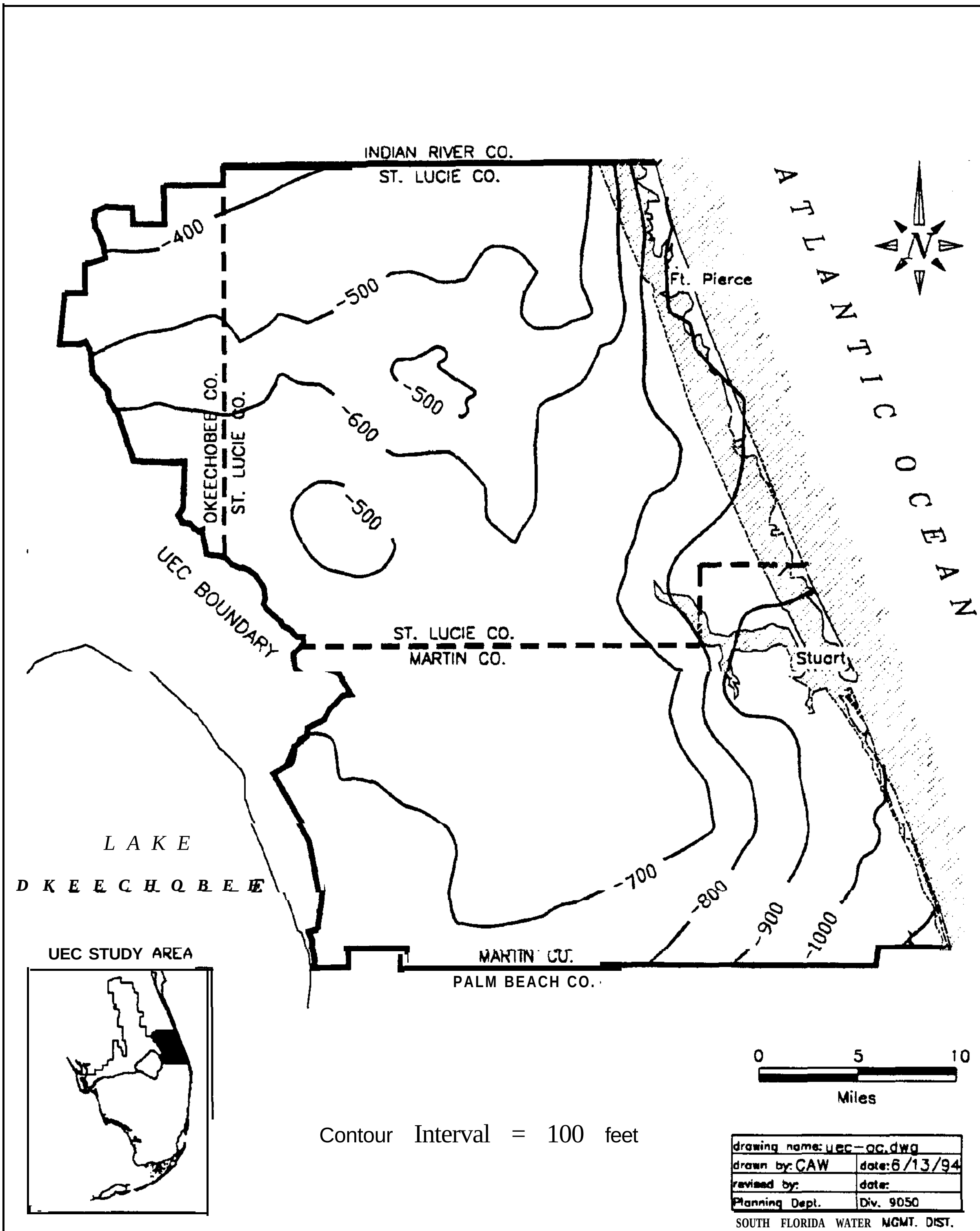

FIGURE D-6. Elevation (in feet NGVD) of the Unconformity Between the Suwannee Formation and the Ocala Group (first continuous flow zone of the Upper Floridan Aquifer) - After Lukasiewicz, 1992.

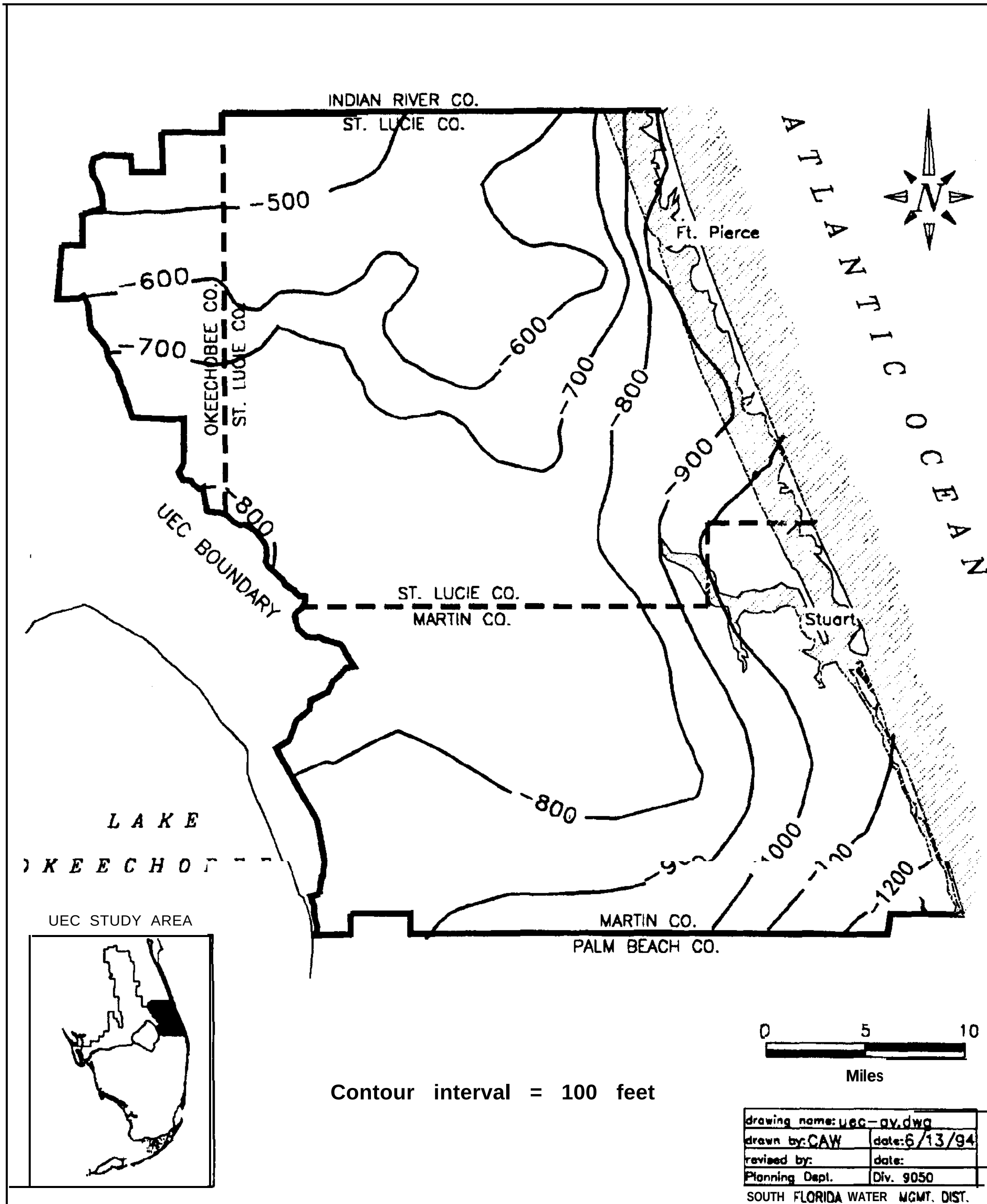

FIGURE D-7. Elevation (in feet) of the Unconformity Between the Ocala Group and the Avon Park Formation (second continuous flow zone of the Upper Floridan Aquifer) - After Lukasiewicz, 1992.

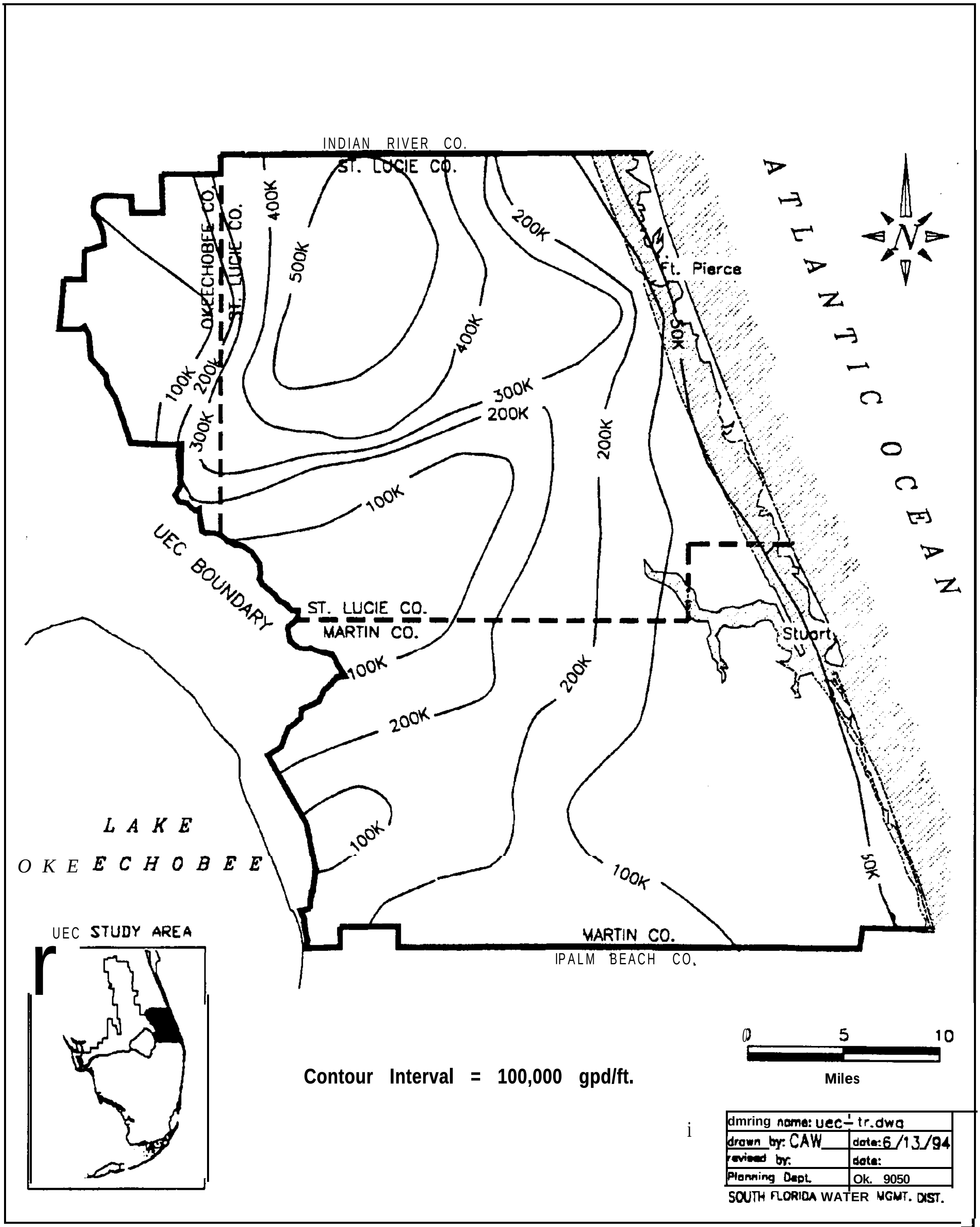

FIGURE D-8. Transmissivity (gpd/ft.) of the Upper Floridan Aquifer (After Lukasiewicz, 1992).

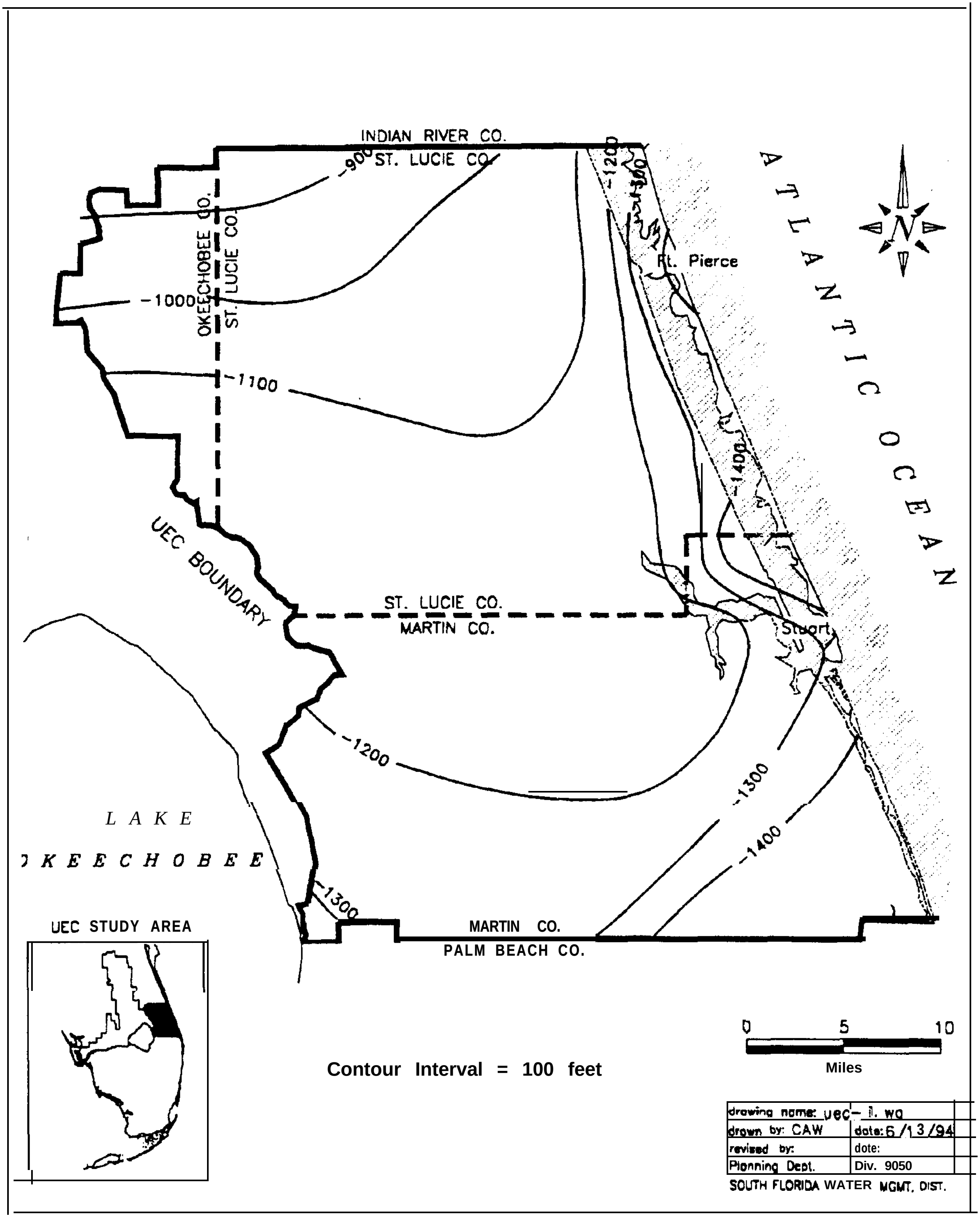

FIGURE D-9. Elevation (in feet NGVD) of the Top of the Lower Floridan Producing Zone 1 (After Lukasiewicz, 1992).

Individual Permit Allocations

TABLE D-2. Individual Permit Allocations in the UEC Planning Area.

Water Use	Allocations (MGD)					Number of Permits			
	Ground Water	Surface Water	Both	Total	% of Total	Ground Water	Surface Water	Both	Total
Martin County Agriculture	12.02	115.77	105.88	233.67	84.06	38	26	24	88
Public Water Supply	20.73	0.00	0.00	20.73	7.46	57	0	0	57
Golf	1.27	0.68	6.27	8.22	2.96	4	2	16	22
Landscape	1.53	0.03	4.55	6.11	2.20	33	3	17	53
Dewatering	0.00	0.00	4.98	4.98	1.79	0	0	6	6
industrial	2.6	0.00	0.00	2.6	0.94	8	0	0	8
Nursery	0.29	0.18	0.06	0.53	0.19	5	1	1	7
Recreational	0.00	0.00	0.33	0.33	0.12	1	0	1	2
Aquaculture	0.18	0.00	0.00	0.18	0.06	2	0	0	2
Livestock	0.00	0.00	0.00	0.00	0.00	1	0	0	1
Other	0.00	0.11	0.51	0.62	0.22	0	1	1	2
Total	38.62	116.77	122.58	277.97	100.00	149	33	66	248
St. Lucie County Agriculture	42.7	7.64	251.32	301.66	86.18	143	19	240	402
Public Water Supply	24.93	0.00	0.00	24.93	7.12	86	0	0	86
Golf	1.31	1.46	1.9	4.67	1.33	2	2	6	10
Landscape	0.47	0.38	1.03	1.88	0.54	28	5	5	38
Dewatering	0.09	0.18	13.9	14.17	4.05	1	1	7	9
Industrial	0.91	0.00	0.11	1.02	0.29	5	0	1	6
Nursery	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Recreational	0.00	0.00	1.68	1.68	0.48	0	0	1	1
Aquaculture	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Livestock	0.15	0.00	0.00	0.00	0.00	1	0	0	1
Other	0.01	0.00	0.00	0.01	0.00	1	0	0	1
Total	70.57	9.66	269.94	350.02	100.00	267	27	260	554
Okeechobee Area Agriculture	8.32	0.00	18.49	26.81	99.70	9	0	6	15
Public Water Supply	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Golf	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Landscape	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Dewatering	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Industrial	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Nursery	0.00	0.08	0.00	0.08	0.30	0	1	0	1
Recreational	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Aquaculture	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Livestock	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Other	0.00	0.00	0.00	0.00	.000	0	0	0	0
Total	8.32	0.08	18.49	26.89	100.00	0	1	6	16

TABLE D-2. Individual Permit Allocations (continued).

Water Use	Allocations (MGD)					Number of Permits			
	Ground Water	Surface Water	Both	Total	% of Total	Ground Water	Surface Water	Both	Total
UEC Planning Area Agriculture	63.04	123.41	375.69	562.14	85.84	190	45	270	505
Public Water Supply	45.66	0.00	0.00	45.66	6.97	143	0	0	143
Golf	2.58	2.14	8.17	12.89	1.97	6	4	22	32
Landscape	2	0.41	5.58	7.99	1.22	61	8	22	91
Dewatering	0.09	0.18	18.88	19.15	2.92	1	1	13	15
Industrial	3.51	0.00	0.11	3.62	0.55	13	0	1	14
Nursery	0.29	0.26	0.06	0.61	0.09	5	2	1	8
Recreational	0.00	0.00	2.01	2.01	0.31	1	0	2	3
Aquaculture	0.18	0.00	0.00	0.18	0.03	2	0	0	2
Livestock	0.15	0.00	0.00	0.00	0.00	2	0	0	2
Other	0.01	0.11	0.51	0.63	0.10	1	1	1	3
Total	117.51	126.51	411.01	654.88	100.00	425	61	332	818

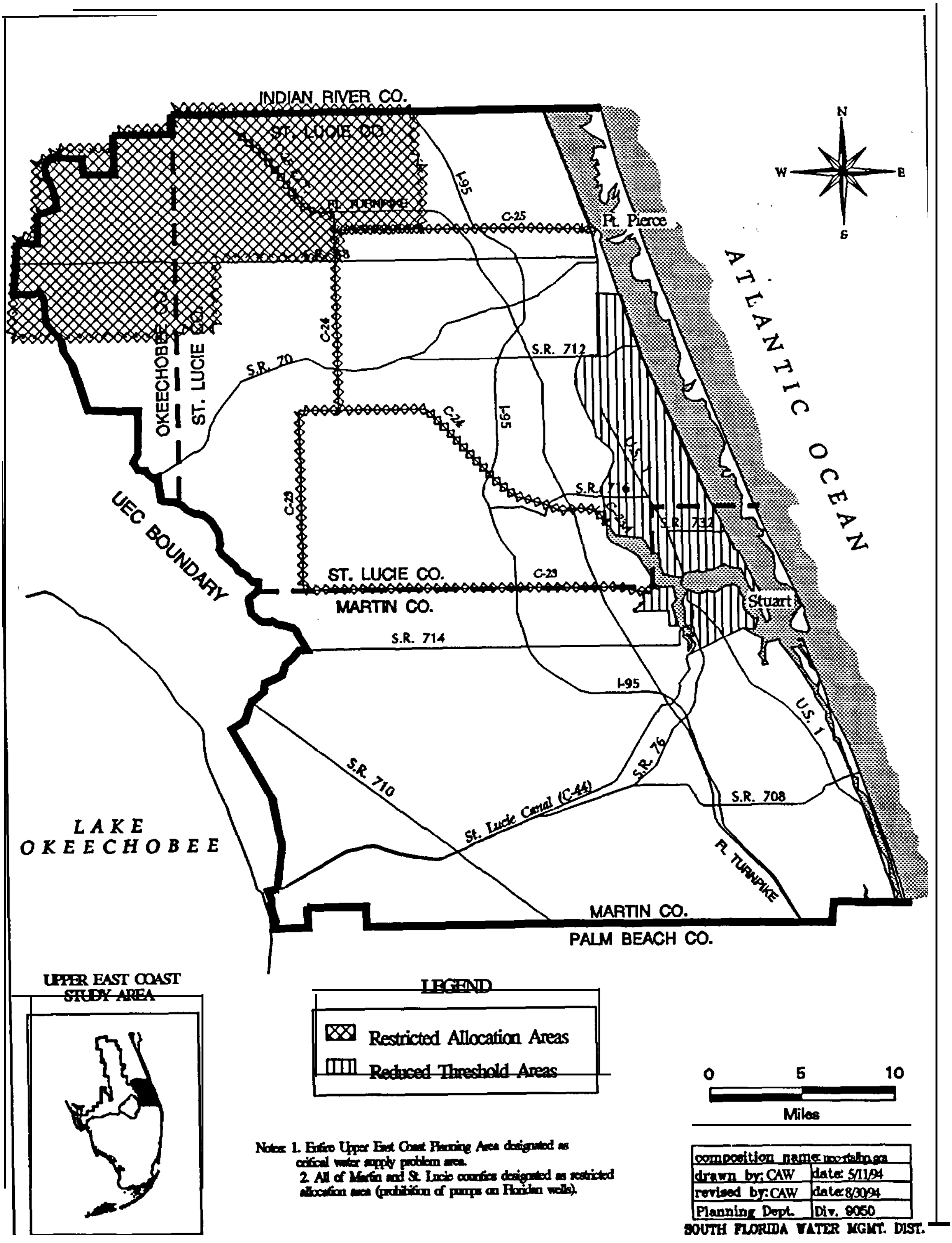

FIGURE D-10. Consumptive Use Permitting Program Specially Designated Areas in the UEC Planning Area.

REFERENCES CITED

Lukasiewicz, J. **1992.** A three-dimensional finite difference ground water flow model of the Floridan Aquifer System in Martin, St. Lucie and eastern Okeechobee counties in Florida. Technical Publication 92-03. Department of Research and Evaluation, South Florida Water Management District, West Palm Beach, FL. 292 pp.

APPENDIX E

Potable and Wastewater Treatment Facilities

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POTABLE WATER TREATMENT FACILITIES

Most potable water used in the Upper East Coast Planning Area is produced both by large (20 MGD) and small ($\leq$ 0.01 MGD) water treatment facilities. This section will focus on the larger and/or regional facilities, which due to their existing and/or future design capacities, could have an impact on the water resource.

There are 12 existing and 1 proposed large and/or regional facilities. These water treatment facilities and proposed/future facilities are mostly located in the urbanized areas throughout the UEC Planning Area, as indicated on Figure E-l. Six of the facilities are privately owned. Of the 12 existing facilities, 5 use lime softening exclusively, 2 use a membrane technology, 4 use aeration and chlorination, and 1 uses a combination of lime softening and reverse osmosis. The total treatment capacity of these facilities is 50.96 million gallons per day (MGD), of which there was a 1993 average annual demand of 24.93 MGD. Key information for each utility is summarized in Table E-l.

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

Raw Water Supply - This section states the SFWMD permit number with the issue and expiration dates, a summary of withdrawal facilities, and the SFWMD approved allocations. All well depths are measured from land surface.

Treatment Method - This section presents the current FDEP-rated capacity, the method of treatment, the location of the treatment plant, and the 1993 average daily flow. The concentrate/brine reject disposal method, if a membrane or electrodialysis (ED) technology is used for treatment, is provided.

Interconnections - This section describes water distribution system interconnections with other potable water distribution systems.

Proposed - This section states any current construction or permitting that is underway.

Future- This section presents projected utility flows (as provided by the utility) and known future treatment plant expansions and plans, including additional facilities and wellfields.

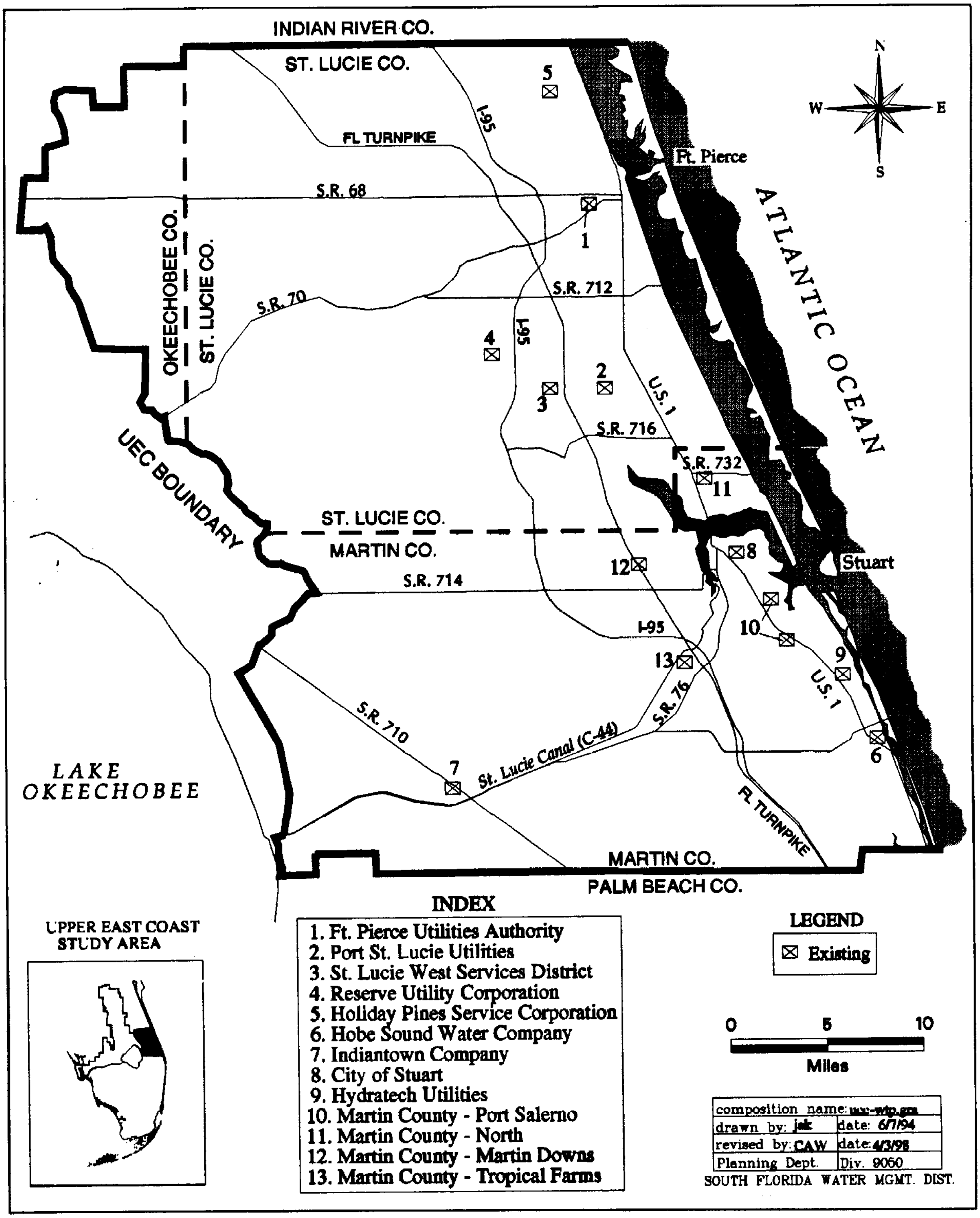

FIGURE E.1 - Potable Water Treatment Facilities in the UEC Planning Area.

TABLE E-1. Potable Water Treatment Facilities in the UEC Planning Area.

Facility	FDEP Rated Capacity (MGD)	1993 Average Daily Flow (MGD)	Method of Treatment			SFWMD Permit Number	Approved Annual Allocation (MGD)	Raw Water Source	
			Lime Softening	Membrane Technology	Aeration			Surficial Aquifer	Floridan Aquifer
Martin County									
Hobe Sound	7.10	2.20			X	43-00076-W	2.93	xxx	
Hydratech	2.17	1.19			X	43-00066-W	2.06	x	
Indiantown	1.20	0.61			X	43-00041-W	0.97		
Martin Co. - Martin Downs	1.00	0.87	x			43-00169-W	1.68	x	
Martin Co. - North	3.05	2.68	x	X		43-00102-W	4.22	x	X
Martin Co. - Port Salerno	3.00	1.62			X	43-00089-W	2.86	x	
Martin Co. - Tropical Farms	1.50	A		X		43-00752-W	0.92		
Stuart	6.00	2.90	X			43-00053-W	3.86	x	
St. Lucie County									
Ft. Pierce	20.00	8.70	X			56-00085-W	2.45	x	X
Holiday Pines	0.24	0.21		X		56-00406-W	0.42	x	
Reserve	0.20	0.10	x			56-00552-W	0.20	x	
Port St. Lucie Utilities	6.00	3.59	x			56-00142-W	5.90	x	
St. Lucie West	1.00	0.33		X		56-00614-W	2.68	x	

A = Not in operation in 1993.

MARTIN COUNTY

POTABLE WATER TREATMENT FACILITIES

Hobe Sound Water Company
SFWMD Permit Number: 43-00076-W
FDEP PWS ID: 4430624

Raw Water Supply:
Raw water is withdrawn from 10 existing wells located in the vicinity of U.S. Highway 1, north and west of Old Dixie Highway (A1A) and south of Bridge Road. The wells withdraw water from the Surficial Aquifer, are 16 and 20 inches in diameter, have total depths between 100 and 125 feet, and cased depths between 50 and 81 feet. The wells were drilled between 1963 and 1990. The well capacities are between 350 and 500 GPM. Specific well information is provided in Table E-2 and the location of the wells can be found in Figure E-2.

The current SFWMD permit was issued July 14, 1988 and expired July 14, 1993. The approved allocations are:

Annual Allocation:	1,070.00 MGY (2.93 MGD)
Maximum Daily Allocation:	6.42 MGD

Treatment:
Treatment is provided by a 7.10 MGD (FDEP-rated capacity) aeration and chlorination facility. The facility is located at 12450 S.E. Ridge Avenue, in Hobe Sound (Figure E-2). The 1993 average daily flow was 2.2 MGD with a maximum day of 4.2 MGD. The unaccounted-for water is estimated to be approximately 13.3 percent.

Interconnections:
There are no distribution interconnections with other utilities. A tie-in with Hydratech Utilities is being considered.

Proposed:
Saltwater intrusion has occurred in the vicinity of the wellfield site. Two wells are being constructed west of U.S. 1.

Future:
The projected water use incorporated into the facility's permit forecasts the water use for the service area to increase to 2.92 MGD average day with a maximum day flow of 5.53 MGD by 2003.

Information Source:
Information was obtained from the Hobe Sound Water Company and SFWMD water use permit files.

TABLE E-2. Hobe Sound Water Company Potable Water Supply Wells.

Well Number	3	6	8	9	10	11	12
Planar Coordinates	783302 988719	784468 988097	783293 988484	783030 988400	783279 989272	783556 989313	782864 987958
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	No	No	Yes	Yes	Yes	No	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	100	100	105	105	105	100	120
Cased Depth (ft)	60	60	50	60	60	60	65
Well Diameter (in)	16	16	20	20	16	16	16
Pump Capacity (GPM)	450	500	450	500	500	350	450
Intake Depth (ft)	---	---	---	---	---	---	---
Year Drilled	1985	1984	1963	1963	1968	1985	1978

TABLE E-2. Hobe Sound Water Company Potable Water Supply Wells (continued).

Well Number	13	14	15	16	19	23a
Planar Coordinates	782960 987613	782490 988484	782090 989037	781785 989535	781636 990253	781180 989901
Status	Existing	Existing	Existing	Proposed	Proposed	Proposed
Active (yes/no)	Yes	Yes	Yes	No	No	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	125	104	124	100	75	100
Cased Depth (ft)	65	52	81	60	45	60
Well Diameter (in)	16	16	16	16	12	12
Pump Capacity (GPM)	500	450	500	400	400	---
Intake Depth (ft)	---	---	---	---	---	---
Year Drilled	1978	1990	1990	---	---	---

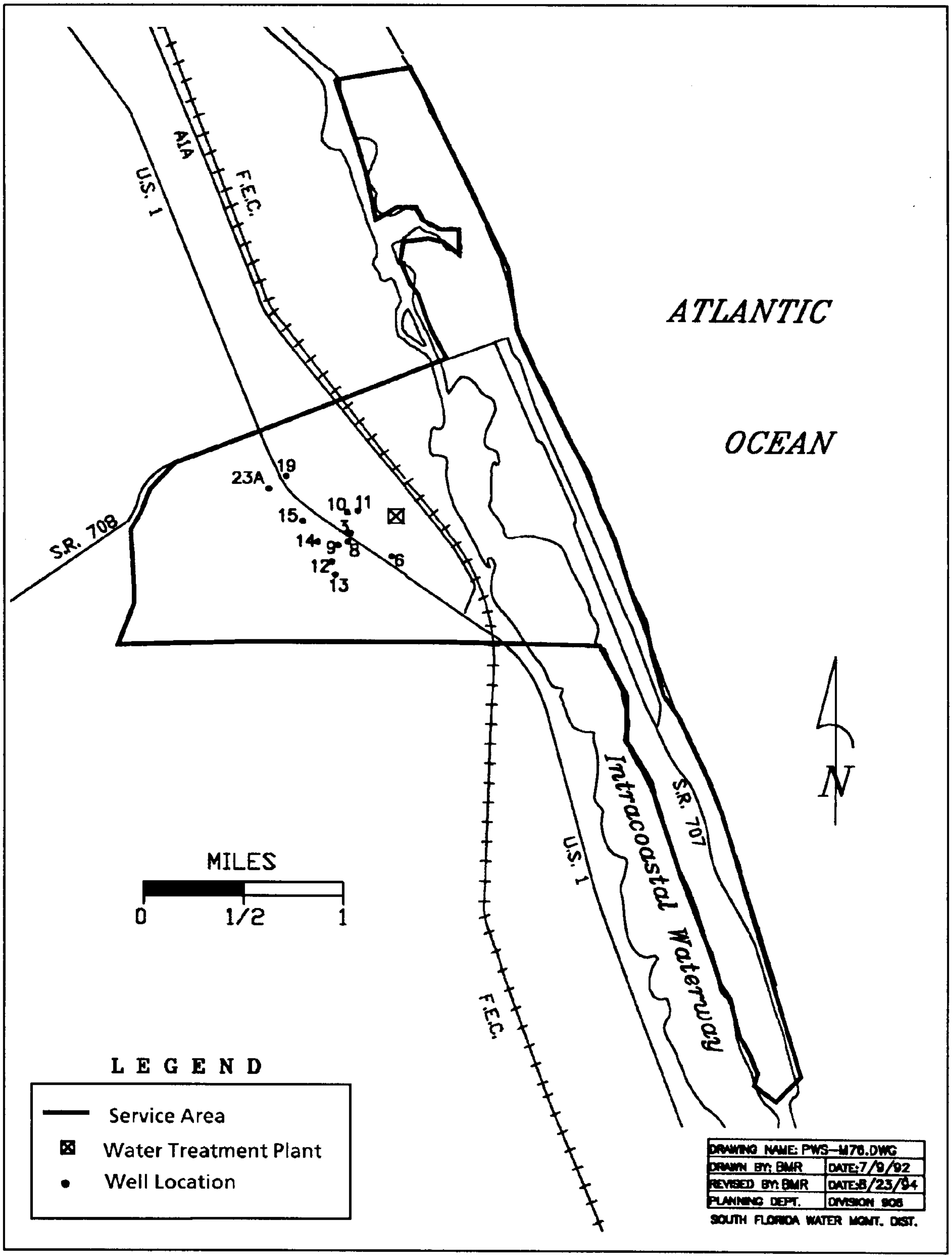

FIGURE E-2. Hobe Sound Water Company Potable Water Supply Wells.

Hydratech Utilities
SFWMD Permit Number: 43-00066-W
FDEP PWS ID: **4431215**

Raw Water Supply:
Raw water is withdrawn from from eight Surficial Aquifer wells located north of Hobe Sound. The wells, which are between 4 and 10 inches in diameter, have total depths between 65 and 160 feet, and cased depths between 55 and 150 feet. The pumping capacities of these wells are between 100 and 400 GPM. Specific well information is provided in Table E-3 and the location of the wells can be found in Figure E-3.

The current SFWMD permit was issued January 17, 1991 and expires January 17, 2001. The approved allocations are:

Annual Allocation:	**752** MGY (2.06 MGD)
Maximum Daily Allocation:	3.61 MGD

The 1993 average daily pumpage from the Surficial Aquifer wells was 1.25 MGD with a maximum day of 1.84 MGD.

Treatment:
Treatment is provided by a 2.17 MGD (FDEP-rated capacity) chlorination facility. The facility is located on Southeast Osprey Street in Hobe Sound (Figure E-3). The 1993 average daily flow was 1.19 MGD with a maximum day of 1.59 MGD. The unaccounted-for water is estimated to be approximately 4.4 percent.

Interconnections:
There are no distribution interconnections with other utilities. A tie-in with Hobe Sound Water Company is being considered.

Proposed:
It is proposed to have wells 14 and 15 online in 1995. The current consumptive use permit allows construction of an additional five Surficial Aquifer wells as indicated in Table E-3 and Figure E-3.

Future:
Martin County is considering the purchase of Hydratech Utilities. The county's five-year plan would include increasing the capacity of Hydratech to 2.4 MGD and include conversion to lime softening.

Information Source:
Information was obtained from Hydratech Utilities, Martin County and SFWMD water use permit files.

TABLE E-3. Hydratech Utilities Potable Water Supply Wells.

Well Number	1A	2a	Sandcastle	2	3	4a	6
Planar Coordinates	775851 1005162	776159 1005041	780238 996165	775631 1006278	775356 1006373	775261 1006094	775507 1006557
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	Yes	Yes	No	No	No	Yes	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	130	130	65	75	75	150	75
Cased Depth (ft)	120	120	55	65	65	135	65
Well Diameter (in)	8	8	8	4	4	8	4
Pump Capacity (GPM)	300	300	100	100	100	275	100
Intake Depth (ft)	45	45	45	45	45	45	45
Year Drilled	---	---	---	---	---	---	---

TABLE E-3. Hydratech Utilities Potable Water Supply Wells (continued).

Well Number	10b	12	13	14	15	16
Planar Coordinates	772376 1007302	768627 1011113	768069 1011891	771729 1014556	771975 1013998	775073 1008356
Status	Existing	Proposed	Proposed	Proposed	Proposed	Proposed
Active (yes/no)	No[1]	No	No	No	No	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	160	160	160	160	160	160
Cased Depth (ft)	150	150	150	150	150	150
Well Diameter (in)	10	10	10	10	10	10
Pump Capacity (GPM)	300	150	150	400	400	400
Intake Depth (ft)	45	45	45	45	45	45
Year Drilled	1991	---	---	---	---	---

[1] Drilled awaiting approval from FDEP.

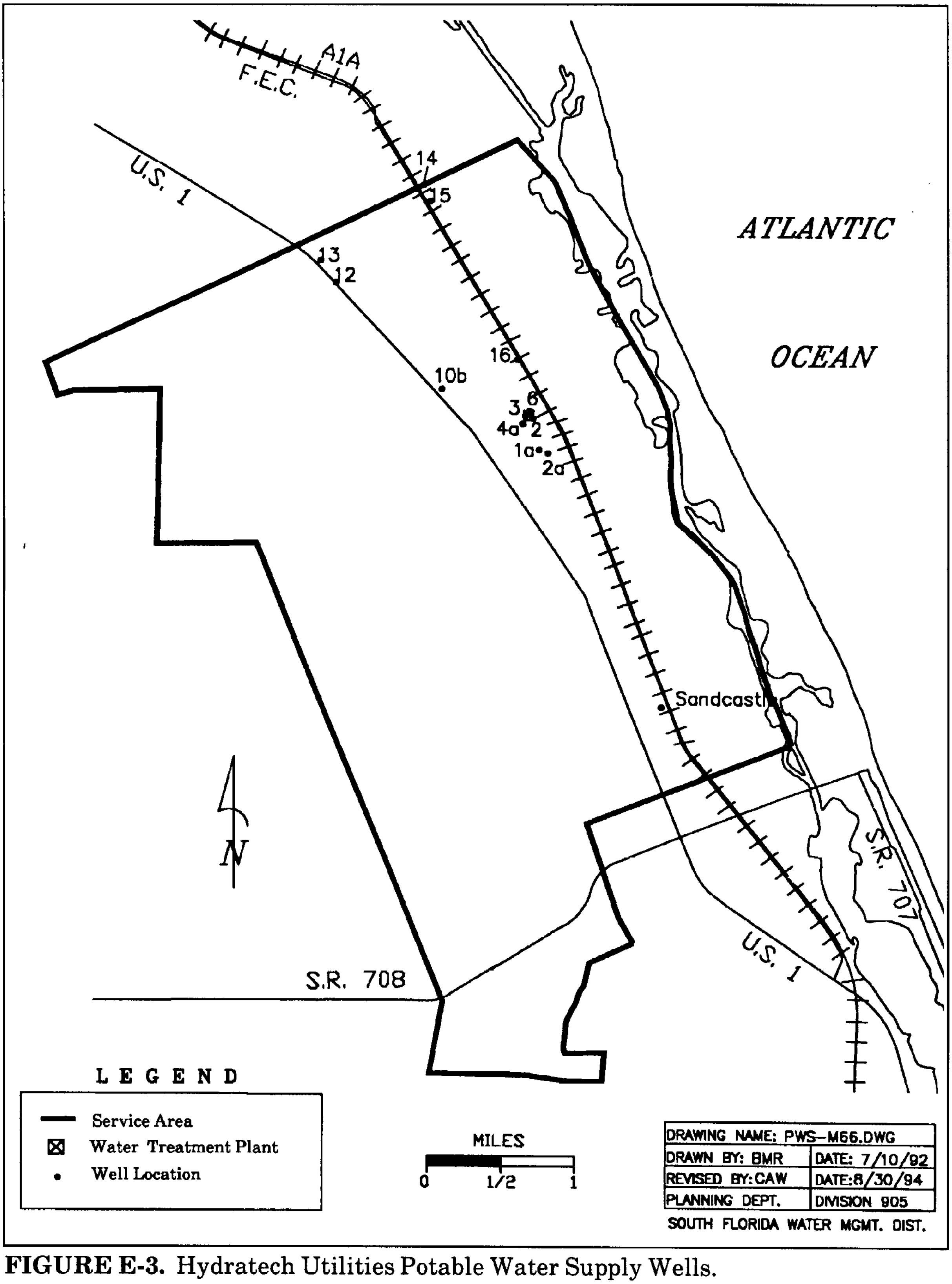

FIGURE E-3. Hydratech Utilities Potable Water Supply Wells.

Indiantown Company
SFWMD Permit Number: 43-00041-W
FDEP PWS ID: 4430667

Raw Water Supply:
Raw water is withdrawn from eight Surficial Aquifer wells located within Indiantown. The wells are between 8 and 10 inches in diameter, have total depths between 115 and 130 feet, and cased depths between 60 and 115 feet. These wells were drilled between 1958 and 1991, and have pumping capacities between 90 and 450 GPM. Specific well information is provided in Table E-4 and the location of the wells can be found in Figure E-4.

The current SFWMD permit was issued January 7, 1988 and expires January 7, 1997. The approved allocations are:

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

The 1993 average daily pumpage from the Surficial Aquifer wells was 0.63 MGD with a maximum day of 0.86 MGD.

Treatment:
Treatment is provided by a 1.2 MGD (FDEP-rated capacity) aeration and chlorination facility. The facility is located at 15851 S.W. Farms Road in Indiantown (Figure E-4). The 1993 average daily flow was 0.61 MGD with a maximum day of 0.74 MGD. The unaccounted-for water is estimated to be approximately 3.5 percent.

Interconnections:
There are no distribution interconnections with other utilities.

Proposed:
Plans not available.

Future:
The projected water use for the service area is to increase to 1.4 MGD average day by the year 2000, based on 300 gallons per day per capita and a population of 6868. The utility is considering expanding the plant to 1.5 MGD and adding either a lime softening or membrane filtration system.

Information Source:
Information was obtained from Indiantown Company, Martin County and SFWMD water use permit files.

TABLE E-4. Indiantown Company Potable Water Supply Wells.

Well Number	1	2	3	4	5	6	7	8
Planar Coordinates	673248 976582	672891 976801	672700 976588	672339 976772	671927 977067	671566 977306	671278 977532	673460 975603
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	120	130	120	115	115	115	120	120
Cased Depth (ft)	60	100	85	115	115	115	85	85
Well Diameter (in)	8	8	8	10	8	8	8	8
Pump Capacity (GPM)	450	110	90	110	125	290	425	450
Intake Depth (ft)	66	80	65	60	60	80	80	80
Year Drilled	1989	1983	1987	1958	1973	1973	1991	1991

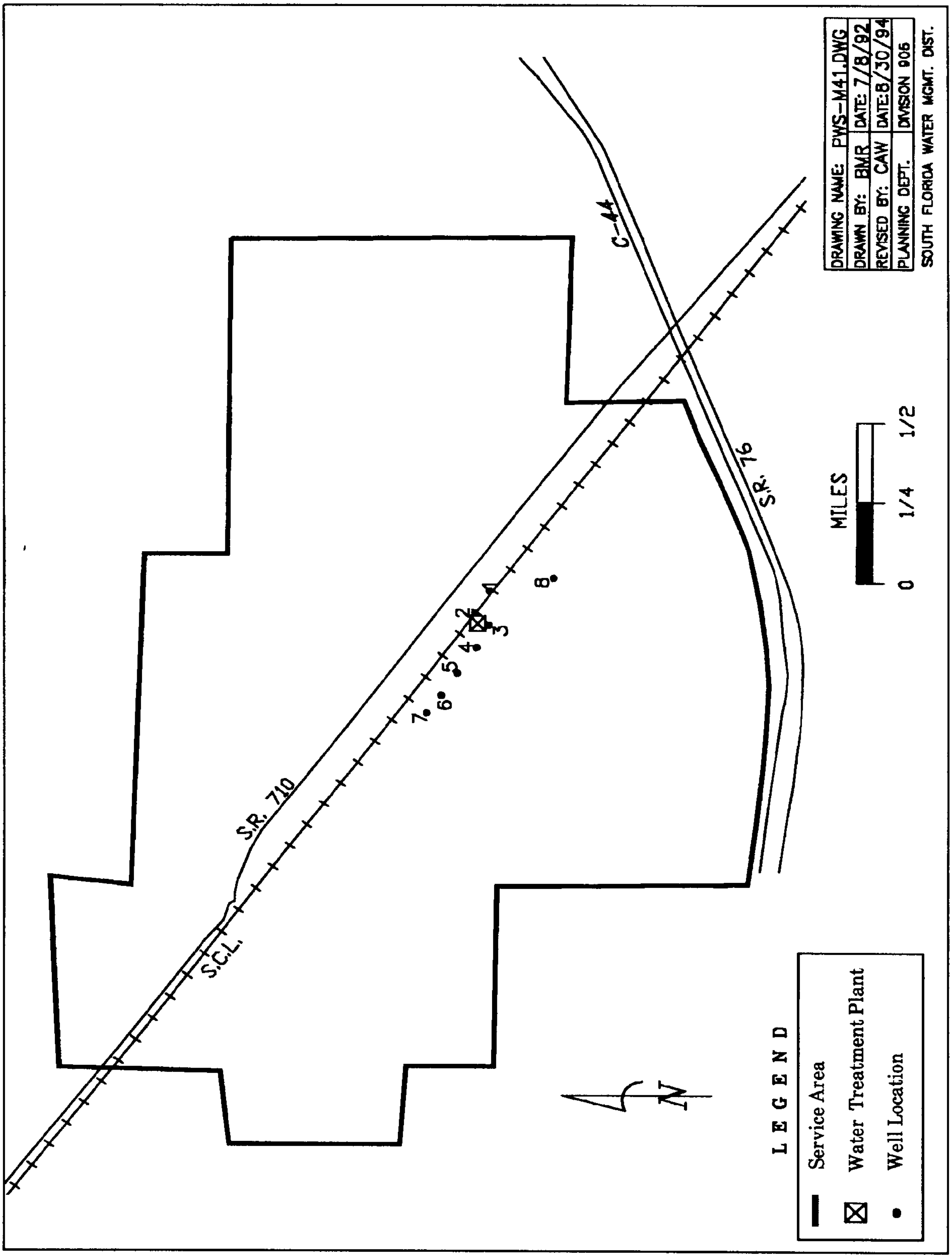

FIGURE E-4. Indiantown Company Potable Water Supply Wells.

Martin County - Martin Downs
SFWMD Permit Number: 4300169-W
FDEP PWS ID: 4434383

Raw Water Supply:
Raw water is withdrawn from three existing Surficial Aquifer wells located in the Martin Downs area. The wells are 12 inches in diameter, have total depths of 125 and 129 feet, and cased depths of 80 and 84 feet. The wells were drilled in 1982, and have pumping capacities of 700 and 1,000 GPM. Specific well information is provided in Table E-5 and the location of the wells can be found in Figure E-5,

The current SFWMD permit was issued October 27, 1993 and expires February 13, 1996. The approved allocations are:

Annual Allocation:	613 MGY (1.68 MGD)
Maximum Daily Allocation:	**2.52** MGD

The 1993 average daily pumpage was 1.05 MGD with a maximum day of 1.4 MGD.

Treatment:
Treatment is provided by a 2.0 MGD (FDEP-rated capacity) lime softening facility located approximately one mile north of State Road 714, east of Florida's Turnpike (Figure E-5). The 1993 average daily flow was 0.87 MGD with a maximum daily flow of 0.99 MGD. The unaccounted-for water is estimated to be approximately 18.4 percent.

Interconnections:
There are no distribution system interconnections with other utilities.

Proposed:
The current consumptive use permit allows construction of three additional Surficial Aquifer wells as indicated in Table E-5 and Figure E-5.

Future:
Plans not available. The existing allocation is forecast to serve a population of 16,800 in 1996, based on a 100 gallons per day per capita.

Information Source:
Information was provided by Martin County and SFWMD water use permit files.

TABLE E-5. Martin County - Martin Downs Potable Water Supply Wells.

Well Number	1	2	3	4	5	6
Planar Coordinates	723300 1033430	725600 1035280	723200 1034230	724000 1032180	726650 1033530	720000 1038830
Status	Existing	Existing	Existing	Proposed	Proposed	Existing
Active (yes/no)	Yes	Yes	Yes	No	No	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	125	126	125	155	155	65
Cased Depth (ft)	80	81	80	70	20	40
Well Diameter (in)	12	12	12	12	12	8
Pump Capacity (gpm)	700	700	1,000	700	700	150
Intake Depth (ft)	57	57	60	60	60	18
Year Drilled	1982	1982	1992	---	---	---

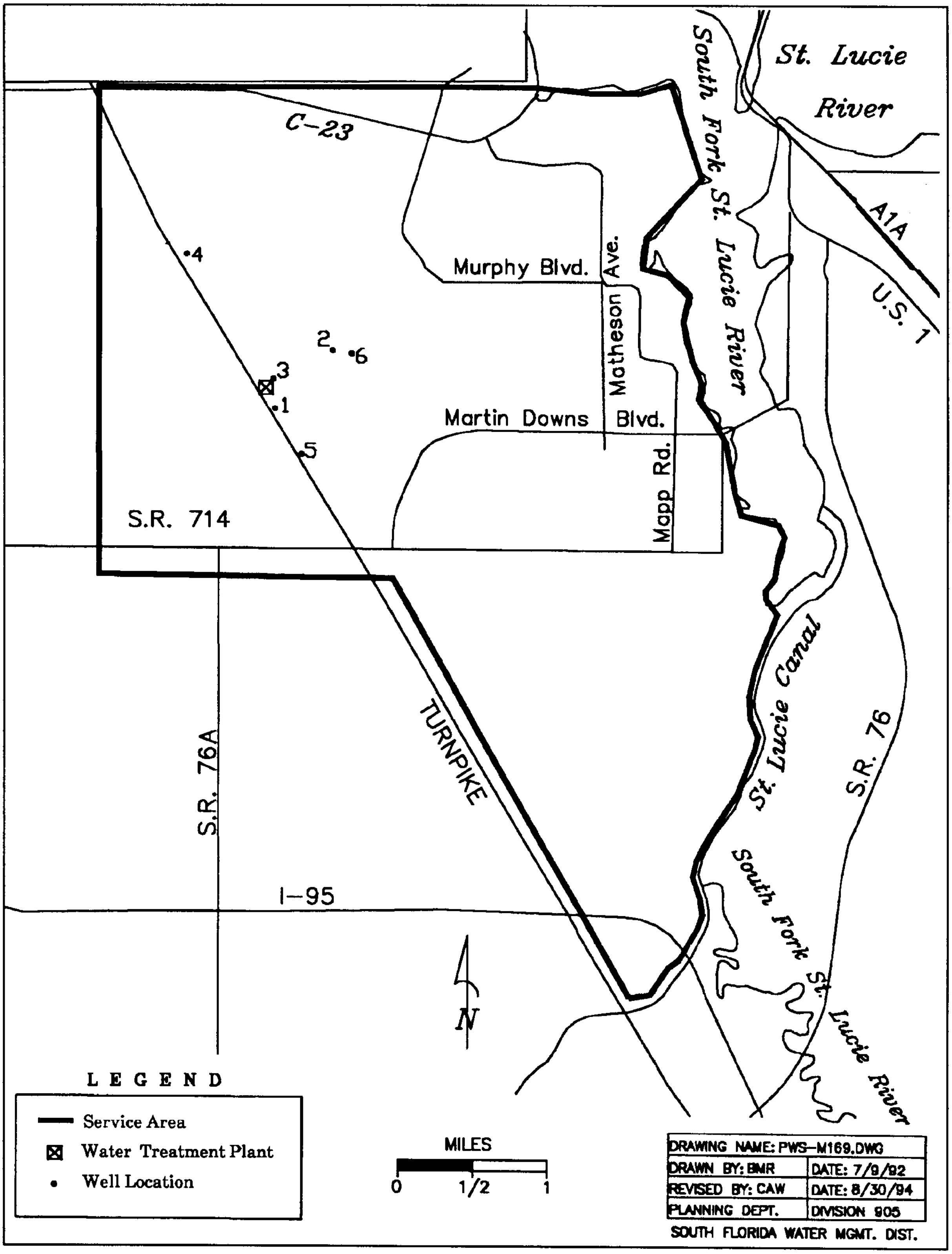

FIGURE E-5. Martin County - Martin Downs Potable Water Supply Wells.

Martin County - North
SFWMD Permit Number: 43-00102-W
FDEP PWS ID: 4431891

Raw Water Supply:
Raw water is withdrawn from Surficial and Floridan aquifer wells located within northern Martin County. There are 10 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 pumping capacity of the wells are all 300 GPM.

There are two existing Floridan Aquifer wells which are 12 inches in diameter with total depths of 1,260 and 1,289 feet and cased depths of 1,062 and 967 feet. The wells were drilled in 1991. The capacity of the Floridan wells are both 1,578 GPM. Specific well information is provided in Table E-6 and the location of the wells can be found in Figure E-6.

The current SFWMD permit was issued December 14, 1989 and expires December 14, 1994. The approved allocations are:

Surficial Aquifer	
Annual Allocation:	920.00 MGY (2.52 MGD)
Maximum Daily Allocation:	4.09 MGD (all wellfields)
Floridan Aquifer	
Annual Allocation:	620.50 MGY (1.7 MGD)
Maximum Daily Allocation:	4.09 MGD (all wellfields)

The 1993 average daily pumpage from the Surficial and Floridan aquifer wells was 2.68 MGD with a maximum day of 3.15 MGD.

The service area and withdrawal facilities are located in the Savanna's and Jensen Beach Peninsula Reduced Threshold Area (RTA).

Treatment:
The treatment methods employed at this facility are lime softening and reverse osmosis. The treatment plant is located at 600 N.W. Jensen Beach Boulevard in Jensen Beach (Figure E-6). The lime softening plant has a FDEP-rated capacity of 3.05 MGD. The 1993 average daily flow was 2.68 MGD with a maximum daily flow of 2.99 MGD. The unaccounted-for water is estimated to be about 13.3 percent. The reverse osmosis plant has a capacity of 1.33 MGD and was placed in operation in 1994. Reject water is injected into the Martin County - North deep well.

Interconnections:
Interconnections exist with St. Lucie County Utilities and Martin County - Port Salerno. Two additional interconnections are proposed with FPUA and the City of Stuart.

Proposed:
The county has applied to the FDEP to expand the reverse osmosis (RO) water treatment plant to 3.56 MGD by adding one additional treatment train. In addition, the county has applied to the District for six Surficial wells. The expansion will supplement the Port Salerno service area. The current consumptive use permit allows construction of an additional three Floridan Aquifer wells as indicated in Table E-6 and Figure E-6.

Future:
The projected water use incorporated into the previously referenced permit forecasts the water use for the service area to increase to 4.70 MGD average day by 1999 based on 155 gallons per day per capita and a population of 21,161.

Information Source:
Information was obtained from Martin County and SFWMD water use permit files.

TABLE E-6. Martin County - North Potable Water Supply Wells.

Well Number	1	2	3	4	5	6	7	8	9	10	11
Planar Coordinates	739059 1059279	741560 1059144	744651 1059185	737917 1055431	738182 1056359	737390 1058637	742884 1058402	742901 1056344	746821 1059004	739589 1057878	734279 1062919
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Proposed
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	115	115	115	125	115	125	152	125	135	145	115
Cased Depth (ft)	70	70	70	80	70	80	71	70	80	100	70
Well Diameter (in)	8	8	8	8	8	8	8	8	8	8	8
Pump Capacity (GPM)	300	300	300	300	300	300	300	300	300	300	200
Intake Depth (ft)	60	60	60	60	60	60	60	60	60	60	---
Year Drilled	1982	1982	1983	1982	1983	1982	1982	1982	1988	1988	---

TABLE E-6. Martin County - North Potable Water Supply Wells (continued).

Well Number	12	13	14	15	16	F1	F2	F3	F4	F5
Planar Coordinates	735876 1060229	738157 1050473	749652 1056947	750291 1055671	748831 1063375	738090 1059217	739424 1059046	740335 1059056	740092 1057580	740083 1056699
Status	Proposed	Proposed	Proposed	Proposed	Proposed	Existing	Existing	Proposed	Proposed	Proposed
Active (yes/no)	No	No	No	No	No	Yes	Yes	No	No	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Floridan	Floridan	Floridan	Floridan	Floridan
Total Depth (ft)	115	115	115	115	115	1260	1289	1000	1000	1000
Cased Depth (ft)	70	70	70	70	70	1062	967	700	700	700
Well Diameter (in)	8	8	8	8	8	12	12	12	12	12
Pump Capacity (GPM)	200	200	200	200	200	1578	1578	885	885	885
Intake Depth (ft)	---	---	---	---	---	---	---	---	---	---
Year Drilled	---	---	---	---	---	1991	1991	---	---	---

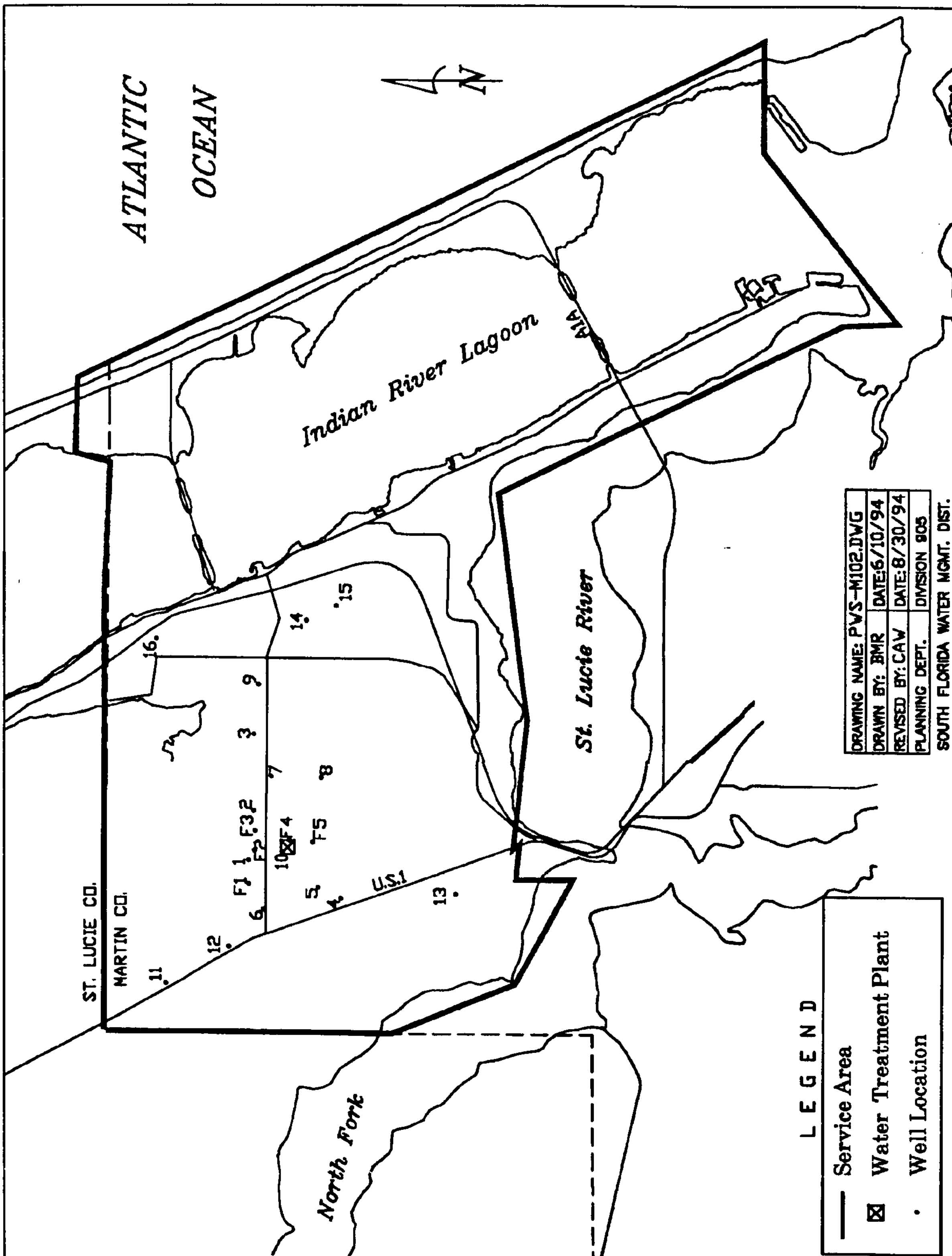

FIGURE E-6. Martin County - North Potable Water Supply Wells.

Martin County - Port Salerno
SFWMD Permit Number: 43-00089-W
FDEP PWS ID: 4431490

Raw Water Supply:
Raw water is withdrawn from seven Surficial Aquifer wells located within east and central Martin County. The wells are 6 and 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 300 and 500 GPM. Specific well information is provided in Table E-7 and the location of the wells can be found in Figure E-7.

The current SFWMD permit was issued October 14, 1993 and expires December 31, 1997. The approved allocations are:

Annual Allocation:	1046.0 MGY (2.86 MGD)
Maximum Daily Allocation:	4.41 MGD

The 1993 average daily pumpage was 1.78 MGD with a maximum day of 2.77 MGD.

Treatment:
Treatment is provided by two treatment facilities known as the Vista Salerno Plant and the Stuart Yacht and Country Club Plant. The treatment methods employed at these facilities are aeration and chlorination. The Vista Salerno Plant is located at 6510 S.E. Parkwood Drive just west of U.S. Highway 1. The Stuart Yacht and Country Club (SYCC) plant is located at 2901 S.E. Fairway West at the entrance into the subdivision on Dixie Highway (A1A). The location of these facilities is shown in Figure E-7. Both plants have FDEP-rated capacities of 1.5 MGD. The combined 1993 average daily flow was 1.62 MGD with a maximum daily flow of 2.00 MGD. The unaccounted-for water is estimated to be approximately 10.2 percent. An activated carbon filter has been installed at the SYCC due to ground water contamination.

Interconnections:
The Vista Salerno system and the Yacht and Country Club system are interconnected by an 8-inch main. There is a proposed interconnection with Martin County - North and Tropical Farms.

Proposed:
The county has applied for a permit modification. The modification will allow water from Martin County North to supply the Port Salerno water system with 1.78 MGD of treated water. The water will come from the North County Reverse Osmosis Water Treatment Plant (ROWTP), Permit No. 43-00102W, which is being modified concurrently with this request. The current consumptive use permit allows construction of an additional seven Surficial wells as indicated in Table E-7 and Figure E-7.

Future:
Plans not available.

Information Source:
Information was obtained from Martin County and SFWMD water use permit files.

TABLE E-7. Martin County - Port Salerno Potable Water Supply Wells.

Well Number	1	2	3	4	5	6	7	8
Planar Coordinates	756904 1026664	761066 1015872	761613 1015281	759969 1015245	758369 1015260	760359 1015213	757282 1026133	761911 1017354
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Proposed
Active (yes/no)	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	130	100	130	130	130	130	130	130
Cased Depth (ft)	50	60	63	63	40	63	40	60
Well Diameter (in)	8	8	6	8	8	8	8	8
Pump Capacity (GPM)	500	300	300	300	300	300	500	300
Intake Depth (ft)	35	40	40	40	20	40	35	40
Year Drilled	1985	1984	1983	1983	1983	1983	1985	--

TABLE E-7. Martin County - Port Salerno Potable Water Supply Wells (continued).

Well Number	10	10B	11	14	15	16
Planar Coordinates	769868 1016759	769301 1018156	770568 1015527	754813 1018164	753868 1019649	752786 1021448
Status	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed
Active (yes/no)	No	No	No	No	No	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	120	120	120	130	130	130
Cased Depth (ft)	70	70	70	60	60	60
Well Diameter (in)	12	12	12	12	12	12
Pump Capacity (GPM)	500	500	500	300	300	300
Intake Depth (ft)	45	45	45	45	45	45
Year Drilled	--	--	--	--	--	--

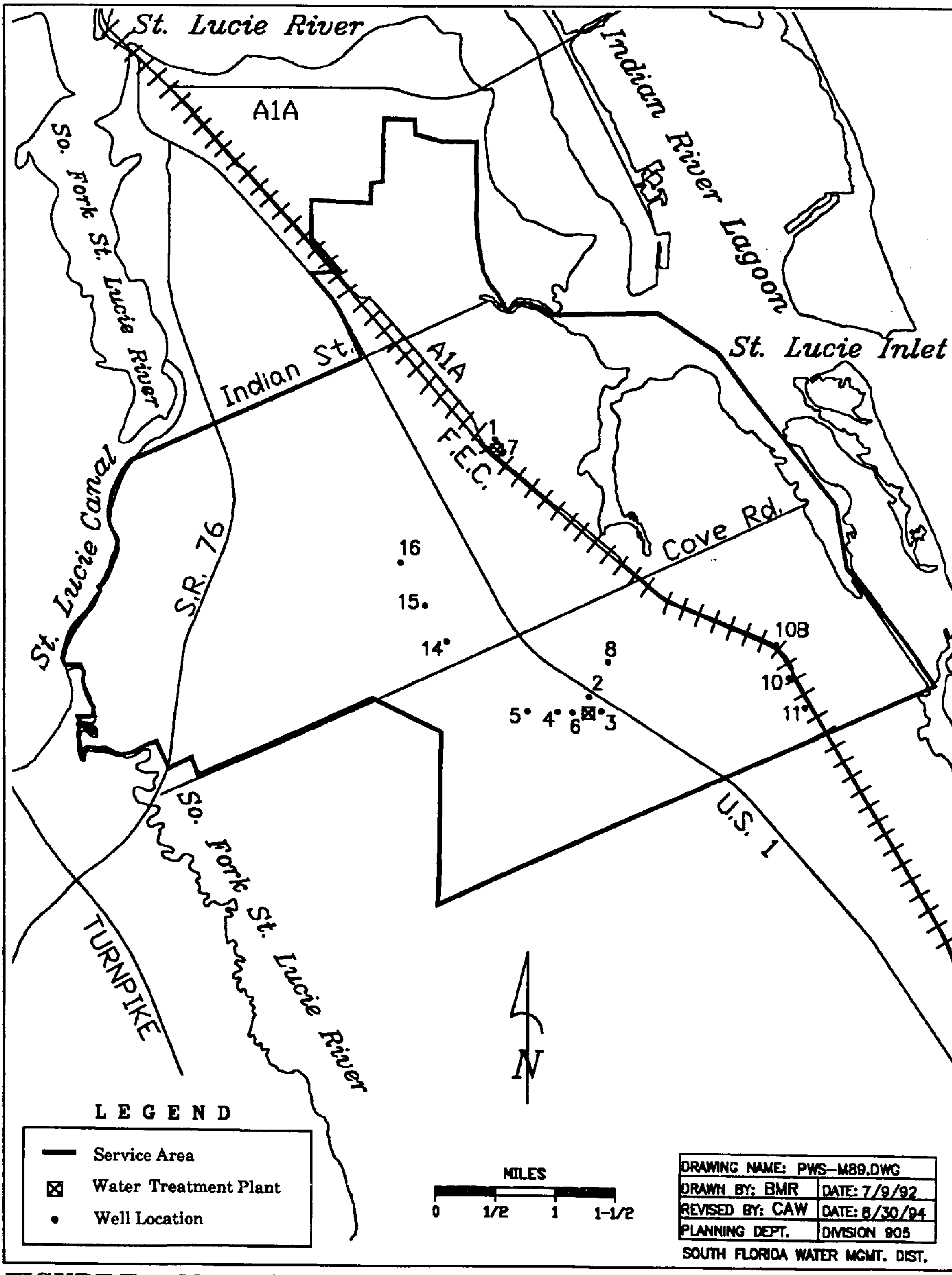

FIGURE E-7. Martin County - Port Salerno Potable Water Supply Wells.

Martin Countv -Tropical Farms
SFWMD Permit Number: 43-00752-W
FDEP PWS ID:

Raw Water Supply:
Raw water will be withdrawn from seven Surficial Aquifer wells located in central Martin County. The proposed wells will be 8 inches in diameter, have total depths of 100 feet and cased depths of 60 feet. The well capacities are proposed at 200 GPM. Specific well information is provided in Table E-8 and the proposed location of the wells can be found in Figure E-8.

The current SFWMD permit was issued April 15, 1993 and expires April 15, 2003. the approved allocations are:

Annual Allocation:	336.00 MGY (0.92 MGD)
Maximum Daily Allocation	1.57 MGD

Treatment:
Treatment will be provided by a proposed 1.5 MGD membrane softening treatment facility with an efficiency of approximately 80 percent. The facility will be located on Kansas Avenue. Concentrate from the treatment process will be blended with the wastewater effluent (prior to the chlorine contact chamber).

Interconnections:
Tropical farms water system will be interconnected with Martin County - Port Salerno. Ultimately, this facility will contribute approximately 1.2 MGD to the Martin County - Port Salerno System.

Proposed:
No plans available.

Future:
No plans available.

Source:
Information was obtained from Martin County and SFWMD water use permit files.

TABLE E-8. Martin County - Tropical Farms Potable Water Supply Wells.

Well Number	1	2	3	4	5	6	7
Planar Coordinates	739654 1005133	732171 1002050	731421 1002044	730624 1002038	729868 1002033	729118 1002004	738154 1001642
Status	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed
Active (yes/no)	No	No	No	No	No	No	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	100	100	100	100	100	100	100
Cased Depth (ft)	60	60	60	60	60	60	60
Well Diameter (in)	8	8	8	8	8	8	8
Pump Capacity (GPM)	200	200	200	200	200	200	200
Intake Depth (ft)	--	--	--	--	--	--	--
Year Drilled	--	--	--	--	--	--	--

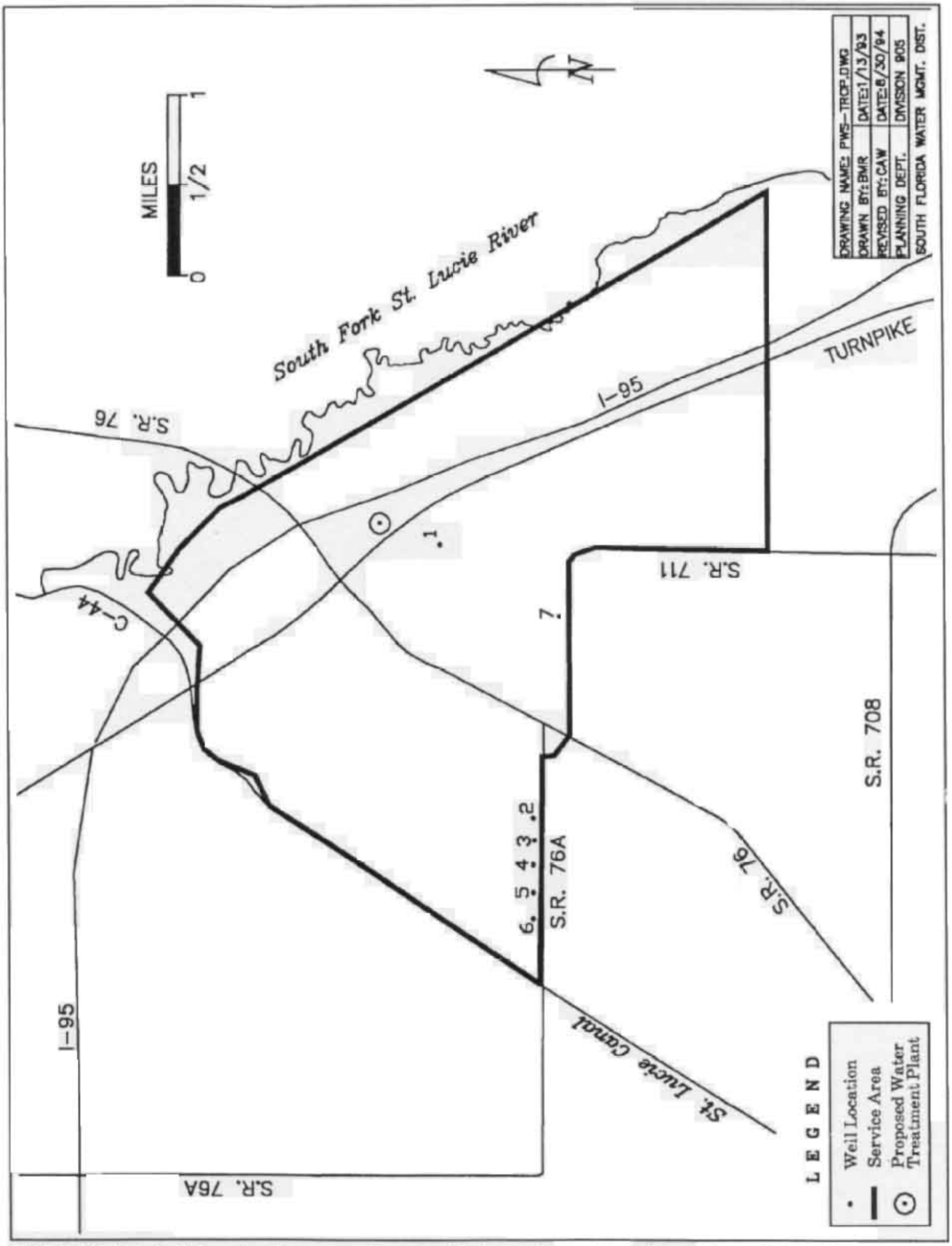

FIGURE E-8. Martin County - Tropical Farms Potable Water Supply Wells.

Stuart, City of
SFWMD Permit Number: 43-00053-W
FDEP PWS ID: 4430259

Raw Water Supply:
Raw water is withdrawn from 30 Surficial Aquifer wells located in the central and southern portion of the City of Stuart. The wells are 6 and 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. Specific well information is provided in Table E-9 and the location of the wells can be found in Figure E-9.

The current SFWMD permit was issued May 17, 1979 and expired May 17, 1989. The approved allocations are:

Annual Allocation:	1,410.00 MGY (3.86 MGD)
Maximum Daily Allocation:	5.60 MGD

The system is located in the Stuart Peninsula Reduced Threshold Area.

The 1993 average daily pumpage was 2.9 MGD with a maximum day of 3.98 MGD.

Treatment:
Treatment is provided by a 6.0 MGD (FDEP-rated capacity) lime softening facility. The facility is located at Palm Beach Road and 10th Street in the City of Stuart (Figure E-9). The 1993 average daily flow was 2.9 MGD with a maximum day of 3.7 MGD. The 1993 unaccounted-for water was estimated to be approximately 13.5 percent.

Interconnections:
One interconnect (12-inch diameter) with Martin County - North exists at the intersection of St. Lucie Boulevard and East Ocean Boulevard in Stuart. Two additional interconnects with Martin County Utilities is recommended in the master plan.

Proposed:
The city has applied to the District for a permit modification. The request is for a 10-year permit and an allocation of:

Annual Allocation:	1,299.40 MGY (3.56 MGD)
Maximum Daily Allocation:	5.34 MGD

There are no additional withdrawal facilities proposed. The application is under review.

Future:
The 1988 City of Stuart water and wastewater master plan indicates that the build-out average daily finished water demand for the service area is anticipated to increase to 3.96 MGD with a maximum day flow of 5.90 MGD. This is based on a

build-out population of 26,770, anticipated to occur prior to 2010, and an average per capita usage of 145 gallons per day per capita (derived from 100 gallons per day per capita residential and 1,100 gallons per day per acre of nonresidential usage).

Projected raw water withdrawals are 10 percent higher than the projected demand because of in-plant water use. The existing treatment capacity can adequately meet the anticipated future demand.

If future studies conclude that the shallow aquifer may not have capacity to meet the forecasted demand, the Floridan Aquifer is identified as a potential source of water with treatment by reverse osmosis. The Floridan Aquifer may also be used for a source of blending water in the future.

Information Source:
Information was provided by the City of Stuart.

TABLE E-9. City of Stuart Potable Water Supply Wells.

Well Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Planar Coordinates	746577 1038761	746643 1038228	747093 1038788	747100 1038185	747677 1038778	747617 1036615	748163 1038315	748280 1038931	749586 1038395	748283 1037615	748990 1037618	749733 1037625	748296 1036721	748406 1036085	748716 1035521
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	Yes	No[1]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	123	123	123	120	120	120	120	120	120	135	135	135	126	120	126
Cased Depth (ft)	105	105	105	105	105	105	105	105	105	120	120	120	112	104	112
Well Diameter (in)	8	8	8	6	6	6	6	6	8	8	8	8	8	8	8
Pump Capacity (GPM)	180	180	180	140	140	140	160	160	180	180	180	180	180	180	180
Intake Depth (ft)	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
Year Drilled	1950	1950	1950	1960	1960	1960	1960	1960	1960	1964	1964	1964	1967	1967	1967

TABLE E-9. City of Stuart Potable Water Supply Wells (continued).

Well Number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Planar Coordinates	749113 1035098	749536 1034642	749830 1034332	750359 1033795	749776 1035238	750819 1034198	750936 1032728	748503 1034918	747677 1035211	747950 1034508	749640 1039408	748386 1038789	748386 1038789	748386 1038789	748386 1038789
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	No[1]	No[1]	No[1]	No[1]	No[1]	No[1]	Yes	Yes	Yes	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	126	126	122	122	122	122	122	130	130	130	135	135	135	135	135
Cased Depth (ft)	112	112	105	105	105	105	105	105	105	105	105	105	105	105	105
Well Diameter (in)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Pump Capacity (GPM)	180	180	180	180	180	180	180	240	240	240	450	440	520	480	440
Intake Depth (ft)	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
Year Drilled	1967	1967	1967	1968	1968	1968	1968	1977	1977	1977	1979	1979	1979	1979	1979

1 Temporarily inactive due to VOC contamination.
2 Operated intermittently due to nearby landfill.

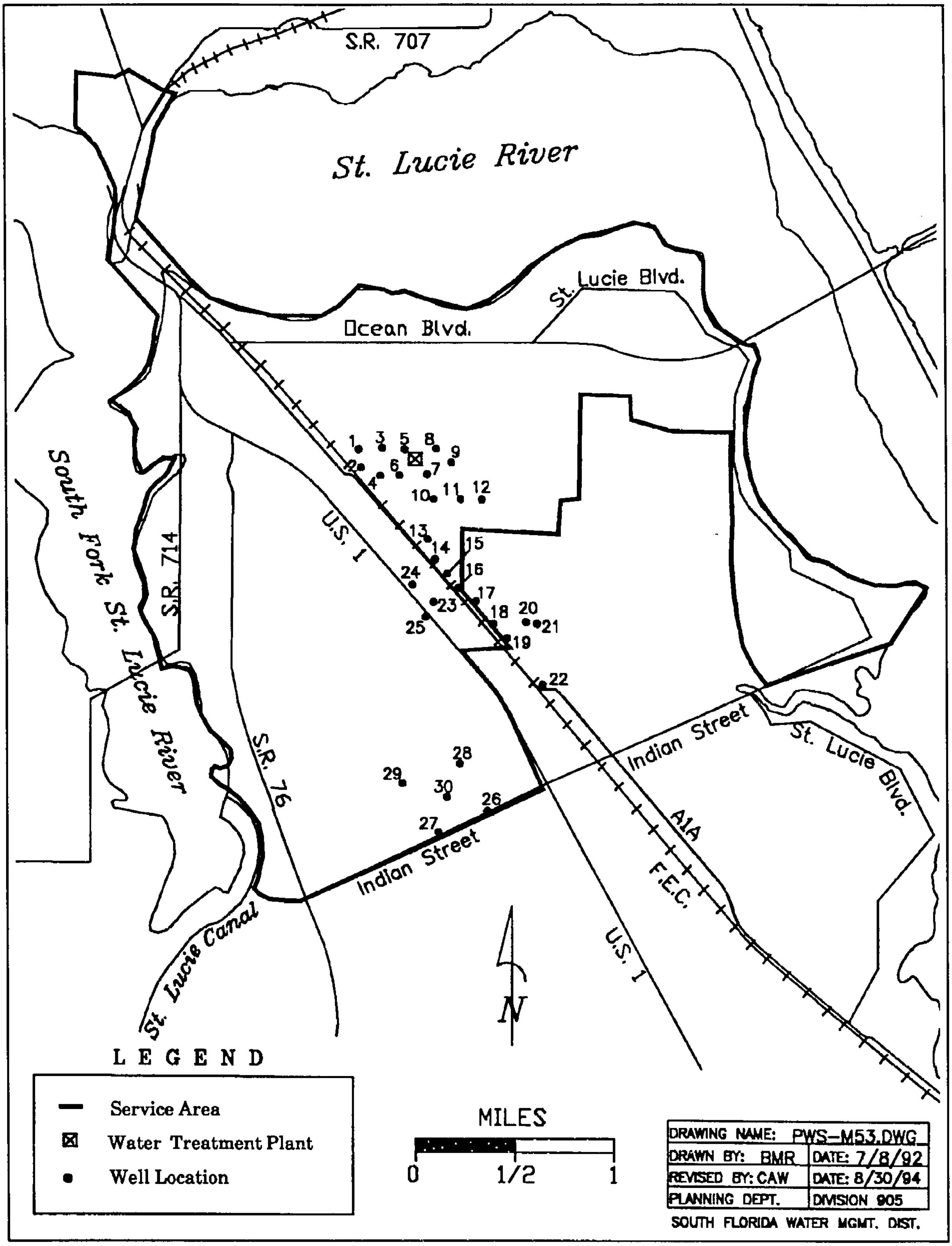

FIGURE E-9. City of Stuart Potable Water Supply Wells.

ST. LUCIE COUNTY

POTABLE WATER TREATMENT FACILITIES

Ft. Pierce Utilities Authoritv
SFWMD Permit Number: 56-00085-W
FDEP PWS ID: 4560490

Raw Water Supply:
Raw water is withdrawn from the Surficial and Floridan aquifers from wells located within the Ft. Pierce area of St. Lucie County. There are 41 existing Surficial Aquifer wells which are between 10 and 16 inches in diameter, have total depths between 92 and 129 feet, and cased depths between 45 and 72 feet. The wells were drilled between 1963 and 1987, and have pumping capacities between 200 and 700 GPM.

There are two existing Floridan aquifer blending wells which are 12 inches in diameter, have total depths of 880 and 904 feet and cased depths of 500 and 508 feet. The wells were drilled in 1988 and 1991 and have capacities of 500 and 600 GPM. Specific well information is provided in Table E-10 and the location of the wells can be found in Figure E-10.

The current SFWMD permit was issued February 11, 1993 and expires November 14, 1995. The approved allocations are:

Surficial Aquifer	
Annual Allocation:	4,544 MGY (12.45 MGD, includes Floridan well)
Maximum Daily Allocation:	17.18 MGD (all wells)
Floridan Aquifer	
Maximum Daily Allocation:	3.80 MGD

The 1993 average daily withdrawal from the Surficial and Floridan aquifer wells was 8.9 MGD with a maximum day of 12.2 MGD.

Treatment:
The treatment method employed at this facility is lime softening. The facility has a FDEP-rated capacity of 20 MGD. The Floridan Aquifer wells are for blending with water treated in the lime softening facility. The treatment plant is located at 715 South 25th Street in Fort Pierce (Figure E-10). The 1993 average daily flow was 8.7 MGD with a maximum daily flow of 12.0 MGD. The unaccounted-for water is estimated to be approximately 11.5 percent. An air stripper on the facility is provided due to ground water contamination of the Surficial Aquifer.

Interconnections:
There is a 12-inch interconnection with St. Lucie County Utilities at 25th and Midway and a proposed 8-inch interconnection with Martin County Utilities on South Hutchinson Island.

Proposed:
Ft. Pierce Utilities Authority (FPUA) has experienced contamination of several of the Surficial wells. FPUA is preparing an application for development of the Floridan Aquifer (an additional 4 wells are proposed) and construction of an RO facility.

Future:
The master plan for FPUA projects the water service demand for the existing service area to increase to 12.0 MGD average day with a maximum day flow of 18.1 MGD by 2010 based on 170 gallons per day per capita, and a population of 70,895. The master plan projects the water service demand for the ultimate service area (expanded service area) to increase to 16.2 MGD average day with a maximum day flow of 24.3 MGD by 2010 based on 170 gallons per day per capita, and a population of 95,239.

Information Source:
Information was obtained from the master plan for FPUA and SFWMD water use permit files.

TABLE E-10. Ft. Pierce Utilities Authority Potable Water Supply Wells.

Well Number	N1	N2	N3	N4	N5	N6	N7	N8A	N9	N10	N11	N12
Planar Coordinates	710326 1130035	710378 1130487	710366 1131064	710305 1131504	710334 1132121	710348 1132609	710327 1130035	710271 1133131	710485 1133478	710248 1133971	710277 1134771	710262 1135148
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	92	114	114	110	113	113	113	110	129	114	100	105
Cased Depth (ft)	45	49	59	56	65	65	72	65	70	63	64	64
Well Diameter (in)	10	10	10	10	10	10	10	10	10	10	10	10
Pump Capacity (gpm)	350	350	350	350	350	350	350	---	350	350	350	350
Intake Depth (ft)	65	49	74	72	63	63	59	---	68	65	54	54
Year Drilled	1963	1963	1963	1963	1963	1963	1963	---	1963	1963	1968	1968

TABLE E-10. Ft. Pierce Utilities Authority Potable Water Supply Wells (continued).

Well Number	N13	N14	N15	N16	N17	N18	N19	N20	N21	S1	S4	S5
Planar Coordinates	710262 1136112	709959 1136465	711316 1139569	711635 1139771	711231 1139756	710795 1139791	710339 1139802	709929 1139787	709427 1139795	708935 1139797	710410 1129267	710841 1125864
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	110	---	---	105	105	105	110	110	110	114	97	105
Cased Depth (ft)	60	---	---	52	52	62	62	65	50	49	60	65
Well Diameter (in)	10	---	---	16	16	16	16	10	10	10	12	16
Pump Capacity (gpm)	350	---	---	700	700	700	650	350	350	350	300	200
Intake Depth (ft)	56	57	53	52	52	65	62	55	55	59	60	65
Year Drilled	1968	1968	1970	1970	1970	1970	1970	1970	1970	1963	1980	1980

TABLE E-10. Ft. Pierce Utilities Authority Potable Water Supply Wells (continued).

Well Number	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17
Planar Coordinates	711366 1125859	711963 1125923	712193 1125050	712570 1125918	713593 1125891	713300 1125381	713301 1124833	713234 1124318	713837 1124349	714211 1124361	714776 1124405	712050 1125421
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	105	105	105	105	105	105	105	105	105	105	105	105
Cased Depth (ft)	65	65	65	65	65	65	65	65	65	65	65	65
Well Diameter (in)	16	16	16	---	---	16	16	16	16	16	16	10
Pump Capacity (gpm)	200	300	600	---	---	200	400	300	450	325	300	350
Intake Depth (ft)	65	65	65	65	65	65	65	65	54	65	65	60
Year Drilled	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1987

TABLE E-10. Ft. Pierce Utilities Authority Potable Water Supply Wells (continued).

Well Number	S18	W1	W2	W3	W4	FB1	FB2	FB3	FB4	FB5	FB6
Planar Coordinates	714068 1125617	714419 1125623	709538 1130542	709820 1130568	709599 1130155	709839 1130246	714793 1129643	708194 1129712	708856 1130600	708282 1130556	708275 1130765
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Proposed	Proposed	Proposed	Proposed
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Floridan	Floridan	Floridan	Floridan	Floridan	Floridan
Total Depth (ft)	105	105	105	105	105	904	880	900	900	900	900
Cased Depth (ft)	65	70	70	70	70	508	500	500	500	500	500
Well Diameter (in)	10	10	10	10	10	12	12	12	12	12	12
Pump Capacity (gpm)	350	350	350	350	350	500	600	600	600	600	600
Intake Depth (ft)	60	65	65	65	65	60	35	---	---	---	---
Year Drilled	1987	1984	1984	1984	1984	1988	1991	---	---	---	---

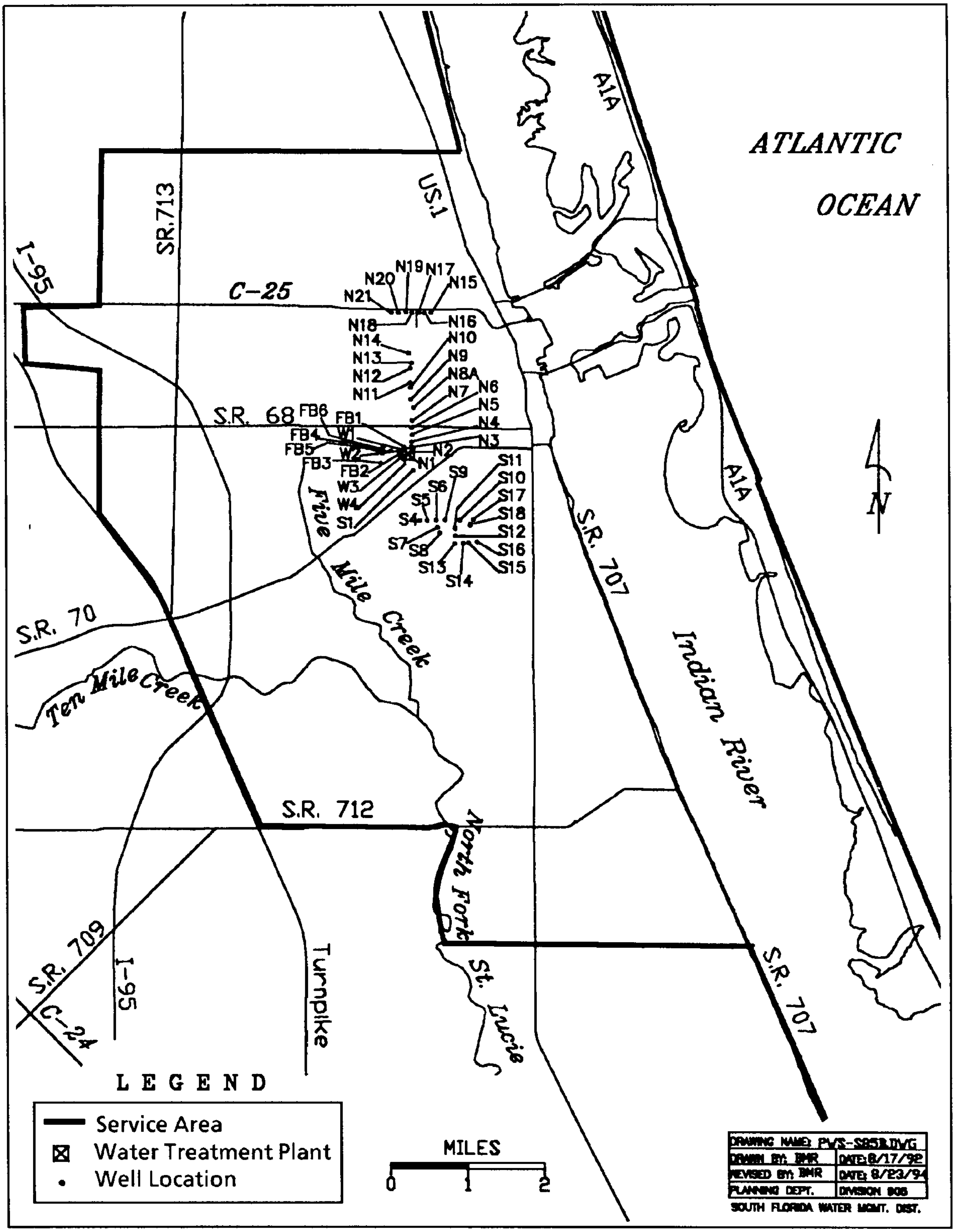

FIGURE E-10. Ft. Pierce Utilities Authority Potable Water Supply Wells.

Holiday Pines Service Corporation
SFWMD Permit Number: 56-00406-W
FDEP PWS ID: 4561689

Raw Water Supply:
Raw water is withdrawn from two Surficial Aquifer wells located in the northern area of St. Lucie County. 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. Specific well information is provided in Table E-11 and the location of the wells can be found in Figure E-11.

The current SFWMD permit was issued July 9, 1992 and expires July 9, 2002. The approved allocations are:

Annual Allocation:	153.00 MGY (0.419 MGD)
Maximum Daily Allocation:	0.58 MGD

The 1993 average daily pumpage was 0.16 MGD with a maximum day of 0.28 MGD.

Treatment:
Treatment is provided by a 0.24 MGD (FDEP-rated capacity) membrane softening treatment facility. The facility is located at the southern most point of Feather Creek Drive adjacent to Indigo Road. (Figure E-11). The 1993 average daily flow was 0.14 MGD with a maximum day of 0.21 MGD. The unaccounted-for water is estimated to be approximately 3.9 percent. Concentrate is disposed of via blending with wastewater treatment facility effluent which is discharged in percolation ponds.

Interconnections:
There are no distribution interconnections with other utilities.

Proposed:
No plans available.

Future:
The projected water use for the service area is to increase to 0.419 MGD average day with a maximum day flow of 0.838 MGD by 2001 based on 90 gallons per day per capita and a population of 4,657.

Information Source:
Information was obtained from St. Lucie County Water and Wastewater Master Plan and SFWMD water use permit files.

TABLE E-11. Holiday Pines Service Corporation Potable Water Supply Wells.

Well Number	1	2
Planar Coordinates	698878 1159654	698879 1159250
Status	Existing	Existing
Active (yes/no)	Yes	Yes
Aquifer	Surficial	Surficial
Total Depth (ft)	95	108
Cased Depth (ft)	65	76
Well Diameter (in)	8	8
Pump Capacity (gpm)	200	200
Intake Depth (ft)	---	---
Year Drilled	1989	1977

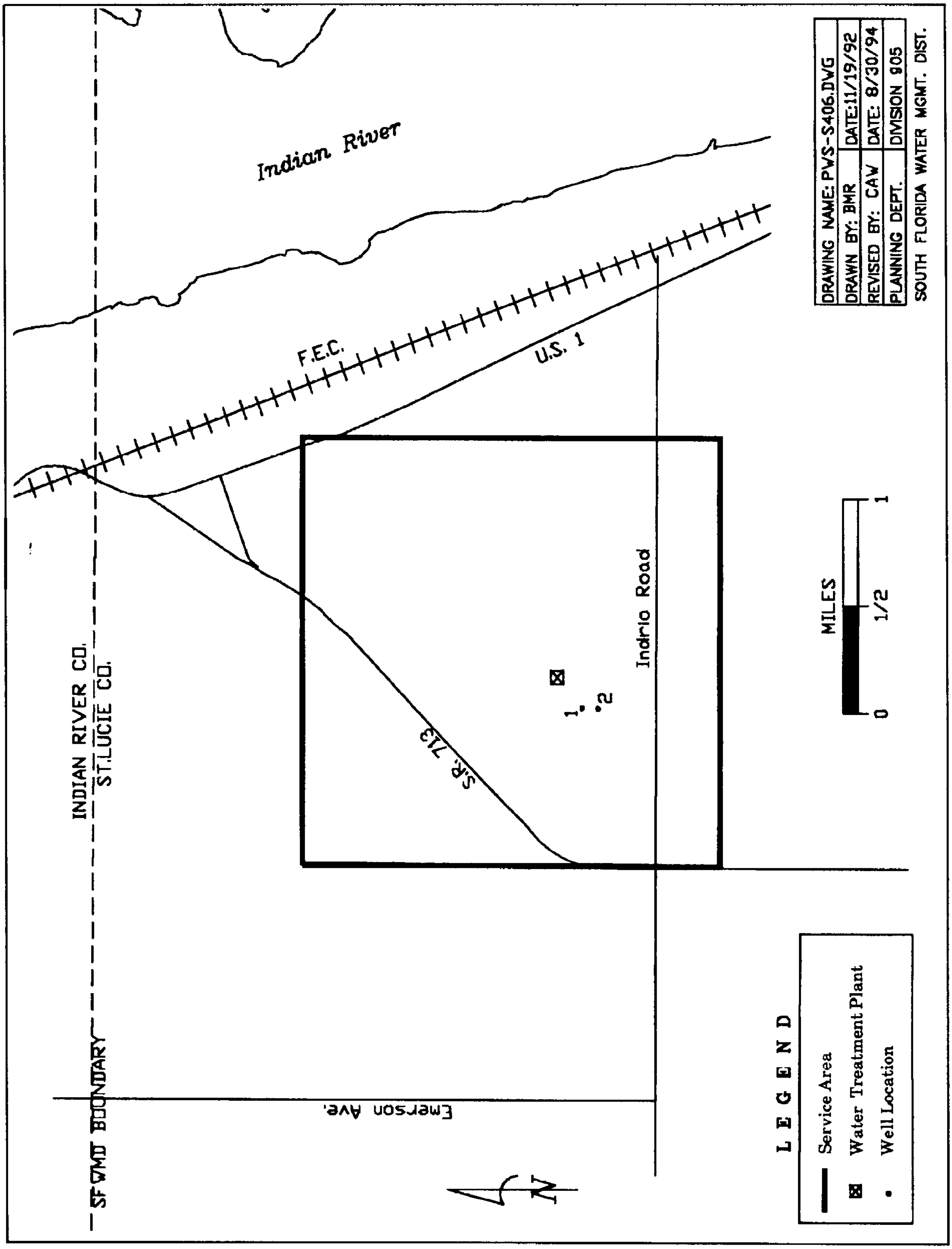

FIGURE E-11. Holiday Pines Service Corporation Potable Water Supply Wells.

Reserve Utilitv Corporation
SFWMD Permit Number: 56-00552-W
FDEP PWS ID: 4565030

Raw Water Supply:
Raw water is withdrawn from six 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 60 and 100 GPM. Specific well information is provided in Table E-12 and the location of the wells can be found in Figure E-12.

The current SFWMD permit was issued August 8, 1985 and expires August 8, 1995. The approved allocations are:

Annual Allocation:	**74.3** MGY (0.204 MGD)
Maximum Daily Allocation:	**0.326** MGD

The 1993 average daily pumpage was 0.11 MGD with a maximum day of 0.28 MGD.

Treatment:
Treatment is provided by a 0.2 MGD (FDEP-rated capacity) lime softening treatment facility. The facility is located at 2401 N.W. Reserve Park Trace (Figure E-12). The 1993 average daily flow was 0.10 MGD with a maximum day of 0.23 MGD. The unaccounted-for water is estimated to be approximately nine percent.

Interconnections:
There are no distribution interconnections with other utilities.

Proposed:
No plans available.

Future:
St. Lucie County is considering the feasibility of acquiring this utility.

Information Source:
Information was obtained from St. Lucie County Water and Wastewater Master Plan and SFWMD water use permit files.

TABLE E-12. Reserve Utility Corporation Potable Water Supply Wells.

Well Number	1	2	3	4	5	6
Planar Coordinates	685944 1091997	685962 1090560	685528 1091131	687087 1091875	685563 1090473	685771 1091304
Status	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	88	88	88	85	88	80
Cased Depth (ft)	40	40	55	50	55	50
Well Diameter (in)	6	6	6	6	6	6
Pump Capacity (gpm)	75	100	85	100	100	60
Intake Depth (ft)	53	52	53	50	53	---
Year Drilled	1986	1986	1990	1988	1990	1986

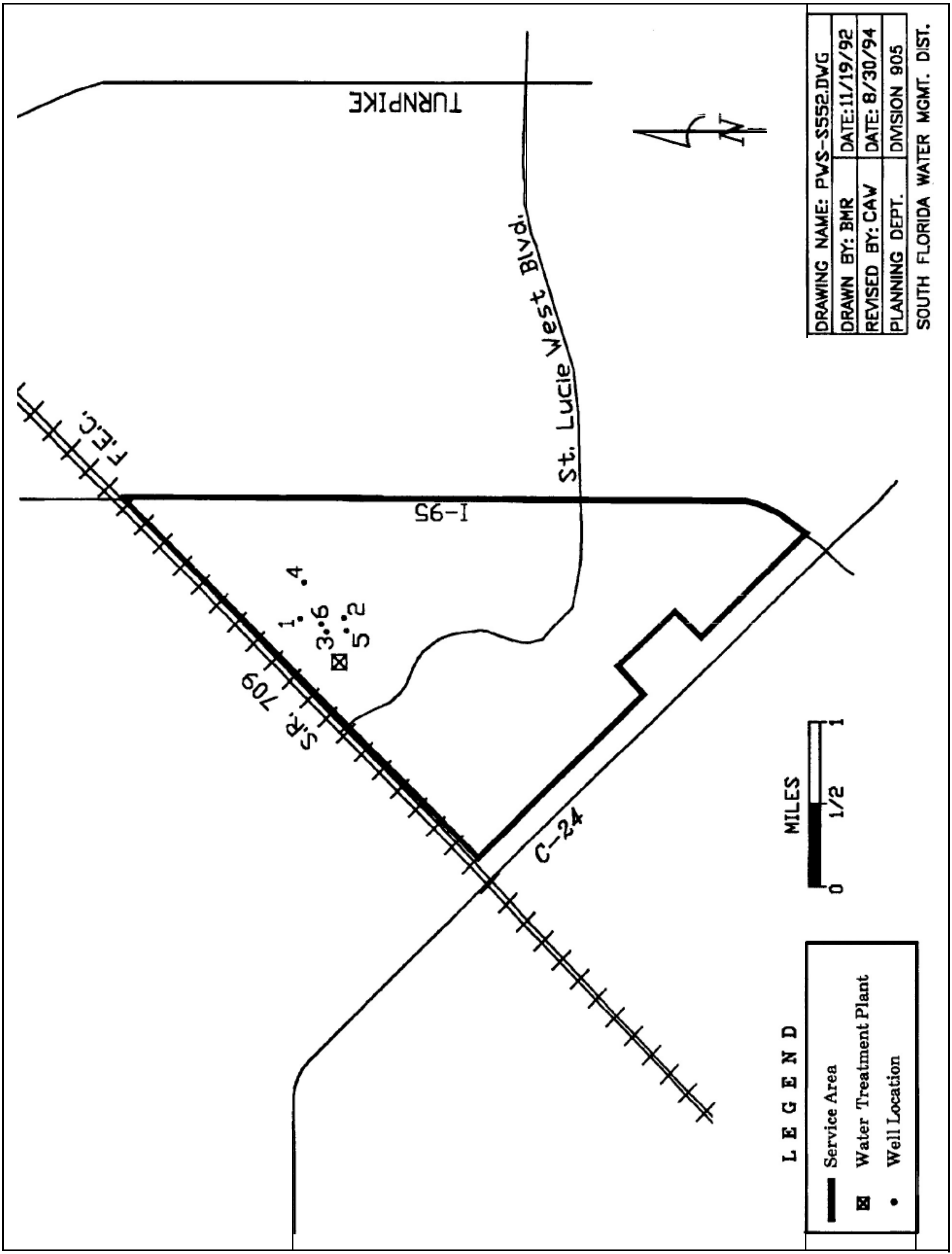

FIGURE E-12. Reserve Utility Corporation Potable Water Supply Wells.

Port St. Lucie Utilities
SFWMD Permit Number: 56-00142-W
FDEP PWS ID: 4560954

Raw Water Supply:
Raw water is withdrawn from 22 Surficial Aquifer wells located in the central area of Port St. Lucie. The wells are 8 inches in diameter, have total depths between 90 and 114 feet, and cased depths between 41 and 79 feet. The wells were drilled between 1969 and 1988 and have well capacities between 100 and 600 GPM. Specific well information is provided in Table E-13 and the location of the wells can be found in Figure E-13.

The current SFWMD permit was issued April 15, 1993 and expires September 12, 1996. The approved allocations are:

Annual Allocation:	2,154.00 MGY (5.9 MGD)
Maximum Daily Allocation:	7.97 MGD

The 1993 average daily pumpage was 3.93 MGD with a maximum day of 4.55 MGD.

Treatment:
Treatment is provided by a 6.0 MGD (FDEP-rated capacity) lime softening facility. The facility is located east of Aroso Boulevard on Lakehurst Drive in Port St. Lucie (Figure E-13). The 1993 average daily flow was 3.59 MGD with a maximum day of 5.0 MGD. The unaccounted-for water is estimated to be approximately 3.3 percent.

Interconnections:
Port St. Lucie Utilities proposes a 12-inch interconnection at the northern boundary of St. Lucie West. St. Lucie West Services District (SLWSD) will deliver approximately 0.17 MGD to Port St. Lucie Utilities. There is a 12-inch interconnection with Fort Pierce Utilities.

Proposed:
The city is presently developing plans to increase the capacity of the plant to 6.0 MGD. The current consumptive use permit allows construction of an additional three Surficial Aquifer wells as indicated in Table E-13 and Figure E-13.

Future:
The projected water use incorporated into the previously referenced permit forecasts the water use for the service area to increase to 4.0 MGD average day with a maximum day flow of 5.4 MGD by 1996 based on 100 gallons per day per capita and a population of 59,000.

Information Source:
Information was obtained from St. Lucie County Water and Wastewater Master Plan and SFWMD water use permit files.

TABLE E-13. Port St. Lucie Utilities Potable Water Supply Wells.

Well Number	1	2	3	4	6	7	8	9	10	11	12	13
Planar Coordinates	713106 1081354	713814 1082268	713072 1082096	710737 1083831	709995 1085134	709500 1086890	709570 1087756	710904 1085148	710855 1085867	710815 1086900	710599 1087728	708518 1085160
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	95	103	90	114	111	111	111	110	110	111	111	95
Cased Depth (ft)	60	45	45	79	76	69	75	65	70	70	71	71
Well Diameter (in)	8	8	8	8	8	8	8	8	8	8	8	8
Pump Capacity (gpm)	600	200	400	125	275	265	200	320	320	180	255	190
Intake Depth (ft)	---	---	---	---	---	68	68	65	63	70	69	---
Year Drilled	1969	1969	1970	1974	1975	1975	1975	1974	1975	1975	1975	1982

TABLE E-13. Port St. Lucie Utilities Potable Water Supply Wells (continued).

Well Number	14	15	16	17	18	19	20	21	22	24	25	26
Planar Coordinates	710046 1080337	709117 1079166	709719 1078168	714659 1079947	713894 1078677	703634 1084639	703320 1085331	706154 1088954	710192 1086883	704119 1089941	714547 1076240	712987 1075400
Status	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Proposed	Proposed	Proposed
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	100	99	90	110	95	95	105	90	100	100	100	100
Cased Depth (ft)	54	60	64	55	50	60	57	45	59	60	60	60
Well Diameter (in)	8	8	8	8	8	8	8	8	16	20	20	20
Pump Capacity (gpm)	300	300	300	300	100	275	350	200	300	350	350	350
Intake Depth (ft)	---	---	---	---	---	---	---	---	---	60	60	60
Year Drilled	1982	1982	1982	1982	1982	1987	1987	1988	1988	1993	1993	1993

TABLE E-13. Port St. Lucie Utilities Potable Water Supply Wells (continued).

Well Number	27	28	29	30	31	32	33	34	35	36	37
Planar Coordinates	705300 1079400	704500 1082800	705000 1084500	706600 1088000	708500 1088300	706500 1090800	707500 1091500	707600 1080700	707500 1077000	710100 1077000	703900 1089800
Status	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	100	100	100	100	100	100	100	100	100	100	100
Cased Depth (ft)	60	60	60	60	60	60	60	60	60	60	60
Well Diameter (in)	20	20	20	20	20	20	20	20	20	20	20
Pump Capacity (gpm)	350	350	350	350	350	350	350	350	350	350	350
Intake Depth (ft)	60	60	60	60	60	60	60	60	60	60	60
Year Drilled	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993	1993

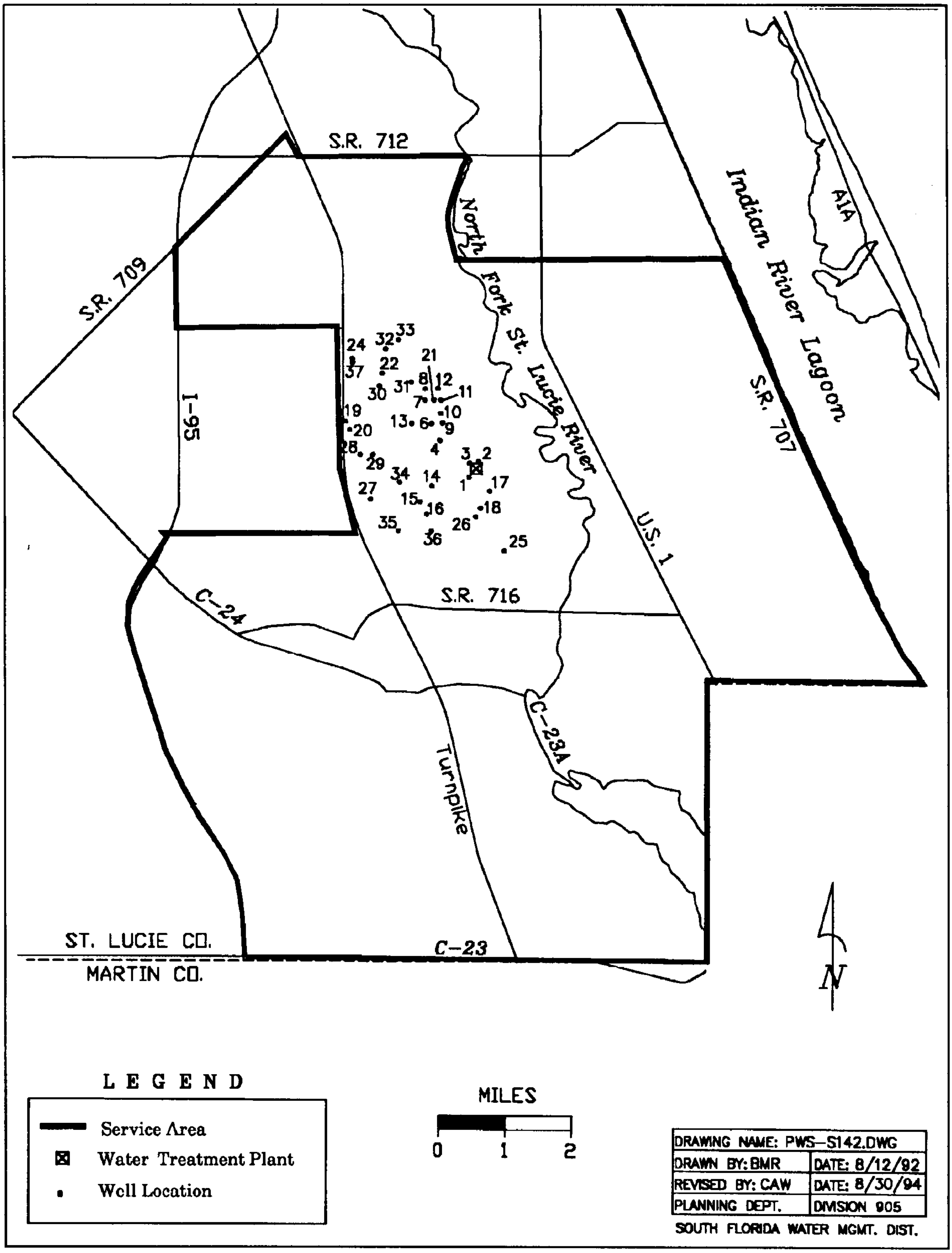

FIGURE E-13. Port St. Lucie Utilities Potable Water Supply Wells.

St. Lucie West Services District
SFWMD Permit Number: 56-00614-W
FDEP PWS ID: 4565031

Raw Water Supply:
Raw water is withdrawn from six 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 40 and 46 feet. The wells were drilled in 1987, and have capacities of 175 GPM. Specific well information is provided in Table E-14 and the location of the wells can be found in Figure E-14.

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

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

The 1993 average daily pumpage was 0.38 MGD with a maximum day of 1.08 MGD.

Treatment:
Treatment is provided by a 1.0 MGD (FDEP-rated capacity) membrane softening treatment facility. The facility is located at 450 SW. Utility Drive (Figure E-14). The 1993 average daily flow was 0.33 MGD with a maximum day of 0.63 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.

Interconnections:
Port St. Lucie Utilities is proposing a 12-inch interconnect at the northern boundary of St. Lucie West. St. Lucie West Services District (SLWSD) will deliver approximately 0.17 MGD to Port St. Lucie .

Proposed:
The current consumptive use permit allows construction of an additional 19 Surficial Aquifer wells as indicated in Table E-14 and Figure E-14.

Future:
The projected water use for the service area is expected to increase to 2.68 MGD average day with a maximum daily withdrawal of 4.03 MGD by 2001 based on 100 gallons per day per capita and a population of 26,795. The plant was designed so that it could be easily expanded to treat a 10 MGD. St. Lucie West has indicated that the first 4.0 MGD would be treated by membrane softening, and the last 6.0 MGD would utilize the Floridan Aquifer with reverse osmosis treatment.

Information Source:
Information was obtained from St. Lucie West, St. Lucie County Water and Wastewater Master Plan and SFWMD water use permit files.

TABLE E-14. St. Lucie West Services District Potable Water Supply Wells.

Well Number	1	2	3	4	5	6	7	8	9	10	11	12	13
Planar Coordinates	701622 1078681	698442 1083411	691241 1080145	690327 1082665	690863 1083678	698009 1079673	693469 1085710	690696 1080950	699666 1091294	696534 1086128	699354 1081396	702795 1082003	698528 1086044
status	Existing	Existing	Existing	Existing	Existing	Existing	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed
Active (yes/no)	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No
Aquifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial
Total Depth (ft)	75	65	70	68	65	60	70	70	70	70	70	70	70
Cased Depth (ft)	42	46	41	42	40	40	40	40	40	40	40	40	40
Well Diameter (in)	8	8	8	8	8	8	8	8	8	8	8	8	8
Pump Capacity (gpm)	175	175	175	175	175	175	150	150	150	150	150	150	150
Intake Depth (ft)	45	45	45	45	45	45	45	45	45	45	45	45	45
Year Drilled	1987	1987	1987	1987	1987	1987	---	---	---	---	---	---	---

TABLE E-14. St. Lucie West Services District Potable Water Supply Wells (continued).

Well Number	14	15	16	17	18	19	20	21	22	23	24	25
Planar Coordinates	696824 1086626	697947 1088628	696802 1090708	696392 1092073	700653 1087582	N/A	700844 1090867	700254 1091152	699621 1091075	698977 1090611	701397 1092047	695809 1091257
Status	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Proposed	Prooosed	Proposed
Active (yes/no)	No	No	No	No	No	No	No	No	No	N o	No	No
Aauifer	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Surficial	Sutficial	Surficial	Surficial	Surficial
Total Depth (ft)	70	70	70	70	70	70	70	70	70	70	70	70
Cased Depth (ft)	40	40	40	40	40	40	40	40	40	40	40	40
Well Diameter (in)	8	8	8	8	8	8	8	8	8	8	8	8
Pump Capacity (gpm)	150	150	150	150	150	150	150	150	150	150	150	150
Intake Depth (ft)	45	45	45	45	45	45	45	45	45	45	45	45
Year Drilled	---	---	- -	---	---	---	---	---	---		---	---

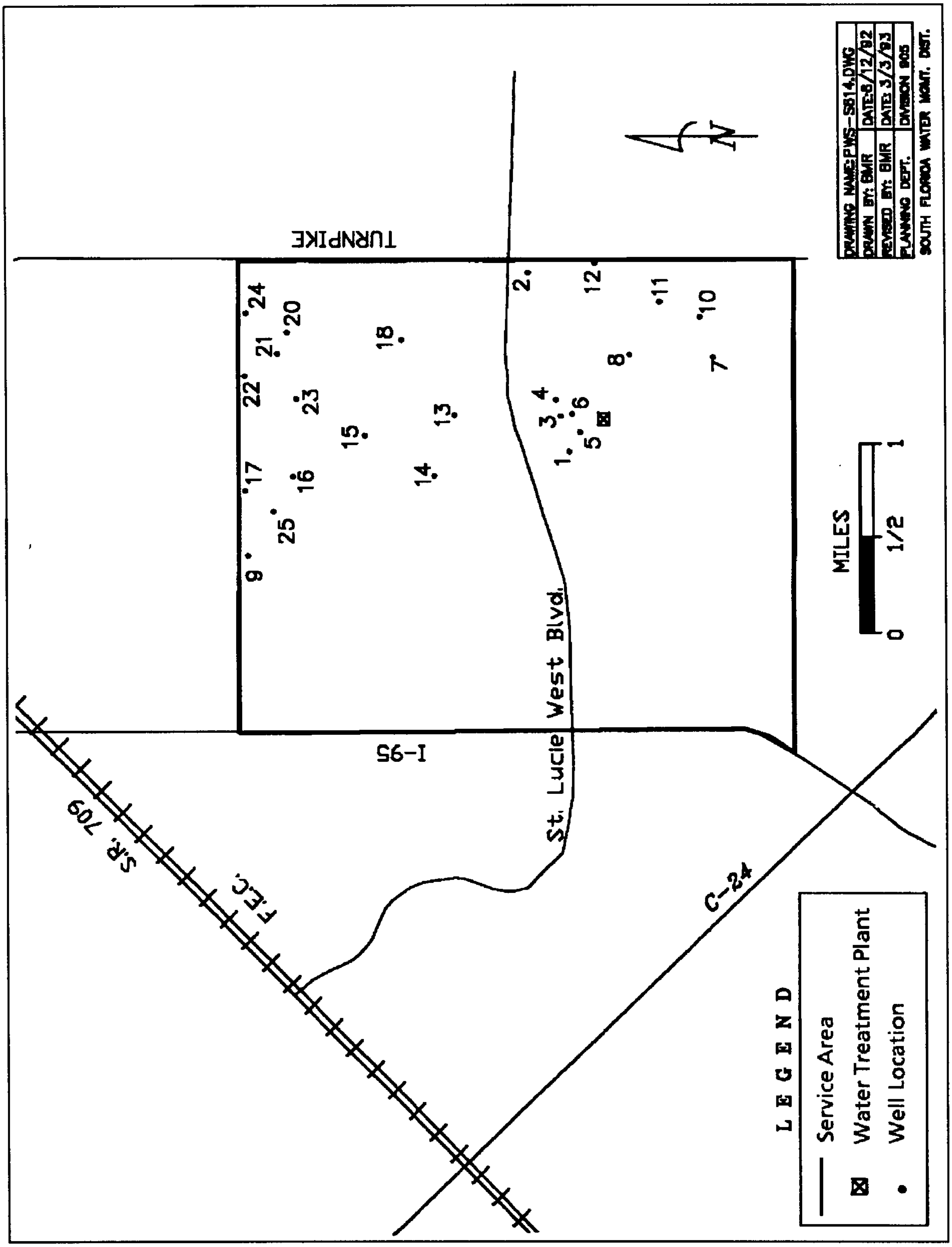

FIGURE E-14. St. Lucie West Services District Potable Water Supply Wells.

WASTEWATER TREATMENT FACILITIES

The primary means of wastewater treatment in the Upper East Coast Planning Area is through wastewater treatment facilities and septic tanks. There are approximately 170 existing FDEP regulated wastewater treatment facilities in the UEC Planning Area, 12 of which have FDEP-rated capacities of 0.2 million gallons per day (MGD) or greater. This discussion focuses on these 12 facilities and 2 proposed facilities because they have sufficient flows that could have a positive impact on the water resource through reuse. These facilities are large enough to allow economy of operation in support of a regional reuse program. Many are also located in areas in close proximity 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 on Figure E-15. More than half of the facilities are municipally owned, and all the facilities use the activated sludge treatment process. The reclaimed water/effluent disposal methods consist of discharge to surface waters, deep well injection, and reuse via green space irrigation and ground water recharge. These facilities have a total rated capacity of 22.71 MGD and are identified by facility name in Table E-15. The table lists the average daily flow (ADF) and the method of disposal in 1993 of each facility. The 1993 ADF for these facilities was 13.05 MGD.

The wastewater flows for these facilities are projected to increase to approximately 43.36 MGD by the year 2010. General descriptions of the disposal methods follow.

Disposal Methods

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

Surface Water Discharge

This method of effluent disposal consists of disposing the effluent through a pipeline to a receiving surface water. Effluent prior to disposal is required to have received at least secondary treatment (20 mg/L carbonaceous biochemical oxygen demand [CBOD], 20 mg/L total suspended solids [TSS] or 90 percent removal, whichever is more stringent) and basic level disinfection. Additional levels of treatment may be required and are based upon 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). A WQBEL is 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. WQBELs are established to ensure that water quality standards in a receiving body of water will not be violated (Chapter 17-650, F.A.C.).

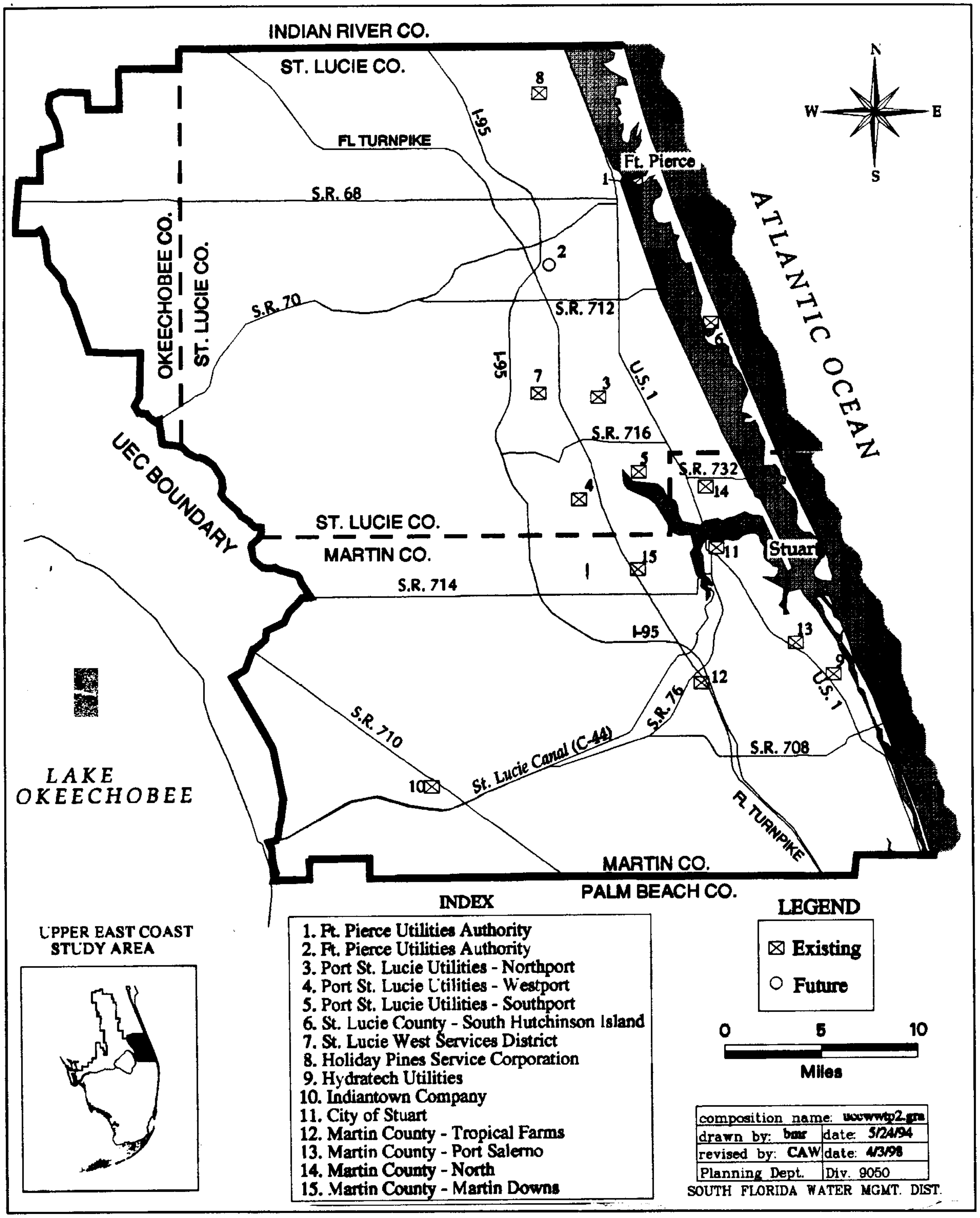

FIGURE E-15. Wastewater Treatment Facilities in the UEC Planning Area.

TABLE E-15. Wastewater Treatment Facilities in the UEC Planning Area.

Facility	FDEP Rated Capacity (MGD)	1993 Average Daily Flow (MGD)	Disposal Method			Chloride (mg/L)	Year 2010 Projected Flow (MGD)
			Deep Well	Surface Water	Reuse		
Martin County							
Hydratech	1.20	0.48			0.48	76	0.85
Indiantown	1.00	0.47			0.47	B	0.96
Martin County - Martin Downs	1.00	0.52			0.52	163	0.87
Martin County - North	0.60	0.29	0.29			B	3.70
Martin County - Port Salerno	1.50	0.79			0.79	135	5.80
Martin County - Tropical Farms	A	A				A	1.80
Stuart	3.00	1.55	1.55			B	3.40
County Subtotal	**8.30**	**4.10**	**1.84**	**0**	**2.26**	---	**17.38**
St. Lucie County							
Ft. Pierce	9.00	6.39		6.39		B	14.40
Holiday Pines	0.21	0.10			0.10	B	1.50
Port St. Lucie - North Port	1.50	0.71	0.71			299	1.69
St. Lucie County - South Hutchinson Island	A	A				A	2.25
Port St. Lucie - South Port	2.20	1.33	1.04		0.29	160	3.04
Port St. Lucie - West Port	0.50	0.17			0.17	B	1.10
St. Lucie West	1.00	0.25			0.25	137	2.00
County Subtotal	14.41	8.95	1.75	6.39	0.81	---	25.98
UEC TOTAL	22.71	13.05	3.59	6.39	3.07	---	43.36

A = Facility not in operation in 1993.
B = chloride concentration not available.

As regulatory requirements become more stringent, many of the dischargers 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 antidegradation requirements prior to issuance of a permit for such a discharge. The antidegradation 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 of domestic reclaimed water is not feasible in lieu of a discharge to surface water, and that such a discharge is clearly in the public interest. A summary of the state's antidegradation rule is provide in Figure E-16. In addition, the 1990 Florida Legislature passed a bill requiring the elimination of existing discharges of treated effluent to the Indian River Lagoon system by July 1, 1995. Surface water discharge accounted for 49 percent (6.39 MGD) of the effluent disposal in 1993.

Florida's Antidegradation Standards

In reviewing a permit application for a surface water discharge, the Florida Department of Environmental Protection must assure the application is consistent with the antidegradation policy set forth in Section 17-3.041, Florida Administrative Code (F.A.C.) prior to issuance of a permit. Such that, when reviewing a permit application for a surface water discharge, the following criteria must be reviewed:

1. **Whether water quality standards will be violated.**
2. **Whether "existing uses" are being maintained.**
3. **Whether the proposed(new or expanded) discharge is "necessary or desirable under federal standards and under circumstances which are clearly in the public interest."**
   This requires consideration of:
   a. **The balancing test**
      The benefit to the public health, safety, and welfare is to be balanced against whether the discharge will adversely affect fish and wildlife, endangered species, or their habitats; whether the proposed discharge will adversely affect recreation or marine resources; and whether the proposed discharge is consistent with any applicable SWIM plan.
   b. **The options review**
      This requires the applicant to demonstrate that neither of the following is economically and technologically reasonable:
      1) **Reuse of domestic reclaimed water.**
      2) **Certain other options other than the proposed discharge that would eliminate or minimize the need to lower water quality (those others being reuse, use of other discharge locations, or land application).**

FIGURE E-16. Surface Water Discharge Antidegradation Standards.

Deep Well Injection Class I Wells

This method of disposal consists of injecting secondary treated (20 mg/L CBOD, 20 mg/L TSS) effluent (no disinfection required) through a steel conduit (casing) to the boulder zone, a fractured carbonate sequence formation found at depths ranging from 1,900 to 3,300 feet below the ground surface in the UEC Planning Area. There are four existing facilities which utilize deep well injection for a portion of their effluent disposal. Deep wells also serve as an alternative means of disposal for the reuse system. Disposal by deep well injection accounted for 28 percent (3.59 MGD) of the effluent disposal in 1993.

Reuse

This method of disposal consists of utilizing treated wastewater (reclaimed water) for a beneficial purpose. Various methods of reuse are identified in Appendix I of this report. There are eight facilities in the UEC Planning Area that reused all or a portion of their 1993 flows. In 1993, reclaimed water was utilized for golf course, residential lawn, park and green space irrigation, and for ground water recharge via percolation ponds. Many of the facilities utilize their reclaimed water/effluent for plant process water, and some for irrigation of the utility site (which also could be considered reuse). In 1993, 24 percent (3.07 MGD) of the treated wastewater was reused. Over 20 golf courses in the planning area utilized reclaimed water for irrigation in 1993.

Effluent disposal via discharge to surface waters and deep well injection result in net loss from the water supply inventory. These methods of effluent disposal accounted for 9.88 MGD of water lost from the water supply inventory in 1993. Most of the facilities utilizing these methods of effluent disposal could have potentially made reclaimed water available for public access reuse with the addition of filtration and associated chemical feed facilities, disinfection, and reclaimed water monitoring equipment at the treatment plant. The facilities would have to justify a facility reliability of Class I, or an equivalent, which may exist as their current method of effluent disposal . The existing method of effluent disposal may also be viable as an alternative means of disposal, which may negate the need for regulatory mandated system storage. Additional information on reuse can be found in the wastewater reuse discussion in Chapter VI.

Summary Descriptions of Existing Wastewater Facilities

Summary descriptions for each of the wastewater treatment facilities 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 following information:

Treatment/Disposal ▪ This section presents the current FDEP-rated capacity, the method of treatment and disposal, the 1993 average daily flow, and the reclaimed water/effluent chloride concentration.

Address ▪ This section provides the treatment plant address or location,

Reuse Feasibility ▪ This section states what would be generally required for the treatment facility to produce reclaimed water for public access irrigation and any known constraints.

Proposed ▪ This section states any current construction or permitting that is underway.

Future- This section presents projected flows and known future treatment plant expansions and plans, including new additional facilities.

MARTIN COUNTY

WASTEWATER TREATMENT FACILITIES

Hvdratech Utilities

Treatment/Disposal:
The wastewater treatment facility consists of an existing 1.2 MGD activated sludge (contact stabilization) wastewater treatment plant with reclaimed water disposal via reuse by golf course irrigation and percolation ponds. The facility is operated by the Hydratech Utilities Inc. Irrigation with reclaimed water is implemented at the following location:

Site	Type	1993 ADF (MGD)
Loblolly Pines	Golf Course	0.27

The 1993 average daily wastewater flow was 0.48 MGD. The maximum month average daily flow was 0.64 MGD in November and the minimum month average daily flow was 0.38 MGD in August. The typical reclaimed water chloride concentration is 76 mg/L.

Location:
8181 SE. Skylark Avenue, Hobe Sound.

Reuse Feasibility:
This facility has existing capacity to produce 0.6 MGD of reclaimed water for public access irrigation. This system will be expanded accordingly as flows increase with the intention of reusing all water treated at this facility via public access irrigation.

Proposed:
A 0.90 MGD reclaimed water land application system for the proposed Medalist Golf Club has been contracted.

Future:
Plans not available.

Source:
Information supplied by the Hydratech Utilities.

Indiantown Company

Treatment/Disposal:
The wastewater treatment facility consists of an existing 1.00 MGD activated sludge wastewater treatment plant with reclaimed water disposal by reuse via percolation ponds. The facility is operated by the Indiantown Company. The 1993 average daily flow was 0.47 MGD. The maximum month average daily flow was 0.50 MGD in March and the minimum month average daily flow was 0.42 MGD in August.

Location:
At the corner of 1st Street and Palm Beach Avenue in Indiantown.

Reuse Feasibility:
This facility is designed to provide secondary standard treatment. For this water to be made available for public access reuse in accordance with Chapter 17-610, F.A.C., filtration and the associated chemical feed system, disinfection facilities and reclaimed water monitoring equipment would have to be constructed. An equivalent to Class I reliability may exist via the existing disposal method, which could also serve as an alternate means of disposal to the public access reuse system.

Proposed:
Two additional percolation ponds and reclaimed water irrigation system for a 20-acre orange grove is anticipated to be completed in the summer of 1994.

Future:
The Indiantown Company proposes to start design and permitting of a plant expansion to 2.0 MGD after the year 2000. Reuse for future disposal will be via an agricultural reuse system.

Source:
Information provided by Indiantown Company.

Martin County - Martin Downs

Treatment/Disposal:
The wastewater treatment facility consists of an existing 1.00 MGD activated sludge wastewater treatment plant with reclaimed water disposal via reuse by golf course irrigation and percolation ponds. The facility is operated by Martin County. Irrigation with reclaimed water is implemented at the following locations:

Site	Type	1993 ADF (MGD)
Crane Creek	Golf Course	0.18
Towers	Golf Course	------

The 1993 average daily wastewater flow was 0.52 MGD of which 0.13 MGD was utilized for irrigation. The maximum month average daily flow was 0.66 MGD in December and the minimum month average daily flow was 0.41 MGD in July. The typical average reclaimed water chloride concentration is 163 mg/L.

Location:
Approximately one mile north of S.R. 714, East of Florida's Turnpike

Reuse Feasibility:
This facility has existing capacity to produce 1.00 MGD of reclaimed water for public access irrigation.

Proposed:
Plans not available.

Future:
Plans not available.

Source:
Information supplied by Martin County.

Martin County - North

Treatment/Disposal:
The wastewater treatment facility consists of an existing 0.6 MGD activated sludge wastewater treatment plant with effluent disposal by deep well injection. The facility is operated by Martin County. The 1993 average daily flow was 0.29 MGD. The maximum month average daily flow was 0.35 MGD in January and the minimum month average daily flow was 0.24 MGD in September. The typical effluent chloride concentration is 142 mg/L.

Location:
On Commercial Boulevard (Jensen Beach Boulevard), approximately 0.7 miles east of U.S. 1 in Jensen Beach.

Reuse Feasibility:
This facility is designed to provide secondary standard treatment. For this water to be made available for public access reuse in accordance with Chapter 17-610, F.A.C., filtration and the associated chemical feed system, disinfection facilities and reclaimed water monitoring equipment would have to be constructed. An equivalent to Class I reliability may exist via the existing disposal method, which could also serve as an alternate means of disposal to the public access reuse system.

Proposed:
Plans not available.

Future:
Martin County is planning to expand the plant to treat 1.2 MGD in 1995. The county is also planning a public access reuse system to serve West Jenson for spray irrigation. The recommended plan for this plant is to convert from contact stabilization to oxidation ditch treatment. The plan indicates the plant will be expanded to 3.6 MGD by the year 2010 based on a population of 46,600 and a 80 GPD per capita flow rate.

Source:
Information provided by Martin County.

Martin County - Port Salerno (Dixie Park)

Treatment/Disposal:
The wastewater treatment facility consists of an existing 1.5 MGD activated sludge wastewater treatment plant with reclaimed water disposal by reuse via spray irrigation and percolation ponds. The facility is operated by Martin County. Irrigation with reclaimed water is implemented at the following locations:

Site	Type	1993 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.

The 1993 average daily flow was 0.79 MGD. The maximum month average daily flow was 1.00 MGD in January and the minimum month average daily flow was 0.68 MGD in November, The typical reclaimed water chloride concentration is 135 mg/L.

Location:
At S.E. Inez Way, Port Salerno.

Reuse Feasibility:
This facility has existing capacity to produce 1.5 MGD of reclaimed water for public access irrigation.

Proposed:
The county is planning to interconnect this reclaimed water system with the proposed Tropical Farms reclaimed water system. This will divert 0.5 MGD of wastewater from the Martin County - Port Salerno wastewater system to the Martin County - Tropical Farms System.

Future:
The Martin County draft master plan proposes a 2.5 MGD expansion to take place prior to 2010, for a total plant capacity of 4.0 MGD. Some potential future users of reclaimed water include:

Site	Type	Estimated Demand (MGD)
Mariner Sands	Golf Course	1.00 (under contract)
Willoughby	Golf Course	0.50
Summerfield	Golf Course	0.50
Florida Club	Golf Course	0.25 (under contract)
Seawind Corp	Golf Course	0.45 (under contract)

Source:
Information provided by Martin County.

Martin County - Tropical Farms

Proposed:
The Tropical Farms area currently does not have a regional facility providing wastewater service. However, flow projections indicate a build-out demand of 1.8 MGD. The proposed facility is a 0.92 MGD activated sludge wastewater treatment plant with reclaimed water disposal by ground water recharge via percolation ponds and by public access irrigation.

The county is planning to interconnect this reclaimed water system with the proposed Tropical Farms reclaimed water system. This will divert 0.5 MGD of wastewater from the Martin County - Port Salerno wastewater system to the Martin County - Tropical Farms System.

Location:
The proposed location is west of the Florida Turnpike and south of Kansas Avenue in Martin County.

Reuse Feasibility:
The proposed treatment facility is designed to provide reclaimed water for public access irrigation. Initially, reuse will be by percolation ponds. However, Tropical Farms will provide reclaimed water to Florida Club Golf Course upon its completion. The county plans to provide reclaimed water to the following users.

Site	Type	Proposed ADF (MGD)
Florida Club	Golf Course	0.25
Mariner Sands	Golf Course	1.25
Seawind Corp	Golf Course	0.45
Summerfield	Golf Course	0.50

Future:
The ultimate design will provide plant capacity to treat 1.8 MGD.

Source:
Information provided by Martin County.

Stuart, City of

Treatment/Disposal:
The wastewater treatment facility consists of an existing 4.00 MGD activated sludge wastewater treatment plant with effluent disposal via a lo-inch diameter deep injection well. The facility has a FDEP rated capacity of 3.00 MGD because of the disposal capacity of the deep well. An emergency discharge is provided to the St. Lucie River via the old outfall pipe. The facility is operated by the City of Stuart. The 1993 average daily flow was 1.55 MGD. The maximum month average daily flow was 2.24 MGD in October and the minimum month average daily flow was 1.27 MGD in July.

Combined sewers within the downtown have been eliminated; however, areas where potential I/I are known.

Location:
Stypmann Boulevard, Stuart.

Reuse Feasibility:
This facility is designed to provide secondary standard treatment. For this facility to provide reclaimed water for public access spray irrigation in accordance with Chapter 17-610, F.A.C., filtration and the associated chemical feed system, disinfection facilities and reclaimed water monitoring equipment would have to be constructed. An equivalent to Class I reliability may exist via the existing deep well injection system, which could also serve as an alternate means of disposal to the reuse system, up to the disposal capacity of the deep well. At this time, it is not anticipated that the deep well injection system can dispose of the build-out forecast peak wastewater flows.

Proposed:
No plans at present.

Future:
The 1988 City of Stuart water and wastewater master plan indicates the build-out average daily wastewater flows for the service area are anticipated to increase to 2.41 MGD with a maximum month average daily flow of 3.40 MGD. Build-out is anticipated to occur prior to 2010. The build-out population is estimated to be 20,900. The flow projections also assume that existing areas served by septic tanks will not be sewered. Approximately 5,900 people are served by septic tanks within the service area. The capacity of the existing deep well is not sufficient to dispose of the projected flows. Construction of an additional deep well or reuse system is planned to dispose of the additional flows.

Source:
Information provided 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 9.00 MGD activated sludge wastewater treatment plant with secondary treated effluent disposal via a surface water discharge to the Indian River near the Fort Pierce Inlet. A deep well injection system was placed into service in August 1994.

The 1993 average daily wastewater flow was 6.39 MGD. The maximum month average daily flow was 8.41 MGD in October and the minimum month average daily flow was 5.47 MGD in May.

Location:
403 Seaway Drive on Hutchinson Island, Fort Pierce.

Reuse Feasibility:
This existing WWTP is designed to provide secondary standard treatment. For this facility to provide reclaimed water for public access spray irrigation in accordance with Chapter 17-610, F.A.C., filtration and the associated chemical feed system, disinfection facilities and reclaimed water monitoring equipment would have to be constructed. An equivalent to Class I reliability may exist via the proposed deep well injection system. This facility has existing capacity to produce 7.2 MGD of reclaimed water for public access irrigation.

The Indian River Lagoon Act of 1990 requires that wastewater treatment facility discharges into the Indian River Lagoon be terminated by July 1, 1995 and that utilities investigate the feasibility of a water reclamation system. A deep well injection system for Fort Pierce Utilities Authority (FPUA) went into service in June 1994. Construction of the 20-inch diameter reuse line transversing the Indian River Lagoon will start in May 1994. The utility is waiting for the FDEP construction permit. Future disposal will be a combination of deep well injection and reuse of reclaimed water, surface discharge will be eliminated when the deep well comes on line.

Proposed:
FPUA recently began planning construction for wastewater reuse. A 20-inch reclaimed water line to cross the Indian River Lagoon will be constructed starting in May 1994. No costumers for reuse have been identified. The deep well will serve as a backup to the reuse system once reuse is implemented.

Future:
The FPUA Water and Wastewater Master Plan projects future annual average wastewater flows of 12 MGD and maximum month average day wastewater flows of 14.4 MGD for the ultimate service area in the year 2010. These flows are greater than the capacity of the existing WWTP. A 25 acre site on Glades Cutoff Road, north of Midway Road has been purchased for a Mainland WWTP (MWWTP). Preliminary studies are underway for an initial phase of 3 MGD expandable to 15 MGD. Phase 1 is expected to go on line in late 1999. The proposed MWWTP will incorporate reclaimed water treatment processes.

Source:
Information supplied by Fort Pierce Utilities Authority.

Holiday Pines Service Corporation

Treatment/Disposal:
The wastewater treatment facility consists of an existing 0.21 MGD activated sludge wastewater treatment plant with reclaimed water disposal by reuse via percolation ponds. The facility is owned by the Holiday Pines Service Corporation (HPSC). The 1993 average daily flow was 0.1 MGD. The maximum month average daily flow was 0.12 MGD in March and the minimum month average daily flow was 0.08 MGD in May.

Location:
At Kings Highway (S.R. 713) and Indian Pines Boulevard.

Reuse Feasibility:
This facility is designed to provide secondary standard treatment. For this water to be made available for public access reuse in accordance with Chapter 17-610, F.A.C., filtration and the associated chemical feed system, disinfection facilities and reclaimed water monitoring equipment would have to be constructed. An equivalent to Class I reliability may exist via the existing disposal method, which could also serve as an alternate means of disposal to the public access reuse system.

Proposed:
The St. Lucie County Utilities Services Department is in the process of acquiring this facility.

Future:
The draft St. Lucie County Water and Wastewater Master Plan proposes a 1.50 MGD expansion to take place prior to 1996, for a total plant capacity of 1.71 MGD. Reclaimed water disposal is proposed to be reuse via irrigation of the Indian Pines golf course and the St. Lucie County International Airport which will account for approximately 0.85 MGD. Additional disposal would be needed for the 1.71 MGD capacity. Projected flow is to increase to 1.50 MGD by 2011. Prior to this time, a new 4.00 MGD regional facility is planned to be constructed along Kings Highway, just south of Indrio Road.

Source:
Information provided by Holiday Pines Service Corporation and St. Lucie County.

Port St. Lucie Utilities- North Port

Treatment/Disposal:
The wastewater treatment facility consists of an existing 1.50 MGD activated sludge wastewater treatment plant, limited to 1.00 MGD, with effluent disposal via a 12-inch diameter deep injection well. The facility is operated by the St. Lucie County Utility Services Department (SLCUSD). The 1993 average daily flow was 0.71 MGD. The maximum month average daily flow was 0.98 MGD in August and the minimum month average daily flow was 0.54 MGD in March. The typical effluent chloride concentration is 299 mg/L.

Location:
On St. James Road, one quarter mile north of Airosa Boulevard, Port St. Lucie.

Reuse Feasibility:
This facility is designed to provide secondary standard treatment. For this water to made available for public access reuse in accordance with Chapter 17-610, F.A.C., filtration and the associated chemical feed system, disinfection facilities and reclaimed water monitoring equipment would have to be constructed. An equivalent to Class I reliability may exist via the existing deep well injection system, which could also serve as an alternate means of disposal to the reuse system.

Proposed:
No plans available.

Future:
The draft St. Lucie County Water and Wastewater Master Plan proposes a 1.50 MGD expansion to take place prior to 2005. The 2010 projected flow for this facility is 1.69 MGD. In **1993,** it was proposed to construct a 1.50 MGD reclaimed water facility and a reclaimed water transmission system to St. Lucie West, where it is projected that the irrigation demand will exceed their reclaimed water supply. In addition, green space and residential reuse is planned for future developments.

Source:
Information provided by St. Lucie County.

St. Lucie County - South Hutchinson Island

Proposed:
This proposed facility and collection system will serve South Hutchinson Island in St. Lucie County. Residents in Martin County on South Hutchinson Island will likely become a wholesale customer to this St. Lucie County Utility Services Department (SLCUSD) facility. This area is currently served by approximately 39 package wastewater treatment plants (23 in St. Lucie County, 16 in Martin County), of which many are problem plagued.

The proposed wastewater treatment facility will consist of an 2.25 MGD activated sludge (oxidation ditch) wastewater treatment plant with reclaimed water disposal by green space irrigation on the island. Excess reclaimed water will be discharged into the Florida Power and Light (FPL) cooling water canal.

Location:
On Hutchinson Island, immediately South of the “Dunes” Condominium and FPL power plant.

Reuse Feasibility:
This facility will be designed to provide reclaimed water for public access irrigation at its design capacity.

Future:
This facility is designed for build-out.

Source:
Information provided by St. Lucie County and Camp, Dresser & McGee, Inc.

Port St. Lucie Utilities - South Port

Treatment/Disposal:
The wastewater treatment facility consists of an existing 2.20 MGD activated sludge wastewater treatment plant with reclaimed water disposal via golf course irrigation and a 12-inch diameter deep injection well. Irrigation with reclaimed water has been initiated on 158 acres of golf course and 120 acres of green space at Ballantrae Golf and Yacht Club. The facility is operated by the St. Lucie County Utility Services Department (SLCUSD). The 1993 average daily flow was 1.33 MGD. The maximum month average daily flow was 1.71 MGD in April and the minimum month average daily flow was 1.52 MGD in May. Approximately 22 percent of the wastewater flow in 1993 was reused. The typical reclaimed water/effluent chloride concentration is 160 mg/L.

Location:
Intersection of Sunshine Avenue and Pine Valley Street, Port St. Lucie.

Reuse Feasibility:
The 1.40 MGD reclaimed water treatment system was completed in 1992. The Ballantrae Golf and Yacht Club has a estimated demand of 0.75 MGD (actual .3 MGD). Expansion of the reuse system is planned to two adjacent golf courses, Club Med (.5 MGD) and Atlantic Gulf Community's "Wilderness" course (.25 MGD).

Proposed:
Plans not available.

Future:
The draft St. Lucie County Water and Wastewater Master Plan proposes two 2.00 MGD expansions to take place in 1997 and 2007. During this time period an existing 1.20 MGD treatment train will be abandoned, resulting in total treatment plant capacity of 5.00 MGD following these expansions. The 2010 projected flows for this facility are 3.04 MGD. Disposal of the expanded flow will be by deep well injection. Reclaimed water will be made available when needed.

Source:
Information provided by St. Lucie County.

Port St, Lucie Utilities - West Port

Treatment/Disposal:
The wastewater treatment facility consists of an existing 0.50 MGD activated sludge wastewater treatment plant, limited to 0.25 MGD, with reclaimed water disposal by reuse via nine acres of percolation ponds. The facility is operated by the St. Lucie County Utility Services Department (SLCUSD). The 1993 average daily flow was 0.17 MGD. The maximum month average daily flow was 0.22 MGD in July and the minimum month average daily flow was 0.10 MGD in January.

Location:
Corner of Darwin Boulevard and Feldman Street, Port St. Lucie.

Reuse Feasibility:
This facility is designed to provide secondary standard treatment. For this water to be made available for public access reuse in accordance with Chapter 17-610, F.A.C., filtration and the associated chemical feed system, disinfection facilities and reclaimed water monitoring equipment would have to be constructed. An equivalent to Class I reliability may exist via the existing percolation ponds which could also serve as an alternate means of disposal to the public access reuse system.

Proposed:
The SLCUSD has applied for three additional percolation ponds.

Future:
The draft St. Lucie County Water and Wastewater Master Plan proposes a 1.50 MGD expansion to take place prior to 2005. The 2010 projected flow for this facility is 1.10 MGD. It is proposed to obtain land for restricted public access irrigation for 0.30 MGD of disposal for a total disposal capacity of 0.55 MGD. The county also proposes to construct reclaimed water transmission facilities for irrigation of an existing and proposed park in Windmill Point. Other potential reclaimed water uses are an existing elementary school, future high school, commercial and multifamily developments.

Source:
Information provided by St. Lucie County.

St, Lucie West Services District

Treatment/Disposal:
The wastewater treatment facility consists of an existing 2.00 MGD activated sludge wastewater treatment plant, limited to 1.0 MGD, with reclaimed water disposal via reuse by irrigation of all landscape areas within the development, including residential areas, via a dual water system. The facility is operated by St. Lucie West Services District. The 1993 average daily wastewater flow was 0.25 MGD. The maximum month average daily flow was 0.28 MGD in November and the minimum month average daily flow was 0.22 MGD in June. The typical average reclaimed water chloride concentration is 137 mg/L.

Location:
The southwest corner of the intersection of Prima Vista Boulevard and Cashmere Boulevard in St. Lucie West.

Reuse Feasibility:
This facility has existing capacity to produce 1.00 MGD of reclaimed water for public access irrigation. Reclaimed water is used to irrigate a 100 acre golf course, 57 acres of residential home sites, a 6-acre clubhouse and 10 acres of medium strips with 500 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.

Proposed:
No plans available.

Future:
No plans available.

Source:
Information supplied by St. Lucie County, and St. Lucie West.

APPENDIX F

Environmental Resources and Needs

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FACTORS AFFECTING WETLANDS

Factors which influence wetland systems include hydrology, fire, geology and soils, climate, and ecological succession. This section presents an overview of each of these factors.

Hydrology

Hydrology is the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes (Mitsch and Gosselink, 1986). Hydraulic inflows and outflows, such as precipitation, surface runoff, ground water inputs, and in some cases, tides and river flooding, provide the energy to transport nutrients and other organic material to and from wetlands. Water depth, hydroperiod, flow patterns, stage, duration, frequency of flooding and water quality all influence the biochemistry of wetlands and ultimately, the species composition and type of wetland community that develops. The hydrology of a wetland acts both as a limit and a stimulus for determining the numbers and types (species) of flora and fauna that can live within or utilize a specific wetland. Hydrology also strongly affects aquatic primary production, organic accumulation, and the cycling of nutrients (Mitsch and Gosselink, 1986).

Precipitation

The UEC Planning Area experiences wide variations in annual rainfall, resulting in both flooding and extended drought periods. During heavy rainfall years, there is overland flow and discharge to the ocean. During extended drought years, however, the natural system is stressed by saltwater intrusion, increased frequency of fires, loss of organic soils, and invasion of wetlands by exotics.

Evapotranspiration

Evapotranspiration (ET) is the combined process of evaporation from land and water surfaces, and from plants. ET rates vary as a function of solar radiation, air and water temperature, relative humidity, wind velocity and duration and the type and density of vegetation (Duever et al., 1986). In south Florida, ET ranges from 70 to 95 percent of annual rainfall. During the dry season and drought years, ET exceeds rainfall inputs (Klein et al., 1975). Temperature is often regarded as the most important factor controlling ET. Minimum ET rates occur during the winter months of December and January, with highest values experienced during the spring months of April and May. Typical ET values for south Florida range from 40 to 45 inches a year, up to a maximum of 60 inches a year (Parker et al., 1955). ET rates frequently account for virtually all water losses in a wetland because of their slow rate of flow and high surface area to depth ratio (Mitsch et al., 1988). As a result, ET plays a very important role in the development of any hydrologic model that might be developed for a particular wetland system and is usually the most difficult parameter to estimate. Wetlands have higher ET rates than other habitats largely because they store water at or near the ground surface where it can be lost to the atmosphere (Duever, 1988).

Hydroperiod

Hydroperiod refers to the annual period of water level inundation, specifically the depth and length of time (duration) that a wetland contains water above ground level. Figure F-l presents examples of typical hydroperiods experienced by three different south Florida plant communities. Duever et *al.* (1986) reports that hydroperiod is the dominant factor controlling both the existence, plant community composition and succession of south Florida wetland systems. Hydroperiod is often expressed in terms of the range of the number of days that a wetland is normally inundated. Each wetland type is thought to have a hydrologic signature that describes the rise and fall of water levels from year to year (Mitsch and Gooselink, 1986). In contrast, O'Brian and Ward (1980) state that from a hydrological point of view, the most significant feature of a wetland is the level of the ground water table. They point out that the depth to the ground water table is more significant than the hydroperiod or time the wetland is flooded.

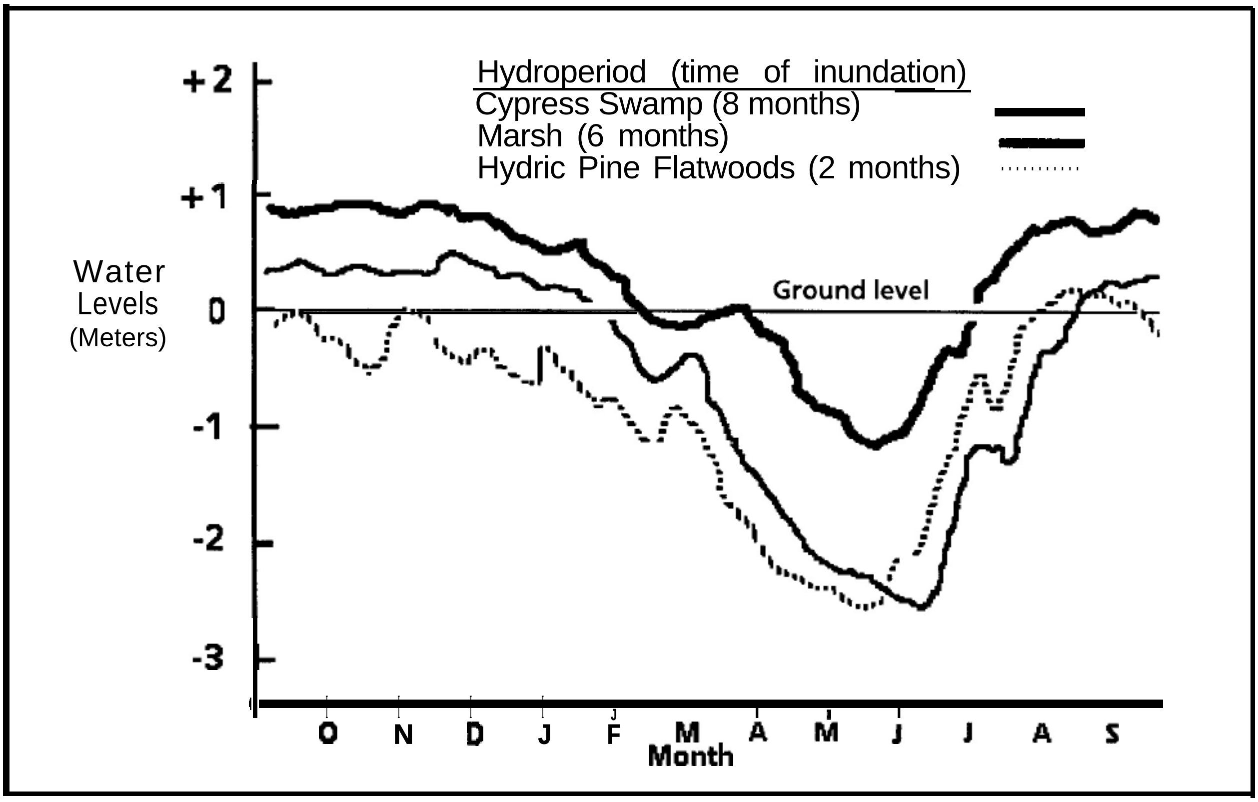

FIGURE F-l. Hydrographs and Hydroperiod Ranges for Three Different South Florida Vegetation Types (From Duever et al., 1986).

Water Level Depth and Timing

In south Florida's freshwater wetlands, wading bird nesting success is highly dependent on present and past water level conditions, which influence the amount and availability of wading bird prey items, such as crayfish and small forage fish (Kushlan, 1976, 1978, 1979, 1980, 1986; Powell, 1987. Kahl (1964) found that the timing and initiation of wood stork breeding attempts was predictable from the measurement of marsh surface water levels. Kushlan et al. (1975) found that wading bird nesting success was directly related to the rapid winter/spring recession of water levels (drying rate) of south Florida wetlands. Therefore, maintenance of appropriate water depths and timing of wetland water level fluctuations is a critical factor in determining wading bird nesting success.

Topography

In general, wetlands in temperate and tropical regions tend to develop in areas of low topographic relief and high rainfall inputs. Topography also controls the shape and size of watersheds, and affects the timing and quantity of runoff. Topography is also an important factor in controlling the vertical and horizontal extent of seasonal water level fluctuations within a wetland. At the site-specific level, wetlands are determined by the depth and duration of inundation, which in turn are influenced by site microtopography (differences in water depth of only a few centimeters), soil type, and vegetative cover (Duever et al., 1986).

Vegetation Type

Vegetation type can affect the hydrologic cycle of a wetland, primarily through ET. Vegetation also influences water movement and water quality. Plant leaves, leaf litter and attached periphyton (algae) communities tend to impede water flow which: (1) increases the period of inundation, (2) reduces surface water runoff and erosion, (3) allows more time for aquifer recharge, and (4) assimilates nutrients and chemical exchanges between the soil vegetation and water (Duever et al., 1986).

Tropical Storms and Hurricanes

Hurricanes, tropical storms which generate winds in excess of 75 miles per hour, are recurrent events in south Florida and are important physical processes which affect the regional ecology (Craighead and Gilbert, 1962). Hurricanes normally cause the greatest amount of damage when wind velocities average greater than **111** miles per hour. They also have the potential of producing massive quantities of precipitation in a very short period of time.

Fire

Fire is also an important factor controlling the species composition, distribution and succession of wetland communities in the planning area. Within the constraints of wetland hydrology, fires occur with variable frequency and severity affecting plant succession.

Theoretically, hardwood hammocks represent the climax plant community for south Florida (Alexander and Crook, 1973; Wharton et al., 1977; Duever, 1984). Hammocks develop when fire is absent or infrequent, and organic soils are allowed to build up over time to support the succession of hardwoods. However, fire is a common component of the south Florida landscape.

Ewel and Mitsch (1978) investigated the effects of fire on a cypress dome in Florida. They found that fire had a cleansing effect on the dome, selectively killing almost all of the pines and hardwoods and yet killing relatively few pond cypress, suggesting a possible advantage of fire to some shallow cypress ecosystems in eliminating competition that is less water tolerant (Mitsch and Gosselink 1986).

Geology and Soils

The primary geological feature that controls regional hydrology is the permeability of the underlying rock. Quartz sand, clay and shell with stringers of limestone comprise the underlying aquifer.

Two primary factors which affect the hydrogeology of wetlands are the porosity and permeability of its underlying soils (Duever, 1988). A highly porous soil can hold or store large amounts of water, while a highly permeable soil allows water to flow to the underlying aquifer. The high capillary action of peat or clay soils enable wetlands to store large quantities of water, somewhat similar to how a sponge takes up water.

Some wetlands contain perched water tables. A perched water table exists where a saturated soil layer is found above a water table and is separated from it by an unsaturated zone (Freeze and Cherry, 1979). This can occur where a relatively impermeable clay or organic soil layer is present near the ground level and restricts the downward movement of water. Perched water tables come in various sizes and can influence surface water levels over large areas or have only local, temporary effects (Duever, 1988). A common misconception is that wetlands can only occur on sites containing a perched water table.

Climate

In addition to hydrology and fire, climate also plays an important role in controlling plant community succession. The area1 extent, species composition, and existence of wetlands are all affected by long-term climatic changes. In addition to normal cyclic drought and flood conditions, long-term cycles have the ability to produce gradual, and nevertheless, major shifts in the normal year-to-year range of hydrologic conditions. As climatic cycles become wetter, wetlands will tend to cover larger areas of the landscape. Wetland communities would also tend to become more diverse as a result of the presence of greater ranges of hydroperiods on different topographic sites. A wetter climate might also increase the rate of peat accretion in wetlands, thus encouraging the development of edaphic plant communities. Long-term drier conditions might produce the opposite effects. A wetter or dryer climate might also affect the frequency of fire, shifting plant community succession. A major difficulty in managing wetlands is our inability to distinguish between shifts in hydrologic conditions that result from man's activities and those that result from occasional natural events or long-term shifts in climate (Duever, 1984).

Succession

Overdrainage of wetlands and reduction of hydroperiod length influences the direction of plant community succession within a wetland. McPhearson (1973) reported that "differences of only a few inches in depth or changes in period of inundation will determine, in time, what plant communities are present [in the Everglades]." Numerous investigators have documented changes in the species composition of south Florida plant communities resulting from altered water level conditions (Davis, 1943; Loveless, 1959; Kolipinski and Higer, 1969; Dineen, 1972, 1974; Alexander and Crook, 1973, 1988; Schortemeyer, 1980; Worth, 1983). The successional relationships of south Florida wetland and upland plant communities have been discussed by Alexander and Crook (1973), Craighead (1971), Davis, (1943), Wharton et al. (1977), and Duever, *et al.* (1986). This successional relationship is presented in Figure F-2. These data are useful for making a general assessment of the direction that succession may take as a result of increasing or decreasing hydroperiod in a Florida wetland.

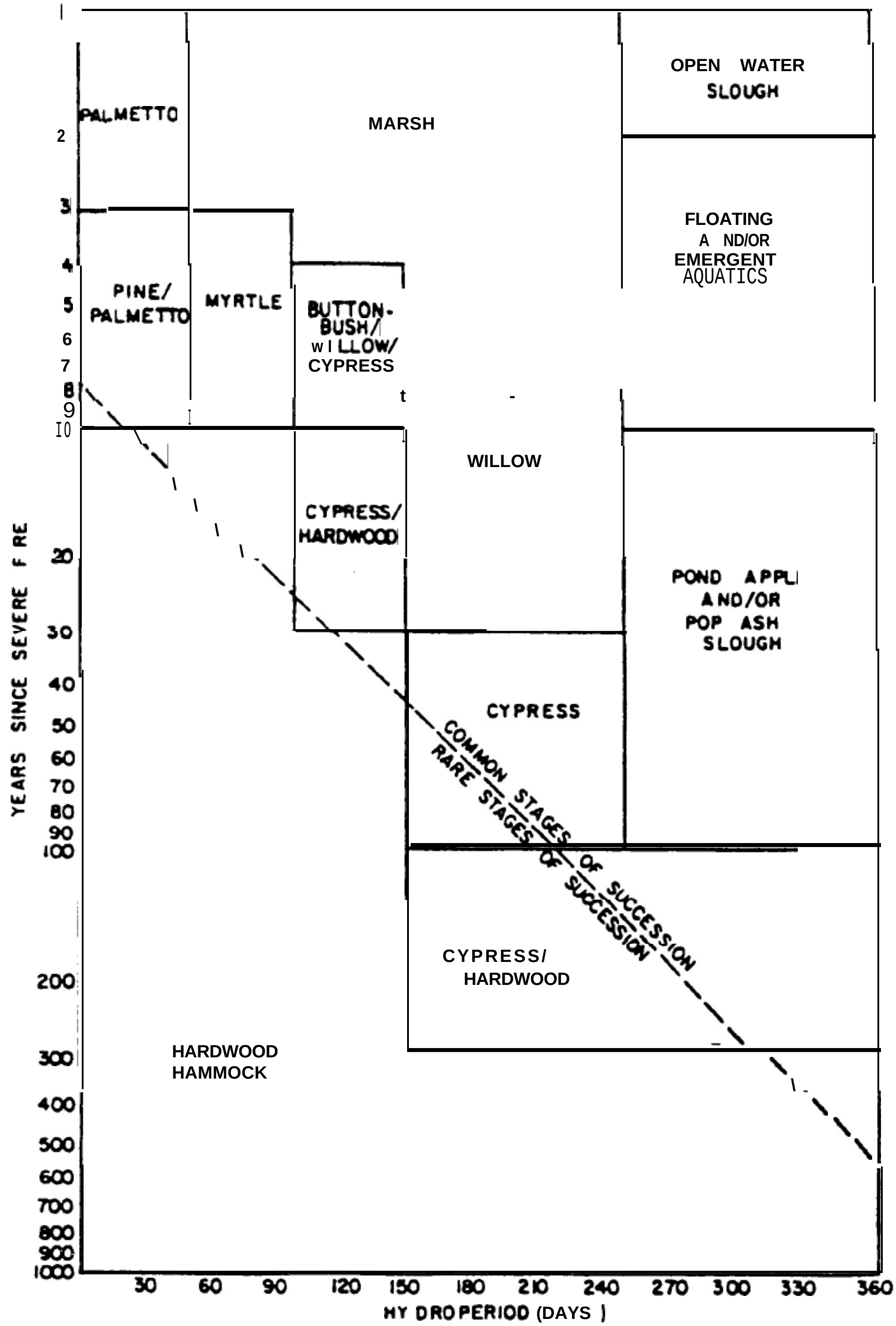

FIGURE F-2. Successional Patterns and Rates within South Florida Inland Plant Communities (From Duever, 1984).

Threatened, Endangered, and Species of Special Concern

TABLE F-l. Threatened, Endangered, and Species of Special Concern in Martin, St. Lucie, and Okeechobee Counties.

SPECIES	County	FGFC	FDA	USFWS
Mammals				
Florida Mouse *Podomys floridanus*	M,S	SSC		
Florida Panther *Felis concolor coryi*	M	E		E
Sherman's Fox Squirrel *Scuirus niqer'shermani*	M,S,0	SSC		
Southeastern Beach Mouse *Permyscus polionotus niveiven tris*	S	T		T
West Indian Manatee *Trichechus manatus*	M,S,0	E		E
Birds				
American Oystercatcher *Haematopus palliatus*	M,S	SSC		
Arctic Peregine Falcon *Falco peregrinus*	~~M,S,O~~	[redacted]		[redacted]
Audubon's Crested Caracara *Polyborus plancus audubonii*	M,S,O	T		T
Bald Eagle *Haliaeetus leucocephalus*	M,S,O	T		E
Black Skimmer *Rynchops niqer*	M,S	SSC		
Brown Pelican *Pelecanus occidentalis*	M,S	SSC		
Florida Grasshopper Sparrow *Ammadramus savannarum floridanus*	0	E		E
Florida Sandhill Crane *Grus canadenses pratensis*	M,S,O	T		
Florida Scrub Jay *Aphelocoma coerulescens coerulescens*	M,S,0	T		T
Least Tern *Sterna antillarum*	M,S,O	T		
Limpkin *Aramus quarauna*	M,S,O	SSC		
Little Blue Heron *Eqretta coerulea*	M,S,0	SSC		
Piping Plover *Charadrius melodus*	M,S	T		T
Red-Cockaded Woodpecker *Picoides borealis*	M	[illegible]		[illegible]
Roseate Spoonbill *Aiaia ajaia*	M,S	SSC		
Snail Kite *Rostrhamus sociabilis plumbeus*	S	E		E
Snowy Egret *Egretta thula*	M,S,O	SSC		

County: M = Martin; S = St. Lucie; 0 = Okeechobee.
Species Designations: E = Endangered; T = Threatened; SSC = Species of Special Concern.
Agencies: FGFC = Florida Game and Fresh Water Fish Commission • Jurisdictional over Florida's animals (vertebrates and invertebrates); FDA = Florida Department of Agriculture and Consumer Services • Jurisdictional over Florida's plants; USFWS = United States Fish and Wildlife Service • Jurisdictional nationally over plants and animals.
Source: The Nature Conservancy, 1990 and Florida Game and Fresh Water Fish Commission, 1993.

TABLE F-l. Threatened, Endangered, and Species of Special Concern in Martin, St. Lucie, and Okeechobee Counties (Continued).

SPECIES	County	FGFC	FDA	USFWS
Birds (Continued)				
Southeastern American Kestrel *Falco sparverius paulus*	M,S,O	T		
Tricolor Heron *Egretta tricolor*	M,S,O	SSC		
Wood Stork *Mycteria americana*	M,S,O	E		E
Reptiles				
American Alligator *Alligator mississippiensis*	M,S,O	SSC		
Atlantic Green Turtle *Chelonia mydas mydas*	M,S	E		E
Atlantic Hawksbill Turtle *Eretmochelys imbricata imbricata*	M	E		E
Atlantic Loggerhead Turtle *Caretta caretta caretta*	M,S	T		T
Eastern Indigo Snake *Drymarchon corais couperi*	M,S,O	T		T
Florida Pine Snake *Pituophis melandeucus mugitus*	S	SSC		
Gopher Tortoise *Gopherus polyphemus*	M,S,O	SSC		
Leatherback Turtle *Dermochelys coriacea*	M,S	E		E
Plants				
Beach Star *Remirea maritima*	M,S	T	E	
Burrowing Four O'Clock *Okenia hypogaea*	O		E	
Carter's Large-flowered flax *Linum carteri var smallii*	M		E	
Catesby's Lily *Lilium catesbaei*	M,S,O		T	
Curtiss' Milkweed *Asclepias curtissii*	M,S		E	
Dollar Orchid *Encyclia boothiana var erythroniodes*	M		E	
Fall Flowering Pleat-leaf *Nemeastylis floridana*	O		E	
Florida Keys Ladies' Tresses *Spiranthes polyantha*	M		E	
Fragrant Prickly Apple *Cereus eriophorus var fragrans*	S		E	
Hand Adder's tongue fern *Ophioglossum palmatum*	M,S		E	
Large Flowered Rosemary *Conradina grandiflora*	M,S		E	

Countv: M = Martin; S = St. Lucie; 0 = Okeechobee.
Species Designations: E = Endangered; T = Threatened; SSC = Species of Special Concern.
Agencies: FGFC = Florida Game and Fresh Water Fish Commission • Jurisdictional over Florida's animals (vertebrates and Invertebrates); FDA = Florida Department of Agriculture and Consumer Services • Jurisdictional over Florida's plants, USFWS = United States Fish and Wildlife Service -Jurisdictional nationally over plants and animals.
Source: The Nature Conservancy, 1990 and Florida Game and Fresh Water Fish Commission, 1993.

TABLE F-l. Threatened, Endangered, and Species of Special Concern in Martin, St. Lucie, and Okeechobee Counties (Continued).

SPECIES	County	FGFC	FDA	USFWS
Plants (Continued)				
Night Scent Orchid *Epidendrum nocturnum*	M,O		T	
Nodding Pinweed *Lechea cernua*	M,S		E	
Pepper *Peperomia humilis*	M,S		E	
Pine Pinweed *Lechea divaricata*	M		E	
Redberry Ironwood *Eugenia confusa*	M		T	
Simpson Zephyr Lily *Zephyranthes simpsonii*	M,O		E	
Spotless - Petaled Balm *Dicerandra immaculata*	S		E	
Twisted Air Plant *Tillandsia flexuosa*	M		T	
Vanilla *Vanilla mexicana*	M		T	
Venus Hair Fern *Adiantum capillus-veneris*	M		T	
Wild Coco *Pteroglossaspis ecristata*	M		T	

Countv: M = Martin; S = St. Lucie; 0 = Okeechobee.
Species Designations: E = Endangered; T = Threatened; SSC = Species of Special Concern.
Agencies: FGFC = Florida Game and Fresh Water Fish Commission • Jurisdictional over Florida's animals (vertebrates and invertebrates); FDA = Florida Department of Agriculture and Consumer Services • Jurisdictional over Florida's plants; USFWS = United States Fish and Wildlife Service • Jurisdictional nationally over plants and animals.
Source: The Nature Conservancy, 1990 and Florida Game and Fresh Water Fish Commission, 1993.

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APPENDIX G

Methodology for Urban and Agricultural Demand Projections

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URBAN DEMAND

Public Water Supply and Residential Self Supplied

Public water supply (PWS) and residential self-supplied demand estimates and projections were developed for the Upper East Coast Planning Area for the years 1990 and 2010. Water supply demands were calculated by multiplying population data by per capita water use rates. Per capita water use rates were determined using the 1990 water withdrawals for each utility reported by the U.S. Geological Survey (USGS) and dividing that number by the 1990 population determined to be in the area by the U.S. Bureau of the Census. The resulting 1990 per capita water use rates were held constant to project 2010 water demand.

PWS and residential self-supplied water demands are broken down by utility service areas and planning areas (Figure G-1). Utility service area boundaries were obtained from the regional water supply utilities and incorporate areas currently serviced.

Areas outside of regional water utility service areas are referred to as planning areas. A Geographic Information Systems (GIS) coverage showing these planning areas was developed generally using the Traffic Analysis Zones (TAZs) obtained from the Metropolitan Planning Organization. By dividing each county into utility service areas and planning areas, more detailed area-specific estimates of water demand could be obtained.

Population

1990 Estimates. U.S. Census data for 1990 was used as the basis for the 1990 population, which was 252,086 (Table G-1). Block group level information was used as the basic unit of analysis. Total population, total housing units, occupied housing units, and persons per occupied housing unit were taken from Census Data. The total units connected to a public water system and total units self supplied were obtained from the Summary Tape File 3A Sample Census Data (U.S. Bureau of the Census, 1992).

The population served by PWS and the self-supplied population were calculated by multiplying the number of occupied dwelling units by the average persons per occupied unit for each respective block group. The result of this calculation was subsequently assigned to specific census block groups, assuming a uniform population distribution. These population data were input as polygon coverages into the SFWMD GIS. Utility service areas and planning areas were also entered into the GIS as polygon coverages and superimposed on the census block data in order to assign population to specific utilities.

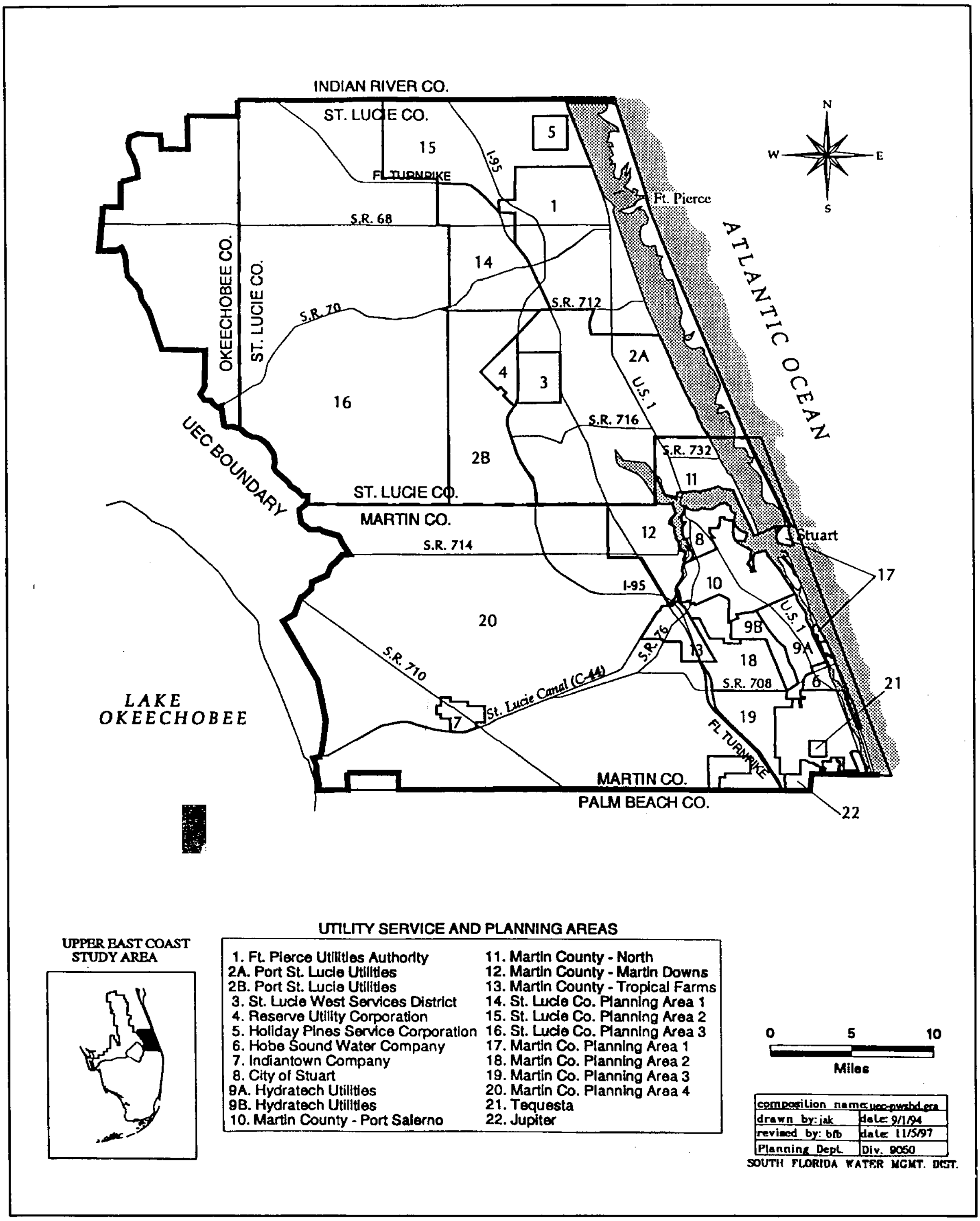

FIGURE G-1. Utility Service Areas and Planning Areas.

Assuming a uniform distribution can underestimate the population in developed areas and overestimate the population in the less developed areas. This problem is especially evident in areas where urban densities are adjacent to very low intensity development or undeveloped areas and where the census block group is split by a service area boundary.

TABLE G-l. Population Estimates and Projections in the UEC Planning Area.

Jurisdiction	1990 Census Data Estimate	2010 Comp. Plan Projection
Martin County Jupiter Island	549	684
Ocean Breeze Park	519	630
Sewalls Point	1,588	3,200
Stuart	11,936	15,094
Unincorp. Martin County	86,308	134,592
Martin County Total	100,900	154,200
Okeechobee County Unincorp. Okeechobee	1,015	1,625
Okeechobee Area Total	1,015	1,625
St. Lucie County Fort Pierce	36,830	55,500
Port St. Lucie	55,866	140,700
St. Lucie Village	584	833
Unincorp. St. Lucie County	56,891	93,067
St. Lucie County Total	150,171	290,100
Planning Area Total	**252,086**	**445,925**

Source: U.S. Bureau of the Census, Local Government Comprehensive Plans.

To account for this distribution problem, adjustments were made in the population estimates for the following areas:

Martin County
- Planning Areas 2 and 4
- Martin County Utilities (Port Salerno and Tropical Farms)

St. Lucie County
- Planning Areas 4 and 5
- Holiday Pines

In addition, the assumption that self-supplied population was evenly distributed led to questionable identification of potential problem areas. For example, population and its associated demand were sometimes distributed in undeveloped wetland areas, resulting in an exceedance of the wetland protection criterion. Therefore, more refined data inputs were developed for the location of self-supplied population.

Specifically, rather than distributing residential self-supplied demand evenly over an entire planning or utility service area, more precise locations for residential self supplied and small water treatment "package plant" withdrawals were determined by looking at aerial photography and meeting with utility representatives. Subsequently, areas that were identified as having no residential self-supplied demand were entered into the GIS as polygons and "masked out."

These masked out areas included:

*Areas where development was concentrated
*Publicly owned conservation lands and transportation facilities (including airports)
*Areas identified as wetlands by the National Wetlands Inventory (Martin County only)
•Areas in agricultural production

These modifications resulted in an enhanced distribution of population which was assumed to better reflect actual 1990 conditions.

2010 Projections. The 2010 population projections were based on population data in adopted local government comprehensive plans. The region's total population, 445,925, was controlled to the total future growth in the comprehensive plans. For those jurisdictions whose comprehensive plan did not extend population projections to 2010, the population projection was extrapolated to provide a 2010 population estimate.

For Martin and St. Lucie counties, the geographic distribution of the 2010 population was determined using TAZ population data. The percentage of the total population identified for a particular TAZ in the MPO plan was used as the basis for distributing the comprehensive plan population. This assumes that the MPO plan is generally consistent with the comprehensive plan as required by Chapter 339, Florida Statutes. The geographic distribution of future population in Okeechobee County was based upon the future land use element and map in the Okeechobee County Comprehensive Plan.

Using the ratios of population growth from the MPO plan to distribute the 2010 population, population densities were calculated for each TAZ, assuming a uniform density within each zone. This assumption was modified in geographically large TAZs. Future county land use maps were examined to determine the geographic areas within the TAZ where the comprehensive plan was directing population. The larger TAZs were divided into multiple polygons consistent with the land use maps. Future growth was concentrated in the areas identified for development in the adopted and approved comprehensive plans.

The geographic areas resulting from this analysis of the TAZs were input as polygon coverages into the GIS and superimposed on the utility polygon coverages used in the 1990 analysis. The resulting coverages were joined to create a new polygon coverage. Population estimates for the year 2010 were then recalculated for the new polygon coverage by multiplying the area of the polygon by the population density. The population of all service areas were then totaled and controlled to local comprehensive plan projection totals.

As with the 1990 population estimates, areas identified as having no residential self-supplied demand were entered into the GIS as polygons and “masked out.” Within both Martin and St. Lucie counties, publicly owned conservation lands and transportation facilities were defined as separate polygons with no population assigned to them in 2010. In Martin County, areas identified as wetlands in the NWI were also defined as separate polygons with no population assigned to them unless recorded plats could be identified within the wetland areas; this modification was designed to reflect Martin County’s strong wetland protection program, assuming its continuation in the future. In addition, lands designated “agriculture” on Martin County’s adopted future land use map were defined as discrete polygons with no 2010 population assignment, assuming that the water demand in these areas would be addressed through projections of agricultural demand. Similar modifications affecting the distribution of population in St. Lucie County were not required based upon empirical review of the data.

Per Capita Rates

Per capita water use rates for each utility were estimated using raw water withdrawal data for 1990 obtained from the USGS. This information was divided by the calculated 1990 population of the service area to calculate per capita usage rates for 1990. Per capita rates ranged from 102 MGD (Martin County/Martin Downs) to 1,205 (Hobe Sound).

Self-supplied per capita water use rates for households within a PWS utility service area were assumed to be the same as those households on the public water supply system. Within Martin County, the per capita rates for the self-supplied planning areas were assumed to be the same as the weighted average PWS per capita rate for the three county utility service areas. Total withdrawals for all three utilities were divided by the total population served in order to arrive at this weighted average. Within St. Lucie County, the self-supplied per capita use rate of Port St. Lucie was applied in the planning areas. The per capita use rate in Okeechobee County was assumed to be similar to that of the St. Lucie County planning areas.

Irrigation demand for PWS-served households using private well water for their irrigation was not estimated.

Demand

Demand was defined as population times per capita water use rate. The estimated total water demand was 43.85 MGD in 1990. Water demand is projected to increase 87 percent from 1990 to 2010 to a total water demand of 81.88 MGD.

For each service area, a PWS demand and a residential self-supplied demand were calculated for 1990 and 2010. The 2010 projections assumed the same per capita use rates as in 1990. In addition, the self-supplied population within each PWS service area (other than the Port St. Lucie and Hydratech service areas, which expanded during the period) was held constant. It was assumed that, in all service areas other than Port St. Lucie and Hydratech, all future growth would use the utility for their water source.

Within the Port St. Lucie service area, an allowance was made for growth in the recently expanded area between 1990 and the time the service area was extended. The expanded service area was treated as a sub-unit of the Port St. Lucie service area with its distinctive growth rate calculated using the methodology described above. The growth rate of this area was assumed to be constant during the period between 1990 and 2010, with all population growth in the area prior to the extension of service assumed to use residential self-supply as its water source. All population growth after the extension of the service into this area was assumed to use the utility as its source of water. Port St. Lucie is also planning to extend public water supply throughout its service area. Based on information from the utility, half of the population using residential self-supply wells in 1990 was assumed to become connected to public water supply by 2010.

Within the Hydratech service area, a similar expansion was accounted for. Estimates of the number of households within this expanded service area were obtained from the Redi-Maps for 1995, assuming a constant vacancy rate between 1990 and 1995 and a average household size consistent with that of the block group as identified in the 1990 Census. All of the households within the expanded service area in 1995 were assumed to use individual wells as their source of water. The total number of households relying on wells was assumed to remain constant between 1995 and the end of the planning period, with all subsequent growth assumed to use the utility.

Summary

The total population estimates for the UEC Planning Area for 1990 was 252,086. The projected total population for 2010 increased to 445,925. The estimated water demand for urban users was 43.85 million gallons per day (MGD) in 1990. Water demand is projected to increase 87 percent from 1990 to 2010 to a total water demand of 81.88 MGD.

Table G-2 shows the per capita water use rate for each service area, the population estimates, and the resulting water demand for 1990. Table G-3 shows the per capita water use rate for each service area, the population projections, and the resulting water demand for 2010.

TABLE G-2. Population and Water Demand Estimates, 1990.

Service Area	Utility Served Population	Utility Served Use (MGD)	Computed GPCD*	Self Supplied Population	Self Supplied Use (MGD)	Service Area Population	Total Service Area Use (MGD)
Martin County							
Hobe Sound	2,099	2.53	1,205	498	0.60	2,597	3.13
Hydratech	8,065	1.10	136	3,269	0.45	11,334	1.55
Indiantown	3,003	0.69	230	197	0.05	3,200	0.74
Jupiter	1,478	0.36	244	267	0.07	1,745	0.43
Martin Co./Martin Downs	5,368	0.55	102	6,131	0.63	11,499	1.18
Martin Co. North	9,030	1.77	196	10,461	2.05	19,491	3.82
Martin Co./Port Salerno	10,938	2.14	196	11,561	2.26	22,499	4.40
Martin Co./ Tropical Farms	0		176	627	0.11	627	0.11
Stuart	13,237	3.22	243	757	0.18	13,994	3.40
Tequesta	1,717	0.38	221	514	0.11	2,231	0.49
Planning Areas							
Planning Area 1	0		176	702	0.12	702	0.12
Planning Area 2	0		176	2,555	0.45	2,555	0.45
Planning Area 3	0		176	585	0.10	585	0.10
Planning Area 4	0		176	7,841	1.38	7,841	1.38
Martin County Total	54,935	12.74	---	45,965	8.56	100,900	21.30
Okeechobee County							
Planning Area	0		120	1,015	0.12	1,015	0.12
Okeechobee Co. Total	0	0.00	120	1,015	0.12	1,015	0.12
St. Lucie County							
Fort Pierce	53,786	9.29	173	20,337	3.51	74,123	12.80
Holiday Pines	1,921	0.38	198	1,156	0.23	3,077	0.61
Port St. Lucie	30,515	3.67	120	30,625	3.68	61,140	7.35
Port St. Lucie A							
Port St. Lucie B	0		120	694	0.08	694	0.08
Reserve	260	0.12	462	101	0.05	361	0.17
St. Lucie West	326	0.12	368	138	0.05	464	0.17
Planning Areas							
Planning Area 3A	0		120	472	0.06	472	0.06
Planning Area 3B			120	0	0.00	0	0.00
Planning Area 4A	0		120	9,719	1.17	9,719	1.17
Planning Area 4B			120	492	0.06	492	0.06
Planning Area 5	0		120	121	0.01	121	0.01
St. Lucie County Total	86,808	13.58	---	63,364	8.85	150,171	22.43
TOTAL	141,743	26.32		110,344	17.53	252,086	43.85

*GPCD = Gallons per capita per day.

TABLE G-3. Population and Water Demand Projections, 2010.

Service Area	Utility Served Population	Utility Served Use (MGD)	Computed GPCD*	Self Supplied Population	Self Supplied Use (MGD)	Service Area Population	Total Service Area Use (MGD)
Martin County							
Hobe Sound	3,475	4.19	1,205	498	0.60	3,973	4.79
Hydratech							
Hydratech A	13,434	1.83	136	2,747	0.37	16,703	2.27
Hydratech B	0	1.83	136	522	0.07	522	0.07
Indiantown	4,699	1.08	230	197	0.05	4,896	1.12
Jupiter	2,403	0.59	244	267	0.07	2,670	0.65
Martin Co./Martin Downs	11,461	1.17	102	6,131	0.63	17,592	1.80
Martin Co. North	19,360	3.79	196	10,461	2.05	29,821	5.85
Martin Co./Port Salerno	24,340	4.37	196	11,561	2.26	35,754	7.00
Martin Co./ Tropical Farms	5,153	0.91	176	640	0.11	5,793	1.02
Stuart	16,296	3.96	243	757	0.18	17,053	4.15
Tequesta	2,899	0.64	221	514	0.11	3,413	0.76
Planning Areas							
Planning Area 1	0		176	1,075	0.19	1,075	0.19
Planning Area 2	0		176	2,043	0.36	2,043	0.36
Planning Area 3	0		176	895	0.16	895	0.16
Planning Area 4	0		176	11,997	2.11	11,997	2.11
Martin County Total	101,520	24.36	---	52,680	9.32	154,200	32.30
Okeechobee County							
Planning Area	0		120	1,625	0.20	1,625	0.20
Okeechobee Co. Total	0	0.00	120	1,625	0.20	1,625	0.20
St. Lucie County							
Fort Pierce	81,105	14.03	173	16,965	2.93	98,070	16.94
Holiday Pines	7,067	1.40	198	1,156	0.23	8,223	1.63
Port St. Lucie							
Port St. Lucie A	103,378	12.40	120	16,753	2.01	120,131	14.45
Port St. Lucie B			120	13,237	1.59	13,237	1.59
Reserve	9,371	4.33	462	101	0.05	9,472	4.37

*GPCD = Gallons per capita per day.

TABLE G-3. (Continued)

Service Area	Utility Served Population	Utility Served Use (MGD)	Computed GPCD*	Self Supplied Population	Self Supplied Use (MGD)	Service Area Population	Total Service Area Use (MGD)
St. Lucie West	20,399	7.51	368	138	0.05	20,537	7.56
Planning Areas							
Planning Area 3A	0		120	1,760	0.21	1,760	0.21
Planning Area 3B	0		120	879	0.11	879	0.11
Planning Area 4A	0		120	12,680	1.53	12,680	1.53
Planning Area 4B	0		120	3,460	0.42	3,460	0.42
Planning Area 5	0		120	1,651	0.20	1,651	0.20
St. Lucie County Total	221,320	40.06	---	88,780	9.32	290,100	48.99
TOTAL	322,840	64.42	---	123,085	18.84	445,925	81.49

*GPCD = Gallons per capita per day.

The employment by sector was evaluated regarding the predominant types of employment found in the county, and if these employment types could be expected to grow at the same rate and in the same direction as the population. In the UEC Planning Area, 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. Water used for commercial and industrial purposes supplied by utilities are included with other utility demands. Self-supplied commercial and industrial demands are shown in Table G-4. Industrial self-supplied water use was assumed to increase at the same rate as the county population, with 1990 used as the base year.

TABLE G-4. Commercial and Industrial Self-Supplied Demand.

County	1985*	1990	1995	2000	2005	2010
St. Lucie County						
Population	116,235	150,171	184,514	218,858	253,201	287,544
Demand (MGD)	0.11	0.81	1.oo	1.19	1.37	1.56
Martin County						
Population	80,909	100,900	120,532	140,163	159,795	179,426
Demand (MGD)	1.28	1.52	1.81	2.10	2.40	2.74

* 1985 population from University of Florida, Bureau of Economic and Business Research, unpublished 1988 data.

Recreation Self Supplied

Landscape

Demand projections for this section include irrigated acreage permitted for landscaping and recreation, excluding golf courses. Landscaping water use was assumed to increase at the same rate as the county population, with 1990 used as the base year. Projections for landscaping and recreation self supplied demand are outlined in Table G-5.

TABLE G-5. Landscape Self-Supplied Demand.

County	1985*	1990	1995	2000	2005	2010
St. Lucie County						
Population	116,235	150,171	184,514	218,858	253,201	287,544
Demand (MGD)	2.76	3.98	4.89	5.80	6.71	7.62
Martin County						
Population	80,909	100,900	120,532	140,163	159,795	179,426
Demand (MGD)	0.27	1.87	2.23	2.60	2.96	3.38

*** 1985 population from University of Florida, Bureau of Economic and Business Research, unpublished 1988 data.**

Golf Course

Golf courses in the UEC Planning Area are found in St. Lucie and Martin counties. There are some water demands for irrigating golf courses in Okeechobee County, but these are outside of the planning area. Historical irrigated golf course acreage data were gathered from the *Official Florida Golf Guide* (Florida Dept. of Commerce, 1990, 1991), Golf *Guide to the South* (Florida Golfweek, 1989), *The Golf Course* (Cornish and Whitten, 1988), District water use permits, and personal communication with several of the golf courses listed.

St. Lucie County. The golf courses presently in St. Lucie County are described in Table G-6, As in other counties, the growth in golf course acreage has occurred irregularly on a year-by-year basis.

The first reported golf course opening in St. Lucie County was in 1938; however there were no additional golf courses opened prior to 1961. In order to improve the model fit, these early observations, prior to 1960 were dropped from the estimation process. Equation G-l was estimated to project irrigated golf course acreage in St. Lucie County.

TABLE G-6. Golf Courses in St. Lucie County.

Name	Year Opened	Total Acres	Irrigated Acres
Indian Hills G & CC	1938	98	98
Village Hotel of Sandpiper	1960	257	234
Spanish Lakes	1971	8	8
Indian Pines CC	1971	108	50
Golf Village CC	1980	16	5
Spanish Lakes Golf Village	1980	17	8
Spanish Lakes CC	1981	25	14
Island Dunes GC*	1983	112	50
Meadowood (Monte Carlo)*	1983	394	122
Reserve G & TC, The	1984	264	146
Harbour Ridge*	1984	200	160
Gator Trace CC	1985	100	60
Savanna Club GC	1985	59	59
St. Lucie West*	1988	100	100
Spanish Lakes Fairways*	1989	56	31
Fait-winds	1991	300	144
Wilderness GC	1992	178	47
Ballentrae G & YC*	1993	188	120
Total		2,480	1,456

*Golf courses using reclaimed water.

$$CUMACRES_t = f\,(time_t, pop_t, d) \qquad \textbf{(G-1)}$$

where:

$time_t$ = **1** *in 1938, increasing by 1 unit per year thereafter.*

pop_t = *estimated or forecasted St. Lucie County population (in thousands) in year t.*

d = a dichotomous variable equal to 1 for the period 1984 and after and 0 otherwise.

Historic population data came from the Bureau of Economic and Business Research and the U. S. Bureau if the Census; forecasted population data came from the County Comprehensive Plan. When Equation G-l was estimated using ordinary least squares, the results shown in Equation G-2 were obtained.

$$CUMACRES_t = 1963.701 - \underset{(-4.49)}{79.42 * time_t} + \underset{(6.37)}{21.06 * pop_t} + \underset{(6.21)}{315.670 * d} \qquad \textbf{(G-2)}$$

Goodness of fit statistics
$R^2 = .9780$
$F = 117.85$
$Pr\ F > 0 > .999$
D-W = 2.214
t-statistics in parentheses

It should be noted that the negative sign on the time variable does not mean that golf courses are decreasing over time, but rather that population and golf course acreage are both increasing over time with population increasing at a faster rate than golf course acreage.

When Equation G-2 was used to project St. Lucie County golf course acreage, the results shown in Table G-7 were obtained.

TABLE G-7. Historical and Projected Irrigated Golf Course Acreage in St. Lucie County.

Year	Historical	Primary projection	Primary -15%	Primary +15%
1960	332			
1965	332			
1970	332			
1975	390			
1980	403			
1981	417			
1982	417			
1983	589			
1984	895			
1985	1,014			
1986	1,014			
1987	1,014			
1988	1,114			
1989	1,145			
1990	1,145			
1991	1,289			
1992	1,336			
1993	1,456	1,379		
Projections				
1994		1,521	1,293	1,749
1995		1,559	1,325	1,793
1996		1,624	1,380	1,868
1997		1,689	1,436	1,942
1998		1,754	1,491	2,017
1999		1,820	1,547	2,093
2000		1,885	1,602	2,168
2001		1,950	1,658	2,243
2002		2,015	1,713	2,317
2003		2,081	1,769	2,393
2004		2,146	1,824	2,468
2005		2,211	1,879	2,543
2006		2,276	1,935	2,617
2007		2,342	1,991	2,693
2008		2,407	2,046	2,768
2009		2,472	2,101	2,843
2010		2,537	2,156	2,918

The irrigation requirements in Table G-9 were calculated by applying projected irrigated acreages to the supplemental water requirements (as calculated by the Blaney-Criddle permitting model). Input variables used were irrigated acreage of grass from Table G-7, sandy soil with 0.8 inch usable soil water capacity, sprinkler irrigation systems with an irrigation efficiency of 75 percent, and Fort Pierce as the rainfall station (Table G-8).

TABLE G-8. Supplemental Water Requirements for Grass in St. Lucie County.

Month	Average (in.)	2-in-10 (in.)
January	0.79	1.01
February	0.96	1.20
March	2.18	2.47
April	3.33	3.67
May	4.28	4.74
June	3.88	4.58
July	4.74	5.36
August	4.37	5.01
September	2.47	3.24
October	1.54	2.21
November	1.80	2.05
December	1.20	1.40
Total	**31.54**	**36.94**

Rainfall station = Fort Pierce
Soil type = 0.8 in.

TABLE G-9. Irrigation Requirements (MG) for the Primary Irrigated Golf Course Acreage Projection in St. Lucie County.

Average	1985	1990	1995	2000	2005	2010
January	29	33	45	54	63	73
February	35	40	54	66	77	88
March	80	90	123	149	175	200
April	122	138	188	227	267	306
May	157	177	242	292	343	393
June	142	161	219	265	311	356
July	174	197	268	324	397	435
August	160	181	247	298	350	401
September	91	102	139	169	190	227
October	57	64	87	105	123	141
November	66	75	102	123	144	165
December	44	50	68	82	96	110
Total	**1,158**	**1,308**	**1,780**	**2,153**	**2,525**	**2,897**
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	37	42	57	69	81	93
February	44	50	68	82	96	110
March	91	102	139	169	198	227
April	135	152	207	250	294	337
May	174	197	268	324	379	435
June	168	190	259	313	367	421
July	197	222	304	366	429	492
August	184	208	283	342	401	460
September	119	134	183	221	259	298
October	81	92	125	151	177	203
November	75	85	116	140	164	188
December	51	58	79	96	112	129
Total	**1,356**	**1,531**	**2,085**	**2,521**	**2,957**	**3,393**

Martin County. The golf courses presently in Martin County are described in Table G-10. Martin County has experienced rapid growth in irrigated golf course acreage since the early 1960s. There was an over three-fold increase in Martin County irrigated golf course acreage between 1960 and 1970. Between 1970 and 1980, Martin County golf course acreage more than doubled and again more than doubled during the 1980s. As in other counties, the growth in golf course acreage has occurred irregularly on a year-by-year basis.

TABLE G-10. Golf Courses in Martin County.

Name	Year opened	Total acres	Irrigated acres
Martin County G & CC	1951	304	182
Yacht & CC of Stuart	1965	220	140
* Jupiter Hills Club	1969	366	298
Monterey Yacht & CC	1970	18	18
Pine Lakes GC (Holiday)	1971	75	50
* Crane Creek (Martin Downs CC)	1972	105	85
* River Bend GC	1974	182	68
** Jupiter Island GC (Hobe Sound Water Co.)	1974	103	103
* Turtle Creek Club	1976	158	105
Evergreen Club, The	1978	70	70
* Indian River Plantation	1978	195	70
Cypress Links	1979	250	150
* Heritage Ridge	1980	110	110
* Sailfish Point GC	1981	310	250
Mariner Sands CC	1982	568	215
* Towers (Martin Downs CC)	1982	150	101
* Piper's Landing CC	1982	467	66
Old Trail	1983	326	225
* Miles Grant CC	1983	88	88
* Eaglewood GC	1983	164	50
Indianwood G & CC	1984	119	86
Monarch	1986	110	110
Hobe Sound GC	1987	235	110
Cobblestone CC (Stuart West)	1988	95	95
Willoughby Golf Club	1988	154	105
* Loblolly Pines GC	1988	115	85
* Cutter Sound G & YC	1990	75	65
Golf World	1990	16	8
Summerfield GC (Palmetto Cove)	1991	553	155
* Lost Lake GC (Double Tree)	1992	110	90
Total		5,811	3,353

*Golf courses using reclaimed water.
**Golf courses using PWS potable water.

The first reported golf course opening in Martin County was in 1951. However, there were no additional golf courses opened prior to 1965. In order to improve the model fit, these early observations, prior to 1965 were dropped from the estimation process. Equation G-4 was estimated to project irrigated golf course acreage in Martin County.

$$CUMACRES_t = f(time_t, logime_t, d) \qquad \text{(G-4)}$$

where:

$time_t$ = *1 in 1951 and increasing one unit per year thereafter.*

$logtime_t$ = *the natural log of time.*

d = a dichotomous variable equal to 1 in 1982 and thereafter and 0 otherwise.

Equation G-4 was estimated using ordinary least squares, and adjusted for the 1990 acreage. This resulted in Equation G-5.

$$CUMACRES_t = -4036.858 + \underset{(9.33)}{181.32 * time_t} - \underset{(-4.52)}{2357.70 * logime_t} + \underset{(7.50)}{521 * d} \qquad \textbf{(G-5)}$$

Goodness of fit statistics

$R^2 = .9894$

$F = 812.54$

$Pr\ F > 0 > .999$

$D\text{-}W = 1.401$

t-statistics in parentheses

Equation G-5 was used to develop the primary projection of irrigated golf course acreage in Martin County. This projection is presented in Table G-11.

TABLE G-11. Historical and Projected Irrigated Golf Course Acreage in Martin County.

Year	Historical	Primary Projection	Primary -15%	Primary + 15%
1955	182			
1960	182			
1965	322			
1970	638			
1975	944			
1980	1,449			
1981	1,699			
1982	2,306			
1983	2,444			
1984	2,530			
1985	2,530			
1986	2,640			
1987	2,750			
1988	3,035			
1989	3,035			
1990	3,108			
1991	3,263			
1992	3,353			
1993	3,353			
Projec tions				
1994		3,480	2,958	4,002
1995		3,608	3,067	4,149
1996		3,738	3,177	4,299
1997		3,869	3,289	4,449
1998		4,000	3,400	4,600
1999		4,133	3,513	4,753
2000		4,267	3,627	4,907
2001		4,401	3,741	5,061
2002		4,537	3,856	5,218
2003		4,673	3,972	5,374
2004		4,811	4,089	5,533
2005		4,949	4,207	5,691
2006		5,087	4,324	5,850
2007		5,227	4,443	6,011
2008		5,367	4,562	6,172
2009		5,508	4,682	6,334
2010		5,650	4,803	6,498

The irrigation requirements in tables G-13, G-14, and G-15 were calculated by applying projected irrigated acreages (PWS supplied, non-PWS supplied and total) to the supplemental water requirements. PWS supplied refers to potable water, and does not include reclaimed water. Input variables used were total and self supplied irrigated acreage of grass, sandy soil with 0.4 inch usable soil water capacity, sprinkler irrigation systems with an irrigation efficiency of 75 percent, and Stuart as the rainfall station (Table G-12).

TABLE G-12. Supplemental Water Requirements (inches) for Grass in Martin County.

Month	Average	2-in-10
January	1.02	1.15
February	1.24	1.38
March	2.53	2.71
April	3.76	3.97
May	4.55	4.85
June	4.18	4.65
July	4.79	5.24
August	4.73	5.14
September	2.69	3.22
October	1.76	2.22
November	2.24	2.38
December	1.34	1.47
Total	**34.83**	**38.38**

Rainfall station = Stuart
Soil type = 0.4 in.

Jupiter Island Golf Club is the only golf course in Martin County that is irrigated with potable water from a public utility. This golf course opened in 1974 and no more golf courses supplied in this manner are anticipated through 2010. Irrigation requirements for this PWS supplied golf course are presented in Table G-13.

TABLE G-13. Irrigation Requirements (MG) for the PWS Supplied Golf Courses in Martin County.

Month	Average	2-in-10
January	4	4
February	5	5
March	9	10
April	14	15
May	17	18
June	16	17
July	18	20
August	18	19
September	10	12
October	7	8
November	8	9
December	5	5
Total	130	143

TABLE G-14. Irrigation Requirements (MG) for the Non-PWS Supplied Primary Projection for Irrigated Golf Course Acreage in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	90	111	129	154	179	205
February	109	135	157	187	218	249
March	222	275	321	381	444	508
April	330	409	477	567	660	755
May	400	495	577	686	798	914
June	367	455	530	630	733	840
July	421	521	608	722	840	962
August	416	515	600	713	830	950
September	236	293	341	406	472	540
October	155	191	223	265	309	353
November	197	244	284	338	393	450
December	118	146	170	202	235	269
Total	3,061	3,790	4,420	5,251	6,111	6,995
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	101	125	146	173	202	231
February	121	150	175	208	242	277
March	238	295	344	409	476	544
April	349	432	504	599	697	797
May	426	528	616	731	851	974
June	409	506	590	701	816	934
July	460	570	665	790	919	1,052
August	452	559	652	775	902	1,032
September	283	350	409	485	565	647
October	195	242	282	335	390	446
November	209	259	302	359	418	478
December	129	160	187	222	258	295
Total	3,373	4,176	4,871	5,787	6,734	7,708

TABLE G-15. Irrigation Requirements (MG) for the Total Irrigated Golf Course Acreage Projection in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	93	115	133	158	183	209
February	114	140	162	192	222	254
March	232	285	331	391	453	518
April	344	423	491	581	674	769
May	417	512	594	703	815	931
June	383	470	546	646	749	855
July	439	539	626	740	858	980
August	433	532	618	731	848	968
September	246	303	351	416	482	550
October	161	198	230	272	315	360
November	205	252	293	346	401	458
December	123	151	175	207	240	274
Total	3,191	3,920	4,550	5,381	6,241	7,125
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	105	129	150	178	206	235
February	126	155	180	213	247	282
March	248	305	354	419	486	554
April	364	447	519	613	711	812
May	444	546	634	749	869	992
June	426	523	607	718	833	951
July	480	590	685	810	939	1,072
August	471	578	671	794	921	1,052
September	295	362	421	497	577	659
October	203	250	290	343	398	454
November	218	268	311	368	426	487
December	135	165	192	227	263	301
Total	3,516	4,319	5,014	5,930	6,877	7,852

AGRICULTURAL DEMAND PROJECTIONS

Acreage Projections

Agricultural water demand estimates were made by time horizon and month. The techniques chosen to project crop acreages were those judged by District staff to best reflect the specific crop scenario in the Upper East Coast (UEC) Planning Area. 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 used which produced tangible projections universally, no such functional form was established.

In some cases, a single mathematical model could be chosen as it accurately explained past trends, and was judged as clearly the most valid scenario for the future. In other cases, several models accurately explained past trends, and none of these provided explicitly more likely projections than the others. In those cases, the projections of several statistically valid and empirically sound models were averaged. This approach was justified by research performed at the Bureau of Economic and Business Research at the University of Florida (Mahmoud, 1984) which showed that taking the average of a number of different projections reduces the chances of making large errors and leads to more reliable projections.

Where no statistically valid trend, nor any convincing empirical knowledge on future changes in a crop's acreage in a county could be found, the crop's acreage was projected at its most recently reported level (± 15 percent). Usually these situations arose from relatively insignificant (in terms of quantity) water users.

Irrigation requirements were calculated for the six time horizons for the primary crop acreage projections for crops using forty acres or more of land in any of the counties in the planning area. Average and 2-in-10 irrigation requirements were calculated by month using the District's modified Blaney-Criddle permitting model. Historical weather data from the rainfall station most commonly used for permitting for each crop, in each county, were used to calculate irrigation requirements. In each case, the relevant rainfall station is identified.

Irrigation Demands

A crop's supplemental water requirement is the amount of water used for evapotranspiration minus effective rainfall, while irrigation requirement includes both the supplemental water requirement and the losses incurred in getting irrigation to the crop's root zone. This relationship is expressed in Equation G-6. Irrigation efficiency refers to the average percent of total water applied that is stored in the plant's root zone.

$$\textit{Irrigation requirement} = \frac{\textit{Supplemental water requirement}}{\textit{Irrigation efficiency}}$$

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

Usable soil water capacity has a direct affect on effective rainfall. For each crop, assumptions for soil type were made for present and future growth. The District classifies 5 types of soil with regard to usable soil water capacity (USWC) in inches (i.e., 0.2, 0.4, 0.8, 1.5, and 3.6). The percentage distributions of these soils are shown in Table G- 16 and their locations are as shown in Figure G-2.

TABLE G-16. Soil Types in the UEC Planning Area by Percentage Distribution.

Soil Type USWC (inches)	St. Lucie County	Martin County	Okeechobee Area
0.2	0%	0%	0%
0.4	11%	15%	0%
0.8	55%	63%	26%
1.5	31%	20%	61%
3.6	3%	2%	13%

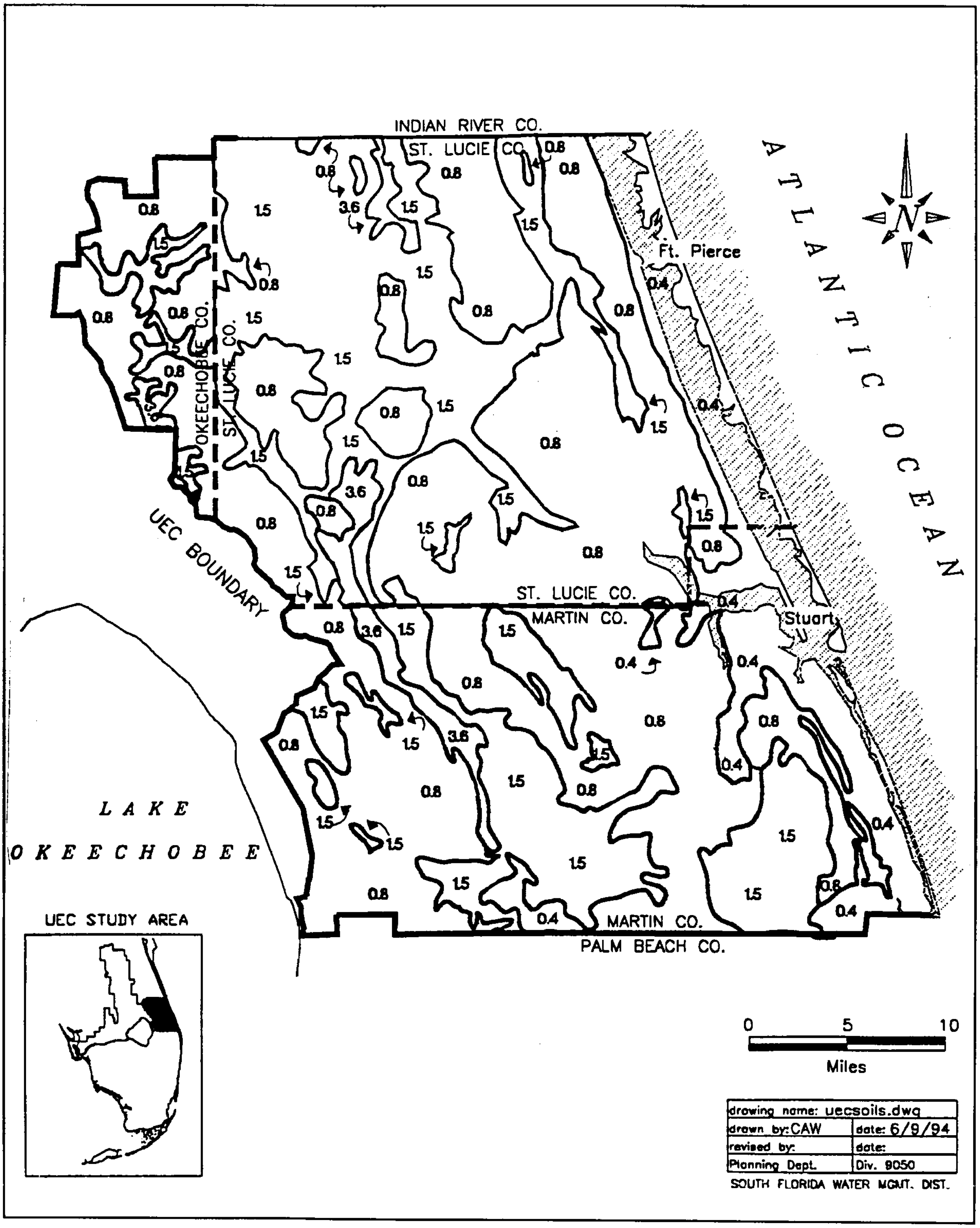

Figure G-2. Usable Soil Water Capacity in the UEC Planning Area.

Crop Types

Irrigation requirements for agriculture in the UEC Planning Area include those for citrus, sugarcane, vegetables, sod, cut flowers, ornamental nurseries and improved pasture. There are also some demands for cattle watering.

Agricultural irrigation and cattle watering demand estimates were made by crop type, time horizon and month. Historical crop acreage data were gathered from the Florida Department of Agriculture and Consumer Services' Florida Agricultural Statistics Service (FASS) and Division of Plant Industry (DPI), Institute of Food and Agricultural Sciences (IFAS), Soil Conservation Service (SCS) and District records.

Citrus

All categories of citrus (oranges, grapefruit, tangerines, etc.) were grouped together for projection purposes. Historical citrus acreage data were gathered from volumes of the "Commercial Citrus Inventory" which is published biennially by the Florida Agricultural Statistics Service. Citrus acreage in the UEC Planning Area was constant from 1968 through 1982. Since 1982 acreage has increased with each citrus survey concurrent with a period of post-freeze recovery and relatively high returns. A generic model of the form Equation G-7 was used to project citrus acreage.

$$XCIT_t = f(time,\ RP_p,\ RP_w,\ RP_o,\ D) \qquad \textbf{(G-7)}$$

where:

$XCIT_t$ = *County "X" citrus acreage in year t.*

time = a time-trend variable equal to 1 in 1966 and increasing one unit each year thereafter.

RP_p = *real price of pink grapefruit, in year t.*

RP_w = *real price of white grapefruit, in year t.*

RP_o = *real price of oranges, in year t.*

D = a dichotomous variable equal to 0 for the period before an observed intercept shift in the historical acreage and 1 for the period after. This is stipulated for each county if used.

For St. Lucie and Martin counties, prices are for the Indian River production district. For Okeechobee County, prices are for the Interior Region production district.

Models were run which weighted all observations equally and with the latest observation assigned the most weight. Weighted citrus acreage is denoted as WXCIT.

$$XCIT_t = f(time, RP_p, RP_w, RP_o, D) \quad \textbf{(G-8)}$$

$$WXCIT_t = f(time, RP_p, RP_w, RP_o, D) \quad (G\text{-}9)$$

$$XCIT_t = f(time, D) \quad \textbf{(G-10)}$$

$$WXCIT_t = f(time, D) \quad \textbf{(G-11)}$$

$$XCIT_t = f(time, RP_p, RP_w, RP) \quad (G\text{-}i2)$$

$$WXCIT_t = f(time, RP_p, RP_w, RP) \quad \textbf{(G-13)}$$

$$XCIT_t = f(time) \quad \textbf{(G-14)}$$

$$WXCIT_t = f(time) \quad \textbf{(G-15)}$$

The three basic types of irrigation systems used in citrus production are seepage, overhead sprinkler, and micro irrigation. All three types of irrigation systems are currently used in citrus production. In recent years micro irrigation has been the system of choice on new citrus groves for a variety of reasons. These include the cost advantage that micro irrigation systems have over sprinkler systems, and the production advantage (less time to tree maturity) micro irrigation systems have over seepage systems. However, there are still substantial citrus acreages in the Planning Area which use seepage irrigation, and to a lesser extent, sprinkler irrigation.

St. Lucie County. Functional forms G-8 through G-15 were estimated using ordinary least squares regression. The results are shown in equations G-16 through G-23. Note that for the initial sets of projections, there were no attempts made to project changes in the exogenous variables (other than time) the major difference in forecasts results from differences in the estimates of the coefficient on the time variable. The dichotomous variable (D) is set equal to 0 for the period 1976 and before and 1 for the period after 1976.

$$SLCIT_t = 56461.57 + \underset{(8.61)}{1650.707} * time - \underset{(-2.01)}{2409.074} * RP_p + \underset{(4.25)}{4664.374} * RP,$$
$$- \underset{(-0.84)}{689.096} * RP_o - \underset{(-2.16)}{8030,918} * D \quad \textbf{(G-16)}$$

Goodness of fit statistics
$R^2 = .9647$
$F = 43.75$
$Pr\, F > 0 > .999$
$D\text{-}W = 2.421$
t-statistics in parentheses

$$WSLCIT_t = -13054.93 + 4107{,}119 \text{ *time} - 3479.403 * RP_p + 5701.989 * RP_w$$
$$(19.28) \quad (-2.61) \quad (4.68)$$

$$- 690.9116 * RP_o - 6908.817 * D \qquad (G-17)$$
$$(-0.76) \quad (-1.68)$$

Goodness of fit statistics
$R^2 = .9948$
$F = 305.36$
$Pr\ F>0>.999$
D-W = 1.290
t-statistics in parentheses

$$SLCIT_t = 61797.42 + 1779.097 * \text{time} - 13063.73 *D \qquad (G-18)$$
$$(5.68) \quad (-2.56)$$

Goodness of fit statistics
$R^2 = .8276$
$F = 26.40$
$Pr\ F>0 >.999$
D-W = .8606
t-statistics in parentheses

$$WSLCIT_t = - 9103.637 + 4246.372 \text{ *time} - 11609.76 *D \qquad (G-19)$$
$$(11.95) \quad (-2.01)$$

Goodness of fit statistics
$R^2 = .9735$
$F = 202.11$
$Pr\ F>0 >.999$
D-W = .699
t-statistics in parentheses

$$SLCIT_t = 558518.45 + 1303.601 * \text{time} - 2094.726 * RP_p + 5023.689 * RP_w$$
$$(10.45) \quad (-1.48) \quad (3.90)$$

$$-1745.339 * RP_o \qquad (G-20)$$
$$(-2.23)$$

Goodness of fit statistics
$R^2 = .9441$
$F = 37.97$
$Pr\ F>0>.999$
D-W = 2.344
t-statistics in parentheses

$$WSLCIT_t = -11285.45 + \underset{(29.76)}{3808.513 * time} - \underset{(-2.21)}{3208.977 * RP_p} + \underset{(4.55)}{6011.099 * RP_w} - \underset{(-1.99)}{1599.57 * RP_o} \qquad \textbf{(G-21)}$$

<u>*Goodness of fit statistics*</u>
$R^2 = .9930$
$F = 317.28$
$Pr\, F>0 > .999$
$D\text{-}W = 1.223$
t-statistics in parentheses

$$SLCIT_t = 63979.49 + \underset{(5.62)}{1090.021 * time} \qquad (G\text{-}22)$$

<u>*Goodness of fit statistics*</u>
$R^2 = .7250$
$F = 31.63$
$Pr\, F>0 > .999$
$D\text{-}W = .600$
t-statistics in parentheses

$$WSLCIT_t = -7164.425 + \underset{(17.88)}{3633.989 * time} \qquad (G\text{-}23)$$

Goodness of fit statistics
$R^2 = .9638$
$F = 319.63$
$Pr\, F>0>.999$
$D\text{-}W = .406$
t-statistics in parentheses

Equations G-16 through G-23 were used to calculate the alternatives projections in columns G-16 and G-23 in Table G-17.

TABLE G-17. Alternative Projections for Citrus Acreage in St. Lucie County.

Year	Historical	Column (G-16)	Column (G-17)	Column (G-18)	Column (G-19)	Column (G-20)	Column (G-21)	Column (G-22)	Column (G-23)
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								
Projections									
1993		105,472	106,329	98,548	98,185	104,721	105,683	94,500	94,587
1994		107,123	110,436	100,328	102,431	106,024	109,491	95,590	98,221
1995		108,774	114,543	102,107	106,678	107,328	113,300	96,680	101,855
1996		110,424	118,651	103,886	110,924	108,632	117,108	97,770	105,489
1997		112,075	122,758	105,665	115,171	109,935	120,917	98,860	109,123
1998		113,726	126,865	107,444	119,417	111,239	124,725	99,950	112,757
1999		115,376	130,972	109,223	123,663	112,542	128,534	101,040	116,391
2000		117,027	135,079	111,002	127,910	113,846	132,342	102,130	120,025
2001		118,678	139,186	112,781	132,156	115,150	136,151	103,220	123,659
2002		120,329	143,293	114,560	136,402	116,453	139,959	104,310	127,293
2003		121,979	147,400	116,339	140,649	117,757	143,768	105,400	130,927
2004		123,630	151,508	118,119	144,895	119,060	147,576	106,490	134,561
2005		125,281	155,615	119,898	149,142	120,364	151,385	107,580	138,195
2006		126,931	159,722	121,677	153,388	121,668	155,193	108,670	141,829
2007		128,582	163,829	123,456	157,634	122,971	159,002	109,760	145,463
2008		130,233	167,936	125,235	161,881	124,275	162,810	110,850	149,097
2009		131,884	172,043	127,014	166,127	125,578	166,619	111,940	152,731
2010		133,534	176,150	128,793	170,373	126,882	170,427	113,030	156,365

An analysis of the projections from equations G-16 through G-23 showed that equations G-17, G-19, G-21, and G-23, which used the weighted acreage as the dependent variable consistently yielded projections which were considered unreasonably high, particularly for the later years of the projection period. Consequently, to develop a primary projection for citrus acreage in St. Lucie County, projections from equations G-16, G-18, G-20, and G-22 were calculated and these results were averaged and adjusted for the 1992 observation to arrive at a primary projection. The resulting primary projection is shown in Table G-18.

TABLE G-18. Historical and Projected Citrus Acreage in St. Lucie County.

Year	Historical	Primary projection	Primary -15%	Primary+ 15%
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	99,357		
Projections				
1993		106,571	90,585	122,556
1994		108,027	91,823	124,231
1995		109,482	93,060	125,905
1996		110,938	94,298	127,579
1997		112,394	95,535	129,253
1998		113,850	96,773	130,928
1999		115,306	98,010	132,602
2000		116,762	99,248	134,276
2001		118,218	100,485	135,950
2002		119,674	101,722	137,625
2003		121,129	102,960	139,299
2004		122,585	104,197	140,973
2005		124,041	105,435	142,647
2006		125,497	106,672	144,321
2007		126,953	107,910	145,996
2008		128,409	109,147	147,670
2009		129,864	110,385	149,344
2010		131,320	111,622	151,018

In St. Lucie County there are some older citrus groves on low lying heavy soils which are not irrigated. In 1990 these groves made up about 10 percent of the citrus acreage in the county and are subtracted in the calculation of irrigation requirements.

The acreage ratio of the three different types of irrigation systems currently in use for citrus was assessed from District permits. This ratio was applied to the irrigated acreage for 1990, and the corresponding efficiencies used to calculate irrigation requirements. All citrus planted after 1985 was assumed to have some form of micro irrigation system. In October 1990 permitted citrus acreage in St. Lucie County had irrigation systems in the ratio shown in Table G-19.

TABLE G-19. Ratio of Permitted Irrigation System Type on Citrus in St. Lucie County.

Type of system	Percent of permitted citrus	Estimated efficiency
Micro irrigation	61	0.85
Sprinkler	7	0.75
Seepage	32	0.50

In 1990 about half of the citrus acreage permitted by the District in St, Lucie County was on soil with a usable soil water capacity of 0.8 inch, and half on 1.5 inch soil. Future citrus acreage is anticipated to have a similar soil type ratio. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in Ft. Pierce for the two soil types, and the average of the two are shown in Table G-20.

TABLE G-20. Supplemental Water Requirements (MG) for Citrus in St. Lucie County.

Month	Avg. (0.8 in.)	2-in-10 (0.8 in.)	Avg. (1.5 in.)	2-in-10 (1.5 in.)	Overall Avg.	Avg. 2-in-10
Januarv	1.30	1.52	1.09	1.36	1.20	1.44
February	1.28	1.53	1.06	1.35	1.17	1.44
March	1.95	2.24	1.70	2.03	1.83	2.14
April	2.52	2.85	2.23	2.62	2.38	2.74
May	3.07	3.49	2.69	3.19	2.88	3.34
June	2.51	3.15	1.95	2.70	2.23	2.93
July	3.24	3.81	2.74	3.40	2.99	3.61
August	2.99	3.57	2.48	3.16	2.74	3.37
September	1.49	2.21	0.85	1.70	1.17	1.96
October	0.98	1.63	0.41	1.17	0.70	1.40
November	1.80	2.05	1.57	1.87	1.69	1.96
December	1.54	1.74	1.36	1.59	1.45	1.67
Total	24.67	29.79	20.13	26.14	22.40	27.97

Rainfall station = Ft. Pierce.

Table *G-20* shows the supplemental water requirement by month for citrus in St. Lucie County. To yield the irrigation requirement, these numbers must be divided by the irrigation efficiency.

Example: Irrigation requirement for citrus in July 1990.

Assumptions:

- Citrus acreage for St. Lucie County in 1990 = 94,878 ac.
- 90 percent of citrus in St. Lucie County is irrigated = 85,390 ac.
- Half citrus acreage on 0.8 in. soil and half on 1.5 in. soil.
- 61 percent using micro irrigation = 52,088 ac. @ 85 percent eff.
- 7 percent using sprinkler irrigation = 5,977 ac. @ 75 percent eff.
- 32 percent using seepage irrigation = 27,325 ac. @ 50 percent eff.

Calculation:

The average irrigation requirement for citrus in July of 1990 is:

*(((2.99 in./0.85) * 52,088 ac.) + ((2.99 in./0.75) * 5,977 ac.)*
*+ ((2.99 in./0.50) * 27,325 ac))/ 12 in. = 30,872 ac.ft.*
(30,872 ac.ft. x 325,872 gal/ac.ft.)/1,000,000 = 10,060 mg

The irrigation requirements for 1985 were estimated by subtracting the 1985 acreage from the 1990 total, and assuming that all citrus planted between 1985 and 1990 was put in with micro irrigation (85 percent efficient). Irrigation requirements for years future to 1990 were projected with the assumption that micro irrigation will be used on all additional acreage. Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-21.

TABLE G-21. Irrigation Requirements (MG) for the Primary Citrus Acreage Projection in St. Lucie County.

Average	1985	1990	1995	2000	2005	2010
January	3,513	4,021	4,578	4,856	5,134	5,412
February	3,440	3,937	4,482	4,755	5,027	5,299
March	5,365	6,140	6,992	7,416	7,841	8,265
April	6,982	7,991	9,099	9,651	10,204	10,756
May	8,467	9,690	11,034	11,704	12,373	13,043
June	6,556	7,503	8,544	9,062	9,581	10,099
July	8,790	10,060	11,455	12,151	12,846	13,541
August	8,041	9,202	10,478	11,114	11,750	12,386
September	3,440	3,937	4,482	4,755	5,027	5,299
October	2,043	2,338	2,663	2,824	2,986	3,148
November	4,954	5,669	6,456	6,847	7,239	7,631
December	4,263	4,879	5,555	5,892	6,230	6,567
Total	65,855	75,367	85,819	91,028	96,238	101,447
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	4,234	4,845	5,517	5,852	6,187	6,522
February	4,234	4,845	5,517	5,852	6,187	6,522
March	6,277	7,183	8,180	8,676	9,173	9,669
April	8,041	9,202	10,478	11,114	11,750	12,386
May	9,819	11,238	12,796	13,573	14,350	15,126
June	8,599	9,841	11,206	11,887	12,567	13,247
July	10,599	12,129	13,811	14,650	15,488	16,327
August	9,893	11,322	12,892	13,675	14,457	15,240
September	5,748	6,578	7,490	7,945	8,399	8,854
October	4,116	4,710	5,364	5,689	6,015	6,340
November	5,762	6,595	7,509	7,965	8,421	8,877
December	4,895	5,602	6,379	6,766	7,153	7,541
Total	82,216	94,091	107,139	113,643	120,147	126,650

Martin County. A generic model of the form Equation G-7 was used to project Martin County citrus acreage. The variable D was included to capture the one-time increase of almost 5,400 acres between 1988 and 1990. Models were run which weighted all observations equally and with the latest observation assigned the most weight. Weighted Martin County citrus acreage is denoted $WMCIT_t$. Between 1966 and 1968, Martin County citrus acreage almost doubled, increasing from 21,889 acres to 39,157 acres. To make the estimation period more accurately reflect conditions expected to prevail in the future, the 1966 observation was dropped for estimation purposes. This data selection process significantly reduces the variation in the data set; the small variation in the historical acreage data is one reason for the relatively weak explanatory power (as measured by R^2) of the models.

Between 1988 and 1990, Martin County citrus acreage increased by about 5,400 acres. This represents approximately a 13 percent increase in citrus acreage over a two-year period. This is higher than the recent historic rate of growth in Martin County citrus acreage, and results in the weighted acreage projection models producing much higher projections than the unweighted projections.

Functional forms G-8 through G-15 were estimated using ordinary least squares regression. The results are shown in equations G-24 through G-31. Note that for the initial sets of projections, there were no attempts made to project changes in the exogenous variables (other than time). The major difference in forecasts results from differences in the estimates of the coefficient on the time variable.

D = a dichotomous variable equal to 1 for 1990 and 0 for all other years.

$$MCIT_t = 41146.2 + \underset{(3.54)}{168.062} * time - \underset{(-1.96)}{892.596} * RP_p + \underset{(3.56)}{1451.619} * RP_w - \underset{(-4.00)}{885.605} * RP_o + \underset{(3.30)}{3440.252} * D \qquad \text{(G-24)}$$

<u>Goodness of fit statistics</u>
R^2 = .9225
F = 16.66
Pr F>0 = .999
D-W = 1.590
t-statistics in parentheses

$$WMCIT_t = -818.303 + \underset{(41.64)}{1665.644} * time - \underset{(-1.62)}{668.7405} * RP_p + \underset{(3.32)}{1220.464} * RP_w - \underset{(-2.66)}{587.0667} * RP_o + \underset{(2.99)}{3034.273} * D \qquad \text{(G-25)}$$

Goodness of fit statistics
$R^2 = .9977$
$F = 690.42$
$Pr\ F > 0 > .999$
$D\text{-}W = 1.066$
t-statistics in parentheses

$$MCIT_t = 38940.43 + \underset{(2.10)}{140.946} * time + \underset{(2.02)}{3818.916} * D \qquad \text{(G-26)}$$

Goodness of fit statistics
$R^2 = .5799$
$F = 6.90$
$Pr\ F > 0 = .987$
$D\text{-}W = 1.069$
t-statistics in parentheses

$$WMCIT_t = -1367.988 + \underset{(27.49)}{1631.783} *time + \underset{(2.06)}{3428.31} *D \qquad \text{(G-27)}$$

Goodness of fit statistics
$R^2 = .9895$
$F = 471.87$
$Pr\ F > 0 > .999$
$D\text{-}W = 0.854$
t-statistics in parentheses

$$MCIT_t = 39226.18 + \underset{(4.07)}{248.317} *time - \underset{(-0.64)}{416.600} * RP_p + \underset{(1.94)}{1152.325} * RP_w - \underset{(-2.79)}{920.041} * RP_o \qquad \text{(G-28)}$$

Goodness of fit statistics
$R^2 = .8020$
$F = 8.10$
$Pr\ F > 0 = .904$
$D\text{-}W = 2.157$
t-statistics in parentheses

$$WMCIT_t = -2319.800 + \underset{(29.24)}{1729.001} * time - \underset{(-0.49)}{309.8541} * RP_p + \underset{(1.76)}{1014.484} * RP_w - \underset{(-1.92)}{616.569} * RP_o \qquad \text{(G-29)}$$

Goodness of fit statistics
$R^2 = .9940$
$F = 333.14$
$Pr\ F > 0 > .999$
$D\text{-}W = 1.892$
t-statistics in parentheses

$$MCIT_t = 38447.33 + 193.4038 * time \qquad \text{(G-30)}$$
$$(2.75)$$

Goodness of fit statistics
$R^2 = .4082$
$F = 7.59$
$Pr\ F > 0 = .991$
$D\text{-}W = 1.029$
t-statistics in parentheses

$$WMCIT_t = -1810.618 + 1678.872 * time \qquad \text{(G-31)}$$
$$(26.95)$$

Goodness of fit statistics
$R^2 = .9851$
$F = 726.39$
$Pr\ F > 0 > .999$
$D\text{-}W = 0.842$
t-statistics in parentheses

Equations G-24 through G-31 were used to calculate the alternative projections in columns G-24 through G-31 in Table G-22.

TABLE G-22. Alternative Projections for Citrus Acreage in Martin County.

Year	Historical	Column (G-24)	Column (G-25)	Column (G-26)	Column (G-27)	Column (G-28)	Column (G-29)	Column (G-30)	Column (G-31)
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								
Projections									
1993		45,593	46,674	42,887	44,322	46,444	47,447	43,863	45,198
1994		45,761	48,331	43,028	45,954	46,692	49,176	44,056	46,877
1995		45,929	49,987	43,169	47,586	46,940	50,905	44,249	48,556
1996		46,097	51,643	43,310	49,217	47,189	52,634	44,443	50.234
1997		46,265	53,299	43,451	50,849	47,437	54,363	44,636	51,913
1998		46,433	54,955	43,592	52,481	47,685	56,092	44,830	53,592
1999		46,601	56,611	43,733	54,113	47,934	57,821	45,023	55,271
2000		46,769	58,268	43,874	55,744	48,182	59,550	45,216	56,950
2001		46,937	59,924	44,014	57,376	48,430	61,279	45,410	58,629
2002		47,105	61,580	44,155	59,008	48,679	63,008	45,603	60,308
2003		47,273	63,236	44,296	60,640	48,927	64,737	45,797	61,987
2004		47,441	64,892	44,437	62,272	49,175	66,466	45,990	63,665
2005		47,609	66,548	44,578	63,903	49,424	68,195	46,183	65,344
2006		47,777	68,205	44,719	65,535	49,672	69.924	46,377	67,023
2007		47,945	69,861	44,860	67,167	49,920	71,653	46,570	68,702
2008		48,113	71,517	45,001	68,799	50,169	73,382	46,764	70,381
2009		48,282	73,173	45,142	70,430	50,417	75,111	46,957	72,060
2010		48,450	74,829	45,283	72,062	50,665	76,840	47,151	73,739

An analysis of the projections from equations G-24 through G-31 showed that equations G-25, G-27, G-29, and G-31, which used the weighted acreage as the dependent variable consistently yielded projections which were considered unreasonably high, particularly for the later years of the projection period.

To develop a primary projection for citrus acreage in Martin County, projections from equations G-24, and G-28 above were calculated, adjusted for the 1992 survey, and averaged to arrive at a primary projection. The primary citrus acreage projection is shown in Table G-23.

TABLE G-23. Historical and Projected Citrus Acreage in Martin County.

Year	Historical	Primary projection	Primary-15 %	Primary + 15 %
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	45,813		
Projections				
1993		46,540	39,559	53,521
1994		46,748	39,736	53,760
1995		46,956	39,913	54,000
1996		47,165	40,090	54,239
1997		47,373	40,267	54,479
1998		47,581	40,444	54,718
1999		47,789	40,621	54,958
2000		47,997	40,798	55,197
2001		48,206	40,975	55,436
2002		48,414	41,152	55,676
2003		48,622	41,329	55,915
2004		48,830	41,506	56,155
2005		49,038	41,683	56,394
2006		49,246	41,860	56,633
2007		49,455	42,036	56,873
2008		49,663	42,213	57,112
2009		49,871	42,390	57,352
2010		50,079	42,567	57,591

There are still substantial citrus acreages in Martin County which use seepage or sprinkler irrigation. The acreage ratio of the three different types of irrigation systems currently in use for citrus was assessed from District permits. This ratio was applied to the primary projected acreage for 1990, and the corresponding efficiencies used to calculate irrigation requirements. All citrus planted after 1985 was assumed to have some form of micro irrigation system. In October 1990, permitted citrus acreage in Martin County had irrigation systems in the ratio shown in Table G-24.

TABLE G-24. Ratio of Permitted Irrigation System Type on Citrus in Martin County.

Type of system	Percent of permitted citrus	Estimated efficiency
Micro irrigation	39	0.85
Sprinkler	49	0.75
Seepage	12	0.50

All citrus production was assumed to take place on soil with a usable soil water capacity of 1.5 inches. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in Indiantown are shown in Table G-25.

TABLE G-25. Supplemental Water Requirements for Citrus in Martin County.

Month	Average (in.)	2-in-10 (in.)
January	1.14	1.31
February	0.85	1.08
March	1.60	1.85
April	1.75	2.08
May	2.70	3.04
June	0.24	0.97
July	2.06	2.59
August	1.69	2.26
September	1.05	1.61
October	1.09	1.51
November	1.87	2.03
December	1.54	1.66
Total	17.58	21.99

Rainfall station = Indiantown.
Soil type = 1.5 inches.

Table G-25 shows the supplemental water requirement by month for citrus in Martin County. To yield the irrigation requirement these numbers must be divided by the irrigation efficiency. For the year 1990 the ratio presented in Table G-24 was used to calculate irrigation requirements.

The irrigation requirements for 1985 were estimated by subtracting the 1985 acreage from the 1990 total, and assuming that all citrus planted between 1985 and 1990 was put in with micro irrigation (85 percent efficient). Irrigation requirements for years future to 1990 were projected with the assumption that micro irrigation will be used on all additional acreage. Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-26,

TABLE G-26. Irrigation Requirements (MG) for the Primary Citrus Acreage Projection in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	1,737	1,937	1,962	2,000	2,038	2,076
February	1,295	1,445	1,463	1,491	1,519	1,548
March	2,438	2,719	2,754	2,807	2,860	2,913
April	2,667	2,974	3,012	3,070	3,128	3,186
May	4,115	4,589	4,647	4,736	4,826	4,916
June	366	408	413	421	429	437
July	3,139	3,501	3,545	3,614	3,682	3,751
August	2,575	2,872	2,908	2,965	3,021	3,077
September	1,600	1,784	1,807	1,842	1,877	1,912
October	1,661	1,852	1,876	1,912	1,948	1,985
November	2,850	3,178	3,218	3,280	3,343	3,405
December	2,347	2,617	2,650	2,702	2,753	2,804
Total	26,791	29,877	30,255	30,839	31,424	32,009
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	1,996	2,226	2,254	2,298	2,342	2,385
February	1,646	1,835	1,859	1,895	1,930	1,966
March	2,819	3,144	3,184	3,245	3,307	3,368
April	3,170	3,535	3,580	3,649	3,718	3,787
May	4,633	5,166	5,232	5,333	5,434	5,535
June	1,478	1,648	1,669	1,702	1,734	1,766
July	3,947	4,402	4,457	4,543	4,630	4,716
August	3,444	3,841	3,889	3,965	4,040	4,115
September	2,454	2,736	2,771	2,824	2,878	2,931
October	2,301	2,566	2,599	2,649	2,699	2,749
November	3,094	3,450	3,494	3,561	3,629	3,696
December	2,530	2,821	2,857	2,912	2,967	3,022
Total	33,512	37,371	37,844	38,576	39,307	40,038

Okeechobee Area. When equations G-8 through G-15 were estimated empirically using ordinary least squares regression, the results shown in equations G-32 through G-39 were obtained.

- *D = a dichotomous variable equal to 0 in 1980 and before and 1 after 1980.*

$$OKEECIT_t = 3358.636 + \underset{(7.34)}{199.6891} * time - \underset{(-3.03)}{688.626} * RP_p + \underset{(3.75)}{734.5867} * RP_w - \underset{(-1.72)}{172.2878} * RP_o + \underset{(2.74)}{1384.892} * D \quad \text{(G-32)}$$

Goodness of fit statistics

$R^2 = .9849$
$F = 104.16$
$Pr\, F > 0 > .999$
$D\text{-}W = 2.337$
t-statistics in parentheses

$$WTOKEE_t = -845.6995 + \underset{(11.12)}{346.1192} * time - \underset{(-3.53)}{889.90} * RP_p + \underset{(5.17)}{1157.19} * RP_w - \underset{(-1.86)}{213.968} * RP_o + \underset{(0.92)}{534.185} * D \quad \text{(G-33)}$$

Goodness of fit statistics

$R^2 = .9884$
$F = 136.53$
$Pr\, F > 0 > .999$
$D\text{-}W = 1.589$
t-statistics in parentheses

$$OKEECIT_t = 2438.375 + \underset{(4.36)}{161.0} * time + \underset{(3.79)}{2278.125} * D \quad \text{(G-34)}$$

Goodness of fit statistics

$R^2 = .9554$
$F = 117.90$
$Pr\, F > 0 > .999$
$D\text{-}W = 1.283$
t-statistics in parentheses

$$WTOKEE_t = -1022.991 + \underset{(4.72)}{276.7252} * time + \underset{(1.87)}{1785.117} * D \quad \text{(G-35)}$$

Goodness of fit statistics
$R^2 = .9344$
$F = 78.30$
$Pr\ F>0>.999$

$D\text{-}W = 0.678$
t-statistics in parentheses

$$OKEECIT_t = 3743.498 + \underset{(12.24)}{260.0872} * time - \underset{(-4.28)}{1014.64} * RP_p + \underset{(4.74)}{1024.287} * RP_w - \underset{(-1.49)}{196.27} * RP_o \qquad (G\text{-}36)$$

Goodness of fit statistics
$R^2 = .9707$
$F = 74.46$
$Pr\ F>0>.999$
$D\text{-}W = 2.384$
t-statistics in parentheses

$$WTOKEE_t = -697.249 + \underset{(20.41)}{369.4161} * time - \underset{(-4.99)}{1023.367} * RP_p + \underset{(6.79)}{1268.939} * RP_w - \underset{(-1.97)}{223.219} * RP_o \qquad (G\text{-}37)$$

Goodness of fit statistics
$R^2 = .9872$
$F = 173.26$
$Pr\ F>0>.999$
$D\text{-}W = 1.987$
t-statistics in parentheses

$$OKEECIT_t = 1732.407 + \underset{(10.24)}{281.1648} * time \qquad (G\text{-}38)$$

Goodness of fit statistics
$R^2 = .8974$
$F = 104.93$
$Pr\ F>0>.999$
$D\text{-}W = 1.133$
t-statistics in parentheses

$$WTOKEE_t = -1576.182 + \underset{(11.26)}{370.885} * time \qquad (G\text{-}39)$$

Goodness of fit statistics
$R^2 = .9135$
$F = 126.75$
$Pr\ F > 0 > .999$
$D\text{-}W = 0.676$
t-statistics in parentheses

Note that for the initial sets of projections, there were no attempts made to project changes in the exogenous variables (other than time). The major difference in forecasts results from differences in the estimates of the coefficient on the time variable. When equations G-32 through G-39 were used to project citrus acreage in Okeechobee County, the results shown in columns G-32 through G-39 in Table G-27 were obtained.

The primary projection was derived by averaging the adjusted projections generated by equations G-32 through G-39. All eight of these models accurately explained past trends, and were judged empirically to provide feasible projections. Table G-28 show the historical and projected acreage of citrus in Okeechobee County.

TABLE G-27. Alternative Projections for Citrus Acreage in Okeechobee County.

Year	Historical	Column (G-32)	Column (G-33)	Column (G-34)	Column (G-35)	Column (G-36)	Column (G-37)	Column (G-38)	Column (G-39)
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								
Projections									
1993		10,355	10,456	9,225	8,510	10,846	10,646	9,605	8,809
1994		10,554	10,802	9,386	8,787	11,106	11,015	9,886	9,179
1995		10,754	11,149	9,547	9,064	11,366	11,385	10,167	9,550
1996		10,954	11,495	9,708	9,341	11,626	11,754	10,449	9,921
1997		11,153	11,841	9,869	9,617	11,886	12,123	10,730	10,292
1998		11,353	12,187	10,030	9,894	12,146	12,493	11,011	10,663
1999		11,553	12,533	10,191	10,171	12,406	12,862	11,292	11,034
2000		11,753	12,879	10,352	10,448	12,666	13,232	11,573	11,405
2001		11,952	13,225	10,513	10,724	12,926	13,601	11,854	11,776
2002		12,152	13,571	10,674	11,001	13,186	13,970	12,136	12,147
2003		12,352	13,918	10,835	11,278	13,447	14,340	12,417	12,517
2004		12,551	14,264	10,996	11,554	13,707	14,709	12,698	12,888
2005		12,751	14,610	11,157	11,831	13,967	15,079	12,979	13,259
2006		12,951	14,956	11,318	12,108	14,227	15,448	13,260	13,630
2007		13,150	15,302	11,479	12,385	14,487	15,818	13,541	14,001
2008		13,350	15,648	11,640	12,661	14,747	16,187	13,822	14,372
2009		13,550	15,994	11,801	12,938	15,007	16,556	14,104	14,743
2010		13,749	16,340	11,962	13,215	15,267	16,926	14,385	15,114

TABLE G-28. Historical and Projected Citrus Acreage in Okeechobee County.

Year	Historical	Primary projection	Primary -15 %	Primary + 15 %
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	9,524		
Projections				
1993		10,722	9,114	12,330
1994		11,005	9,354	12,656
1995		11,288	9,595	12,981
1996		11,571	9,836	13,307
1997		11,854	10,076	13,632
1998		12,137	10,317	13,958
1999		12,421	10,558	14,284
2000		12,704	10,798	14,609
2001		12,987	11,039	14,935
2002		13,270	11,280	15,261
2003		13,553	11,520	15,586
2004		13,836	11,761	15,912
2005		14,119	12,002	16,237
2006		14,403	12,242	16,563
2007		14,686	12,483	16,889
2008		14,969	12,723	17,214
2009		15,252	12,964	17,540
2010		15,535	13,205	17,865

Table G-28 shows the historical and projected citrus acreage in Okeechobee County as a whole. To generate estimates of citrus acreage in the Okeechobee Area, it was assumed that changes in crop acreage will be proportional to the current acreages within the two districts.

District land use maps for 1986-1988 show that approximately 90 percent of the citrus mapped in Okeechobee County was within the District, and 32 percent of this acreage in the District was within the Okeechobee Area. These ratios were used to divide acreage projections, and the estimated citrus acreages for the six time horizons are shown in Table G-29.

TABLE G-29. Historical and Projected Citrus Acreage in Okeechobee County.

	1985	1990	1995	2000	2005	2010
Okeechobee County	7,747	8,541	11,288	12,708	14,119	15,535
Okeechobee County within District	6,972	7,687	10,159	11,437	12,707	13,982
Okeechobee Area	2,231	2,460	3,251	3,660	4,066	4,474

The acreage ratio of the three different types of irrigation systems currently in use for citrus was assessed from District permits. Permitted citrus acreage (as of March 1991) in the SFWMD portion of Okeechobee County has permitted irrigation systems in the ratio shown in Table G-30.

TABLE G-30. Ratio of Permitted Irrigation System Type on Citrus in the Okeechobee Area.

Type of system	Percent of permitted citrus	Estimated efficiency
Micro irrigation	89	0.85
Sprinkler	7	0.75
Seepage	4	0.50

District water use permits show that 89 percent of the citrus currently permitted in the Okeechobee Area has a micro irrigation system. All future citrus is expected to have micro irrigation systems. Therefore, the irrigation efficiency associated with micro irrigation systems (0.85) was used to calculate the irrigation requirement for all citrus.

All citrus production was assumed to take place on soil with a usable soil water capacity of 0.8 inches. The average and 2-in-10 supplemental water requirements for citrus at the rainfall station in Okeechobee are shown in Table G-31.

TABLE G-31. Supplemental Water Requirements for Citrus in Okeechobee Counts.

Month	Average (in.)	2-in-10 (in.)
January	1.43	1.55
February	1.44	1.58
March	1.83	2.04
April	2.49	2.72
May	2.97	3.29
June	2.03	2.57
July	2.56	3.07
Auqust	2.69	3.16
September	1.64	2.15
October	1.85	2.19
November	2.22	2.33
December	1.67	1.77
Total	24.82	28.42

Rainfall Station = Okeechobee.
Soil Type = 0.8 inches.

Table G-31 shows the supplemental water requirement by month for citrus in Okeechobee County. Average and 2-in-10 irrigation requirements were calculated for the primary projection, and are shown in Table G-32.

TABLE G-32. Irrigation Requirements (MG) for the Primary Citrus Acreage Projections in Okeechobee Area.

Average	1985	1990	1995	2000	2005	2010
January	102	112	149	167	186	204
February	103	113	150	168	187	206
March	130	144	190	214	238	262
April	177	196	259	291	323	356
May	212	233	308	347	386	425
June	145	160	211	237	264	290
July	182	201	266	299	333	366
August	192	211	279	315	349	385
September	117	129	170	192	213	234
October	132	145	192	216	240	264
November	158	174	231	260	288	317
December	119	131	173	195	217	239
Total	1,769	1,951	2,578	2,902	3,224	3,548
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	110	122	161	181	201	222
February	113	124	164	185	205	226
March	145	160	212	239	265	292
April	194	214	283	318	353	389
May	235	259	342	385	427	470
June	183	202	267	301	334	367
July	219	241	319	359	399	439
August	225	248	328	369	411	452
September	153	169	223	251	279	307
October	156	172	227	256	285	313
November	166	183	242	272	303	333
December	126	139	184	207	230	253
Total	2,026	2,233	2,952	3,323	3,692	4,062

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 Martin County the land is invariably fallowed during this period. This means that there is approximately 20 percent of the land associated with sugarcane production will not be reported as production by 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 Field Crops Summary, which is published by FASS, and are presented in Table G-33.

TABLE G-33. Historical Sugarcane Acreage in Martin County.

Year	Sugarcane 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	12,479
1986	14,044
1987	14.211
1988	14,589
1989	14,415
1990	13,433
1991	13,455
1992	13.518

Sugarcane production in Martin County grew gradually from 3,015 acres in 1975 to 7,180 acres in 1984. Between 1984 and 1986, it almost doubled to 14,044 acres and has remained 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 further growth is anticipated (phone conversation May 5, 1991 with Bob Whitty, County Extension Director, Martin County Cooperative Extension Service, IFAS, Stuart, FL.). There may be some slight fluctuation in acreage due to the planting cycle and weather limitations.

The primary projection for sugarcane production in Martin County was developed by averaging production acreage for the most recent seven years, which account for the period since the expansion was completed. The primary projection is 13,952 acres and the primary range is from 11,859 to 16,045 acres.

There are three basic soil types on which sugarcane is grown in Martin County (i.e., muck, loam, and sand). The average and 2-in-10 supplemental water requirements for sugarcane on each of these soil types at the rainfall station in Indiantown are shown in Table G-34.

TABLE G-34. Supplemental Water Requirements for Sugarcane in Martin County.

Soil Type USWC (in.)	Sand 0.8 Average (in.)	Sand 0.8 2-in-10 (in.)	Loam 1.5 Average (in.)	Loam 1.5 2-in-10 (in.)	Muck 3.6 Average (in.)	Muck 3.6 2-in-10 (in.)
January	0.47	0.61	0.30	0.46	0.08	0.27
February	0.00	0.02	0.00	0.00	0.00	0.00
March	1.19	1.39	0.93	1.17	0.61	0.90
April	1.64	1.19	1.29	1.61	0.87	1.25
May	3.00	3.28	2.64	2.97	2.20	2.60
June	1.49	2.14	0.67	1.43	0.00	0.56
July	3.16	3.62	2.58	3.12	1.85	2.50
August	3.15	3.67	2.50	3.11	1.69	2.41
September	1.83	2.32	1.22	1.79	0.47	1.14
October	2.57	2.94	2.08	2.53	1.49	2.02
November	2.26	2.40	2.09	2.25	1.87	2.06
December	1.85	1.95	1.71	1.84	1.55	1.70
Total	22.61	26.25	18.90	22.28	12.68	17.41

Rainfall station = Indiantown.

Historical acreage of sugarcane in Martin County was taken from Table G-33. The 1990 ratio of each soil type was taken from the District water use permits. Projected distribution of sugarcane acreage in Martin County is shown in Table G-35.

TABLE G-35. Projected Soil Type Distribution for Sugarcane in Martin County.

Soil Type	1985	1990	1995	2000	2005	2010
Sand	7,843	8,598	8,933	8,933	8,933	8,933
Loam	2,755	2,955	3,139	3,139	3,139	3,139
Muck	1,881	1,881	1,881	1,881	1,881	1,881
Total	12,479	13,434	13,952	13,952	13,952	13,952

The projected sugarcane acreages by soil type in Table G-35 and the supplemental water requirements in Table G-34 were used to calculate the irrigation demands for sugarcane in Martin County. These demands are shown in Table G-36.

TABLE G-36. Irrigation Requirements (MG) for the Primary Sugarcane Acreage Projection in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	253	276	287	287	287	287
February	0	0	0	0	0	0
March	708	767	798	798	798	798
April	980	1,062	1,104	1,104	1,104	1,104
May	1,898	2,049	2,130	2,130	2,130	2,130
June	735	803	837	837	837	837
July	1,921	2,079	2,162	2,162	2,162	2,162
August	1,889	2,045	2,127	2,127	2,127	2,127
September	1,010	1,098	1,144	1,144	1,144	1,144
October	1,558	1,686	1,754	1,754	1,754	1,754
November	1,466	1,582	1,644	1,644	1,644	1,644
December	1,202	1,297	1,347	1,347	1,347	1,347
Total	13,621	14,744	15,335	15,335	15,335	15,335
2-in-10	1985	1990	1995	2000	2005	2010
January	356	386	402	402	402	402
February	9	9	10	10	10	10
March	859	929	966	966	966	966
April	1,182	1,278	1,329	1,329	1,329	1,329
May	2,107	2,274	2,363	2,363	2,363	2,363
June	1,183	1,286	1,339	1,339	1,339	1,339
July	2,264	2,447	2,543	2,543	2,543	2,543
August	2,275	2,459	2,557	2,557	2,557	2,557
September	1,373	1,487	1,547	1,547	1,547	1,547
October	1,837	1,985	2,064	2,064	2,064	2,064
November	1,569	1,692	1,758	1,758	1,758	1,758
December	1,280	1,380	1,433	1,433	1,433	1,433
Total	16,294	17,612	18,312	18,312	18,312	18,312

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 planning area.

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. Also, 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 whole. With these constraints in mind, planting and harvesting schedules were developed on which 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 Summaries, and acreage data for St. Lucie County individually is not available from FASS. The only vegetable acreage data available was that supplied by the local IFAS extension office, and only for 1990. These estimates are outlined in Table G-37.

TABLE G-37. Land Acreage Estimate Used for Vegetable Production in St. Lucie County, 1990.

Year	Potatoes	Cabbage	Zucchini	U-pick*	Green-house**	Total
1990	300	60	150	50	20	580

* mainly strawberries.
** mainly tomatoes.

Due to the lack of historical data, future vegetable acreage was projected at its 1990 level (± 15 percent). Present vegetable production is modest in St. Lucie County (approximately 580 acres), and is anticipated to remain constant by the local extension office. The primary projection for the six time horizons is therefore 580 acres, and the primary range is from 493 to 667 acres.

Vegetable crops in St. Lucie County (except those grown in greenhouses or u-pick operations) are usually cultivated once a year between August and December. The vegetable acreage in St. Lucie County was estimated to have a planting and harvesting schedule as shown in Table G-38. Table G-39 represents the supplemental water requirements and irrigation requirements for vegetable crops using the general cultivation schedule outlined in Table G-38, and the irrigation efficiency associated with seepage systems.

TABLE G-38. Generalized Cultivation Schedule for Vegetable Crops in St. Lucie County

Crop	Crops per year	Acres of land	Jan *	% tot land **	Feb *	% tot land **	Mar *	% tot land **	Apr *	% tot land **	May *	% tot land **
Tomatoes (green house)	2	20	50	2	100	3	100	3	100	3	50	2
Zucchini	1	150	0	0	0	0	0	0	0	0	0	0
Strawberries (u-pick)	2	50	50	4	100	9	100	9	100	9	50	4
Potatoes	1	300	100	52	66	34	33	17	0	0	0	0
Cabbage	1	60	0	0	0	0	0	0	0	0	0	0
TOTAL		**580**		**58** ***		**46** ***		**29** ***		**12** ***		**6** ***

TABLE G-38. (Continued).

Crop	Jun *	% tot land **	Jul *	% tot land **	Aug *	% tot land **	Sep *	% tot land **	Oct *	% tot land **	Nov *	% tot land	Dec *	% tot land **
Tomatoes (green house)	0	0	0	0	50	2	100	3	100	3	100	3	50	2
Zucchini	0	0	0	0	50	13	100	26	100	26	100	26	50	13
Strawberries (u-pick)	0	0	0	0	50	4	100	9	100	9	100	9	50	4
Potatoes	0	0	0	0	0	0	100	52	100	52	100	52	100	52
Cabbage	0	0	0	0	50	5	100	10	100	10	100	10	50	5
TOTAL		**0**		**0** ***		**24** ***		**100** ***		**100** ***		**100** ***		**76** ***

* Percentage of land dedicated to relevant crop which is actually in the ground in that particular month.

** Land dedicated to relevant crop /vegetable production (percentage).

*** Weighted average percent of vegetable land acreage which is actually in production during the relevant month.

TABLE G-39. Supplemental Water Requirements and Projected Irrigation Requirements for Vegetables in St. Lucie County.

Month	Supplemental water requirements		Percent in ground	Irrigation requirements	
	Average (inch)	2-in-10 (inch)		Average (MG)	2-in-10 (MG)
January	1.38	1.62	60	26	31
February	1.26	1.51	50	20	24
March	1.83	2.12	30	17	20
April	2.28	2.60	10	7	8
May	2.71	3.12	10	7	9
June	2.14	2.76	0	0	0
July	2.83	3.39	0	0	0
August	2.60	3.17	20	16	20
September	1.22	1.93	100	38	61
October	0.86	1.49	100	27	47
November	1.73	1.99	100	54	63
December	1.59	1.79	80	40	45
Total	22.43	27.47		255	328

Rainfall station = Ft. Pierce.
Soil type = 0.4 inch.
Acreage = 580.

Martin County. Martin County vegetable production is included in the "Southeast" area as defined by the FASS Vegetable Summaries; therefore acreage data for Martin County individually is not available from FASS. The only vegetable acreage data available was that supplied by the local IFAS extension office, and only for the 1988-1989 growing season.

Vegetable acreage for the 1988-89 growing season is outlined in Table G-40, and was assembled in the following manner:

- Acreage data for snap beans, cucumbers, cabbage, peppers, and tomatoes were taken from the IFAS County annual Agricultural Commodity report (University of Florida, 1989). A default value for Chinese vegetables was estimated by the local IFAS extension office.

- These acreages were divided by two (to reflect the two growing seasons), and summed to yield the subtotal. IFAS reports acreage as acres of production row (i.e., **10** acres of row cultivated twice a year is reported as 20 acres).
- Fifteen percent of the subtotal was added to account for non-harvested acreage. An examination of historical planted vs. harvested acreage for vegetable crops within south Florida showed that an average of 15 percent of the acreage cultivated is not harvested. As IFAS reports harvested acreage, this 15 percent needed to be added to reflect the total acreage used for vegetable production.
- Vegetable acreage data reported in the FASS Vegetable Summaries and by IFAS represent the estimated area of land in the production rows or, as it is sometimes termed, "under plastic." The District's model for estimating irrigation requirements is based on total land acreage, which includes the land necessary for vegetable production, but does not include rows (i.e., spaces between rows, irrigation furrows, etc.). Land in rows represents approximately 60 percent of this total land (phone conversation 1991 with D. Pitts, Assistant Professor, IFAS, Southwest Florida Research and Education Center. Immokalee, FL.) so the row acreage column was divided by 0.6 to yield the total acreage column.

TABLE G-40. Vegetable Acreage in Martin County, 1988-1989.

Year	Snap-beans	Cucum-bers	Cabbage	Peppers	Tomatoes	Chin. veg.	Double crop/2 (row)	Total (row)	Total land
1988-89	100	100	500	600	500	100	950	1,093	1,821

Due to the lack of historical data, future vegetable acreage was projected at its 1989 level (± 15 percent). The primary projection is 1,821 acres, and the primary range from 1,548 to 2,044 acres for the six time horizons. The projection of vegetable acreage remaining relatively constant was consistent with empirical input from the local IFAS extension office. The generalized cultivation schedule shown in Table G-41 was developed with the assistance of the local IFAS extension office.

Vegetables are planted throughout the year, and crop ET values depend on planting dates. Average ET values were developed based on an average of Blaney-Criddle values with planting dates at the beginning of each month.

For the calculation of irrigation requirements, soil with a usable soil water capacity of 0.8 inch and data from the Indiantown rainfall station were used, as these are the variables used most by the District's Regulation Department for permitting vegetables in Martin County. Table G-41 shows the supplemental water requirements and the estimated percentage of vegetable land in production in any given month. The primary acreage projection of 1,821 was used to calculate the irrigation requirements.

TABLE G-41. Supplemental Water Requirements and Projected Irrigation Requirements for Vegetables in Martin County

Month	Average (inch)	2-in-10 (inch)	Approx. percent in ground	Average (MG)	2-in-10 (MG)
January	1.42	1.56	100	140	155
February	1.08	1.28	100	107	126
March	1.75	1.96	100	173	194
April	1.87	2.14	100	185	212
May	2.71	2.99	50	134	148
June	0.79	1.31	0	0	0
July	2.25	2.68	0	0	0
August	1.94	2.41	50	96	119
September	1.39	1.86	100	137	183
October	1.41	1.76	100	139	174
November	1.98	2.12	100	196	209
December	1.72	1.82	100	170	180
Total	20.28	23.88		1,476	1,700

Rainfall station = Indiantown.
Soil type = **0.8** inch.
Acreage = **1,821.**

Sod

The sod projections presented here refer to irrigated sod. There is additional sod harvested from pastureland which is not irrigated.

St. Lucie County. Currently there are two companies producing irrigated sod in St. Lucie County. Based on an annual agricultural commodity report (IFAS, 1989) and communication with the local IFAS extension office (phone conversation 1991 with J. Cummings, St. Lucie County Extension Office, Cooperative Extension Service, IFAS, Ft. Pierce, FL.) a total estimate of 760 acres was made for these two companies. No meaningful trend or explanatory mathematical model could be developed 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 2010 (± 15 percent). The primary projection for the six time horizons is 760 acres, and the primary range is from 646 to 874 acres.

The irrigation requirements in Table G-42 were calculated by applying the current irrigated acreage to the Blaney-Criddle permitting model. Input variables used were 760 acres of grass, sandy soil with 0.8 inch usable soil water capacity, seepage irrigation systems with an irrigation efficiency of 50 percent, and Ft. Pierce as the rainfall station.

TABLE G-42. Supplemental Water Requirements and Projected Irrigation Requirements for Sod in St. Lucie County.

Month	Supplemental water requirements		Irrigation requirements	
	Average (inch)	2-in-10 (inch)	Average (MG)	2-in-10 (MG)
January	0.79	1.01	33	42
February	0.96	1.20	40	50
March	2.18	2.47	90	102
April	3.33	3.67	137	151
May	4.28	4.74	177	196
June	3.88	4.58	160	189
July	4.74	5.36	196	221
August	4.37	5.01	180	207
September	2.47	3.24	102	134
October	1.54	2.21	64	91
November	1.80	2.05	74	85
December	1.20	1.40	50	58
Total	**31.54**	**36.94**	**1,302**	**1,525**

Rainfall station = Ft. Pierce.
Soil type = 0.8 inch.
Acreage = 760.

Martin County. According to the local IFAS extension office, there are about 100 acres of irrigated sod produced annually in Martin County. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical data. Therefore, irrigated sod acreage was projected to remain constant at 100 acres through the year 2010 (± 15 percent). The irrigation requirements are presented in Table G-43. Irrigated sod in Martin County is produced primarily in Hobe Sound, which is of closer proximity to Stuart than to Indiantown, Input variables used were 100 acres of grass, sandy soil with 0.4 inch usable soil water capacity, sprinkler irrigation systems with an irrigation efficiency of 75 percent, and Stuart as the rainfall station.

TABLE G-43. Supplemental Water Requirements and Projected Irrigation Requirements for Sod in Martin County.

Month	Supplemental water requirements		Irrigation requirements	
	Average (inch)	2-in-10 (inch)	Average (MG)	2-in-10 (MG)
January	1.02	1.15	4	4
February	1.24	1.38	4	5
March	2.53	2.71	9	10
April	3.76	3.97	14	14
May	4.55	4.85	16	18
June	4.18	4.65	15	17
July	4.79	5.24	17	19
August	4.73	5.14	17	19
September	2.69	3.22	10	12
October	1.76	2.22	6	8
November	2.24	2.38	8	9
December	1.34	1.47	5	5
Total	34.83	38.38	126	139

Rainfall station = Stuart
Soil type = 0.4 inch.
Acreage = 100.

Okeechobee Area. The local IFAS extension office estimates that there are 350 acres of irrigated sod in Okeechobee County, all of which takes place in the District (phone conversation 1992 with Oliver Miller, IFAS Cooperative Extension Service, Okeechobee, FL.). Of this 350 acres, about 100 acres takes place in the UEC Planning Area. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical sod acreage data in the Okeechobee Area.

Therefore, irrigated sod acreage was projected to remain constant through the year 2010 (±15 percent). The primary projection of 100 acres was applied to the supplemental water requirements for sod at the Okeechobee rainfall station to yield the irrigation requirements. Other variables used were a usable soil water capacity of 0.8 inch, seepage irrigation systems with an irrigation efficiency of 50 percent. Irrigation requirements are presented in Table G-44.

TABLE G-44. Supplemental Water Requirements and Projected Irrigation Requirements for Sod in the Okeechobee Area.

Month	Supplemental water requirements		Irrigation requirements	
	Average (inch)	2-in-10 (inch)	Average (MG)	2-in-10 (MG)
January	0.95	1.07	5	6
February	1.13	1.27	6	7
March	2.05	2.27	11	12
April	3.28	3.52	18	19
May	4.17	4.51	23	24
June	3.34	3.93	18	21
July	3.97	4.53	22	25
August	4.03	4.54	22	25
September	2.62	3.16	14	17
October	2.43	2.78	13	15
November	2.22	2.33	12	13
December	1.35	1.45	7	8
Total	31.54	35.36	171	192

Rainfall station = Okeechobee.
Soil type = 0.8 inch.
Acreage = 100.

Cut Flowers

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 production. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical data. Therefore, irrigated cut flower acreage was projected to remain constant at 40 acres through the year 2010.

Currently the Blaney-Criddle permitting model has no category of cut flowers, and the value for sod is used for permitting purposes. Supplemental water requirements for sod on 0.4 inch soil in Martin County were applied to the cut flower acreage of 40 acres, and sprinkler irrigation systems with an irrigation efficiency of 75 percent, to calculate the irrigation requirements.

Cut flowers grown in Martin County are usually cultivated from July through May, with no production taking place in June. This is reflected in the irrigation requirement calculations in Table G-45.

TABLE G-45. Supplemental Water Requirements and Projected Irrigation Requirements for Cut Flowers in Martin County.

Month	Supplemental water requirements		Percent in ground	Irrigation requirements	
	Average (inch)	2-in-10 (inch)		Average (MG)	2-in-10 (MG)
January	1.02	1.15	100	1	2
February	1.24	1.38	100	2	2
March	2.53	2.71	100	4	4
April	3.76	3.97	100	5	6
May	4.55	4.85	50	3	4
June	4.18	4.65	0	0	0
July	4.79	5.24	50	3	4
August	4.73	5.14	100	7	7
September	2.69	3.22	100	4	5
October	1.76	2.22	100	3	3
November	2.24	2.38	100	3	3
December	1.34	1.47	100	2	2
Total	34.83	38.38		38	42

Rainfall station = Stuart.
Soil type = 0.4 inch.
Acreage = 100.

Ornamental Nursery

Ornamental nursery acreage in the UEC Planning Area are in St. Lucie and Martin counties. Nurseries in Okeechobee County are not in the planning area. In order to project ornamental nursery acreage in the planning area, the models shown in equations G-40 or G-41 were estimated.

$$XORN_t = f(XPOP_t, D) \quad \text{(G-40)}$$

$$XORN_t = f(TIME_t, D) \quad \text{(G-41)}$$

where:

$XORN_t$ = ornamental nursery acreage in X county in year t.

$XPOP_t$ = 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.***

Currently the District's Blaney-Criddle permitting model has no category of ornamental nursery, and the value for sod is used for permitting purposes. Supplemental water requirements for sod on the relevant soil were applied to the ornamental nursery acreage projections to calculate the irrigation requirements.

The majority of ornamental nurseries in the UEC Planning Area use overhead sprinkler systems for irrigation. Normally overhead sprinkler irrigation systems are estimated by the District to have an irrigation efficiency of 75 percent. However, an indeterminable number of nurseries containerize their plants, and this reduces the system efficiency to approximately 20 percent. To account for this range of efficiencies, an average efficiency of 50 percent was assumed. Micro irrigation systems will be required on all new container nursery projects, raising the estimated efficiency of these projects to 85 percent, and the future overall average efficiency to 80 percent. This often means that, even with increased acreage, the overall ornamental nursery irrigation demands are reduced (SFWMD, 1993).

St Lucie County. Ornamental nursery acreage has varied widely since 1972, from a low of 20 acres in 1979 to a high of 178 acres in 1978. A model of the form shown in Equation G-40 was estimated using ordinary least squares, and the results shown in Equation G-42 were obtained.

$$ORN_t = 23.8339 + \underset{(180)}{.3853} * POP_t + \underset{(3.71)}{68.6033} * D \quad \text{(G-42)}$$

D = a dichotomous variable equal to 1 for the period 1984-86 inclusive and 0 for all other time periods. This dichotomous variable captures the effects of killing freezes in the mid-1980s, which required replacement of landscapeplantings.

Goodness of fit statistics
$R^2 = .5608$
$F = 10.22$
$Pr\ F > 0 = .999$
$D\text{-}W = 2.448$
t-statistics in parentheses

When Equation G-47 was estimated using robust regression, with an value of 0.2, the results shown in Equation G-43 were obtained.

$$ORN_t = -10.0491 + \underset{(2.93)}{.5924} * POP_t + \underset{(3.39)}{56.4608} * D \qquad (G\text{-}43)$$

Goodness of fit statistics
$R^2 = .9154$
$F = 70.34$
$Pr\ F > 0 > .999$
$D\text{-}W = 1.689$
t-statistics in parentheses

The projections derived from Equations G-42 and G-43 are presented in Table G-46. The projections using OLS and robust regression are very close. Equation G-43 was chosen as it has better goodness of fit statistics.

TABLE G-46. Historical and Projected Ornamental Nursery Acreage in St. Lucie County.

Year	Historical	Column (E-49)	Column (E-50)	Primary Projection	Primary -15 %	Primary +15 %
1972	53					
1973	97					
1974	36					
1975	22					
1976	34					
1977	42					
1978	Unavailable					
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	87	87			
Projections						
1992		88	90	90	77	103
1993		91	93	93	79	107
1994		93	97	97	82	112
1995		95	101	101	86	116
1996		98	104	104	88	120
1997		100	108	108	92	124
1998		103	112	112	95	129
1999		106	116	116	99	133
2000		108	120	120	102	138
2001		111	124	124	105	143
2002		113	128	128	109	147
2003		116	132	132	112	152
2004		118	136	136	116	156
2005		121	140	140	119	161
2006		123	144	144	122	166
2007		126	148	148	126	170
2008		129	151	151	128	174
2009		131	155	155	132	178
2010		134	159	159	135	183

Supplemental water requirements for sod on 0.8 inch soil in St. Lucie County are shown in Table G-42. These water requirements were applied to the ornamental nursery acreage projections (shown in Table G-46) to calculate the irrigation requirements (shown in Table G-47).

TABLE G-47. Irrigation Requirements (MG) for the Primary Ornamental Nursery Acreage Projection in St. Lucie County.

Average	1985	1990	1995	2000	2005	2010
January	5	3	3	3	4	4
February	6	4	3	4	5	5
March	14	9	7	9	10	12
April	21	14	11	14	16	18
May	27	18	15	17	20	23
June	24	17	13	16	18	21
July	30	20	16	19	23	26
August	28	19	15	18	21	24
September	16	11	8	10	12	13
October	10	7	5	6	7	8
November	11	8	6	7	9	10
December	8	5	4	5	6	6
Total	199	135	108	128	150	170
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	6	4	3	4	5	5
February	8	5	4	5	6	6
March	16	11	8	10	12	13
April	23	16	13	15	17	20
May	30	20	16	19	23	26
June	29	20	16	19	22	25
July	34	23	18	22	25	29
August	32	21	17	20	24	27
September	20	14	11	13	15	17
October	14	9	8	9	11	12
November	13	9	7	8	10	11
December	9	6	5	6	7	8
Total	233	158	127	150	176	199

Martin County. Martin County ornamental nursery acreage has fluctuated historically, but has shown some growth in recent years. In order to project Martin County ornamental nursery acreage, the model shown in Equation G-47 was estimated using ordinary least squares and robust regression, and the results shown in Equations G-44 and G-45 respectively were obtained.

The variable POP_t is included to account for the relationship between landscape nursery plantings for new homes and population. Historical population data from the U.S. Bureau of the Census and the Bureau of Economic and Business Research, and projected population from the county comprehensive plan were utilized.

Ordinary least squares

$$MARORN_t = 59.27091 + .002821 * POP_t - 130.0754 * D \qquad \text{(G-44)}$$
$$\qquad\qquad\qquad\qquad (3.76) \qquad\qquad (2.85)$$

D = a dichotomous variable equal to 0 prior to 1989 and 1 in 1989 and after.

Goodness of fit statistics
$R^2 = .7954$
$F = 31.10$
$Pr\ F > 0 = .999$
$D\text{-}W = 1.454$
t-statistics in parentheses

Robust regression

$$MARNORN_t = 44.2639 + .003014 * POP_t - 145.2052 * D \qquad \text{(G-45)}$$
$$\qquad\qquad\qquad\qquad (8.12) \qquad\qquad (6.06)$$

Goodness of fit statistics
$R^2 = .9544$
$F = 167.53$
$Pr\ F > 0 > .999$
$D\text{-}W = 1.631$
t-statistics in parentheses

On the basis of an examination of the goodness of fit statistics and the projections resulting from the application of the two models, Equation G-45, adjusted for the amount by which it over projected 1991 acreage, was selected to generate a set of primary projections. Projections are shown in Table G-48.

TABLE G-48. Historical and Projected Ornamental Nursery Acreage in Martin County.

Year	Historical	Column (G-44)	Column (G-45)	Primary Projection	Primary -15 %	Primary +15 %
1972	160					
1973	141					
1974	225					
1975	182					
1976	110					
1977	175					
1978	Unavailable					
1979	206					
1980	334					
1981	313					
1982	273					
1983	274					
1984	290					
1985	282					
1986	365					
1987	294					
1988	200					
1989	402					
1990	518					
1991	521	505	527			
Projectionss						
1992		534	534	534	454	614
1993		546	548	548	466	630
1994		559	561	561	477	645
1995		565	568	568	483	653
1996		578	582	582	495	669
1997		590	595	595	506	684
1998		603	608	608	517	699
1999		615	622	622	529	715
2000		628	635	635	540	730
2001		641	649	649	552	746
2002		653	662	662	563	761
2003		666	676	676	575	777
2004		678	698	698	593	803
2005		691	703	703	598	808
2006		704	716	716	609	823
2007		716	730	730	621	839
2008		729	743	743	632	854
2009		741	756	756	643	869
2010		754	770	770	655	885

Supplemental water requirements for sod on 0.8 inch soil in Martin County are shown in Table G-43. These water requirements were applied to the ornamental nursery acreage projections (shown in Table G-48 to calculate the irrigation requirements (shown in Table G-49).

TABLE G-49. Irrigation Requirements (MG) for the Primary Ornamental Nursery Acreage Projection in Martin County.

Average	1985	1990	1995	2000	2005	2010
January	14	25	17	19	21	23
February	17	31	21	24	26	29
March	36	66	45	51	56	61
April	55	100	69	77	85	93
May	65	119	82	91	101	111
June	57	104	71	80	88	97
July	66	122	84	94	104	113
August	66	122	83	93	103	113
September	33	61	42	47	52	57
October	20	37	25	28	31	34
November	32	59	40	45	50	55
December	19	34	24	26	29	32
Total	479	880	603	674	747	818
2-in-10	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**
January	16	29	20	22	25	27
February	19	35	24	27	30	33
March	39	72	49	55	61	67
April	58	107	73	82	90	99
May	70	129	88	99	110	120
June	65	119	82	91	101	111
July	74	136	94	105	116	127
August	73	135	92	103	114	125
September	42	78	53	60	66	72
October	28	51	35	39	43	48
November	35	64	44	49	54	59
December	21	38	26	29	32	36
Total	541	994	681	762	843	923

Improved pasture

By District definition, improved pasture has the facilities in place to carry out irrigation. However, these facilities were usually designed and installed for drainage and are rarely used for irrigation. This is because the returns associated with cattle production no longer justify the expense associated with pasture irrigation. In fact, the required pumps and other equipment necessary for irrigation are usually not operable. When irrigation is used, it is usually in a period of extreme drought and is done to prevent grass from dying.

Unless there is evidence of pasture irrigation within a specific county, the assumption is made that, improved pasture will not be irrigated throughout the projection period. 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.

There is one ranch on which irrigation is routinely carried out (phone conversation 1991 with J. Cummings, Director, St. Lucie County Extension Office, Cooperative Extension Service, IFAS, Ft. Pierce, FL.). This ranch has a District water use permit to irrigate 10,000 acres, and a withdrawal allocation of 2,671 mgy. The monthly distribution was estimated using the District's Blaney-Criddle model, and is shown in Table G-50.

TABLE G-50. Estimated Monthly Irrigation Requirements for Pasture in St. Lucie County.

Month	Monthly distribution (Percent)	Irrigation requirements (Average MG)
January	4.9	132
February	7.3	195
March	11.6	311
April	16.0	426
May	19.0	506
June	5.6	151
July	11.8	316
August	11.0	294
September	0.0	0
October	0.0	0
November	7.2	192
December	5.5	147
Total		2,671

Rainfall station = Ft. Pierce.
Soil type = 1.5 inch.
Acreage = 10,000.

Cattle Watering

Water required for cattle watering was calculated as a function of the number of and type (beef or dairy) of cattle, which in turn was appraised as a function of the acreage used for pasture.

By limiting cattle population, total pasture acreage effects the water required for cattle watering . Total pasture was projected by subtracting land expansion for other purposes from the current acreage of pasture. The 1990 pasture acreage estimate was obtained from the local IFAS extension office. Historical and primary projected changes in acreage for other uses were applied to that figure. Note that pasture acreages may include wetlands which will not be converted to other agricultural uses. 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).

St. Lucie County. In 1990, St. Lucie County had approximately 31,000 head of cattle (The Florida Cattleman and Livestock Journal, 1990), of which 1,000 were dairy cows. These cattle accounted for 167,000 acres of improved and unimproved pasture (phone conversation 1991 with J. Cummings, St. Lucie County Extension Office, Ft. Pierce, FL.). The association between cattle and acreage is 5.4 acres per head of cattle. The acreage of pasture and the corresponding number of cattle will be reduced with the expansion of other crops in St. Lucie County. Beef cattle numbers are projected to experience this reduction as dairy cattle numbers are anticipated to remain constant over the projection period.

The projected reduction in beef cattle population and the related water use for cattle watering (based on the primary acreage projections of other crops) is shown in Table G-51.

TABLE G-51. Projected Water Use for Cattle Watering in St. Lucie County.

Year	Approximate Pasture Acreage	Total head of cattle	Dairy cattle	Beef Cattle	MGD	MG/ month
1985	180,000	33,000	1,000	32,000	0.57	17
1990	167,000	31,000	1,000	30,000	0.55	16
1995	161,000	30,000	1,000	29,000	0.53	16
2000	156,000	29,000	1,000	28,000	0.52	16
2005	151,000	28,000	1,000	27,000	0.51	15
2010	146,000	27,000	1,000	26,000	0.50	15

Martin County. The 1990 pasture acreage estimate was obtained from the local IFAS extension office. Historical and primary projected changes in acreage for other uses were applied to that figure (including sugarcane land in fallow). The resulting projections for pasture acreage are presented in Table G-52.

In 1990, Martin County had approximately 31,000 head of cattle, of which 3,000 were dairy cows. These cattle accounted for 145,000 acres of improved and unimproved pasture (phone conversation 1991 with R. Whitty, Martin County IFAS Extension Office, Stuart, FL.). The association between cattle and acreage is 4.68 acres per head of cattle. The acreage of pasture and the corresponding population of cattle will be reduced with the expansion of other crops in Martin County. It is likely that herd reduction will be limited to beef cattle. This projected reduction in cattle population and the related water use for cattle watering (based on the primary acreage projections of other crops) is shown in Table G-52.

TABLE G-52. Projected Water Use for Cattle Watering in Martin County.

Year	Approximate Pasture Acreage	Total head of cattle	Dairy cattle	Beef Cattle	mgd	mg/ month
1985	154,000	33,000	3,000	30,000	0.92	27
1990	145,000	31,000	3,000	28,000	0.89	27
1995	141,000	30,000	3,000	27,000	0.88	26
2000	136,000	29,000	3,000	26,000	0.87	26
2005	132,000	28,000	3,000	25,000	0.86	26
2010	128,000	27,000	3,000	24,000	0.84	25

Okeechobee Area. In 1990 Okeechobee County had about 186,000 head of cattle, of which 81,000 were dairy cows (Florida Cattlemen's Association, 1990). Estimates were developed for dairy and beef cattle numbers in the Okeechobee Area based on acreages mapped by the District as dairy farms (for dairy cattle) and pasture (for beef cattle) of the area of Okeechobee County within the District. Water demand estimates were based on these cattle numbers which are shown in Table G-53. The acreage of pasture and the corresponding population of beef and dairy cattle is anticipated to remain constant in the Okeechobee Area.

TABLE G-53. Projected Water Use for Cattle Watering in the Okeechobee Area.

Area	Dairy cattle	Beef Cattle	MGD	MG/ month	MG/ year
Okeechobee County	141,000	45,000	10.02	301	3,656
Okeechobee District Area	122,670	41,850	9.21	276	3,363
Okeechobee Area	15,947	9,207	1.89	57	692

TOTAL IRRIGATED ACREAGE

Irrigated agricultural acreages for the UEC Planning Area are presented in Table G-54. The table does not include the non-irrigated land used for pasture.

TABLE G-54. Irrigated Acreage in the UEC Planning Area.

Category	St. Lucie County	Martin County	Okeech. Area	Total UEC	Percent of Total
1990					
Citrus	94,878	46,283	2,460	143,621	84
Sugarcane	0	13,433)	0	13,433	8
Vegetables	580	1,821	0	2,401	1
Sod	760	100	100	960	1
Cut Flowers	0	40	0	40	0
Ornamental	79	518	0	597	0
Improved Pasture (irriqated)	10,000	0	0	10,000	6
Total	106,297	62,195	2,560	171,052	100
2010					
Citrus	131,320	50,079	4,474	185,873	87
Sugarcane	0	13,952	0	13,952	7
Vegetables	580	1,821	0	2,401	1
Sod	760	100	100	960	0
Cut Flowers	0	40	0	40	0
Ornamental	159	770	0	929	0
Improved Pasture (irrigated)	10,000	0	0	10,000	5
Total	142,819	66,762	4,574	214,155	100

TOTAL AVERAGE ANNUAL WATER DEMAND

Estimated and projected demands for the UEC Planning Area are shown in Table G-55. Demands are presented by use classification, with agricultural use broken down into its components. The Okeechobee County Area does not have significant urban demands.

TABLE G-55. Annual Water Demand by Use Classification.

Use Classification	Average Annual Water Demand (MG)		
	1990	2000	2010
St. Lucie County			
Public Water Supplied	5,030	8,824	12,618
Residential Self Supplied	3,066	2,816	2,566
Comm. & Ind. Self Supplied	296	434	569
Recreation Self-Supplied	2,761	4,270	5,678
Landscape	1,453	2,117	2,781
Golf Course	1,308	2,153	2,897
Agriculture	79,931	95,574	106,028
Citrus	75,367	91,028	101,447
Vegetables	255	255	255
Sod	1,302	1,302	1,302
Ornamental Horticulture	135	128	170
Improved Pasture	2,671	2,671	2,671
Cattle Watering	201	190	183
TOTAL	91,083	111,918	127,459
Martin County			
Public Water Supplied	4,581	6,946	9,311
Residential Self Supplied	2,796	3,044	3,292
Comm. & Ind. Self Supplied	555	767	1,000
Recreation Self-Supplied	4,473	6,210	8,229
Landscape	683	959	1,234
Golf Course	3,790	5,251	6,995
Agriculture	47,466	48,806	50,109
Citrus	29,877	30,839	32,005
Sugarcane	14,744	15,335	15,335
Vegetables	1,476	1,476	1,476
Sod	126	126	126
Cut Flowers	38	38	38
Ornamental Horticulture	880	674	818
Cattle Watering	325	318	307
TOTAL	59,870	65,773	71,941

TABLE G-55. Annual Water Demand (continued).

Use Classification	Average Annual Water Demand (MG) 1990	2000	2010
Okeechobee Area			
Agriculture	2,812	3,763	4,409
Citrus	1,951	2,902	3,548
Sod	171	171	171
Cattle Watering	690	690	690
TOTAL	2,812	3,763	4,409
GRAND TOTAL	153.765	181.443	203.804

UEC Planning Area Total by Use (MGY)	Estimated 1990	Projected 2000	Projected 2010	Percent of Total 1990	2000	2010
Public Water Supplied	9,610	15,770	2,010	6%	9%	11%
Residential Self Supplied	5,862	5,860	21,924	4%	3%	3%
Comm. & Ind. Self Supplied	850	1,201	1,570	1%	1 %	1%
Recreation Self Supplied	7,233	10,470	13,907	5%	6 %	7%
Agriculture	130,208	148,142	160,545	85%	82%	79%

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APPENDIX H

Water Quality and Protection

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AMBIENT WATER QUALITY

Ambient Ground Water Quality Distribution

A ground water study conducted by the SFWMD (Lukasiewicz and Switanek, 1994) collected and analyzed water sample from 134 Surficial Aquifer System (SAS) wells and 52 Floridan Aquifer System (FAS) wells in the UEC Planning Area during the time interval between 1989 to 1990. Most wells were sampled at the end of the wet and dry seasons between May 1989 and May 1990 and were analyzed for physical parameters, major ions, and specific trace metals. Figures H-1 through H-5 show the distribution of chlorides, total dissolved solids, and hardness for the SAS and FAS wells.

Statewide Ambient Ground Water Quality Monitoring Network

In 1983, the State of Florida passed the Water Quality Assurance Act (WQAA). Part of the WQAA provided for the establishment of a statewide Ambient Ground Water Quality Monitoring Network. The purpose of this network is to establish a ground water quality monitoring network to detect or predict contamination of the state's ground water resources. Water sampling began in September 1984, and samples are collected and analyzed periodically. This monitoring network has 13 locations in the UEC Planning Area. Information on station locations and ground water quality is available through the District's GWIS database (Herr and Shaw, 1989).

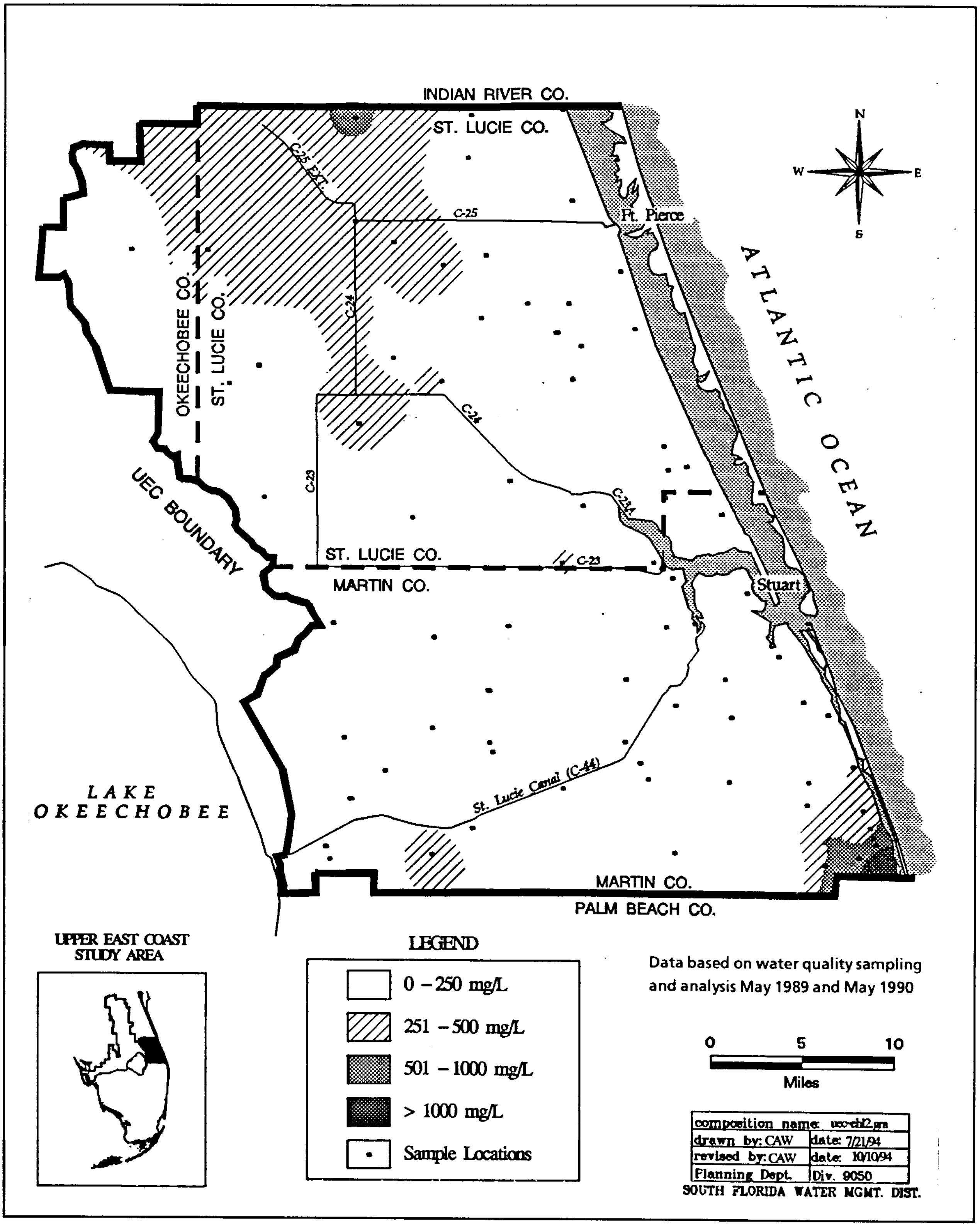

FIGURE H-1. Surficial Aquifer System Chloride Distribution (after Lukasiewicz and Switanek, 1994).

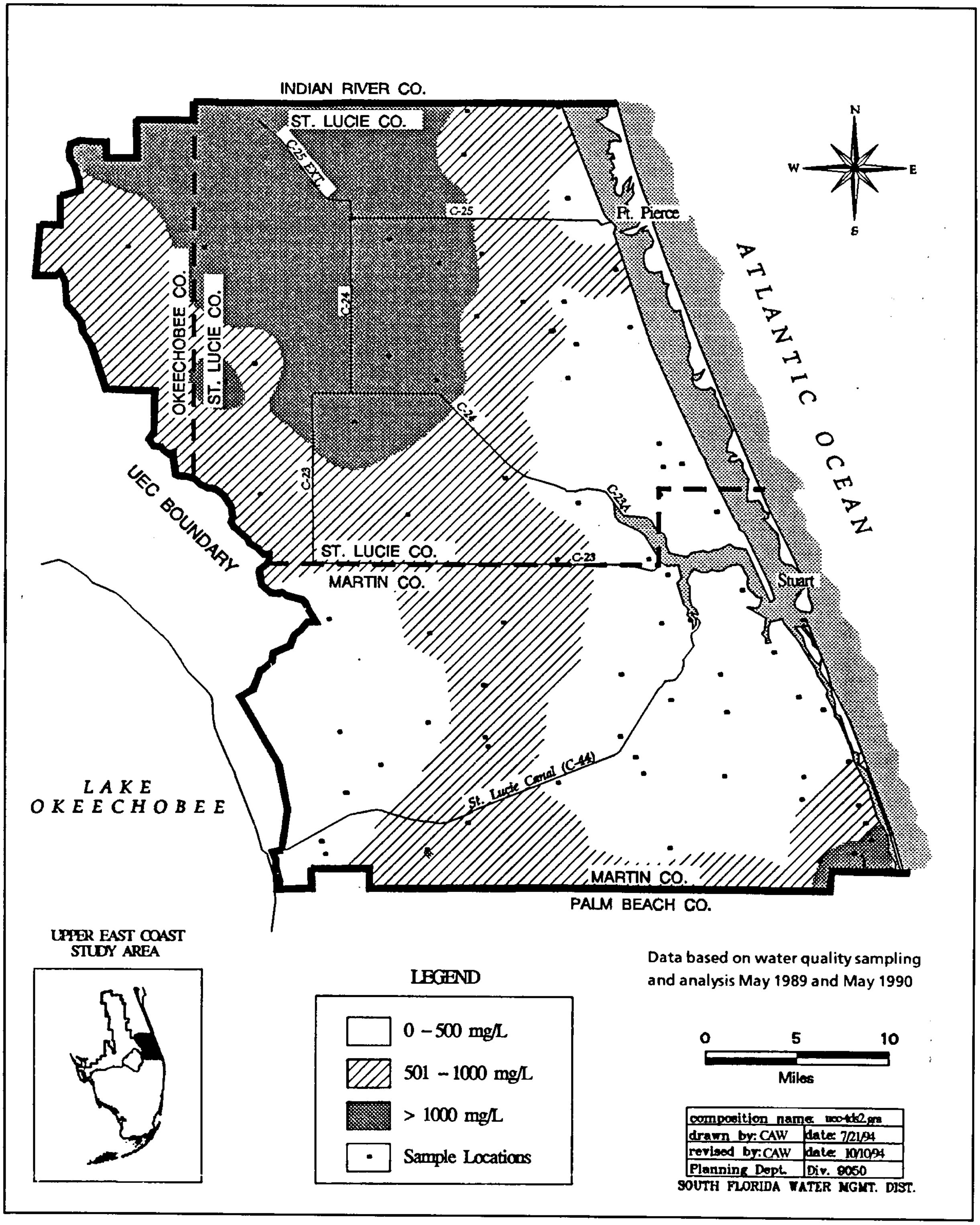

FIGURE H-2. Surficial Aquifer System Total Dissolved Solids Distribution (after Lukasiewicz and Switanek, 1994).

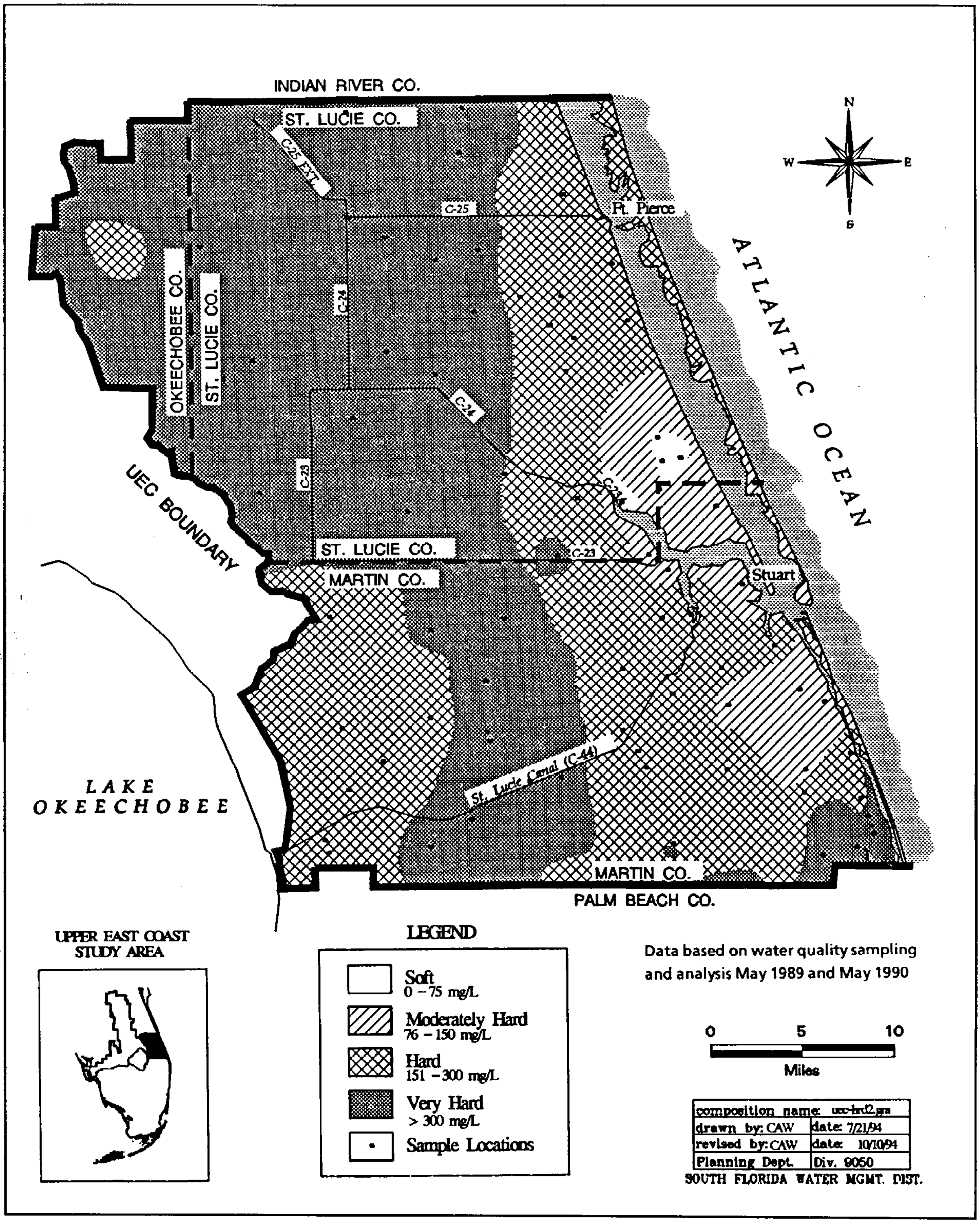

FIGURE H-3. Surficial Aquifer System Hardness Distribution (after Lukasiewicz and Switanek, 1994).

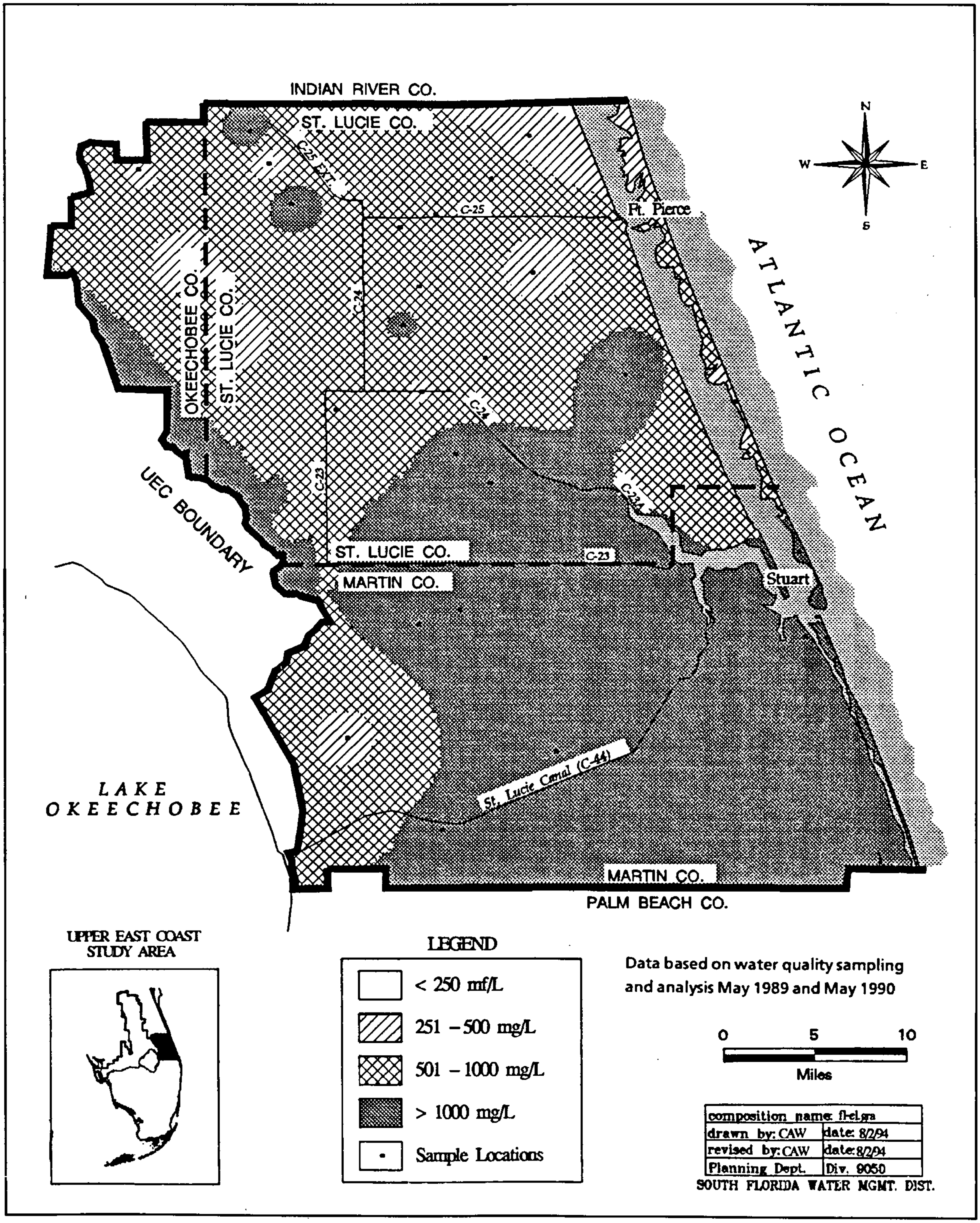

FIGURE H-4. Floridan Aquifer System Chloride Distribution (after Lukasiewicz and Switanek, 1994).

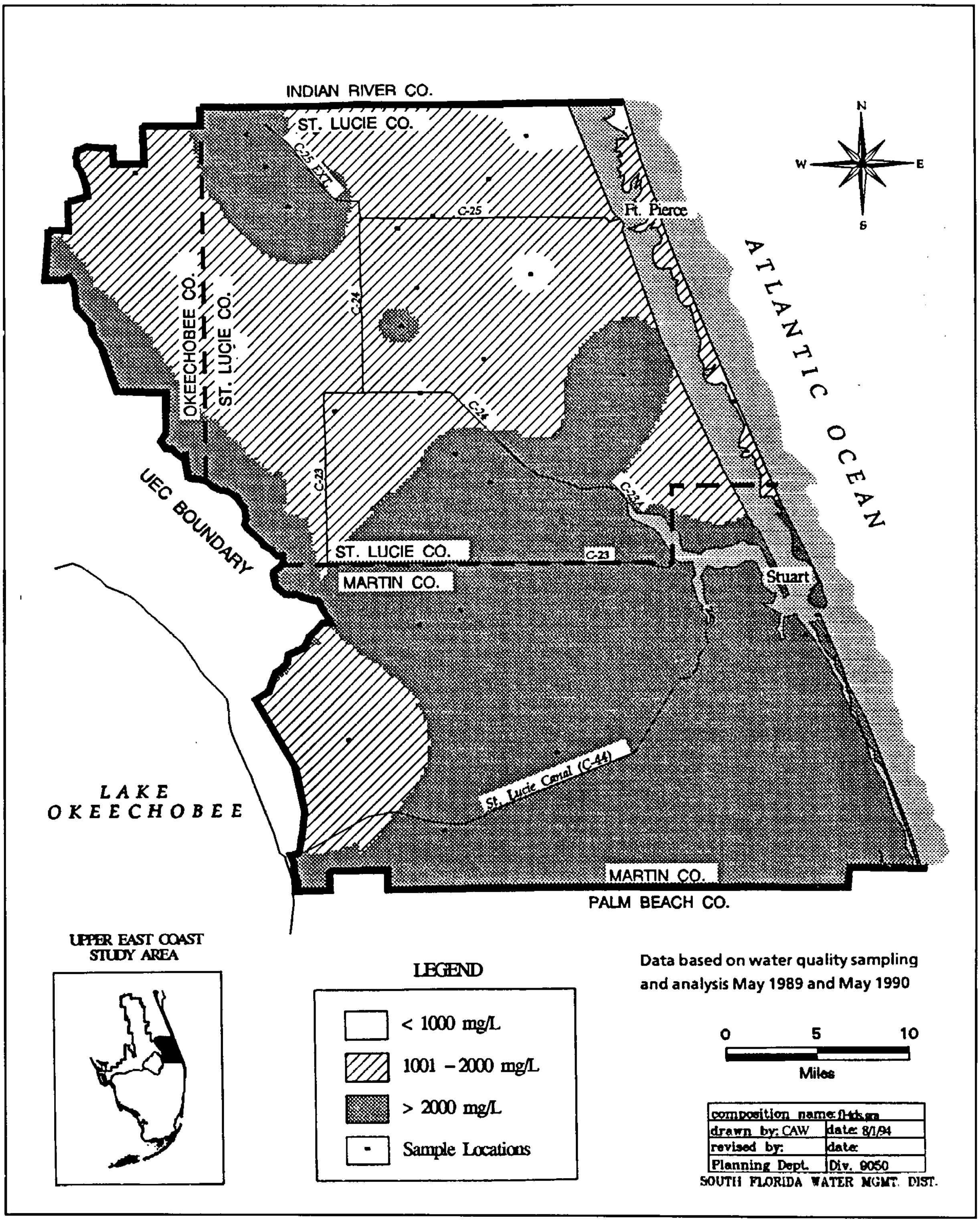

FIGURE H-5. Floridan Aquifer System Total Dissolved Solids Distribution (after Lukasiewicz and Switanek, 1994).

Surface Water Quality Monitoring Network

The District's Surface Water Quality Monitoring Network was initiated in 1979 for the coastal portions of the UEC Planning Area. Water quality monitoring stations are shown in Figure H-6. The following is a description of each site:

C25S99: S-99 is a gate-type structure located inland on C-25 near Fort Pierce. Water flows eastward over this structure. Water samples are collected from the upstream side of this structure.

C25S50: S-50 is a weir structure located on C-25 near Ft. Pierce. This coastal structure is downstream from S-99. Water flows eastward over this structure and is mixed with saltwater on the downstream side. Water samples are collected from the upstream side of this structure.

C24S49: S-49 is a gate-type coastal structure located on C-24 in Port St. Lucie. This structure is about 1/2 mile west of the Florida Turnpike. Water flows eastward through this structure into the St. Lucie River. Water samples are collected from the upstream side of this structure.

C23S97: S-97 is a gate-type structure located inland on C-23 about 1/2 mile west of the Florida Turnpike. Water flows eastward through this structure. Water samples are collected from the upstream side.

C23S48: S-48 is a weir coastal structure located downstream of S-97 on C-23. The water flows eastward over this structure into the St. Lucie River. Water samples are collected from the upstream side of this structure.

C44S80: S-80 is a large gate and boat lock coastal structure located on the St. Lucie Canal and operated by the U.S. Army Corps of Engineers. The water flows northeast through this structure into the St. Lucie River. Water samples are collected from the upstream side of this structure.

Physical parameters and nutrients are sampled and analyzed routinely once a month for the coastal stations. Major cations are added to the list of routine parameters four times a year, and total trace metals are analyzed twice a year (Germain and Shaw, 1988). The remaining inland stations are sampled only if there was a discharge at any time during a one week period prior to the monthly scheduled sampling date.

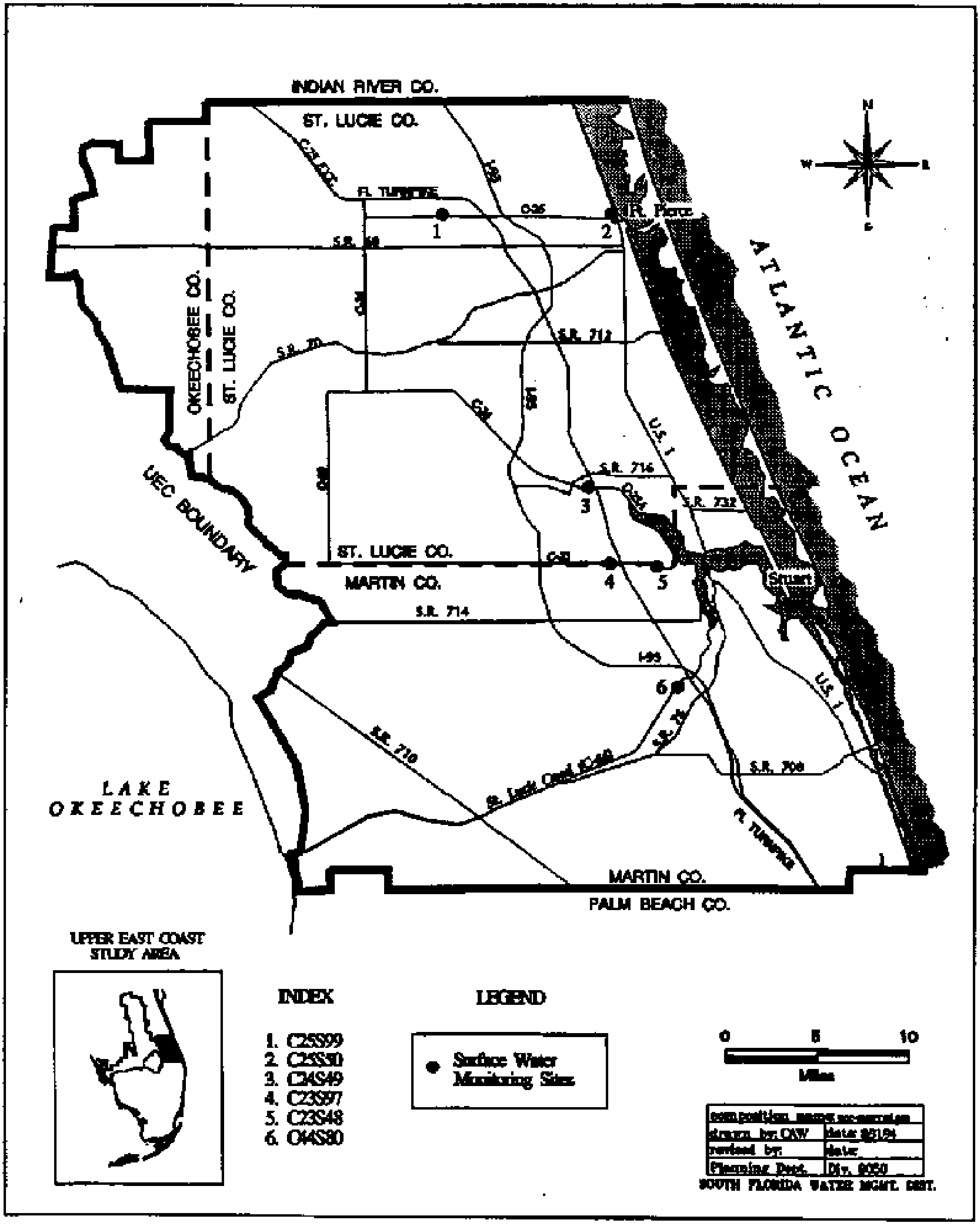

FIGURE H-6. Surface Water Quality Monitoring Network in the UEC Planning Area.

DRINKING WATER STANDARDS

Current FDEP primary and secondary drinking water standards are shown in tables H-1 and H-2. Primary drinking water standards include contaminants which can pose health hazards when present in excess of the maximum contaminant level (MCL). Secondary drinking water standards, commonly referred to as aesthetic standards, are those parameters which may impart an objectionable appearance, odor or taste to water, but are not necessarily health hazards.

TABLE H-1. FDEP Primary Drinking Water Standards.
(Chapter 17-550, F.A.C. -- revised July 1993)

ORGANICS

Volatile Organics	MCL* mg/L
Vinyl chloride	0.001
Benzene	0.001
Carbon tetrachloride	0.003
1,2-Dichloroethane	0.003
Trichloroethylene	0.003
para-Dichlorobenzene	0.075
1,1-Dichloroethylene	0.007
1,1,1-Trichloroethane	0.2
cis-1,2-Dichlorethylene	0.07
1,2-Dichloropropane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
o-Dichlorobenzene	0.6
Styrene	0.1
Tetrachloroethylene	0.003
Toluene	1
trans-1,2-Dichloroethylene	0.1
Xylenes (total)	10
Dichloromethane	0.005
1,2,4-Trichlorobenzene	0.07
1,1,2-Trichloroethane	0.005
Total Trihalomethanes The sum of concentrations of bromodichlormethane, dibromochloro-methane dibromochloromethane dibromochloromethane tribromomethane (bromoform) and trichloromethane (chloroform).	0.10

PESTICIDES & PCBS

	MCL* mg/L
Alachlor	0.002
Atrazine	0.003
Carbofura	0.04
Chlordane	0.002
Dibromochloropropane	0.0002
2,4-D	0.07
Endrin	0.002
Ethylene dibromide	0.00002
Heptachlor	0.0004
Heptachlor epoxide	0.0002
Lindane	0.0002
Methoxychlor	0.04
Polychlorinated biphenyl (PCB)	0.0005
Pentachlorophenol	0.001
Toxaphene	0.003
2,4,5-TP (Silvex)	0.05
Dalapon	0.2
Di(2-ethylhexyl)phtalate	0.006
Di(2-ethylhexyl)adipate	0.4
Dinoseb	0.007
Diquat	0.02
Endothall	0.1
Glyphosate	0.7
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.001
Oxamyl (vydate)	0.2
Benzo(a)pyrene	0.0002
Picloram	0.5
Simazine	0.004

INORGANICS

Contaminant	MCL* mg/L
Antimony	0.006
Arsenic	0.05
Asbestos	7 MFL**
Barium	2
Beryllium	0.004
Cadmium	0.005
Chromium	0.1
Cyanide	0.2
Fluoride	4.0***
Lead	0.015
Mercury	0.002
Nickel	0.1
Nitrate	10 (as N)
Total Nitrate and Nitrate	10 (as N)
Selenium	0.05
Sodium	160
Thallium	0.002

TURBIDITY

Surface Water
- One turbidity unit (NTU) when based on a monthly average.
- Five turbidity units (NTU) when based on an average for two consecutive days.

Ground Water
- One turbidity unit (NTU)

MICROBIOLOGICAL

Coliform Bacteria
- Presence/Absence

RADIONUCLIDES

	MCL*
- Combined radium-226 and radium-228	5 pCi/L
- Gross alpha activity, including radium-226 but excluding radon and uramium	15 pCi/L
- Manmade radionuclides	4 millirem/yr
- Tritium/total body	20,000 pCi/L
- Strontium-90/bone marrow	8 pCi/L

*MCL = maximum contaminant level
**MFL = million fibers per liter > 10 micrometers
***Fluoride also has a secondary standard

TABLE H-2. FDEP Secondary Drinking Water Standards. (Section 17-550.320, F.A.C. -- as amended July 3, 1993).

Contaminant	MCL (mg/L)*
Aluminum	0.2
Chloride	250
Color	15 color units
Copper	1
Fluoride	2.0
Foaming agents	0.5
Iron	0.3
Manganese	0.05
Odor	3**
pH (at collection point)	6.5 - 8.5
Silver	0.1
Sulfate	250
Total Dissolved Solids	500***
Zinc	5
Total Trihalomethanes	0.10

* Except color, odor, corrosivity, and pH.
** Threshold odor number.
*** May be greater if no other MCL is exceeded.

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IRRIGATION WATER QUALITY

Chemical parameters of an irrigation water that affect plant growth, yield, and appearance, soil conditions, and the ground water quality governs the applicability of a water. The University of California Cooperative Extension Service has developed a useful and widely accepted guide to evaluate the suitability of an irrigation water and identifying potential areas of concern. Problems and related constituents include salinity, permeability, specific ion toxicity (sodium, chloride, boron), nitrogen, bicarbonate, and pH. These guidelines can be found in "Water Treatment Principles and Design" (J.M. Montgomery Consulting Engineers, 1985).

In addition to these guidelines, recommended maximum concentration for trace elements have been developed and can be found in J.M. Montgomery Consulting Engineers, 1985.

Salinity

Salinity is a measure of the soluble salts, or the ionic activity of a solution in terms of its capacity to transmit current, in a water and is determined by measuring the water's electrical conductivity (EC) or specific conductance. Water salinity is the most important parameter in determining the suitability of water for irrigation. As salinity increases in irrigation water, the probability for certain soil, water, and cropping problems increases. There are several dissolved salts found in water, the principal salts being the chloride and sulfate salts of sodium, calcium, and magnesium (Augustin *et al*., 1986). Many salts, such as nitrogen, phosphorus, calcium, and potassium are necessary for normal plant growth.

Salt is added continuously via the irrigation water to the soil. Over time, a salinity problem to the plant may occur if the accumulated soil salt concentration increases to where it is harmful to the plant. The accumulation is dependent on the quantity of salt applied and the rate at which salt is removed by leaching. Leaching is essential to successfully irrigate with highly saline water. To assure that salt leaching occurs, additional irrigation water could be applied. Establishment of a net downward movement of water and salts is the only practical way to manage a salinity problem. In addition, under these circumstances, good drainage and/or percolation is essential in allowing movement of the water and salt below the root zone. The climate in an area also affects soil salt accumulation. Evaporation and transpiration remove water and leave the salts behind. Climate also influences the salt tolerance of plants, which will be discussed later.

Ground water salt content increases due to upconing or saline water intrusion. For reclaimed water, salts enter the wastewater stream in many different ways. Salts are contained in drinking water, are introduced through domestic and industrial activities, through water softeners, and through infiltration and inflow (I/I) into the wastewater collection system. Infiltration is where ground water enters the collection system through defective joints, cracked and broken pipes and manholes, whereas inflow is where storm water enters the collection system through combined sewers, manhole covers, foundation drains and roof drains. In coastal areas, I/I of seawater can be major source of salts in the reclaimed water. The advanced secondary wastewater treatment process has little effect on removal of salts from the wastewater stream.

Knox and Black (n.d.) provide a table indicating the degree of salt tolerance of many of the landscape plants adapted to South Florida, including trees, palms, shrubs, ground covers, and vines. Many of the salts are necessary for healthy plant growth; however, excessive concentrations of these salts can have a negative impact on the plant. Salts affect plant growth by: (1) osmotic effects, (2) specific ion toxicity, and (3) soil particle dispersion.

Osmotic Effects

Osmosis is the attraction of dissolved salts which causes water to move from areas of low salt concentration to areas of high salt concentration. Roots selectively absorb compounds that the plant needs to grow. The normal osmotic flow causes water to move from the soil, which is usually an area of low salt concentration, into the roots which is an area of higher salt concentration. Excessive salts in the soil can reverse the normal osmotic flow of water into the plant by reversing the salt concentration gradient, thus causing dehydration of the plant. Increased plant energy is also needed to acquire water and make biochemical adjustments necessary to survive, which will decrease plant growth and crop production. In addition, osmotic effects indirectly create plant nutrient deficiencies by decreasing the nutrient absorption. The salt tolerance of common turf grass species in South Florida can be found in "Saline Irrigation of Florida Turfgrasses" (Augustin *et al*., 1986).

Deposition of salts on foliage through spray irrigation may also cause problems, especially to sensitive ornamental plants. Much work has been devoted to quantify the tolerance of many of the plants. Many researchers have identified the salt tolerance of plants through field observation and have categorized them as having poor, moderate, or good salt tolerance. Several of their publications are available from the Florida Cooperative Extension Service Institute of Food and Agricultural Sciences (IFAS).

Specific Ion Toxicity. Ion toxicity is due to excessive accumulations of specific ions in a plant that result in damage or reduced yield. Toxicity problems may or may not occur in the presence of a salinity problem. Specific ions of concern include boron, chloride, sodium, and bicarbonate. Ion toxicity potential is increased in hot climates. The ions can be absorbed by the plant through the roots or the foliage, but with sprinkler irrigation, sodium and chloride frequently accumulates by direct adsorption through the leaves. Such toxicity occurs at concentrations that are much lower than toxicity caused by surface irrigation. Toxicity associated with overhead sprinkling is sometimes eliminated with night irrigation when lower temperatures and higher humidity exists. Tolerances of these ions vary from plant to plant.

Sodium. Sodium is not considered essential for most plants; however, it has been determined that sodium does positively affect some plants lower than the salt tolerance threshold. The amount of sodium is of concern because it is usually found in the largest amount. Sodium directly and indirectly affects plants. Direct affects of sodium toxicity involves the accumulation of this ion to toxic levels, which is generally limited to woody species (Maas, 1990). Indirect effects resulting from sodium toxicity include nutritional imbalance and impairment of the physical conditions of the soil. Sodium can affect the plant's uptake of potassium. Ornamental sodium toxicity is characterized by burning of the outer leaf edges of older leaves and progresses inward between the veins as severity increases. Sodium is usually introduced into the wastewater stream by I/I. With adequate care, sodium toxicity should not be a problem.

Chloride. Chloride is an essential micronutrient for plants and is relatively nontoxic. Most nonwoody crops, such as turf grass, are not specifically sensitive to chloride. However, many woody, perennial shrubs and fruit tree species are susceptible to chloride toxicity. In addition, chloride contributes to osmotic stress. Ornamentals express chloride toxicity by leafburn starting at the tip of older leave and progressing back along the edges with increasing severity. Chloride is usually introduced into the wastewater stream by I/I. With adequate care, chloride toxicity should not be a problem except possibly for irrigation of salt sensitive plants.

The City of St. Petersburg investigated the effect of reclaimed irrigation water on the growth and maturation of commonly used ornamental plants and trees in the St. Petersburg area. The study, called "Project Greenleaf" was also used to determine the chloride tolerance of those plants and trees (Parnell, 1987). The study suggested a chloride threshold of 400 mg/L be established for reclaimed water that is utilized for green space irrigation. This threshold protects salt sensitive ornamentals from the effects of chlorides, which generally have a lower salt tolerance than turf grasses.

Boron. Boron is an essential element to plants but can become toxic when concentrations of soil water slightly exceed the amount required for optimum growth. Boron is usually not a problem to turf grasses because boron accumulates in the leaf tips, which are removed by mowing; however, other landscape plants may be more sensitive to boron levels. Boron toxicity may be expressed by leaf tip burn or marginal burn accompanied by chlorosis of the interveinal tissue. Boron is commonly introduced to the wastewater stream from household detergents or from industrial discharges.

Water Infiltration Rate

In addition to other concerns with high sodium content, it can lead to deterioration of the physical condition of the soil by formation of crusts, water logging and reducing the soil permeability and nutritional problems induced by the sodium. An excess of sodium in the soil could displace nutrients such as calcium, iron, phosphorus, and magnesium from the soil particles and thereby creating a nutritional deficiency that the plant requires in addition to creating soil permeability problems (Knox, n.d.). Infiltration problems occur within the top few inches of the soil and is mainly related to the structural stability of the surface soil and is related to a relatively high sodium or very low calcium content in this zone or in the irrigation water. Reclaimed water usually contains sufficient amounts of both salt and calcium, such that dissolving and leaching of calcium from the surface soil is minimized.

Salt Levels in Soil

Good drainage is essential to leach soluble salts through the soil profile. To maintain a certain soil salt level, irrigation rates exceeding evapotranspiration are required to leach excess salts through the soil.

Salt Tolerance of Plants

Research has found that salt tolerance of plants usually relates to its ability to: (1) prevent absorption of chloride and sodium ions, (2) tolerate the accumulation of chloride or sodium ions in plant tissue, or (3) tolerate osmotic stress caused by soil or foliar salts. Plant tolerance to salts can be influenced differently based on the age of the plant, the stage of growth, irrigation management, and soil fertility. In addition, some plants are tolerant to soil salts but intolerant to salt deposits on the foliage, or vice versa.

The salt tolerance of plants varies greatly. Some plants avoid salt stress by either excluding salt absorption, extruding excess salts, or diluting absorbed salts. Other plants adjust their metabolism to withstand direct or indirect injury. Most plants utilize a combination of these. Turf grass salt stress is indicated by faster wilting than normal due to the osmotic stress, shoot and root growths are reduced to direct and indirect salt injury, leaf burn, general thinning of the turf and ultimately turf death. Landscape plant salt stress could be expressed by burning of the margins or tips of leaves followed by defoliation and death of salt sensitive plants.

Salt tolerance depends on many factors, conditions, and limits including type of salt, crop growing conditions, and the age and species of the plant. The type and purpose of the plant needs to be considered when evaluating salt tolerance. For example, for edible crops, yield is of primary importance and salt tolerance would be based on growth and yield. However, to establish permissible levels of salinity for ornamental plant species, the aesthetic characteristic of the plant is more important than its yield. The loss or injury of leaves due to salt stress is unacceptable for ornamentals, even if growth is unaffected. Accordingly, landscape plants can tolerate relatively higher levels of salts, since reduced growth and yield are the initial effects of excess salts and appearance of plants is not immediately affected (Knox and Black, n.d.).

Climate is a major factor affecting salt tolerance. Most crops can tolerate greater salt stress if the weather is cool and humid than hot and dry. Rainfall also reduces salinity problems by diluting salt concentration and enhancing leaching by adding additional water. Nighttime irrigation reduces foliar absorption and injury. In addition, some plants may be tolerant to soil salinity but are not tolerant to salt deposition on the leaves and vice versa. Use of an irrigation technique that applies water directly to the soil surface rather than on the leaf surfaces is preferred when using irrigation water which contains excessive salts.

Nutrients

Reclaimed water contains nutrients that provide a fertilizer value to the crop or landscape, which when accounted for, can reduce the amount of fertilizer applied, thus reducing fertilizer costs. The nutrients found in reclaimed water occurring in quantities important to agriculture and landscape management include nitrogen nd phosphorus and occasionally potassium, zinc, boron, and sulfur.

Municipal wastewaters usually contain sufficient amounts of micronutrients to prevent deficiencies. The trace elements of boron (B), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), zinc (Zn), sodium (Na), and chlorine (Cl) are essential for plant growth; however, intake of excessive concentration of these elements can be toxic and detrimental to some plants.

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GROUND WATER CONTAMINATION

There are many potential ground water contamination sources in the UEC Planning Area. These include landfills, petroleum storage tanks, hazardous material storage tanks, septic tanks, industrial waste sites and free-flowing FAS artesian wells. This section focuses on solid waste disposal sites (landfills) and Superfund program sites.

Landfills, old dumps and domestic sludge-spreading sites within the boundaries of the UEC Planning Area are listed in Table H-3, with an accompanying location map included as Figure H-7.

There are 11 sites on the U.S. EPA Superfund list that are either actual or potential threats of hazardous waste substance releases to the UEC Planning Area. These sites are shown on Figure H-8.

TABLE H-3. Solid Waste Disposal Sites in the Upper East Coast Planning Area.

MAP No.	SITE NAME	TYPE*	STATUS Active /Inact.	LINER	LOCATION T-R-S	ACRES	INFO. SOURCE CODE**	COMMENTS
	MARTIN CO. LANDFILLS & DUMPS							
1	Hobe Sound	100	I	None	39S-42E-31		abd	Closed ~ 1977.
2	Martin Co. I (Palm City I)	100	I	None	38S-40E-7	40	ad	Closed 1985. Total Property 388 acres.
	Martin Co. II (Palm City II)	100	I	20 mil PVC	38S-40E-7	10	a	
	Martin Co. II (Palm City II)	100	A	Clay/PVC/Clay	38S-40E-7	5	abd	
	Martin Co. II (Palm City II)	300	A	None	38S-40E-7	10	ad	
3	City of Stuart	100	I	None	38S-41E-16	62	ab	Closed 1980. Proposed golf course. There are 30 public wells within one mile. City was to perform remediation.
4	Town of Ocean Breeze	200	I	None	37S-41E-22		ab	
5	Indiantown Dump	520	I	None			ab	
	MARTIN CO. WWTP SLUDGE SPREADING SITES							USED BY:
6	Allapattah Properties	400	A	n/a		14,000	e	H&H Sludge
7	Allapattah Properties	400	A	n/a		675	e	J&J Baker
8	Bessemer Properties	400	A	n/a		823	e	Martin County Solid Waste
9	Berg: Box Ranch	400	A	n/a		6,000	e	Hutchinson Utilities
	EASTERN OKEECHOBEE CO. LANDFILLS & DUMPS							
10	Okeechobee Co. Yard & Trash	320	A	None	36S-36E-13		b	Owner: Chambers Waste Systems of America
	Okeechobee San. Landfill Phase I (Berman Road Landfill)	100	A		36S-36E-13		b	
	EASTERN OKEECHOBEE CO. WWTP SLUDGE SPREADING SITES WITHIN SFWMD							
11	Adam's Ranch	400		n/a				
	ST. LUCIE CO. LANDFILLS & DUMPS							
12	St. Lucie Co. II (Glades Rd)	100	A	60 mil HDPE	35S-39E-36	60	abc	Total site 600 acres.
	St. Lucie Co. II (Glades Rd)	300	A	40 mil HDPE	35S-39E-36	10	abc	
	St. Lucie Co. I	100	A	Marl	35S-39E-36	25	b	
13	Hammond Road (Old City of Ft. Pierce I)	100	I	None	34S-40E-30	40	abc	Closed 1977. Sold to private owner in 1991.
14	Center Road (Old City of Ft. Pierce II)	100	I	None	34S-40E-30	40	abc	Closed 1977. Located 1 mile south of Hammond Rd. Landfill. Sold to private owner in 1991.

TABLE H-3. Solid Waste Disposal Sites in the Upper East Coast Planning Area (continued).

MAP No.	SITE NAME	TYPE*	STATUS Active /Inact.	LINER	LOCATION T-R-S	ACRES	INFO. SOURCE CODE**	COMMENTS
	ST. LUCIE CO. LANDFILLS & DUMPS (Continued)							
15	St. Lucie Co. (Airport West)	100	I	None	34S-40E-19, 20	58	abc	Closed 1963. Across road from Ft. Pierce Landfills 1 and 2.
16	St. Lucie Co. (Airport N.E.)	100	I	None	34S-40E-19, 20	146	abc	Closed 1978 with remediation. Site is now a golf course.
17	White City Landfill	100 300		None	36S-40E-31	15	cb	
18	Stump Dump		I	None	Port St. Lucie		a	Construction/demo. debris.
19	City of Port St. Lucie	100 300	I	None		10	cb	Western Port St. Lucie. Closed 1971.
20	Old County Dump	520 100 300	I	None		20	cb	Closed approx. 1955. Current site of Indian River Comm. Coll.
21	Old Appliance Dump	520	I	None	see comments	10	c	Closed in early 1960s. South of Ft. Pierce City Limit.
	ST. LUCIE CO. WWTP SLUDGE SPREADING SITES							
22	Biele	400	A	n/a			a	
23	Branscomb	400	I	n/a			a	
24	Dersam	400	I	n/a			a	
25	O'Connel	400	I	n/a			a	
26	Modine	400	A	n/a			a	
27	Stokes	400	A	n/a			a	
28	Frenz Enterprises Sludge Disp. 2	400	A	n/a	T36-R39-10		bc	Lime stabilized septage and WWTP sludge.
29	HES Corp; Roundtree Citrus Ranch	400	A	n/a	T35-R37-01		bc	
30	HES Trnsp. Sludge Disposal	400	I	None	T35-R39-21		bc	

*CLASS CODES (TYPE):
- 100 Class I Landfill
- 200 Class II Landfill
- 300 Class III Landfill
  - 310 Trash/Yard Trash
  - 320 Trash Composting
- 400 SludgeDisposal Facility
- 520 Old Dump

**INFORMATION SOURCE CODES:
- a FDEP, West Palm Beach (Geetha Silvendra)
- b SFWMD, Regulation Dept. (Eduardo Lopez)
- c St. Lucie Co. Dept. of Public Works (Ron Sigmon)
- d Martin Co. Solid Waste Dept. (Ray Cross)
- e Martin County Public Health Unit (Charles Hassler/Joe Grusauskas)

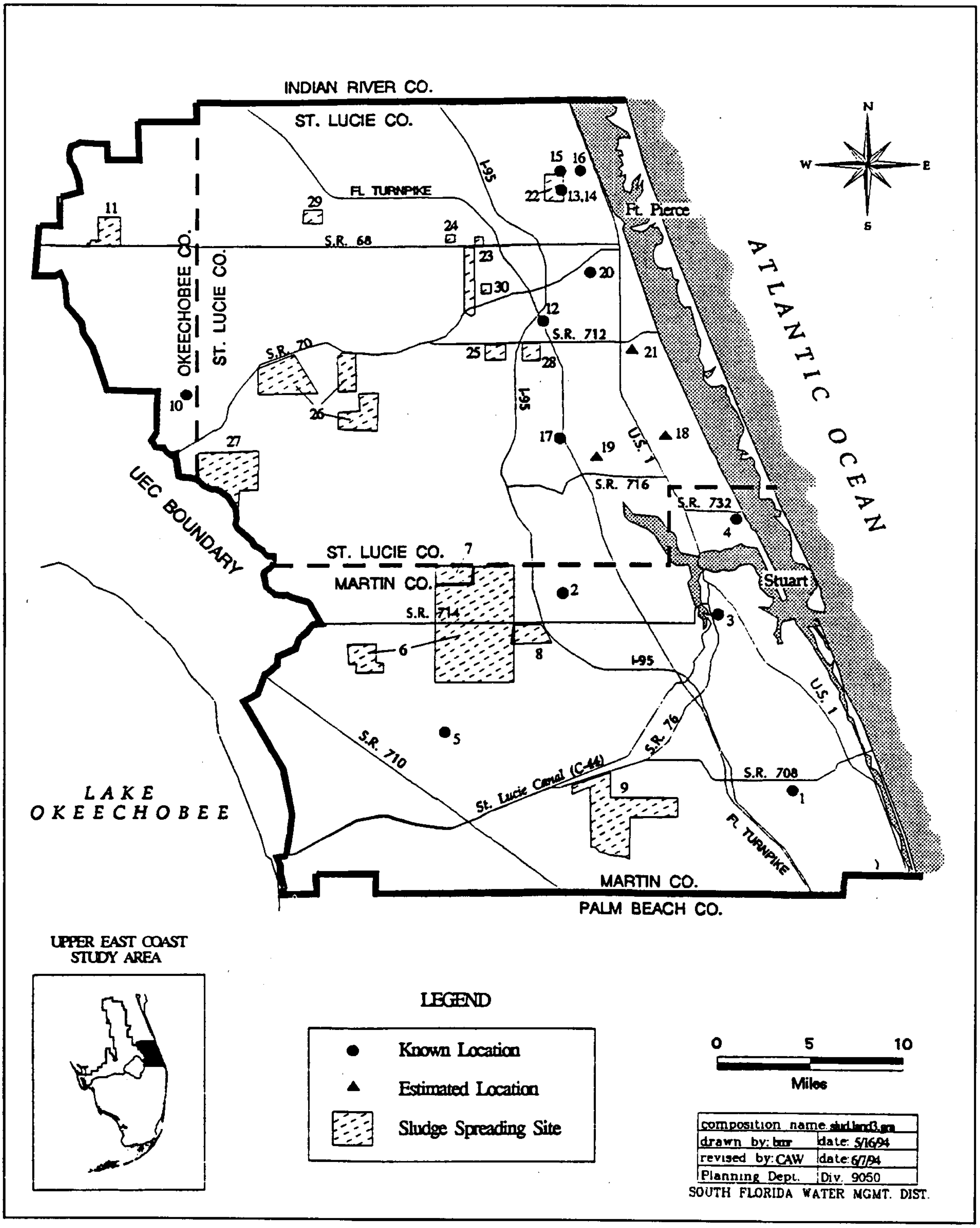

FIGURE H-7. Solid Waste Disposal Sites in the UEC Planning Area.

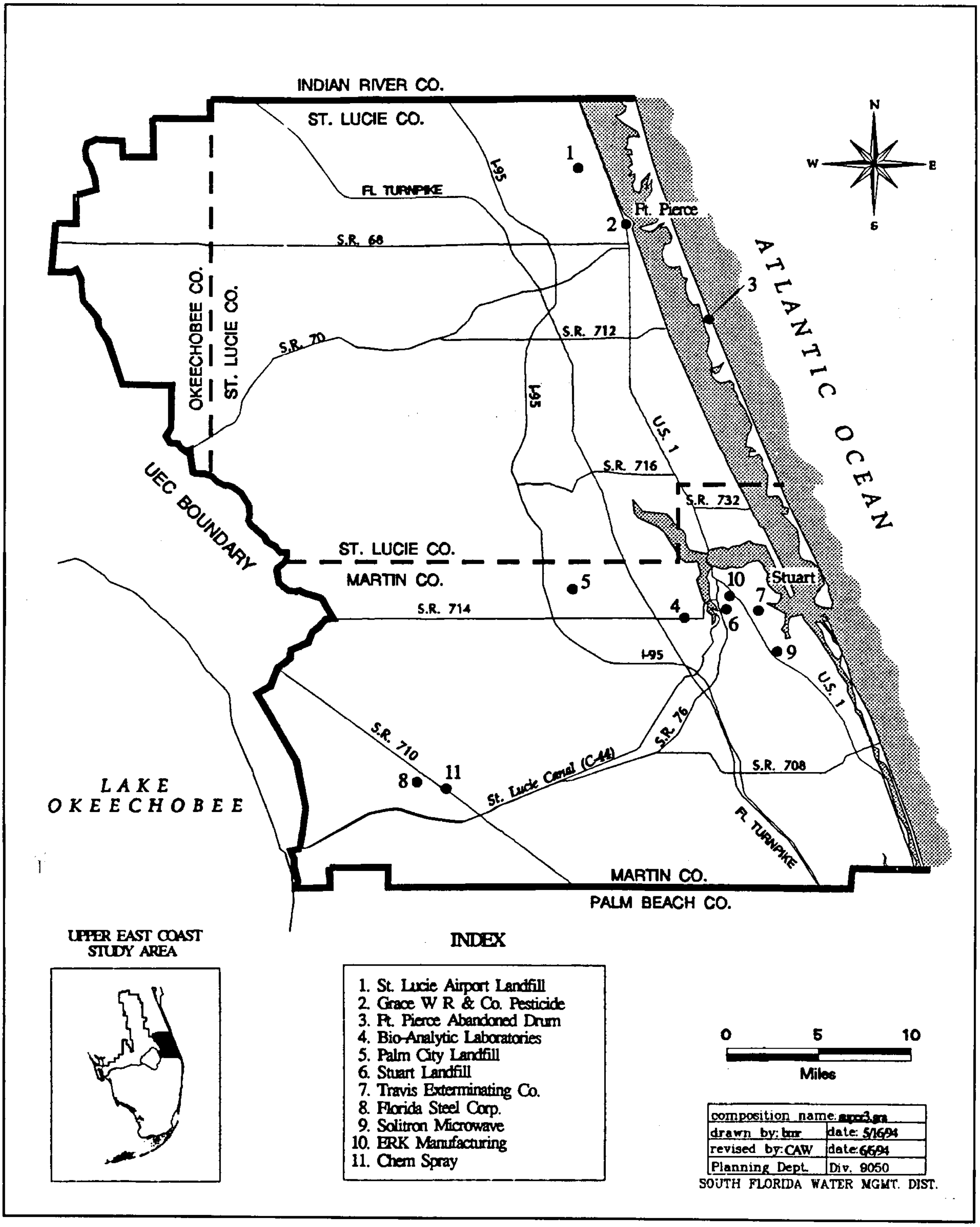

FIGURE H-8. Superfund Sites in the UEC Planning Area.

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WELLFIELD PROTECTION ORDINANCES

Aquifer Protection: Applicable Federal and State Laws

There is no single set of federal or state laws that represents a comprehensive approach to aquifer protection within Florida. Rather, numerous federal and state laws contain a variety of components which are applicable to the protection of ground water resources. Examples of federal legislation include the Safe Drinking Water Act (SWDA); the Resource Conservation and Recovery Act; the Comprehensive Environmental Response, Compensation, and Liability Act; the Clean Water Act; the Toxic Substances Control Act; the Emergency Planning and Community Right-to-Know Act of 1986; and the Federal Insecticide, Fungicide, and Rodenticide Act. The State of Florida, through the Department of Environmental Protection, the Department of Health and Rehabilitative Services (FDHRS), the Department of Agriculture and Consumer Services (FDA), and the Water Management Districts has enacted a series of administrative rules directed toward aquifer protection. FDEP has promulgated a number of different regulations under Title 17 of the Florida Administrative Code (F.A.C.), which function to regulate several types of activities (examples include storage tank systems, hazardous and solid waste, wastewater, underground injection, storm water discharge, etc.) with potential impacts on ground water.

The primary applicable rule regulating onsite sewage disposal administered by FDHRS is codified as Chapter 10D-6, F.A.C., while FDA has promulgated several applicable rules (regulating use of fertilizers and pesticides) within Title 5 of the code. Rules of the WMDs (defining water management activities) are codified in various chapters of Title 40, F.A.C. In addition, the state and local government comprehensive plans (codified at Chapter 187, F.S., and Chapter 163, F.S., respectively) address additional elements relating to ground water protection.

The first cohesive federal effort actually aimed at aquifer protection came in 1984, when the USEPA published its Ground Water Protection Strategy. This strategy recognized the need to prevent future ground water contamination and emphasized the protection of public water supply aquifers or those linked to unique ecosystems. As a result of this approach, federal provisions focused specifically at public water supply well protection were adopted as part of the reauthorization of the SDWA in 1986. This legislation established a nationwide policy to encourage states to develop systematic and comprehensive wellhead protection programs to protect public water supply areas from all man-made sources of contamination, which may cause or contribute to adverse health effects.

By the late 1980s, Florida's Local Government Comprehensive Planning and Land Development Regulation Act, Chapter 163, F.S., was enacted which includes a statutory requirement (under Rule 9J-5, F.A.C.) that local governments implement comprehensive plans and land development regulations which protect potable aquifers and wellfields.

The primary goal of these legislative policies, aimed at aquifer protection, is to prevent problems before they occur as contrasted to correcting or providing remedial action for pre-existing problems. Thus, the most logical and efficient approach to ground water protection is one which reduces the potential for contamination by controlling land uses overlying the aquifer system.

Wellhead Protection Defined

Wellhead protection is a mechanism of preservation employed in the area surrounding a public water supply well or wellfield. It entails a management process that acknowledges the link between activities that take place in wellfield areas and the quality of the ground water supply for those wells. A Wellhead Protection Area (WHPA) is delineated as the surface area, projected from the subsurface, surrounding a well or wellfield through which water (and potential contaminants) will pass and eventually reach the well(s).

Wellhead protection area boundaries or “zones” are determined based on a variety of criteria (e.g., time of travel, drawdown, distance, etc.) and methods (e.g., analytical/numerical flow models, fixed radii, etc.). Factors such as the physical characteristics of the aquifer supplying water to the well(s), aquifer boundaries, the extent of pumping, the degree of confinement, the vulnerability of the aquifer to surface contamination, and the degree of development and land use activity surrounding the well(s) are used in the process. Because methods/criteria employed and physical conditions vary, WHPAs can range anywhere from a distance of a few hundred feet to several miles from pumping wells. Management activities commonly employed within these protection areas include regulation of land use through special ordinances and permits, prohibition of specified activities, and acquisition of land.

Martin and St. Lucie Counties Aquifer Protection Programs

Ground water protection programs are currently undergoing rapid change. At the federal and state levels, additional information is constantly being compiled, new issues are being raised, and new regulatory initiatives are being developed. Local governments must continually assess these changes, in order to determine the adequacy or inadequacy of their applicable program(s).

Several factors make local ground water protection a complicated undertaking in South Florida. First, the existing federal and state laws supply a jigsaw approach to ground water protection that does not adequately address protection at a local level. Additionally, the SAS hydrogeology is fairly complex, making it difficult to accurately assess the physical nature of the resource. Finally, development pressures in the UEC Planning Area are strong, and the increased numbers of potential pollution sources that accompany developed areas, including those currently in existence, place an increased water quality burden on the aquifer system. Therefore, determining what type(s) of technological or operative controls constitute a practical and efficient approach to protecting the resource, under a given set of conditions, requires careful analysis.

Despite these difficulties, local ground water protection programs have been established for all counties within the UEC Planning Area. These programs are more sophisticated than merely restricting the type and intensity of various land uses on the basis of their proximity to a public water supply. Recognizing the SAS's relatively high vulnerability to contamination, Martin and St. Lucie counties employ a variety of programs, funding mechanisms, and environmental regulations focused on contamination cleanup and prevention. Examples include the following:

- Hazardous Waste Generators Program
- Petroleum Cleanup Program
- Commercial/Industrial Septic System Monitoring Program
- Solid Waste Program
- Surface Water Quality Management Program
- Waste Oil Collection/Recycling Program
- Amnesty Day Program
- Pollution Recovery Trust Fund
- Storm Water Discharge and Wastewater Disposal Regulations

These programs continue to build on five principle elements which include water management and monitoring, water and wastewater treatment, land use policy, environmental regulations and enforcement, and public awareness and involvement. These elements, when coupled with an effective wellhead protection ordinance, comprise a holistic aquifer protection strategy, which is focused on pollution source control and based upon implementing a variety of regulatory and non-regulatory approaches (e.g., overlay zoning, site plan review, design and operating standards, ground water monitoring, public education, water conservation, household hazardous waste collection, etc.).

As reflected in the current legislative mandates, the primary responsibility for protecting local sources of drinking water belongs to the local governments. The obligations associated with local police powers require these governments to pass and enforce regulations protecting the health, safety, and welfare of the public. Consequently, in the late 1980s, all counties within the UEC Planning Area (in conjunction with the technical guidance and financial support provided by the SFWMD) initiated wellhead protection measures aimed at protecting the region's potable water supply. Although varying in stages of completion, Martin and St. Lucie counties have enacted wellhead protection ordinances. The intent of these ordinances is to protect and safeguard the health, safety, and welfare of the public by providing criteria for regulating and prohibiting the use, handling, production and storage of certain deleterious substances which may impair present and future public water supply wells and wellfields.

Martin and St. Lucie County Wellhead Protection Ordinances

In striving to assure adequate future potable water resources, Martin County adopted a Wellhead Protection Ordinance in 1993 for the purpose of providing protection to public water supply wells/wellfields throughout the county. This ordinance is summarized in Appendix H. The ordinance incorporates an arbitrary fixed radii of protection about wells within which the use, storage, handling, or production of regulated substances is controlled. Over 70 wells, representing a variety of utilities and eight major wellfields, are encompassed by a static protection zone of 500 feet.

In 1989, St. Lucie County, adopted an Interim Wellhead Protection Ordinance which was designed to be the first step in a comprehensive aquifer protection program (a permanent ordinance has been adopted by St. Lucie County). Like Martin County, the ordinance incorporates a fixed radii of protection about the major public water supply wellfields countywide. The protection zone, represented by a 1,000 foot radial distance, was selected based on field observation of existing contaminant plumes (referenced by Ft. Pierce Utilities Authority) and evaluation of "zones of influence" based on conservative estimates of aquifer parameters and pumping rates.

In general, both ordinances prohibit all new nonresidential activities that use, handle, produce or store regulated substances (as defined by 40 Codified Federal Register (CFR) 302 & 122.21, and Chapter 487, F.S.; and regulated by fixed quantities as specified within the ordinance) within a fixed distance of a public water supply well/wellfield. In addition, the location of septic systems, storm water wet retention/detention areas, and wastewater treatment plant effluent discharges within 200, 300, and 500 feet respectively of a public water supply well/wellfield are prohibited.

A variety of general exemptions are addressed depending on the activity type (e.g., continuous transit regarding regulated substances and vehicular fuel and lubricant use). Special exemptions are granted, if the business can demonstrate adequate protection exists to prevent a contamination event from impacting the water supply. This protection is demonstrated by the implementation of a variety of best management practices as outlined within the ordinance.

Control and/or enforcement of the interim ordinances is administered by the appropriate county offices. In Martin County, this includes coordinated efforts between the Growth Management, Utilities, Building and Zoning, and Public Safety departments, and the Code Enforcement Division. In St. Lucie County, these responsibilities lie with the Department of Community Development.

Future Considerations

Aquifer protection is a dynamic process, continually undergoing change. The principal goal of any aquifer or ground water protection program is ensuring protection of the resource. Continued urban growth and diversification of the UEC Planning Area presents unique challenges to the local governing bodies. Although Martin and St. Lucie counties have established initial precautions to protect the SAS, much remains to be done. A variety of issues are currently being focused upon by these counties which include:

- Construction and maintenance of hazardous waste collection facilities.
- Continued efforts in creating additional local collection/community service recycling stations for proper disposal of motor oil and lead-acid batteries.
- Assessment of new wellfield sites to accommodate future urban expansion and projected water demands.
- Continued development of conservation programs and reuse programs.
- Continued cooperation between county agencies and farming communities in order to minimize pesticide and fertilizer contamination through the implementation of best management practices.

Future water supply planning must continue to seek solutions for these issues with environmentally sound and economically feasible alternatives. These solutions will serve to minimize the potential for contaminating the UEC Planning Area's potable water supply within the SAS for years to come.

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APPENDIX I

Regulation of Wastewater Reuse and Aquifer Storage and Recovery

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REGULATION OF WASTEWATER REUSE AND AQUIFER STORAGE AND RECOVERY

The state's environmental regulation agency, the Florida Department of Environmental Protection (FDEP), regulates the two water supply alternatives discussed in this section, wastewater reuse and aquifer storage and recovery. The FDEP was formerly the Florida Department of Environmental Regulation (FDER). In July 1993, the FDER was merged with the Florida Department of Natural Resources (FDNR) to form the Florida Department of Environmental Protection (FDEP). This appendix refers to the FDEP except in citations to documents or data published by the FDER.

WASTEWATER REUSE

Reuse is the deliberate application of reclaimed water for a beneficial purpose in compliance with the FDEP and South Florida Water Management District's rules. Reclaimed water is wastewater that has received at least secondary treatment and is reused after flowing out of a wastewater treatment plant (Chapter 62-610, F.A.C.). Reuse includes:

- Landscape irrigation (such as irrigation of golf courses, cemeteries, highway medians, parks, playgrounds, school yards, retail nurseries and residential properties).
- Agricultural irrigation (such as irrigation of food, fiber, fodder and seed crops, wholesale nurseries, sod farms, and pastures)
- Aesthetic uses (such as decorative ponds and fountains)
- Ground water recharge (such as slow rate and rapid rate land application systems)
- Industrial uses (such as cooling water, process water and wash waters)
- Environmental enhancement (such as wetlands restoration)
- Fire protection

The FDER 1992 Reuse Inventory identified 308 wastewater treatment facilities ($\geq$ .01 MGD) that are reusing approximately 290 MGD of reclaimed water in Florida, These facilities have a total design capacity of 601 MGD. This is a substantial increase from the 1990 Reuse Inventory, which identified 199 wastewater treatment facilities that were reusing approximately 266 MGD of reclaimed water (FDER, 1992). Among the many reasons for the increased utilization of reuse are: (1) it is an environmentally acceptable means of disposal; (2) state regulations have been adopted; (3) there is an increased public acceptance; and (4) the frequency of drought and water restrictions have increased. Treated wastewater, when properly treated to acceptable standards for the reuse, is no longer a waste but a valuable nonpotable water resource which will enhance the regional water inventory. Reclaimed water is and will continue to have a substantial role in water supply in Florida.

Reuse in the Planning Area

Eight of the regional wastewater facilities in the UEC Planning Area utilized reuse for reclaimed water disposal in 1993. The methods of reuse employed by these facilities include ground water recharge via percolation ponds, and public access spray irrigation of golf courses, residential lots and other green space. The facilities utilizing reuse for all or part of their disposal needs are listed in Table I-l.

Many of the treatment facilities utilized reclaimed water for plant process water and for irrigation of the plant site, is also could considered reuse. Reuse, which accounted for 3.07 MGD in 1993, accounted for 24 percent of the total wastewater processed in the UEC Planning Area. The remaining 9.98 MGD was disposed of by deep well injection or discharge to surface water and lost from the water supply inventory. This water, that was disposed of by deep well injection and discharge to surface water, could be made available for reuse with the addition of regulatory mandated equipment including filtration and the associated chemical feed system, disinfection facilities and reclaimed water monitoring equipment. A facility reliability of Class I, or an equivalent may exist via their existing method of disposal. In some cases, the existing method of disposal may also be utilized as an alternate means of disposal during periods of low demand or when the required reclaimed water quality is not met, which may negate the need for regulatory mandated storage.

Many of the facilities listed in Table I-l will continue to increase their amount of reuse when additional reclaimed water becomes available **and/or** when demand is created. Utility-specific information is provided in Appendix E.

Florida's Comprehensive Reuse Program

The State and District objectives include promoting and encouraging water conservation and reuse of reclaimed water. To achieve this objective, several requirements and regulations have been implemented as part of a comprehensive reuse program. These are: (1) Chapter 62-40, F.A.C., (2) Section 403.064, F.S., (3) the **FDEP's** Antidegradation Policy, (4) guidelines for preparation of reuse feasibility studies, (5) SFWMD Basis of Review, and (6) State reuse regulations.

Chapter 62-40, F.A.C.

This chapter, also referred to as the State Water Policy, requires the water management districts to designate areas that have water supply problems which have become critical or are anticipated to become critical within 20 years. This chapter further states that a reasonable amount of reuse shall be required within these areas. The SFWMD adopted the designated critical water supply problem areas, now referred to as water resource caution areas, by rule (Chapter 403-23, F.A.C.) in October of 1991. The UEC Planning Area is incorporated in this designation.

TABLE I-l. Upper East Coast Planning Area 1993 Reuse Facilities.

Facility	Public Access Spray Irrigation			Percolation Ponds
	Golf Course	Residential Lots	Green Space	
Martin County				
Hydratech Utilities	x			x
Indiantown Company				x
Martin Co. - Port Salerno	x			x
Martin Co. - Martin Downs	x			x
St. Lucie County				
Holiday Pines				x
Port St.Lucie Southport	x			
Port St. Lucie Westport			x	x
St. Lucie West	x	x	x	

Section 403.064, Florida Statutes

This section of the statutes requires all applicants for domestic wastewater permits from the FDEP for facilities located in a critical water supply problem area to evaluate the feasibility of reuse of reclaimed water as part of their application for the permit.

FDEP Antidegradation Policy

This policy is contained in Chapter 62-4, F.A.C., "Permits," and Chapter 62-302, F.A.C., "Surface Water Quality Standards." Compliance with the state's anti-degradation policy must be justified prior to issuance of a permit by FDEP for any new or expanded surface water discharge. The antidegradation policy requires a utility proposing to construct a new discharge or expansion of an existing discharge, to demonstrate that an alternative disposal method such as reuse of domestic reclaimed water is not feasible in lieu of a discharge to surface water, and that such a discharge is clearly in the public interest. This requirement is discussed further in Appendix E.

Reuse Feasibility Studies

There are several rules, statutes, or laws that require preparation of reuse feasibility studies. The FDEP, with assistance from the water management districts and the public service commission, have developed guidelines for preparation of reuse feasibility studies to aid in coordination, consistency and completeness of these studies.

SFWMD Basis of Review

Revisions to the District's Basis of Review, adopted by the Governing Board in October 1992, require feasibility evaluations of reuse. For all potable public water supply utilities who control, directly or indirectly, a wastewater treatment facility, an analysis of the economic, environmental and technical feasibility of making reclaimed water available shall be incorporated into their water conservation plan at the time of permit application.

Applicants for permits for commercial/industrial uses and agricultural, landscape, and golf course irrigation uses which are located in water resource caution areas are required to use reclaimed water in place of higher quality water sources, unless it is demonstrated that its use is either not environmentally, economically or technically feasible. Reclaimed water also has to be readily available for facilities located outside a designated critical water supply problem area,

State Reuse Regulations

The state adopted Chapter 62-610, F.A.C., "Reuse of Reclaimed Water and Land Application," in April of 1989. This Chapter contains the specific reuse and land application requirements of the FDEP and the Local Pollution Control programs where such authority has been delegated to those programs. The chapter is discussed in detail later in this section.

Reuse Benefits

Several benefits result from the use of reclaimed water for nonpotable water needs. When reclaimed water is utilized to replace a potable supply for nonpotable needs, the benefits include:

- Postponement or elimination of future water treatment plant expansions
- Postponement or elimination of construction of additional water supply wells
- Reduction in the size of the potable water distribution lines
- Reduction in monthly water bills

Additional benefits to the above and with respect to other ground water users are:

- Guaranteed source of water
- Reduced demand on the ground- or surface-water resource
- Exempt from water shortage/restriction requirements
- Reduced application of commercial fertilizers since reclaimed water contains nutrients
- More water available and reduced demands during water shortages for the regional water supplier
- Ground water recharge
- Satisfaction of antidegradation requirement for expansion of a surface water disposal facility
- Exempt from SFWMD permitting

Public Health

Health risks with reclaimed water are relative to the degree of human contact and adequacy/reliability of the treatment processes that produce the reclaimed water. The FDEP has developed reuse regulations that require extensive treatment and disinfection to assure that continuous and reliable supplies of high quality reclaimed water are produced to ensure that public health and environmental quality are protected. Each type of reuse is afforded an appropriate level of treatment and disinfection. In addition to extensive treatment requirements, several application site standards must be adhered to which also minimize potential health risks. The Florida Department of Health and Rehabilitative Services has concluded that a reuse facility designed, constructed, and operated to meet the requirements of the state's reuse rules poses no threat to public health (Hunter, 1990).

Regulatory Agencies and Requirements

Reclaimed water treatment, quality and use is regulated by the FDEP. The primary document utilized by the FDEP for regulation of reclaimed water and reuse is Chapter 62-610, F.A.C., "Reuse of Reclaimed Water and Land Application," which was promulgated on April 5, 1989. This chapter contains specific reuse and land application requirements of the FDEP and the Local Pollution Control authority delegated programs providing design, operation and maintenance requirements for land application systems. Chapter 62-610 provides the requirements for reuse via **(1)** Slow-Rate Land Application Systems; Public Access Areas, Residential Irrigation, and Edible Crops; (2) Slow-Rate Land Application Systems; Restricted Public Access, and; (3) Rapid Rate Land Application Systems and Other Land Application Systems. The document specifies the level of treatment required for specific uses of the reclaimed water, the required reclaimed water monitoring equipment, the reliability of the treatment facility, the criteria for the land application system (i.e., golf course, percolation pond, etc.) and system operation. The specific requirements for slow-rate land application systems; public access areas; residential irrigation; and edible crops are located in Table I-2.

In addition to Chapter 62-610, F.A.C., the state has adopted the Wetlands Application Rule, Chapter 62-611, F.A.C., which establishes the foundation and criteria for wetlands receiving reclaimed water.

Reclaimed Water Distribution

Reclaimed water, that has received the required treatment, is delivered to individual users by a dual water system. A dual water system consists of two transmission systems/pipes: One delivers potable water for activities such as cooking, drinking and bathing. The other delivers reclaimed water for activities that do not require potable water, such as irrigation, car washing and industrial uses. Although the reclaimed water transmission system could be designed in several ways and configurations, it is generally one of three basic designs: (1) a low pressure transmission system, (2) a medium pressure transmission system with booster pumps, and (3) a high pressure transmission system. Storage requirements of the system would have to be developed on a case-by-case basis, depending on the design of

TABLE I-2. Chapter 62-610, F.A.C. specific requirements for reuse of reclaimed water and land application for public access areas and edible crops.

Criteria	Requirements
Minimum System Size	- 0.10 mgd FDER rated capacity for slow-rate application in public access areas - 0.50 mgd FDER rated capacity for slow-rate land application on residential properties or edible crops; except for citrus, where the minimum system size can be reduced to 0.10 mgd if the reclaimed water does not contact the fruit, the fruit is processed before human consumption, and public access is restricted
Waste Treatment and Disinfection	Advanced Secondary Treatment - Carbonaceous Biochemical Oxygen Demand (CBOD) ≤ 20mg/L - Total Suspended Solids (TSS) ≤ 5 mg/L - Filtration and chemical feed facilities required High Level Disinfection - No detectable fecal coliform 75 percent of the time with no one sample exceeding 25 colonies per 100 ml
Reliability	- Class I or an equivalent
Monitoring	- Continuous on-line monitoring for turbidity and disinfectant
Storage Requirements	- No storage required if another disposal system is incorporated into system design System Storage - Storage that would be required for a ten year recurrence interval and at a minimum, a volume equal to three times the design average daily flow of the reuse system. Golf course ponds are appropriate for reclaimed water system storage and storm water management provided all Department and District rules are met. - System storage ponds do not have to be lined. Off-Line (Reject) Storage - Minimum volume equal to a one day average daily design flow
Setback Distances Application Site	- 75 feet from edge of wetted area to potable water supply wells - No setback distances to nonpotable water supply wells, surface waters, developed areas, private swimming pools hot tubs, spas, saunas, picnic tables or barbecue pits
Hydraulic Loading Rates	- A maximum annual average loading rate of two inches per week is recommended
Monitoring of Ground Water	- A ground water monitoring program will have to be established for the system

the reclaimed water transmission system and the user's reclaimed water usage schedule. To prevent cross connection, reclaimed water pipes must be color coded or marked to differentiate reclaimed water from domestic or other water.

The low pressure transmission system consists of an open system which delivers reclaimed water at a low pressure 24 hours a day to the user's on-site storage facility (storage tank, pond, etc.). The reclaimed water is repumped by the user when needed. The reclaimed low pressure water transmission system must be designed to meet the peak daily flow because the user's storage facility is filling continuously throughout the day. The operating pressure must be sufficient to deliver water to the user's storage facility for repumping. This system is best suited for large users such as a golf course or industrial facility with ponds or holding tanks to store the reclaimed water until it is needed.

The medium pressure transmission system, with booster pumps, should consist of a closed system to deliver reclaimed water at a pressure, which may be below the minimum pressure requirements of some of the users; the pressure is boosted to meet those user's needs on site. The reclaimed water transmission system must be designed to meet peak hourly flows because reclaimed water should be available on demand. Pressure range for the system is between 40-60 pounds per square inch (psi). This is sufficient pressure to operate most irrigation systems; however, this pressure would have to be boosted to meet the pressure needs of a golf course irrigation system.

The high pressure reclaimed water transmission system is a closed system which is directly connected to, and delivers reclaimed water to the user, at a necessary pressure, to operate the user's distribution (irrigation) system. The reclaimed water transmission system would have to be designed to meet the peak hourly flow since reclaimed water should be available on demand. The system pressure would be approximately 80 psi or higher. Golf course irrigation systems require a pressure of at least 80 psi while residential and other irrigation systems require no greater than 40 psi. This system could include a multi-application reuse system for residential, golf course, park and any other green space irrigation that lacks sufficient space to construct on-site storage facilities.

Potential Uses

Florida's water policy states that water management programs shall seek to "encourage the use of water of the lowest acceptable quality for the purpose intended . . . where economically and environmentally feasible." The District and State support reclaimed water as an appropriate alternate source for irrigation when reasonable and available. There are many uses of reclaimed water as identified previously. A discussion of each follows.

Golf Courses

One of the predominate methods of reuse in Florida is for large-scale irrigation, particularly irrigation of golf courses. Currently, there are approximately 141 golf courses in Florida utilizing reclaimed water for irrigation. In the UEC Planning Area, there are a total of 48 golf courses with a total irrigated acreage of 4,809 acres. The estimated average supplemental (irrigation) water requirements of the existing golf course acreage is about 14 MGD. Potable water is utilized for irrigation by one of these golf courses. The irrigated golf course acreage in the UEC Planning Area is projected to increase to 8,187 acres by the year 2010. The 2010 projected acreage will require an average supplemental irrigation of 27 MGD (see Appendix G for a detailed discussion of demand projections). The golf courses and wastewater treatment facilities in the UEC Planning Area are indicated in Figure I-l. Twenty of these courses utilize reclaimed water for all or a portion of their irrigation. The reuse programs of the Loxahatchee Environmental Control District (ENCON) and Martin County Utilities Dixie Park are examples of golf course reuse systems.

ENCON is a 6.54 MGD wastewater treatment facility located in Jupiter. They provide reclaimed water to nine golf courses in the Jupiter/Tequesta area via a 25 mile distribution network. Many golf courses in the area had drastic reductions in ground water allocations, and the treatment facility was seeking an environmentally accepted means of effluent disposal and a method to enhance the regional water inventory. The first golf course started receiving reclaimed water in 1984 and since then, the response has been overwhelming to the concept (Dent and Davis, 1987). The facility is delivering approximately 4 MGD of reclaimed water to the reuse system.

Martin County Utilities Dixie Park is a 1.5 MGD wastewater treatment facility located in Port Salerno. Currently, the facility utilizes reuse via golf course irrigation and percolation ponds for disposal. The master plan for this facility indicates that five additional golf courses will be served by this facility. By the year 2010, reclaimed water demand is projected to be approximately 3 MGD with a build-out demand of 3.5 MGD (letter dated June 30, 1992 from Orren S. Hillman, Assistant Director, Martin County Utilities, Jensen Beach, FL).

Outdoor Residential

It is estimated that approximately 50 percent of the potable water delivered to single family homes is utilized for outside uses. This can amount to a considerable volume of water treated to potable standards. A substantial savings in potable water, and in turn ground water, could be realized by utilizing reclaimed water for these outdoor nonpotable water uses. These savings may eliminate the need for expansion of existing water treatment facilities, drilling of new wells, or reduce the need for new facilities. The benefit to the consumer in utilizing reclaimed water are lower monthly water bills, reduced need for fertilizer, and exclusion from water shortage restrictions. Some Florida communities which have implemented, or which are proposing to implement, residential reclaimed water systems are St. Petersburg, St. Lucie West, and Boca Raton.

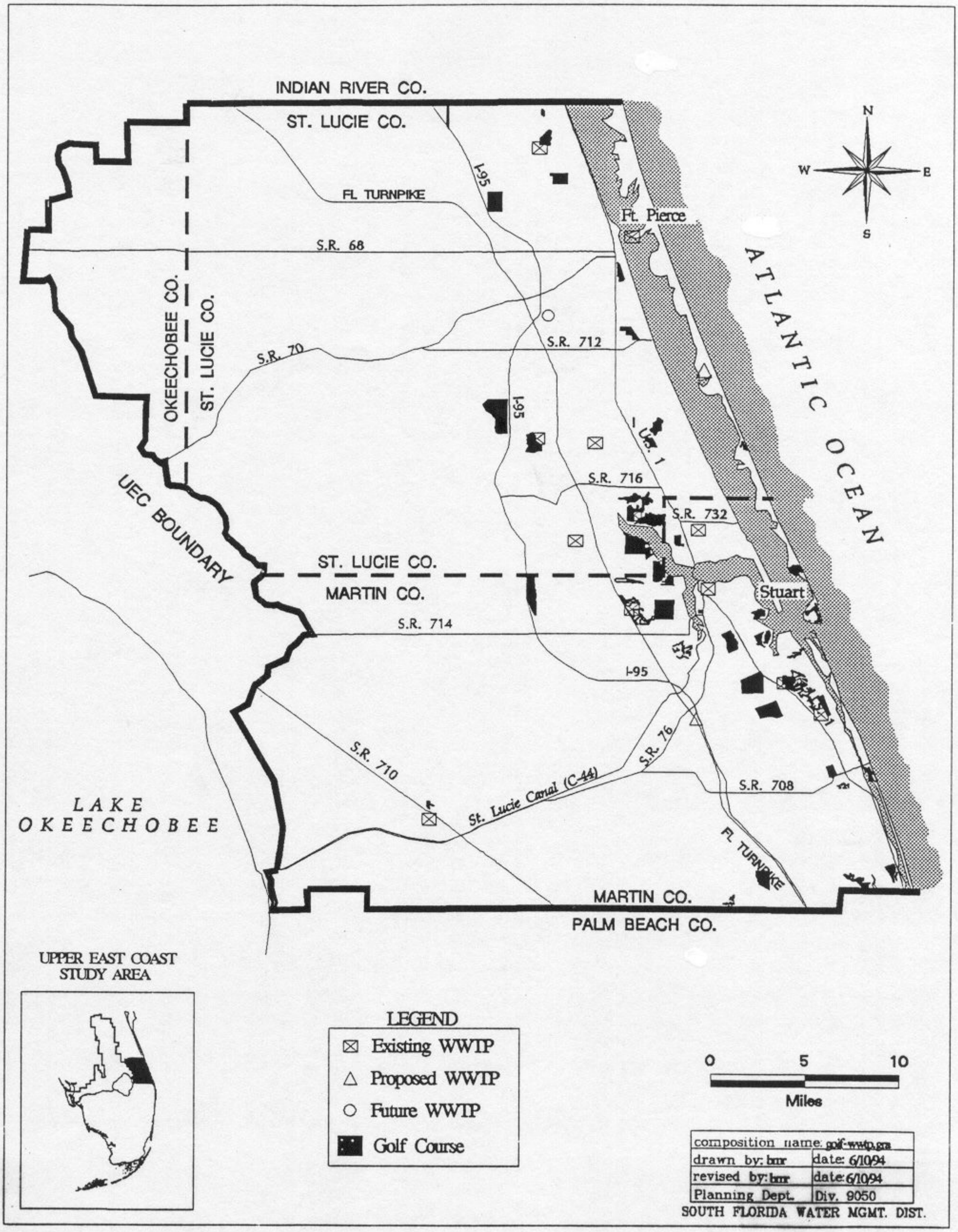

FIGURE I-1. Golf Courses and Wastewater Treatment Facilities.

St. Petersburg has one of the largest urban reuse irrigation systems in the nation. The program was initiated in the mid-to-late 1970s when the city recognized the need to reduce future potable water imports from adjoining counties. In addition, they were faced with required wastewater treatment facility upgrades because of more stringent water quality standards established for Tampa Bay. St. Petersburg was also declared a water short area (Eingold and Johnson, n.d.). Today, the reuse program consists of four treatment facilities with a total rated capacity of 63.4 MGD with approximately 240 miles of reclaimed water transmission main. Deep-well injection systems serve as an alternate means of disposal for the reuse system. The reuse system currently serves 6,570 residential customers among other users. The average daily reclaimed water usage is approximately 21 MGD. It has been estimated that the reuse program in St. Petersburg has extended the capacity of their potable water treatment and supply system by 15 years (phone conversation March 26, 1991 with Joe Towery, Reuse Coordinator, City of St. Petersburg, FL.).

St. Lucie West, located in the City of Port St. Lucie, is a large mixed-use development of approximately seven square miles which was initiated in the late 1980s. During the planning stages of the development, it was identified that the surficial aquifer in the area was very limited. Therefore, a commitment was made to a development-wide wastewater reuse program to conserve this source and provide recharge as well as wastewater disposal. The reuse program will reduce the potable water demand and thus the need for larger water treatment and withdrawal facilities. An extensive dual water distribution system is being constructed as development continues. The system provides reclaimed water for irrigation of golf courses, residential home sites, clubhouse areas, median strips and other green space throughout the development. It is estimated that by the year 2010, the average reclaimed water demand will be approximately 3.5 MGD and at build-out, 5 MGD.

The City of Boca Raton has initated "Project IRIS" or "In-city Reclamation Irrigation System." Project IRIS will be an extensive dual reclaimed water system throughout the eastern two-thirds of the city's service area. It is in this area that reuse will have the greatest impact on potable water consumption and reduction of saltwater intrusion. Boca Raton's 1989 potable water per capita consumption was well over 400 GPD. It was determined 70 percent (280 GPD) of consumption was for outdoor use. There are also several golf courses and other large users with wells for irrigation in this area. Elimination of these wells would also reduce the potential for saltwater intrusion of the freshwater aquifer. It is projected that the wastewater flow in the year 2000 will be 15 MGD, which will be sufficient to supply reclaimed water to the proposed service area. This daily reclaimed water demand will annually conserve three billion gallons of treated potable water and one billion gallons of untreated irrigation water presently withdrawn from the surficial aquifer. With timely implementation, the proposed reuse project will eliminate the need for a 10 MGD expansion of the water treatment plant and related water supply wells, thereby avoiding a capital expenditure of between $7.7 million and $8.7 million. Funding for the project is recommended to come from accumulated water conservation rate funds (Camp, Dresser & McKee, 1990).

Other Green Space

This category includes all other green space that requires supplemental irrigation where use of reclaimed water is desirable. This would include irrigation of parks, activity fields, schools, median strips, cemeteries, commercial landscapes, common areas, and retail nurseries. The Miami-Dade North District has completed construction of a reuse system to provide reclaimed water for irrigation of the 100 acre North Miami campus of Florida International University. The utilization of reclaimed water for irrigation at the campus is estimated to save approximately 70,000 gallons per day of drinking water now being used for irrigation, plus approximately $46,000 per year in water bills.

Agriculture

Agricultural irrigation includes irrigation of food, fiber, fodder and seed crops, wholesale nurseries, sod farms, and pastures. State regulations prohibit direct contact of reclaimed water with edible crops that will not be peeled, skinned, cooked, or thermally processed before human consumption. However, if an indirect reclaimed water-application irrigation method is used (such as ridge and furrow, drip, or subsurface), precluding direct contact of the reclaimed water with the crop, irrigation is allowed. There are several agricultural operations that utilize reclaimed water for irrigation throughout the state, including sites in Tallahassee, Orlando, and Okeechobee and Manatee counties. Citrus, gladiolus, sod, ridge and furrow crops, ferns, hay, corn, soybeans, rye, oats and wholesale nursery plants are some of the crops presently being irrigated with reclaimed water. In 1990, the UEC Planning Area contained approximately 143,000 acres of irrigated agricultural lands. This is projected to increase to 214,000 acres by 2010.

The Conserv II water reclamation facility, located in Orange County, is jointly owned and utilized for reclaimed water disposal by both the City of Orlando and Orange County. Conserv II currently consists of irrigation of 7,000 acres of citrus and 10 acres of ferns plus ground water recharge via 2,000 acres of rapid infiltration basins. This site receives reclaimed water from the City of Orlando Sand Lake Road and Orange County McLeod Road wastewater treatment facilities with rated capacities of 21 MGD and 23 MGD, respectively. Conserv II has a capacity to irrigate 15,000 acres and dispose of 50 MGD (Metcalf & Eddy, n.d.).

Industrial

Potential industrial uses of reclaimed water include cooling, process and wash waters. Potential users include power plants, manufacturers such as metal fabricators and plating, cement makers, commercial and institutional facilities. Facilities in Hillsborough and Broward counties, Tampa and Largo use reclaimed water for industrial uses. Two examples of industrial facilities that utilize reclaimed water are the North Broward resource recovery facility and the Curtis Stanton Energy Center.

The North Broward County resource recovery facility utilizes approximately 2 MGD of reclaimed water from the Broward County North District wastewater treatment facility as cooling water.

The coal fired Curtis Stanton Energy Center power plant in Orange County utilizes approximately 3.5 MGD of reclaimed water from the Orange County Eastern Service Area wastewater treatment facility for boiler cooling water.

Environmental Enhancement

Reclaimed water could be utilized for environmental enhancement in the restoration of hydrologically altered wetlands. There are several wetlands projects utilizing reclaimed water in Florida, two of which are the City of Orlando Iron Bridge and the Orange County Eastern Service Area wastewater treatment facilities.

The Orlando Iron Bridge Regional Water Pollution Control wastewater treatment facility utilizes a man-made wetlands system for reclaimed water disposal. The 1,200 acre created wetlands consist of a deep marsh, mixed marsh, and hardwood swamp. The current flow into the wetlands is limited to 13 MGD, but ultimately the wetland will receive up to 20 MGD of reclaimed water that has received advanced wastewater treatment. From the created wetlands, the reclaimed water flows through the 660 acre Seminole Ranch wetlands prior to discharge to the St. John's River. This system was placed into operation in 1987 (Schnelle and Ferraro, 1991).

The Orange County Eastern Service Area wastewater treatment facility utilizes an overland flow and wetlands system to currently dispose of 3.5 MGD of reclaimed water that has received advanced wastewater treatment. The wetlands system consists of 150 acres of natural wetlands and 150 acres of pine flatwood converted to wetlands which discharges to the Econlockhatchee River. The system will have an ultimate capacity of 6.2 MGD. This system was placed into operation in 1988.

Rapid Rate Land Application

Rapid rate land application involves discharging reclaimed water to a series of percolation ponds or subsurface absorption systems (drainfields). The FDEP requires, at a minimum, that reclaimed water receive secondary treatment and basic level disinfection prior to discharge to a rapid rate land application system. In addition, reclaimed water discharged to subsurface application systems must not contain total suspended solids greater than 10 mg/L. The application rate is limited to 5.6 gallons per day per square foot, unless greater loading rates are justified. There are many rapid rate land application systems in operation in South Florida, mostly associated with reclaimed water disposal from small wastewater treatment plants. However, several large plants utilize rapid rate land application for their primary method of reclaimed water disposal or has a backup to another reuse system.

Hydrodynamic Saltwater Intrusion Barriers

Reclaimed water could be used for ground water recharge in areas of saltwater intrusion. This would be accomplished via rapid rate land application systems or by shallow injection wells. Rapid rate land application such as ponds or drainfields would be strategically placed to deter further migration of the saltwater front. This could be accomplished by constructing long trenches, percolation ponds or subsurface disposal systems parallel to the saltwater front. Injection of reclaimed water by shallow wells has been investigated on Florida's southeast coast. This method of reuse would consist of construction of several injection wells along the saltwater front, which when in operation, would create a positive freshwater head and impede further migration of the saltwater front inland. Injection of reclaimed water is heavily regulated by state and federal agencies. These agencies' regulations prohibit injection of fluids that do not meet applicable water quality standards. Florida Statutes prohibit the direct pumping of reclaimed water into any geologic formation of the Biscayne Aquifer containing less than 500 mg/L total dissolved solids (TDS). Depending on the local geology/geologic profile and the TDS of the formation fluid, various regulations and criteria apply (FDER, 1990).

Reuse Costs and Savings

Costs and savings from the implementation of reuse systems are discussed in this section for wastewater treatment facilities and their customers. Costs are discussed primarily for systems less than 7 MGD because these are the sizes that will most likely be considered by 2010 in the UEC Planning Area. The estimated costs are annualized cost per thousand gallons in 1994 dollars. Annualized costs are presented because they combine the capital and operating costs of the systems. Financing of the capital costs was assumed to be achieved at an 8 percent interest rate over a period of 30 years. Most costs were from earlier years and were updated to 1994 levels using the ENR Engineering News Record (1994) Construction Cost Index.

Reuse Costs

Advanced Secondary Treatment. A cost component common to "public access and edible crops reuse systems" is the requirement for additional wastewater treatment beyond the secondary treatment that is usually provided. This is sometimes called advanced secondary treatment. Generally, filtration with associated chemical feed facilities, high level disinfection and continuous reclaimed water monitoring equipment are required. Engineering cost equations and feasibility studies (Camp Dresser & McKee, 1989) indicate that the annualized costs per thousand gallons for systems less than 7 MGD are generally more than $.10 per thousand gallons and rise significantly to over $.20 per thousand gallons for systems less than 2.5 million gallons per day.

Reclaimed Water Transmission System. Costs include those for the construction, operations and maintenance of the piping and pumping facilities that transport the reclaimed water from the wastewater treatment facility to the user. These total costs increase as the distance the water is transported increases and as the volume increases. However, the increase in costs are less than proportionate such that the larger the volume and the longer the distance, the lower the costs per thousand gallons per mile. The costs also depend on whether the reclaimed water pipes are installed alone or at the same time as other public (sewer or water) works. It is generally much less expensive to complete installations in rural areas than in urban areas. Considerable expense is incurred when waterways, train tracks, interstate highways etc. have to be intersected.

Annualized costs per thousand gallons per mile developed from the Wastewater Reuse System Engineering Cost Model (Camp Dresser & McKee, 1989) show costs per thousand gallons per mile in rural areas varying from $.03 for 6.5 MGD transported 8 miles to $.08 for the same amount transported one mile and from $.07 for 0.5 MGD transported 8 miles to $.15 for the same amount transported one mile. Total transmission system costs (pipline and pumping - capital and operating) for urban areas are about 112 percent of those for rural areas.

Storage Facilities at the Treatment Site. Storage facilities may be integrated into a reuse system for a variety of reasons. Variations in wastewater flows versus reclaimed water demands may necessitate incorporation of storage or regulatory requirements when alternate methods of reclaimed waste/effluent disposal are not available for periods when reclaimed water does not meet the applicable water quality standard (reject storage) or when the reclaimed water demand is less than the wastewater flows. Storage could be provided by above ground storage tanks or by storage ponds. Reject ponds are required to be lined. Data from the Camp Dresser & McKee model indicate that the cost of ground storage tanks would add about $.04 per thousand gallons to a 5 MGD or greater system and over $.10 per thousand gallons for a 1 MGD or less system.

For lined ponds, data from the Camp Dresser & McKee model indicate that the cost is about $.01 per thousand gallons of storage capacity excluding land costs. Obtaining land near an existing treatment plant can be difficult and expensive. On the other hand, land may be available on the plant site that has no other planned use.

Alternate Disposal - Ground Water Recharge Systems. Ground water recharge systems such as percolation ponds or rapid infiltration basins can provide significant aquifer protection and aquifer recharge and wellfield recharge benefits as well as serving as an alternate disposal method to a public access reuse system. Costs of constructing and operating infiltration basins are about $.40 per thousand gallons. Land costs are an additional $.15 to $.40 per thousand gallons depending on the application rates that can be achieved (based on data in CH2M Hill, 1991 and Camp Dresser & McKee, 1989).

Application Area Modifications. Modifications to accept reclaimed water at the user's site could include additional on-site and off-site piping, pumps, ponds and modifications to spray equipment. In a recent survey of reclaimed water users conducted by the Water Management Districts in Florida (KMPG Peat Marwick, 1992) about 60 percent of golf courses responding to the questionnaire reported that modifications to their site were necessary to use reclaimed water. The average capital cost per acre for those reporting these costs was $1,338 (median $740). At the same time 67 percent of agriculture/horticulture respondents reported incurring expenses that averaged $558 per acre (KMPG Peat Marwick, 1992). Using application rates from the same survey, the cost per thousand gallons to finance this investment would be about $.16 per thousand gallons for golf courses (median $.09) and $.07 per thousand gallons for agriculture/horticulture.

Storage Facilities at the Use Site. Storage at the use site is often advantageous since users can integrate the storage area into the existing landscape. Frequently, unlined ponds that are isolated from stormwater systems can be used. Costs to provide on-site storage are included in the broader discussion of on-site modifications.

Reuse Savings

Alternative Effluent Disposal Savings. Alternative effluent disposal costs are a major factor in the costs of reuse systems. A utility can avoid both the capital and the operating costs of alternative disposal methods when the utility is installing new disposal capacity or replacing that capacity. The most likely alternative disposal methods in the UEC Planning Area are deep injection wells or a percolation pond system. As was mentioned above, certain types of percolation pond systems are considered by the Florida Department of Environmental Protection to be reuse systems. Such systems tend to be cost-effective for smaller discharge amounts. For larger amounts, deep well injection is generally used. Where alternative disposal methods are expensive, reuse becomes relatively less costly.

In some cases utilities are asked to consider reuse even when there is existing permitted disposal systems. Operating costs savings of existing disposal systems are achieved for that portion of reclaimed water delivered to the reuse system. Operating costs of deep wells have been estimated by CH2M Hill to be about $.10 per thousand gallons. Annualized capital costs are much larger, on the order of $.30 to $.60 per thousand gallons (CH2M Hill, 1990; Camp Dresser & McKee, 1989).

Alternative Supply Avoidance. The use of reclaimed water saves the customer from paying for an alternative water supply. Most existing irrigation users already have wells or surface intake systems -- the operating costs of these systems is about $.05 to $.10 per thousand gallons. The use of reclaimed water negate these costs.

Fertilizer Value of Reclaimed Water. Reclaimed water contains nitrogen and other nutrients that may substitute for applications of fertilizer. For instance, if the reclaimed water contains .08 pounds of nitrogen per thousand gallons and the nitrogen in fertilizer costs $210 per ton, then the reclaimed water would have a fertilizer value of $.008 per thousand gallons. In some situations, both fertilizer cost and application costs may be reduced. This value does not seem to be recognized by users. Only one user in the survey indicated cost savings due to reductions in fertilizer applications after switching to reclaimed water (KMPG Peat Marwick, 1992).

AQUIFER STORAGE AND RECOVERY

Regulatory Criteria

Guidance for preparation of Class V Aquifer Storage and Recovery injection well system permit applications is provided in a document titled "Guidance for Development of Class V Aquifer and Storage and Recovery Injection Well Systems in South Florida – November 1993" (U. S. Environmental Protection Agency, 1993). This document was prepared by the South Florida Aquifer Storage and Recovery Work Group, which consisted of representatives from the U.S. Environmental Protection Agency, Florida Department of Environmental Protection and the South Florida Water Management District. The following are excerpts taken from that document.

Background

This section outlines circumstances in which a Class V permit would be needed. Aquifer Storage and Recovery (ASR) is the "emplacement of water through the use of an injection well into a suitable aquifer during periods of excess water supply for later retrieval and use during periods of need." Traditionally, public water supply systems employ ASR to store finished drinking water for later recovery and use. ASR can also be used to store excess wet season surface water for later recovery during the dry season as needed to augment drinking water supplies and for other uses, such as agricultural irrigation.

A major impediment to implementing ASR is that the Underground Injection Control (UIC) regulations prohibit injection of fluids into underground sources of drinking water (USDW) if the fluid contains contaminants which violate any federal primary drinking water standard or may adversely affect the public health. If the proposed ASR project will violate any of these criteria, an aquifer exemption must be obtained. This may be difficult to justify in many areas due to the quality of the receiving aquifer (3,000-10,000 mg/L total dissolved soils) and the proven use of reverse osmosis technology in producing drinking water from aquifers of this quality. In addition to meeting the federal primary drinking water standards, Florida's ground water and UIC rules require that all fluids injected into a USDW meet the secondary drinking water standards and minimum criteria. There are, however, state mechanisms which may be used to grant relief from these requirements when appropriate. A costly way to resolve this dilemma is to treat the surface water to the appropriate standards prior to injection. An alternative may be to inject the water into a deeper portion of the aquifer which contains a total dissolved solids (TDS) concentration of more than 10,000 mg/L. The state has limited experience regarding the success or feasibility of recovery from such zones.

Aquifer exemptions represent major or minor modifications to State UIC programs depending on the level of TDS in the aquifer. If the aquifer which is to be

exempted contains water with a TDS concentration of less than 3000 mg/L a major modification is required. Major modifications require notice in the FEDERAL REGISTER and a minimum 30-day public comment period. The state of Florida was delegated primary program responsibility (primacy) for implementing the federal UIC program and follow this process.

Minor exemptions require a more limited public notice but still may be difficult to obtain. Under the current state UIC rules only minor exemptions (3,000-10,000 mg/L TDS) are allowed.

Although ASR is generally considered to be a beneficial use of underground injection, concerns with its use include treatment costs, the classification of the ground water and competing uses for the aquifer. Ground water is classified under Chapter 62-520.410, F.A.C. The fluid injection for storage must meet applicable water quality standards according to the classification. Water may have to be treated to acceptable levels prior to injection. Depending on the source of the water to be stored, treatment costs could be excessive. Also, application of the drinking water standards does not give credit for pollutant reductions obtained from the ASR injection process (i.e., bacteria die-off, phosphorus reductions). Current laws do not provide flexibility for addressing this issue.

In some cases, the receiving aquifer for an ASR project is the same aquifer that is being used to monitor for fluid movement at a Class I injection facility. If the ASR and Class I facilities are in the same area, the use of the aquifer for Class I monitoring may be impaired. If this is the case, it may not be possible to obtain an ASR permit in area where a Class I injection well systems is located. A case-by-case evaluation is therefore essential.

Types of ASR

There are three basic types or uses for ASR: (1) ASR used to provide potable or drinking water during times of peak demand; (2) ASR used for storaging raw ground water; and (3) ASR used for storaging surface water.

Potable or drinking water during peak demand.

Public water supply systems can employ ASR to store finished drinking water for later recovery and use. Water is treated to drinking water standards, stored in the aquifer, and later recovered for use during periods of peak demand.

This is the most common use for ASR. In particular, it is a major benefit to water treatment plants at or near capacity. Stored water can be used during periods of peak demand, reducing the need for increasing plant production capacity. ASR also reduces the impacts on natural systems during peak demand times, particularly when peak demands occur during times of drought.

ASR can also be used as a water storage method to provide an alternative water supply in coastal areas for potential use during emergencies or when regular facilities are not operating. This method can be particularly valuable as a readily available local source of water in emergencies where water lines are destroyed preventing access to regional water supplies (i.e., the Florida Keys). However, disadvantages include costs of establishing the services (capital expenditures) and the unknowns associated with planning for such emergencies.

Raw Ground Water ASR

ASR may be used where untreated ground water is stored in an aquifer for later recovery. The advantages of using ground water is that the quality of ground water is less variable over time than surface water, thereby potentially reducing treatment costs. In cases where the ground water quality is good, treatment may not be needed. Limitations include the limited sites available for use and the need to evaluate the water quantity and quality impacts on the natural systems and other users of the shallow water aquifer from which ground water is being withdrawn.

Surface water ASR

Treated or untreated surface water is stored in an aquifer for later recovery and use. Specific uses of surface water ASR include salinity control, agriculture, and as a storage option for urban supply. This method could potentially reduce treatment needs and provides a conservation tool for water quantity (back-up systems), providing recycling benefits, and reducing evaporation losses. It conserves water that would be lost to runoff and can be used later for water supply or natural systems. However, treatment may be required to meet UIC regulatory requirements or an aquifer exemption may be needed.

Project Feasibility

An ASR project must be evaluated in terms of its technical, environmental and economic feasibility. The technical valuation should include a discussion of the appropriateness of the receiving aquifer and address the adequacy of aquifer storativity and transmissivity.

Where applicable, the following environmental effects must be examined: adverse impacts on adjacent aquifers, the lateral and vertical extent of the water quality impacts, effects on nearby surface waters and saltwater intrusion concerns. The effects of the ASR project on existing uses of the aquifer system must also be examined (i.e., monitoring zones associated with existing Class I and Class V wells, existing sources of potable water).

Economic considerations to the facility and the community should be identified, evaluated and discussed. The costs of initial injection and monitor well construction, operation and maintenance (including mechanical integrity testing and ground water monitoring) should be considered when determining project feasibility.

Advantages and Disadvantages of ASR

The following are potential advantages and disadvantages of ASR:

<u>Advantages</u>

- Small-scale land acquisition required, compared to surface water storage
- No loss of water to evaporation, as compared to surface water storage, where evaporation losses can be significant
- Ability to locate an ASR facility at the point of need
- Use of recovered water during the dry season does not adversely affect the

surficial aquifer, water conservation, or wetlands
- Improved reliability of the utility system in the event of an emergency or drought

Disadvantages

- The quantity of water recovered may be less than the amount injected due to the degradation of the stored water over time
- Increased well maintenance may be needed – formation of deposits, which result from mixing of chemically dissimilar waters, is accelerated
- Initial start up cost for an ASR well is expensive compared to a surficial well – an ASR well requires greater depth and has more stringent well construction design criteria

Existing ASR Facilities

Manatee County. In 1978, Manatee County began treated water ASR investigations in cooperation with the Southwest Florida Water Management District (SWFWMD) and CH2M Hill Engineers. This program start up was a direct result of a 1976 CH2M Hill project for Naples, Florida which included two shallow connector wells that recharged the local production zone by gravity from the overlying water table.

The Manatee County Utilities Department has a surface water treatment plant that operates at 54 MGD adjacent to Lake Manatee, which is an impoundment on the Manatee River. An investigation of an artesian limestone

aquifer beneath Lake Manatee was conducted which evaluated aquifer hydraulic characteristics such as transmissivity, storativity and leakance. After a series of injection and recovery tests were conducted to determine water quality and percent of water recovered, it was concluded that Manatee County could meet peak water demands as high as 70 MGD without expanding their water treatment plant. The ASR facility is currently in operation, with a rated storage capacity of 316 million gallons. At the end of 1993, 294 million gallons were in storage in the aquifer (phone conversation January 6, 1994 with Bruce McCloud, Manatee County Utilities, Bradenton, FL.).

Peace River. A 12 MGD surface water treatment plant built by General Development Utilities, Inc. (GDU) supplies water to Port Charlotte. Port Charlotte's source of raw water is the Peace River (now owned and operated by the Peace River/Manasota Regional Water Supply Authority). Due to variations in both water flow and water quality of the river, including occasional movement of saltwater upstream of the plant intake, a 1,920 acre-foot capacity offstream reservoir was constructed for raw water storage. In 1984, GDU was faced with the need to expand their water storage capacity, and as a result, treated water ASR was examined as a potentially less expensive storage option. Two potential production zones were tested to determine if treated water ASR was feasible. Six ASR wells were installed which provide a treated water expansion of 4.9 MGD. Three additional wells are planned for feasibility testing in 1994 (phone conversation January 6, 1994 with Grady Sorah, Peace River/Manasota Regional Water Supply Authority, Port Charlotte, FL.). Over the next 30 years, ASR is expected to reduce capital investment for water supply and treatment facilities for the Peace River by over 50 percent.

Cocoa. The Floridan Aquifer System (FAS) is the source of well water for the Cocoa service area. The wells are located inland as far as 50 miles from some locations in the service area. This great distance is due to saltwater intrusion which is occurring along the coast. The Claude H. Dyal water treatment plant has a capacity of 40 MGD. In 1987 demand had reached 37 MGD, which prompted the City of Cocoa to investigate the potential for treated water ASR as an alternative to water treatment plant expansion.

The success of this test program allowed Cocoa to proceed with treated water ASR and defer a water treatment plant expansion. The system was permitted in 1991 and presently operates at a maximum permitted recovery rate of 8 MGD, utilizing 6 ASR wells (phone conversation January 6, 1994 with Glenn Loffler, Claude Dyal Water Treatment Plant, Cocoa, FL). Present indications are that plant expansion can be deferred until maximum day demand reached 50 MGD, but an expansion of raw water supply will be necessary to sustain increases in average withdrawals.

Port Malabar. In 1987, the Palm Bay Utility Corporation at Port Malabar began treated water ASR investigations. The Port Malabar development is within the city limits of Palm Bay on the east coast of Florida and obtains its water supply from an intermediate aquifer. At the time the ASR investigation began, water demands were approaching the water treatment plant capacity of 6 MGD and were, at times, equal to wellfield supply capacity. If the treated water ASR project investigation proved successful, it would help Port Malabar meet its upcoming seasonal and daily peak demands and defer water treatment plant expansion.

A test facility was constructed within the Port Malabar distribution system. This location enabled the recovered water to be put directly into a nearby transmission main. The treated water ASR facility was tested and the recovered water met all drinking water standards and required no retreatment other than disinfection. Today, the Port Malabar ASR facility is fully operational and provides an additional 1 MGD of treated water supply during peak demand months.

Boynton Beach. In late 1992, the city of Boynton Beach began testing of its ASR facility. During the wet season, treated ground water from the Surficial Aquifer System is pumped into the upper portion of the Floridan Aquifer System for storage. Upon recovery, the water is filtered and rechlorinated, then used to augment the public water supply during dry periods and during peak demands. This serves to alleviate stress on the Surficial aquifer System which is susceptible to saltwater intrusion.

During a dry spell in May 1993, about 17 million gallons of water were recovered from the ASR system. The single ASR well can provide 2,000 GPM of recovered water, although the city is still gathering information. As of early 1994, five injection/storage/recovery cycles had been completed (phone conversation January 6, 1994 with Peter Mazzella, City of Boynton Beach Utilities, Boynton Beach, FL.).

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APPENDIX J

Analysis/Modeling

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POST CALIBRATION GROUND WATER MODELING

Following calibration, the ground water models were used to predict the impacts of projected water demands on the resource. Two sets of model simulations using identical rainfall conditions were performed for this purpose. The first set of runs represented estimated 1990 water demands, while the second represented projected 2010 water demands under the assumption that water use characteristics and management conditions in the region would remain constant. Comparisons between the two time periods, as well as the application of resource protection criteria pertaining to Surficial Aquifer System drawdowns under wetland systems and water levels in the Floridan aquifer, were used to identify potential problems.

There are inherent differences between modeling for the purpose of calibration and modeling for the purpose of prediction. In the first case, the objective is to simulate water levels for an actual period of time. Great efforts are taken to collect accurate values of rainfall and water use for that period. During the calibration process, the model is in a state of flux. Any data input to the model may be adjusted to move the model towards a more realistic representation of the ground water system, where the ground water system is described by measured values of water levels. When the accuracy of this representation meets pre-determined specifications, the model is calibrated.

Predictive modeling, such as that done for the water supply plans, begins with a previously calibrated model. The objective of the modeling is to predict the response of the ground water system to some specified stress (e.g., a 1-in-10 drought, or increase in water use). Because the stresses being simulated may never have occurred, there are no measured water levels against which to check the veracity of the model. All components of the model that do not vary with time (e.g., hydraulic properties, horizontal and vertical discretization) are fixed at the values established during calibration. The time variant variables (recharge, ET rate and water use) may be significantly different from the values applied during calibration. The issues in documenting the modeling for the water supply plan are not that the values themselves are different, but that the methods used to estimate those variables differ from those used during the calibration.

There are several areas in which the model data estimation methods used in the UEC Water Supply Plan differ from those used during the calibration of those same models.

WATER USE

Water use in the models is divided into three categories: public water supply, residential self-supply, and irrigation. The methods used to estimate each category have evolved during the course of the water supply plan. The following assumptions form the basis for demand estimates calculated for each use category.

Public Water Supply

U.S. Census data were used as basis for 1990 population. Block group level information was used as the basic unit of analysis. The population served by PWS and the self-supplied population were calculated by multiplying the number of occupied dwelling units by the average persons per occupied unit for each respective block group. The result of this calculation was subsequently assigned to specific census block groups, assuming a uniform population distribution. These population data were input as polygon coverages into the SFWMD GIS. Utility service areas and planning areas were also entered into the GIS as polygon coverages and superimposed on the census block data in order to assign population to specific utilities.

Population projections for 2010 were based on local government comprehensive plans and distributed areally using traffic analysis zones (TAZs). For those jurisdictions whose comprehensive plan did not extend population projections to 2010, the population projection was extrapolated to provide a 2010 population estimate. In addition, all demands for 2010 were taken from existing facilities or those proposed in existing permits. For example, Port St. Lucie indicated they would limit production in their surficial aquifer wellfield to 10 mgd, and any additional demand would come from the Floridan (Table J-1).

PWS includes all regional potable water supplies with existing or projected demands of 0.5 mgd or greater. PWS demands were varied monthly based on five years (or as many as available) of historical records for an individual utility. This means that if the average historical demands for the month of September are 15 percent less than those for the average month for the year, then that ratio is maintained in the modeling.

In order to address wetland protection criteria under the 1-in-10 drought condition (see the section on model post-processing for a criteria description), public water supplies were pumped at their maximum daily demand for 5 months, then pumped with a normal distribution pattern throughout the rest of the year. This pumping scenario is not a representation of expected utility demand, but reflects the difference in the anticipated drawdown resulting from continuous public water supply withdrawal compared to drawdown resulting from seasonal agricultural withdrawal.

Table J-1. Demands and Sources of Public Water Supply Utilities, 1990-2010.

Permit	Utility	Year	Demand [mgd] Finished Water	Comments
43-00041W	Indiantown	1990	0.69	Source – 100% Surficial Aquifer; 8 wells
		2010	1.08	
43-00053W	Stuart	1990	3.22	Source – 100% Surficial Aquifer; 30 wells, 10 on stand-by status
		2010	3.95	
43-00066W	Hydratech	1990	1.10	Source – 100% Surficial Aquifer; 13 wells, 3 on stand-by, 5 installed post 1990
		2010	1.83	
43-00076W	Hobe Sound	1990	2.53	Source – 100% Surficial Aquifer; 12 wells, 3 taken out of service post 1990 for high chlorides, 2 installed post 1990
		2010	4.19	
43-00089W	Martin Co. - Port Salerno	1990	2.14	Source – 100% Surficial Aquifer; 7 wells
		2010	4.37	Source – 1.78 mgd finished water transfer from Martin Co. - North (Floridan source), remaining 2.59 mgd from Surficial Aquifer; 14 wells, 1 stand-by, 7 installed post 1990
43-00102W	Martin Co. - North	1990	1.77	Source – 100% Surficial Aquifer, 10 wells
		2010	3.79 (local) + 1.78(transfer) = 5.57	Sources – Surficial Aquifer limited by permit to 57.39 mgm (1.68 mgd average) from 13 wells, 3 installed post 1990. Remaining 3.90 mgd demand from Floridan aquifer with 78% RO efficiency, yields raw Floridan demand of 4.99 mgd from 5 wells.
43-00169W	Martin Co. - Martin Downs	1990	0.55	Source – 100% Surficial Aquifer; 6 wells, 3 installed post 1990
		2010	1.17	
43-00752W	Martin Co. - Tropical Farms	1990	0.00	Source – 100% Surficial Aquifer; 14 wells, all installed post 1990
		2010	0.91	
50-00010W	Jupiter	1990	7.92 (local) + 1.50 (transfer) = 9.42	Sources – Surficial and Floridan aquifers; 38 surficial wells,10 constructed post 1990, and 3 Floridan wells, all post 1990 construction. No water transfers in 2010.
		2010	20.36 (all local)	
50-00046W	Tequesta	1990	2.46	Sources – 1.50 mgd finished water transfer from Jupiter, remaining 0.96 mgd from the Surficial Aquifer; 14 wells, 7 abandoned post 1990 for poor water quality.
		2010	3.21	Sources – Surficial (12 wells) and Floridan Aquifers (5 wells); all Floridan and 5 Surficial wells are post 1990 construction.
56-00085W	Fort Pierce	1990	9.30	Sources – Blending of Floridan and Surficial waters; 41 Surficial and 11 Floridan wells (9 post 1990 construction). The Floridan/Surficial split was based solely on well capacities, ~ 74% (10.36 mgd) Surficial and 26% (3.64 mgd) Floridan in 2010.
		2010	14.00	
56-00142W	Port St. Lucie	1990	3.66	Source – 100% Surficial; 22 wells, 1 on stand-by
		2010	12.40	Sources – 10 mgd from Surficial, 2.40 mgd (finished water) from Floridan; 75% RO efficiency yields 3.2 mgd raw Floridan demand. 37 Surficial wells and an unspecified number of Floridan wells located in the vicinity of the existing Surficial wellfield.
56-00406W	Holiday Pines	1990	0.23	Source – 100% Surficial Aquifer; 2 wells. Insufficient capacity to meet 2010 demand, assumed that additional well capacity would be added in the area of the existing wellfield.
		2010	0.63	

Permit	Utility	Year	Demand [mgd] Finished Water	Comments
Permit	Utility	Year	Demand (mgd) Finished Water	Comments
56-00552W	The Reserve	1990	0.12	Source – 100% Surficial Aquifer, 6 wells.
		2010	4.33	Sources – Treatment plant capacity = 0.59 mgd with no plans for upgrade. Remaining 3.74 mgd demand, to be purchased from St. Lucie West.
56-00614W	St. Lucie West	1990	0.10	Sources – 100% Surficial aquifer, 6 wells. Treated by membrane softening (85% efficiency) so raw water demand=0.12 mgd
		2010	6.38 (local) + 3.74 (transfer) = 10.12	Sources – Surficial wellfield limited to 4.03 mgd (raw water) = 3.42 mgd (finished water). Remaining demand (6.70 mgd finished water) from Floridan at 75% RO efficiency = 8.94 mgd raw Floridan demand.

Residential Self Supply

Within PWS service areas, self-supplied population was held constant between 1990 and 2010. For the subregional analysis, utilities were contacted to identify self-supplied areas within their service areas. Figures J-1 to J-4 show self-supplied areas in the UEC Planning Area. There was very little difference in Martin County from 1990 to 2010. In St. Lucie County, however, there were differences between 1990 and 2010, primarily in the Port St. Lucie area. It was assumed that all new development would be connected to public water supply.

Projected self-supplied population for 2010 was distributed evenly for areas outside public water supply service areas. Self-supplied population within a utility service area was given the same per capita demand as was calculated for the utility-served population. Self-supplied demand did not vary with time in the model simulations.

Demand from small package plants (< 0.5 mgd) was also included in residential self-supply category. These demands were taken from their actual point locations at the withdrawal rates reported to FDEP.

No accounting was made of domestic irrigation demands from people on public water that use individual wells for irrigation. In addition, any recharge to the aquifer from domestic irrigation or septic tanks was not accounted for.

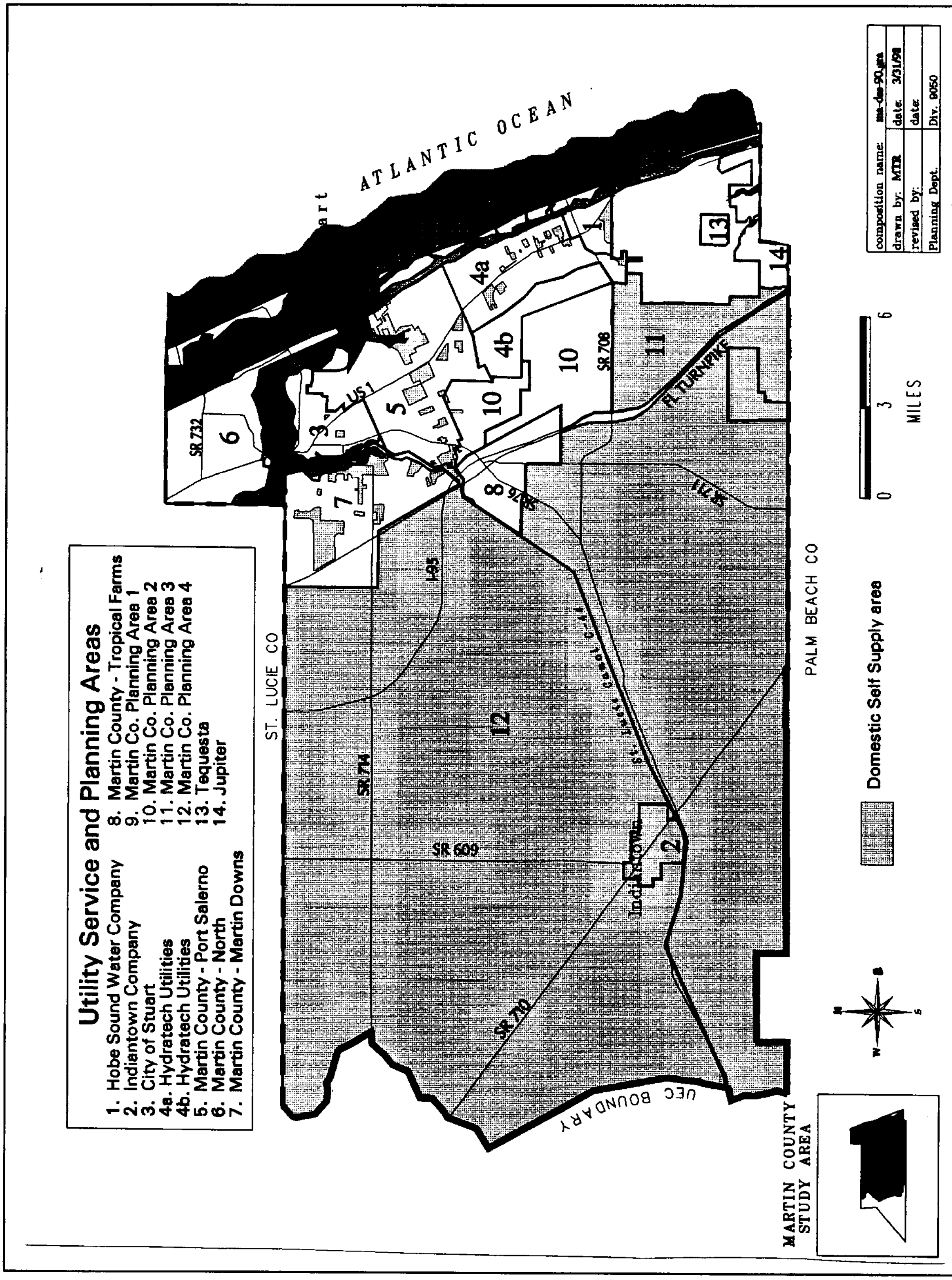


Figure J-1. Martin County 1990 Residential Self-Supplied Areas.

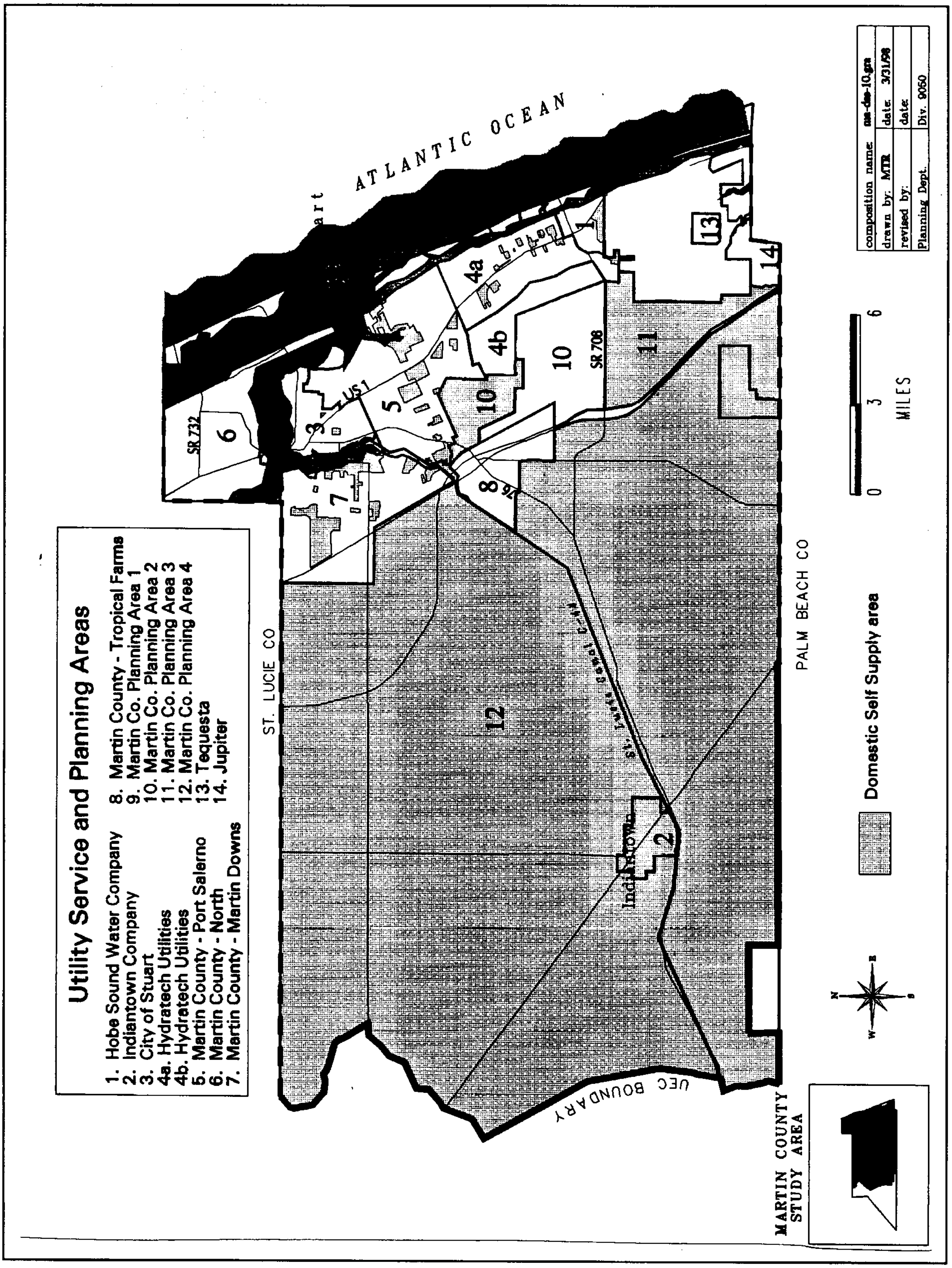


Figure J-2. Martin County 2010 Residential Self-Supplied Areas.

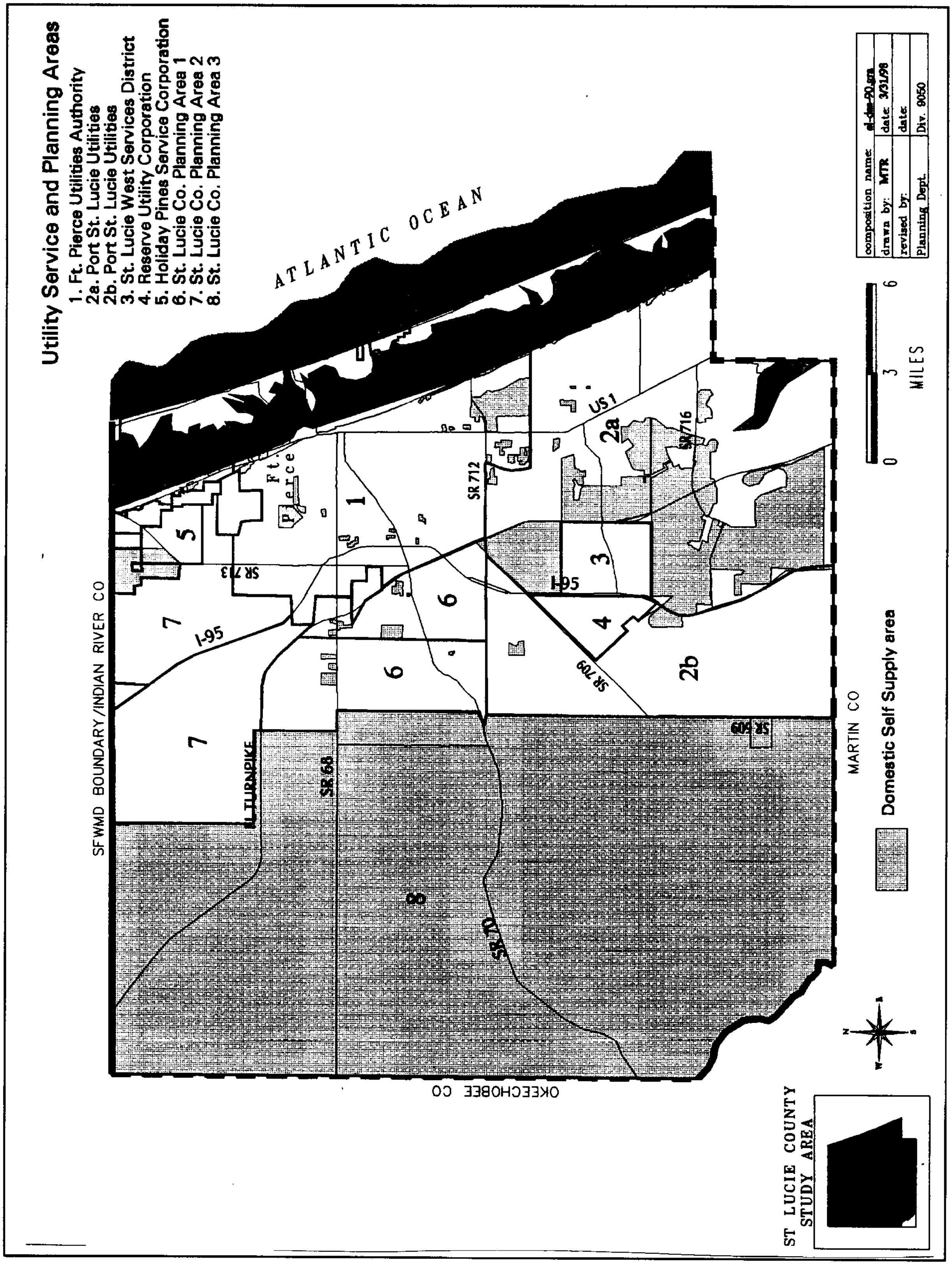


Figure J-3. St. Lucie County 1990 Residential Self-Supplied Areas.

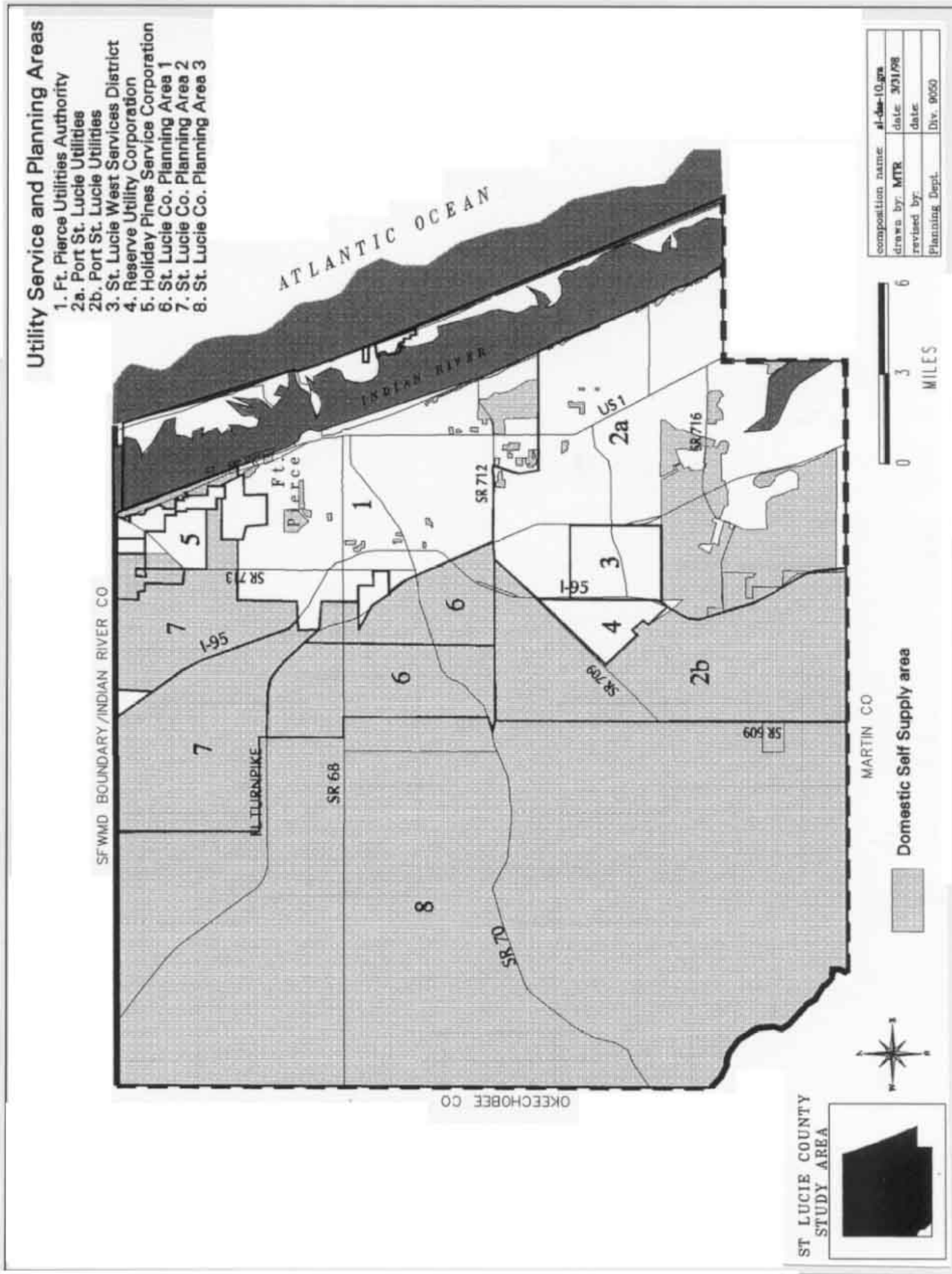


Figure J-4. St. Lucie County 2010 Residential Self-Supplied Areas.

Irrigation

This category includes any water user with an individual permit for irrigation from the SFWMD. Uses include agricultural, golf course and landscape irrigation.

Demand is calculated on a monthly basis, as the difference between evapotranspiration (ET) and effective rainfall for the rainfall event being simulated (average or 1-in-10 drought). The calculation yields demand in inches/month. Table J-2 shows the monthly irrigation demands for the seven selected rainfall stations in the UEC Planning Area.

ET and effective rainfall were estimated using a method developed by the Soil Conservation Service (SCS) and described in USDA Technical Release 21. The approach uses the modified Blaney-Criddle method to estimate ET from mean length of day and mean air temperature. It incorporates a coefficient for specific crops. An empirically derived equation is used to calculate effective rainfall as a function of total rainfall, and local soil conductivity. This method is the same one currently used in the District's regulation department. The methodology, along with all crop coefficients, is described in the SFWMD Water Use Permitting Manual, Vol. III.

The demand in inches/month is multiplied by the total irrigated area, and divided by the irrigation efficiency (both irrigated area and irrigation efficiency are taken from the permit) to get a total demand for that permit in ft^3/day.

Table J-2. Monthly Irrigation Demands (inches).

Station	Crop	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Fort Pierce	Citrus	1.57	1.56	2.96	3.34	3.2	3.47	3.35	3.33	2.02	1.36	2.05	1.61	29.82
	Veg	0.86	1.74	3.64	3.80	2.39	0.00	0.00	1.37	2.09	2.09	2.51	1.18	21.67
	Grass	1.05	1.23	3.20	4.19	4.89	4.93	4.86	4.74	3.03	1.93	2.05	1.27	37.37
Stuart	Citrus	1.60	1.67	3.25	3.65	3.59	3.00	3.25	3.63	1.76	1.49	2.24	1.58	30.71
	Veg	0.87	1.87	3.97	4.11	2.33	0.00	0.00	1.62	1.84	2.23	2.73	1.13	22.70
	Grass	1.07	1.34	3.51	4.53	4.86	4.44	4.76	5.08	2.77	2.08	2.24	1.23	37.91
Vero	Citrus	1.65	1.52	3.04	3.34	3.66	3.14	3.45	2.67	2.19	1.96	1.81	1.34	29.77
	Veg	0.98	1.70	3.71	3.77	2.43	0.00	0.00	0.80	2.26	2.70	2.26	0.94	21.55
	Grass	1.16	1.20	3.28	4.18	4.93	4.57	4.97	4.01	3.21	2.54	1.81	1.02	36.88
Cow Creek	Citrus	2.04	1.83	3.19	3.55	3.48	2.76	3.81	2.97	2.31	2.88	1.83	1.88	32.53
	Veg	1.31	2.02	3.87	3.99	2.26	0.00	0.00	1.06	2.38	3.68	2.29	1.45	24.31
	Grass	1.51	1.50	3.43	4.40	4.73	4.15	5.37	4.35	3.35	3.51	1.83	1.54	39.67
Fort Drum	Citrus	1.74	1.22	2.98	3.49	3.71	2.37	3.10	2.72	2.57	2.51	1.95	1.65	30.01
	Veg	1.07	1.40	3.65	3.93	2.47	0.00	0.00	0.84	2.65	3.28	2.40	1.24	22.93
	Grass	1.25	0.91	3.22	4.34	4.98	3.72	4.57	4.06	3.62	3.12	1.95	1.32	37.06
S 308	Citrus	1.83	1.81	3.18	3.43	3.53	3.08	2.95	3.01	1.99	2.09	2.21	1.80	30.91
	Veg	1.13	2.01	3.87	3.87	2.32	0.00	0.00	1.12	2.06	2.84	2.67	1.38	23.27
	Grass	1.32	1.49	3.42	4.27	4.77	4.48	4.38	4.38	3.00	2.68	2.21	1.47	37.87
Pratt	Citrus	2.00	1.93	3.31	3.74	3.20	2.39	3.00	2.68	1.39	1.51	2.15	1.98	29.28
	Veg	1.19	2.14	4.04	4.20	2.00	0.00	0.00	0.80	1.46	2.27	2.64	1.49	22.23
	Grass	1.41	1.58	3.57	4.64	4.42	3.75	4.45	4.03	2.38	2.10	2.15	1.60	36.08

Distribution of Floridan Use

If water demands are met from both surface and the Floridan aquifer, then distribution occurs as a two step process (described below). Use of the surficial aquifer for irrigation water supply is relatively insignificant within the planning area among growers using both surface and ground water sources. For this reason, there is little difference between the irrigation estimation methods used in the plan, and those used in the calibration of the surficial aquifer models.

This is not the case for the Floridan aquifer model. Historically, there has been a lack of information regarding Floridan water use. In some instances, the Floridan may be a permittee's sole source of irrigation water. In most cases, however, the Floridan is used in conjunction with, or as back up to, surface water resources. Consequently, the estimation of Floridan usage is not a simple process.

The first step in distributing the demands was to survey growers on their Floridan water usage. Lukasiewicz (1992) distributed a detailed questionnaire to the majority of permit holders in the study area. The questionnaire was designed to allow quantitative analysis of Floridan use during the 1989-1990 calibration year as well as "average year" patterns. The water use pattern of the respondents (36% of the recipients) was input into the model during calibration. The average pattern of the respondents was assumed for the non-respondents and also input into the model.

In preparation for the Upper East Coast Water Supply Plan, an attempt was made to fill in major gaps in the original survey. Large landholders that did not respond to the questionnaire were called individually and asked to provide information on their Floridan water-use practices.

Where no information could be acquired, the plan followed the Lukasiewicz pattern of using average values, but with an important distinction: Rather than using the average usage over the whole study area, as done in the calibration, an individual permit without information received a local average of other permits in similar circumstances. Each permit was grouped based on its physical characteristics (e.g., same basin, crop type, soil type, and irrigation methodology). Each group was assigned an average annual source water distribution and average monthly Floridan water distribution based on the responses of group members to either the questionnaire or the telephone survey.

For example:

Permit	Group id
99-00001W	Alpha
99-00058W	Alpha
99-00233W	Alpha

Group *Alpha* might represent citrus permits in the C-23 basin on Windemere soil and using flood irrigation. No Floridan utilization information is available on permit 99-00001W or 99-00233W, but 99-00058W responded to the questionnaire. If 99-00058W said that on average it used 90 percent surface water and 10 percent Floridan, and that all of its Floridan use was in the months of April and May, then that would be the initial source distribution for group alpha. This is the *initial* distribution because it leaves unanswered an important question: Is there sufficient surface water available to meet the demand?

The second step in distributing the demands was to perform a water balance. To find out if there is sufficient surface water available to meet the demand, the water balance (see Surface Water Budgets) was performed on a monthly basis for the C-23, C-24, C-25, North Fork St. Lucie River, and Tidal St. Lucie basins under average rainfall and 1-in-10 drought conditions.

The result of the calculation was a monthly balance (surplus or deficit) for each basin. If a deficit was indicated for a basin, then that amount of water had to be re-directed to other sources (primarily the Floridan aquifer) for each permit in that basin. This was the distribution of Floridan water use used in the modeling.

This process applies to the C-23, 24, 25, North St. Lucie, and Tidal St. Lucie basins. It was assumed that Lake Okeechobee would meet any needs in the C-44 basin that could not be met by runoff from rainfall within the basin.

Seventy-five percent of the irrigation “inefficiency water” is returned to the water table as recharge. For example, if a permittee is irrigating with micro-jet at 85 percent efficiency, then 15 percent of their irrigation water does not go to meeting crop demand. It was assumed that 75 percent of that 15 percent is returned to the surficial aquifer as recharge.

Surface Water Budgets to Determine Floridan Demands

A system of distributing demands across different sources was developed for the Upper East Coast Water Supply Plan. This allocation scheme was based on responses from the user survey and phone calls as well as key characteristics of the permit, such as location, crop type and irrigation method. This scheme was developed in order to estimate ground water demands to be used in conjunction with regional modeling.

Many agricultural water users in Martin and St. Lucie counties use a combination of ground and surface waters to irrigate their crops. Generally, surface water is the preferred source, and ground water, particularly Floridan aquifer water, is used when the surface water becomes inadequate to meet irrigation needs. Consequently, in order to estimate Floridan aquifer demand, knowledge of surface water availability is required.

The UEC Water Supply Plan takes the following approach to determining surface water availability:

Methodology. A volumetric water balance is performed on a monthly basis for each of the major basins under average and 1-in-10 drought conditions using the following algorithm:

Surdef = Rain + Storage + Tailret + Gwrch - Recharge - Runoff – Swdem

Surdef = Surface water surplus or deficit
Rain = Total rainfall in the basin
Storage = Water within the canal from the previous month
Tailret = Tail water return from 298 districts
Gwrch = Inflow to the canal from ground water
Recharge = Component of Rain that infiltrates the ground
Runoff = Water exiting the basin via the canal system
Swdem = Estimated surface water demand

Of the major basins, only the C-44 is omitted from this analysis. The balance approach taken assumes that water availability is solely a function of rainfall within the basin. The C-44 basin receives inflows from Lake Okeechobee that are not correlated to rainfall in the C-44 basin and therefore could not be analyzed in this manner. It is assumed that within the C-44 basin, any surface water demand that cannot be met by rainfall within the basin is supplemented by inflow from Lake Okeechobee rather than ground water. This assumption is consistent with utilization of the base model runs as the 'status quo' condition.

Rainfall. Average and 1-in-10 drought rainfall for each of the stations in the planning area are provided in Appendix C. The rainfall for each basin was calculated as a weighted average, where the weights were the percentage of the basin falling within the thiessen polygon for each rain station.

Storage. The surface water storage capacity for each individual basin was estimated based on widths and average cross-sections of the major canals (Table J-3).

Table J-3. Surface Water Storage Capacity.

Basin	Storage Capacity (acre-feet)	Storage Below 14' NGVD (acre-feet)
C-23	6,136	2,674
C-24	5,123	2,703
C-25	2,091	1,414
North Fork	3,191	N/A
Tidal St. Lucie	0	N/A

For C-23, C-24 and C-25 basins, only the SFWMD canals were figured into the storage capacity. Storage capacity for North Fork St. Lucie River Basin was based on 110 miles of minor canals and 15 miles of major canals within the North St. Lucie River Water Control District. Because there are no structures to maintain water level elevations, storage capacity on the Tidal St. Lucie Basin was set to zero.

These figures are rough estimates. If internal farm drainage canals and on-site retention facilities were included, it is expected the storage numbers would increase.

The storage values used in the balance equation represent the volume of water carried over within the canal from the previous month. These values range between zero and the storage capacity of the basin.

Tail Water Return Flow. Within the local 298 districts a certain amount of water recycling takes place. Where flood irrigation is used, a portion of the water that does not go to the crop root zone is returned to the main drainage system to be used by downstream neighbors. A system without tailwater recovery has an efficiency of 50 percent. Water from the same system with tailwater recovery is distributed within the range shown in Table J-4.

Table J-4. Tail Water Return Flow.

Application Efficiency (percent)	Percent to Plant Root Zone	Percent Tailwater Recovery	Percent Aquifer Recharge	Percent Lost	Total (percent)
50	50	0	37.50	12.50	100
65	50	15	26.25	8.75	100
75	50	25	18.75	6.25	100

For this analysis, the median application efficiency of 65 percent was used. This was applied to any permit within a 298 district using a flood or seepage type irrigation system.

Recharge. The recharge is the component of the total rainfall that infiltrates the ground. It was calculated for this analysis using the same methodology developed for the ground water models, where **Recharge = Rainfall - Interception loss - Runoff - Depression Storage**. It is important to note that evapotranspiration from the unsaturated zone is included in this value. A complete description of this methodology can be found in Bower *et al*., 1990.

Influx from Ground Water. The component of ground water inflow into the canals was estimated from the results of finite difference numerical models of the surficial aquifer system in Martin and St. Lucie counties. Cell-by-cell flows from the steady-state model runs were used to determine the percentage of total recharge going to rivers or drains for each basin (Table J-5).

Table J-5. Average Percentage of Recharge Flowing to Rivers and Drains.

Basin	Percent Recharge
C-23	20
C-24	16
C-25	13
North Fork St. Lucie	51
Tidal St. Lucie	20

Runoff. Volumetric basin runoff was estimated solely as a function of rainfall. The relationship between the two variables was developed by fitting a simple linear regression to the long-term rainfall and runoff records for the individual basins.

A 50-year record of continuous daily runoff from the basins contributing to the St. Lucie Estuary was required for development of the St Lucie Estuary model. The available runoff record in the C-23 and C-24 basins was relatively short, with many data gaps, and little data at all was available from the North Fork St. Lucie (NFSL) and Tidal St. Lucie (TSL) basins.

To fill in these data gaps, a program was developed to compute runoff as a function of rainfall in the C-23, C-24, NFSL, and SFSL basins on a daily basis. This program was calibrated against the actual available runoff data for C-23 and C-24 and modified for NFSL and TSL to account for variations in size and land use. The predicted runoff values were checked again using the St. Lucie Estuary model to insure that predicted flows produced conductivity levels corresponding to those measured. This data was used to estimate the monthly rainfall/runoff relationships for the aforementioned basins (Table J-6). The regression for C-25 relied on 30 years of observed rainfall in the basin and outflow recorded at the S-50 structure.

Table J-6. Monthly Rainfall/Runoff Relationships.

Basin	Equation	R^2	95% Confidence
C-23	Runoff = 1548 + 3116 (Rain)	.836	+/- 477
C-24	Runoff = -2599 + 3267 (Rain)	.842	+/- 431
NFSL	Runoff = -1805 +3807 (Rain)	.885	+/- 457
TSL	Runoff = -1046 + 1369 (Rain)	.865	+/- 194
C-25	Runoff = -2000 + 1731 (Rain)	.690	+/- 907

The equations represent the volume of monthly runoff expected from the basin for any given amount of rain. The value R^2 indicates the how well the equation accounts for observed variation in runoff. It can range from 0 to 1: the closer it is to 1, the better the model is at accounting for variation in the data. The 95 percent confidence value expresses the confidence interval for any estimate of mean runoff. In other words, you can be 95 percent confident that the mean runoff of all the months with rainfall equal a specified amount will equal the prediction plus or minus the confidence value. Runoff is in units of acre-feet, and rain is in units of inches.

Surface Water Demand. Surface water demands in the UEC basins are for agricultural irrigation. The supplemental crop requirement **Scr**, which is potential evapotranspiration **ETp** (calculated using the Blaney-Criddle method) minus the effective rainfall **Re**, was calculated for each SFWMD individual permit. The total demand was this value divided by the system irrigation efficiency, **Demand = Scr / Efficiency**.

This total demand number was apportioned to surface water, the surficial aquifer, and the Floridan aquifer according to the type of withdrawal facilities available (permit information) and user estimates (survey responses and telephone inquiries). Permits for which direct user estimates were not available were grouped according to their location and use practices, and source distributions were applied after the manner of the responding user they most resembled. The results of this analysis are located in Table J-7.

RAINFALL/RECHARGE

The 1-in-10 Drought

Model simulations were used to analyze potential impacts on wetlands and aquifer levels within the UEC Planning Area under average and 1-in-10 year drought rainfall conditions. A 1-in-10 drought condition is defined as below normal rainfall with a 90 percent probability of being exceeded over a twelve-month period. In simpler terms, this means that there is a 10 percent chance that less than this amount will be received in any given year. The 1-in-10 drought condition was codified as a preferred water supply planning goal in Chapter 373, F.S. during the 1997 legislative session.

A statistical 1-in-10 drought condition was developed for use in this analysis. This provided consistent and meaningful rainfall sets. The monthly values in these rainfall data sets have a known cumulative frequency and are derived from the historical record. The sets have the statistical property that the initial month and subsequent *cumulative* amounts (including the 12-month total) have a drought frequency of 10 percent.

The advantages of using the statistical method are that it:

- eliminates subjectivity
- minimizes influences of peaks and valleys
- eliminates inequities between rainfall stations

The statistical approach requires selection of the initial month and an analysis of 12 cumulative rainfall data sets. March was chosen as the month from which 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 for each rainfall collection station. Similar analyses were performed on historical rainfall for durations of two months (March through April) through twelve 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 produces a set of monthly values with 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 random hydrologic variables where the values of the variate are the result of underlying multiplicative factors, and are known to be strictly positive (Ang, 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. Distributions that did not meet the goodness of fit test were discarded.

Recharge

The surficial aquifer models in the Upper East Coast region utilize a standard SFWMD methodology for estimating aquifer recharge from rainfall. During the calibration of the Martin County regional and Martin Coastal subregional models, an additional modification was made to the standard method. In both instances, a multiplier array was applied to reduce the recharge along the Atlantic coastal ridge, in order to improve the calibration of the models) was applied to all planning runs.

RESOURCE PROTECTION CRITERIA

Wetland Protection

For the Surficial Aquifer System, the resulting ground water levels from the 1990 and 2010 model runs were compared to the results from model runs without the demands to determine drawdowns resulting from water withdrawals. This difference between the modeling results with and without demands was evaluated against the wetland resource protection, which states: *ground water level drawdowns induced by pumping withdrawals in areas that are classified as a wetland should not exceed 1 foot at the edge of the wetland for more than 1 month during a 12-month drought condition that occurs as frequently as once every 10 years*. Areas where the difference exceeded the wetland resource protection criterion were identified as a potential problem area.

The Regulation Department of the SFWMD currently utilizes the following guideline for protecting wetlands from the impact of ground water withdrawals: *ground water level drawdowns induced by pumping withdrawals in areas that are classified as a wetland should not exceed 1 foot at the end of 90 days with no recharge; where public water supplies pump at their maximum daily rate, and irrigators pump at their maximum monthly rate for the full 90 day period.* The intent of the water supply plan criterion was to replicate the effect of the regulatory guideline, but for an annual 1-in-10 drought event. Modeling tests have the shown that, with the pumping scheme described in the public water supply section, the effects of the two criteria to be very similar.

Floridan Aquifer Protection

For the Floridan aquifer system, the resulting ground water levels from the 1990 and 2010 model runs were evaluated relative to the land surface elevation and the Floridan aquifer resource protection criterion. The Floridan aquifer resource protection criterion states that *ground water drawdowns induced by water use withdrawals should not cause water levels in the Floridan aquifer to fall below land surface any time during a 12-month drought condition that occurs as frequently as once every 10 years*. Areas where water levels dropped below land surface were identified as a potential problem area.

The land surface elevation used in this analysis refers to the mean elevation in each mile squared model grid cell. The elevation surface was determined using Topogrid, a surface generator available through the geographic information system software ARC/INFO. Topogrid interpolates a hydrologically correct approximation of surface elevation. The interpolated surface was created from U.S. Geological Survey (USGS) point elevation data. The elevations at these points were determined through field surveys or stereoscopic work.

Saltwater Intrusion Protection

This issue was addressed differently, in that no specific criteria was used to identify saltwater intrusion problem areas. Instead, the entire coastline was ranked according to its vulnerability to saltwater intrusion. A vulnerability mapping scheme was created to address potential saltwater intrusion concerns in the UEC coastal areas. Vulnerability mapping is a procedure that assigns numbers to each model grid cell based on weighting inputs. The grid cells with the highest numbers are the most vulnerable to salt water intrusion. Vulnerability mapping is a tool that highlights areas that have a higher relative risk of saltwater intrusion. It does not specifically indicate cells that will or will not be effected by saltwater intrusion; it is not a computer modeling effort.

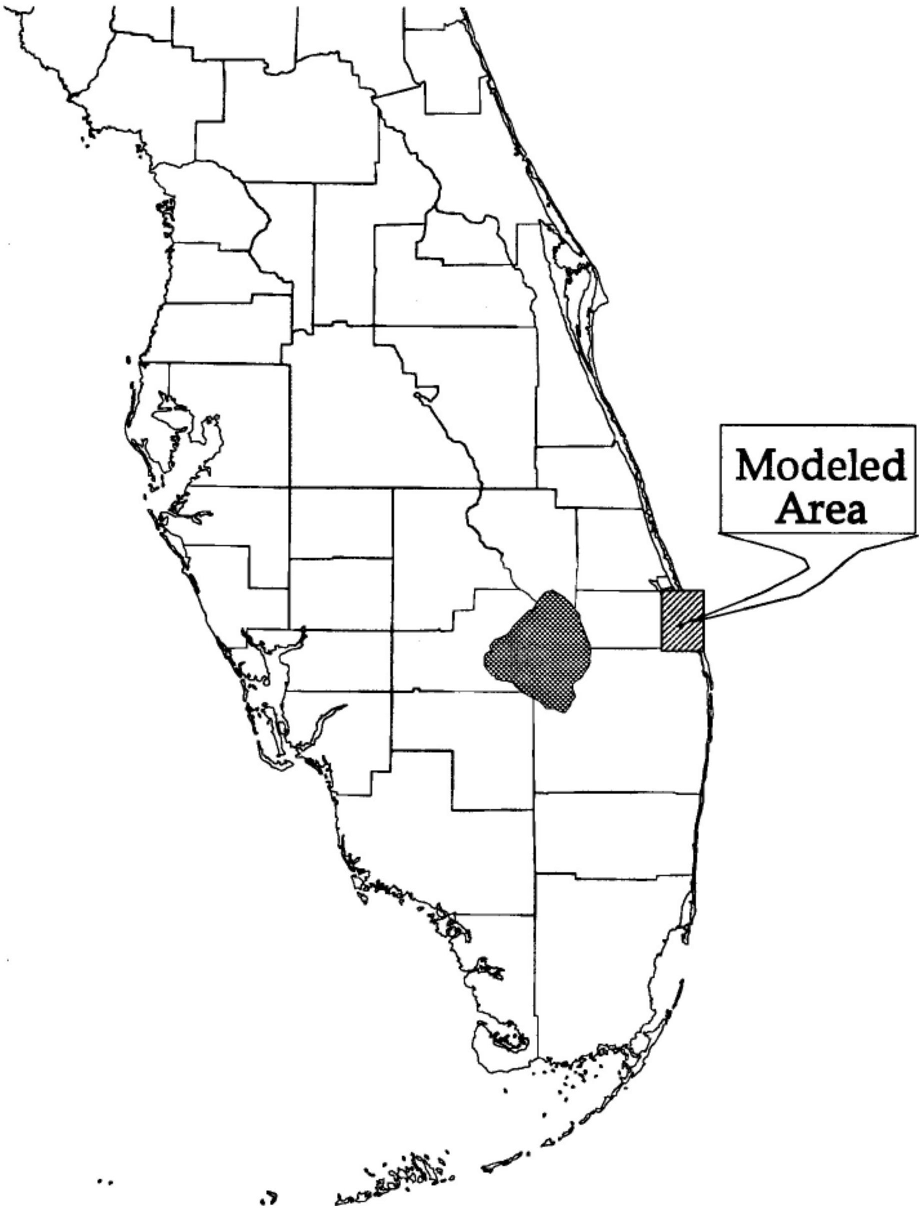
The UEC vulnerability mapping scheme considered three factors. The first factor was the April water levels produced by the St. Lucie and Martin surficial aquifer regional models. These models use hydrogeologic data and system stresses to produce a water level for every model cell. The lower the water level in a cell, the greater the potential for coastal saltwater intrusion into the cell.

The second factor considered for the mapping scheme, was the Euclidean distance between a model cell and a saltwater body. The closer a cell was to a saltwater body, the greater the potential for saltwater intrusion. Values were assigned to each model cell based on the Euclidean distance.

The last factor considered was historic chloride concentration. Field measurements of chloride concentration, taken in 1994 and 1995 at PWS facilities as part of their permit requirements, were used for this purpose. Grid cells containing wells in which chloride readings exceeded 100 mg/l, or showed an overall increasing trend, were used as input into the mapping scheme. In addition, the flow from these cells was tracked for a distance of four cells, and these additional cells were also used as input. The more times a flow path crossed through a cell, the higher its vulnerability to saltwater contamination. Values were assigned to each cell that contained historic chloride data or were cross by a flow path.

A weight from 0.25 to 0.50 was applied to each factor. The factors were then multiplied by the weight that was assigned to each cell. For this effort, water levels were considered twice as important as distance from a saltwater body or previous chloride readings. The total vulnerability for a cell is the sum of the weighted values of the three factors.

Martin Coastal Subregional Model Documentation



Introduction

The Martin Coastal Area Subregional Model was derived from the Martin County Surficial Model **(Adams, 1992).** The model encompasses coastal Martin County, from the St. Lucie Estuary south to the Jupiter Inlet, and as far west as the South Fork of the St Lucie River. It is discretized into 500 foot-square cells, with 16 cells representing each one in the regional model (Figure 1).

During preliminary work for the Upper East Coast Water Supply Plan, output from the regional model projected great potential for impacts to wetlands in coastal Martin County due to drawdowns from water use withdrawals. It was hypothesized that some of these projected impacts might be erroneous, artifacts of the scale of the model. The subregional model described herein was constructed for the purpose of testing this hypothesis. (Note: it is expected that the model will find regulatory application as well, once the water supply plan is completed) After initial construction, predicted heads from the subregional model were compared to both observed water-levels and those predicted by the regional model for the calibration period (1/89 - 12/90). The objective was to produce a large scale model of the area of concern which would function at least as well, or better than its progenitor with minimum alteration. The two models share many things in common. It is the intent of this report to document how they differ.

Summary of Differences

Boundaries: The Martin Coastal model, like the Martin regional model, is surrounded on all sides by a general head boundary. The general head values for the subregional model were extracted from the output of the regional model, while the regional model boundaries were based on interpolation between observed water levels. Starting heads also came from the regional model calibration.

Hydraulic Properties of the Aquifer: With the exception of producing zone transmissivity, all hydraulic properties are interpolated directly from the regional model. The producing zone transmissivity was modified to include information from pumping tests unavailable during the regional model calibration. These included transmissivity estimates from Roschman Enterprises and Intercoastal Utilities **(Lukasiewicz & Adams, 1996).**

Wells: Three classes of demand are incorporated into the models well packages: public water supply, residential self-supply, and irrigation. The public water supply and residential self-supply components are derived directly from data collected for the regional model calibration. Irrigation well demands were estimated based on irrigated acreage information from the 1990 water use permit database. The modified Blaney-Criddle equation was used to estimate monthly supplemental crop requirements for each permit based on observed rainfall for the 1989 - 1990 period, and that demand was distributed across the permitted withdrawal facilities.

Recharge: Initial estimates of groundwater recharge to thMartin Coastal model were made in the same manner described in the regional model documentation. During calibration of the regional model, Adams (1992) found that this methodology delivered excessive recharge in the high dune soils of the coastal ridge, and applied a reduction factor in those areas based on the thickness of the unsaturated zone. A similar problem was noted during calibration of the subregional model, and a variation of Adams reduction factor was applied (Figure 2). The recharge factor was derived through a multi-step process. Areas of sandy, high-slope soils were identified from the county soils coverage. Where land-surface elevation exceeded 20 feet, recharge was multiplied by a factor of 0.3, otherwise recharge on these soils was reduced by a factor of 0.5. In addition, in areas with a high density of impervious surface (identified from satellite ima)gery, recharge was further reduced. The multiplier accounts for areas where significant unsaturated zone storage would reduce the direct recharge to the water table, and local recharge would be strongly impeded by impervious surfaces. The recharge multiplier is

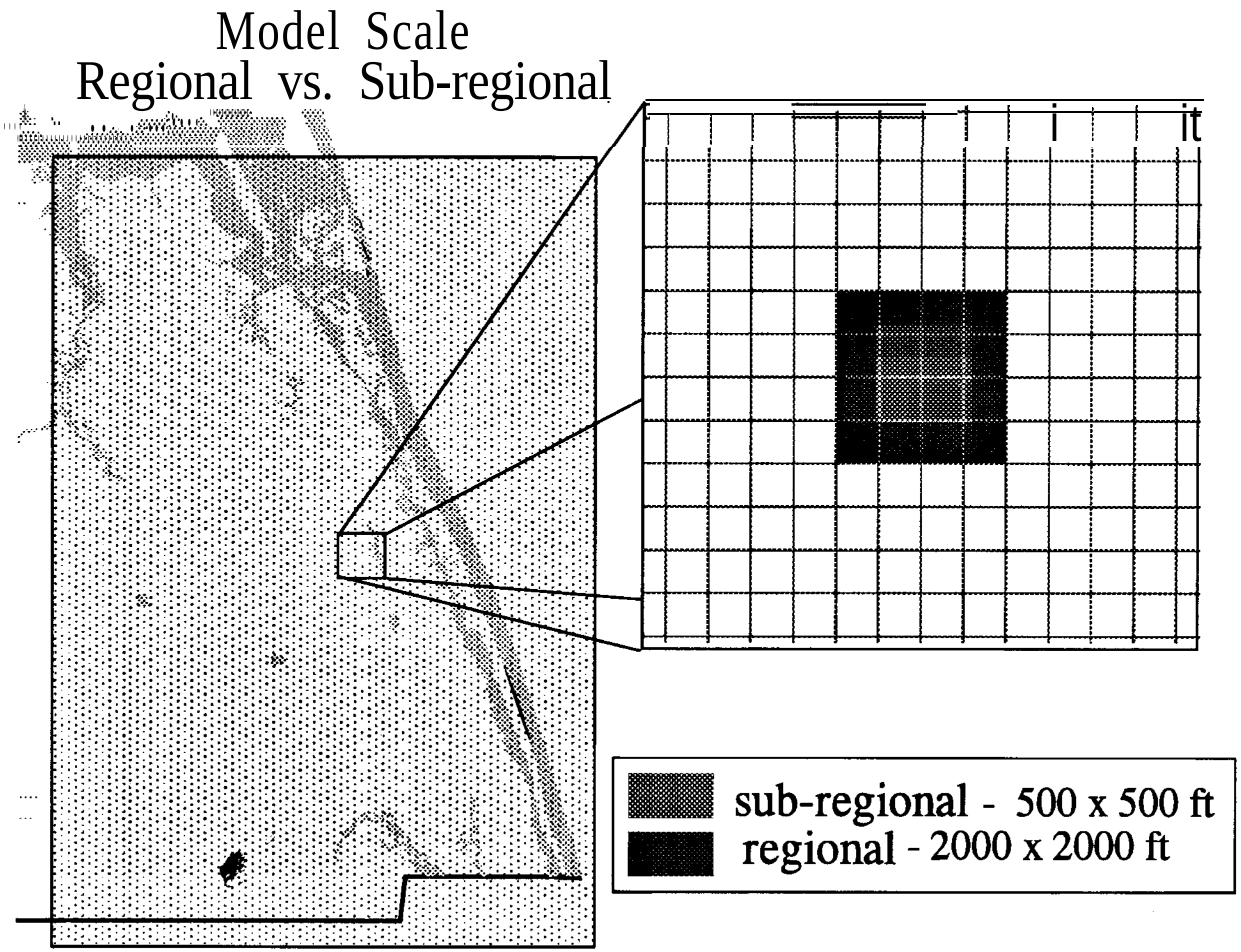

Model Scale
Regional vs. Sub-regional
sub-regional - 500 x 500 ft
regional - 2000 x 2000 ft

Figure 1

essentially a calibration parameter. As more comprehensive methods of estimating recharge are developed, the need for it will be eliminated.

Evapotranspiration (ET):
surface - The ET surface in the subregional model is significantly different from that found in the regional model. This is to be expected since the regional model reflects the average land-surface over 16 times the area of the subregional model. The new ET surface was created using digitized quad-sheet contours and point elevation data from the United States Geological Survey (USGS). The actual surface was created in Arc/Info using the *topogrid* command, a new feature of Version 7 designed specifically for topography. In addition to this, imagery from the SPOT satellite and soils data were used as basis for local modification to the ET surface on the high-ridge in Jonathan Dickinson State park.
extinction depth - ET extinction depths were derived from landcover using the same methodology applied in the regional model. Differences are a function of scale due to the altered ratio of different landcovers within a model cell, and local modifications for the purpose of improving calibration.
rate- The maximum ET rate is identical to that used in the regional model.

Rivers & Drains: Any feature represented by the river package in the regional model is similarly designated within the Martin Coastal model. All of the regional model drains are represented as well, but with some additions. Because the sub-regional model operates on a finer scale, it is more heavily influenced by local

drainage features. For this reason, small lakes and excavated wetlands not represented in the regional model are represented as drains in the subregional model. These included all features on the National Wetlands Inventory designated as permanently flooded, excavated wetlands. These features were assigned a drain elevation of six feet below land

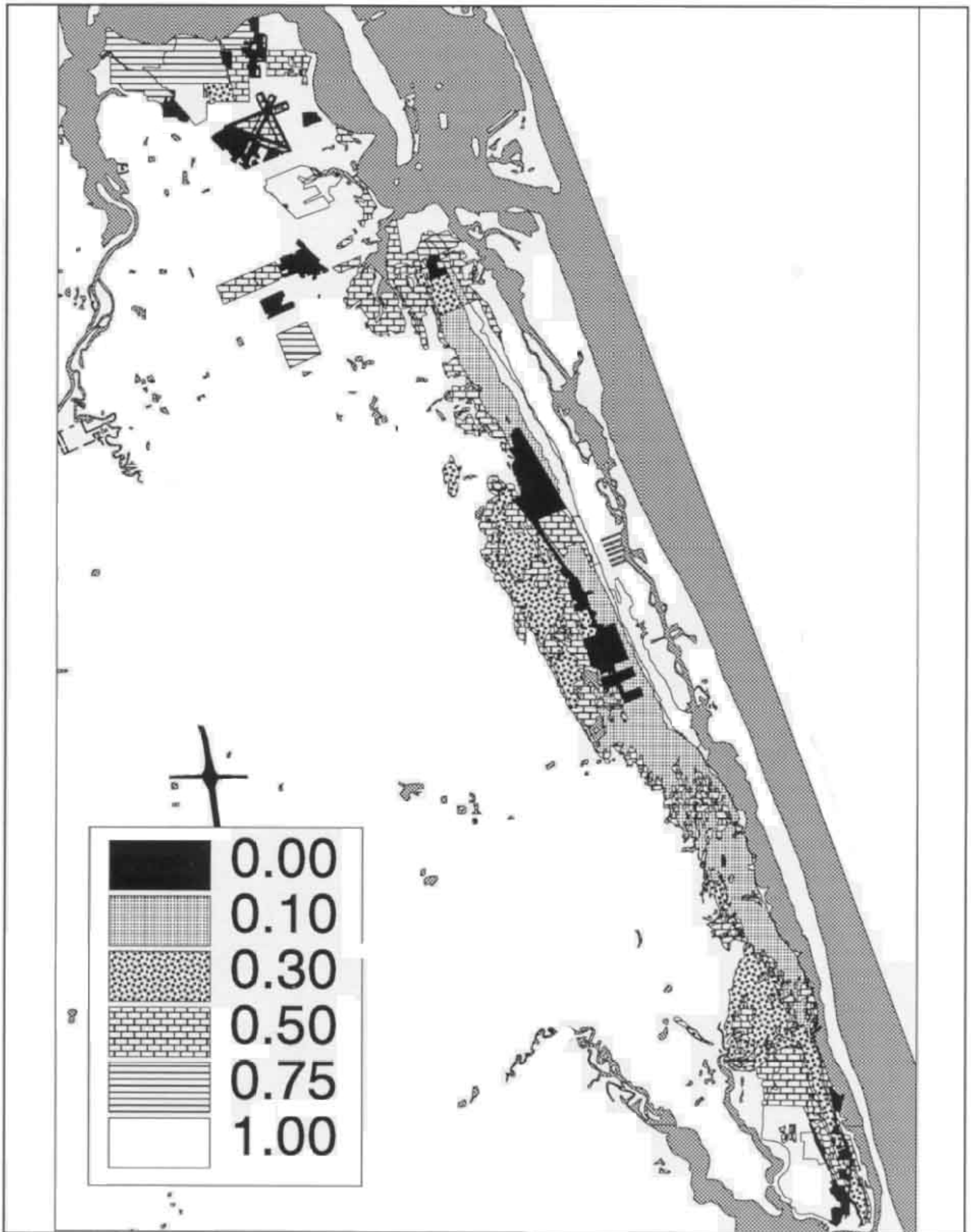


Figure 2. Recharge Multiplier

surface.

Calibration Results

Monthly water-levels were available from 73 observation wells for at least some portion of the period from January 1989 to December 1990. As previously stated, the objective of this project was to produce, with minimum alteration, a high resolution model that worked as well or better than the regional model from which it was created. This condition was tested by comparing the average difference between observed and predicted water-levels for each model (Table 1), and visual evaluation of the pattern match between simulated and observed hydrographs (Appendix A).

The subregional model was considered to meet the quantitative test if, on average, the predicted head at a well fell within one foot of the observed head, or if the head difference was as close or closer than that of the regional model. This criteria was met at 90 percent (66 out of 73) of the observation wells. Figures 3-7 shows the location of each observation well, and the quality of the models response at that location.

Of the seven recalcitrant wells, five (M-1024, M-1028, M-l 183, PB-746 and TQT7R1) are in proximity to public water supply wells (Stuart and Tequesta). The water levels predicted by the subregional model are all lower than observed at these locations. It was noted during sensitivity analysis that if public water supply demands were shut off, the modeled water levels were much closer to observed. The modeled demands from these wellfields were collected by Adams (1992) as total monthly withdrawals based on flow meters (Tequesta) or pump capacity times reported hours of operation (Stuart). As such, it is expected that the withdrawals represented by the model are fairly accurate. It is suspected that the problem lies in the time discretization of the modeling. The model takes the total monthly withdrawal and represents it as a continuous daily withdrawal for that month. Water level readings from the observation wells were taken as a point in time, usually towards the end of the month. Judging by the way the water levels rebound when the wells are turned off, it is suspected that the actual pumping at those wells was concentrated at the beginning of the month, so that the water levels had time to rebound before the observation was recorded. Another well, M- 1141, that meets the difference criteria but displays a poor pattern match is believed to suffer from the same problem.

Table 1. Average Difference Between Observed and Modeled Heads for the Regional and Subregional models over the Calibration Period.

Layer	Row	Column	Well	Difference [ft]	
				Regional	Subregional
2	75	84	HY2	Missing	0.9
3	75	82	HY2R	0.6	0.5
2	75	83	HY3	Missing	0.7
3	75	82	HY3R	0.4	0.4
2	40	45	ICU2	Missing	0.7
2	157	114	JHSW1	2.0	1.8
2	165	117	JHSW3	0.4	0.3
2	16	36	M-1010	2.0	1.5
2	8	22	M-1011	1.3	1.1
2	170	118	M-1024	0.6	1.2
2	171	119	M-1028	0.9	1.2
2	170	118	M-1039	0.4	0.6
2	110	95	M-1044	1.5	1.4
2	50	53	M-1052	3.2	1.0
2	26	37	M-1055	2.7	0.6
2	81	81	M-1057	3.7	0.5
2	148	111	M-1070	0.5	0.5

2	150	106	M-1071	1.4	1.2
1	150	106	M-1072	1.3	1.0
2	135	100	M-1073	0.3	0.7
3	12	15	M-1090	1.7	0.5
2	13	26	M-1091	3.6	1.9
2	112	97	M-1092	1.9	2.1
2	145	104	M-1093	0.5	1.1
2	154	107	M-1094	0.7	0.7
2	142	109	M-1095	0.6	0.9
2	27	42	M-1132	0.6	0.3
2	31	26	M-1141	3.6	3.4
2	33	14	M-1146	2.8	1.1
2	33	14	M-1147	2.4	1.6
2	6	22	M-1158	1.7	0.6
2	16	36	M-1161	2.5	0.5
2	26	39	M-1165	1.1	0.6
1	28	20	M-1179	3.8	1.1
1	31	26	M-1183	2.8	4.5
3	166	79	M-1229	0.5	0.9
3	161	98	M-1230	0.7	0.4
2	182	22	M-1231	1.2	0.9
1	166	79	M-1232	0.8	0.7
1	161	98	M-1233	0.5	0.8
3	119	26	M-1235	2.9	2.0
2	62	24	M-1253	1.7	1.0
1	62	24	M-1257	1.2	1.2
1	110	95	M-1258	0.5	0.5
2	119	70	M-1259	0.5	0.7

1	74	67	M-1269	2.1	0.8
1	119	26	M-1270	1.3	0.8
2	13	22	M-147	2.3	1.7
2	43	64	MGD-1	0.8	0.5
2	42	63	MGD-2	0.8	0.3
2	41	62	MGD-3	Missing	0.3
2	42	57	MGD-4	2.5	0.7
2	48	53	MGD-5	1.1	0.6
1	41	61	MGS-02	1.2	0.8
1	43	54	MGS-03	0.7	0.4
1	45	56	MGS-05	1.0	0.9
1	46	57	MGS-06	1.9	0.6
1	45	59	MGS-07	1.2	0.9
1	44	62	MGS-08	0.8	0.7
1	44	61	MGS-10	1.1	0.9
2	175	118	PB-595	0.4	0.4
2	183	115	PB-720	1.3	0.6
2	181	112	PB-721	0.9	0.4
2	178	112	PB-722	0.9	0.4
2	174	118	PB-746	1.2	1.4
2	174	115	PB-890	3.1	1.8
2	181	112	PB-892	1.0	0.5
2	180	119	PB-932	1.4	1.2
2	179	118	TQD13	0.6	1.0
2	169	118	TQD35	Missing	1.0
2	173	113	TQT231	1.4	1.2
2	180	116	TQT7R1	1.7	2.2

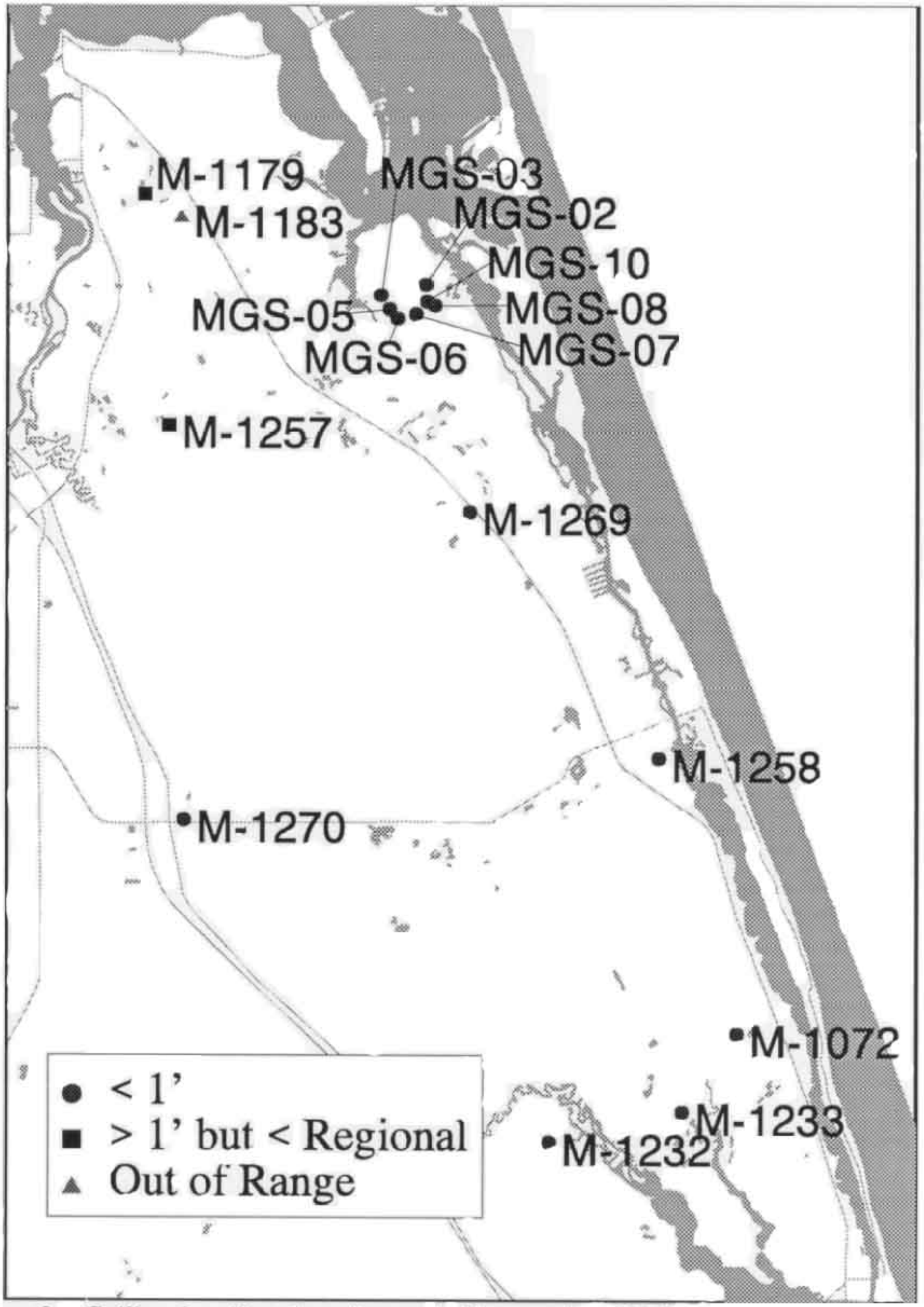


Figure 3. Calibration Results - Layer 1 Observation Wells

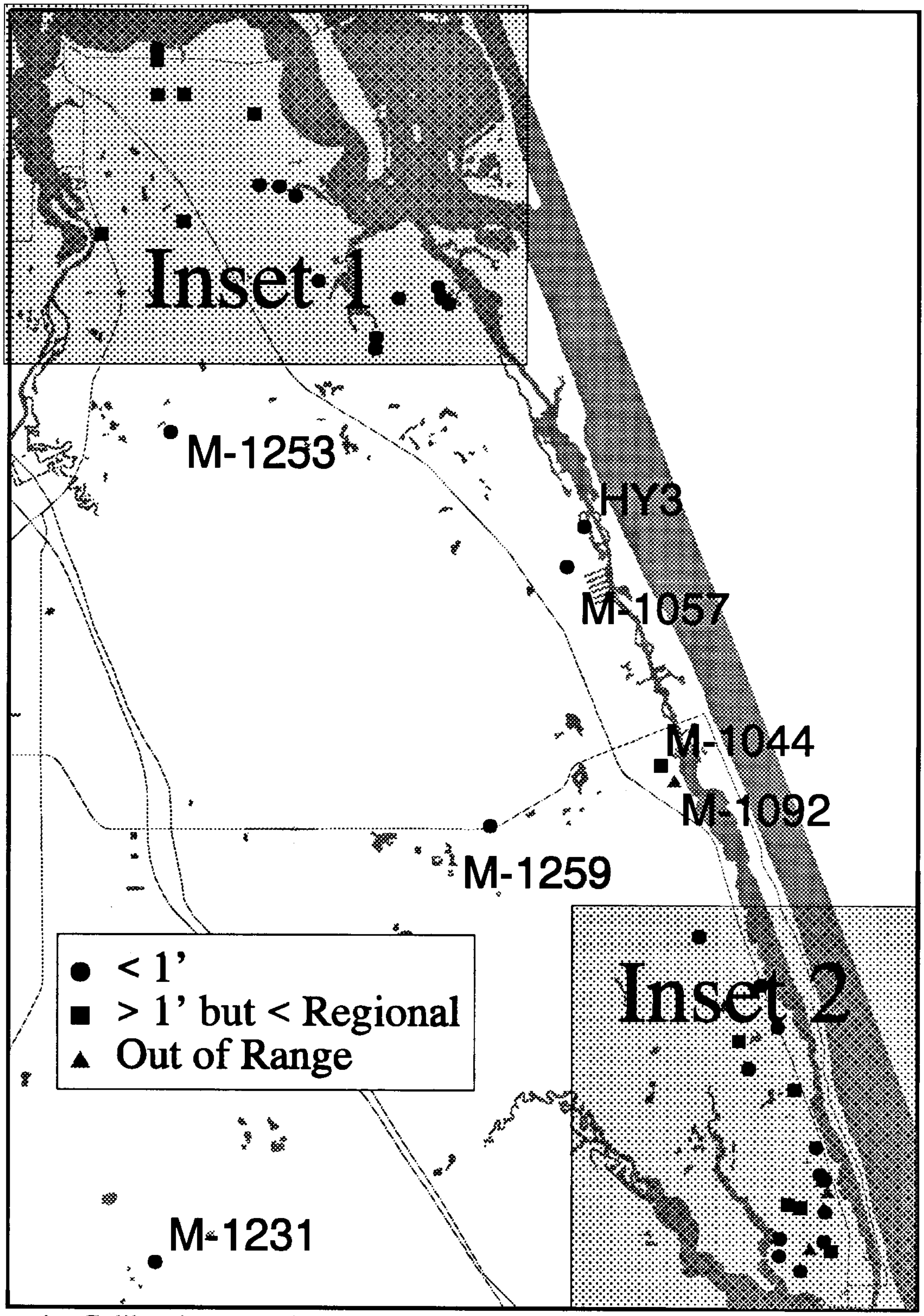


Figure 4. Calibration Results - Layer 2 Observation Wells

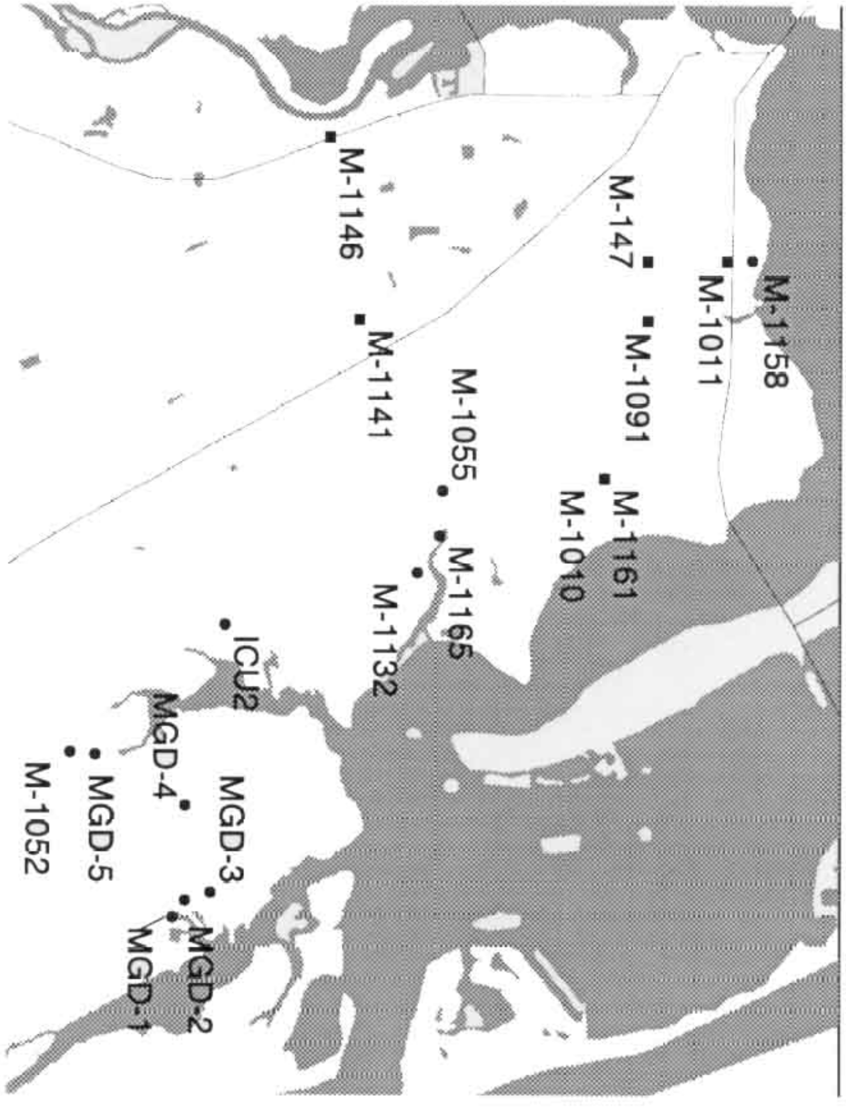


Figure 5. Layer 2 - Inset 1

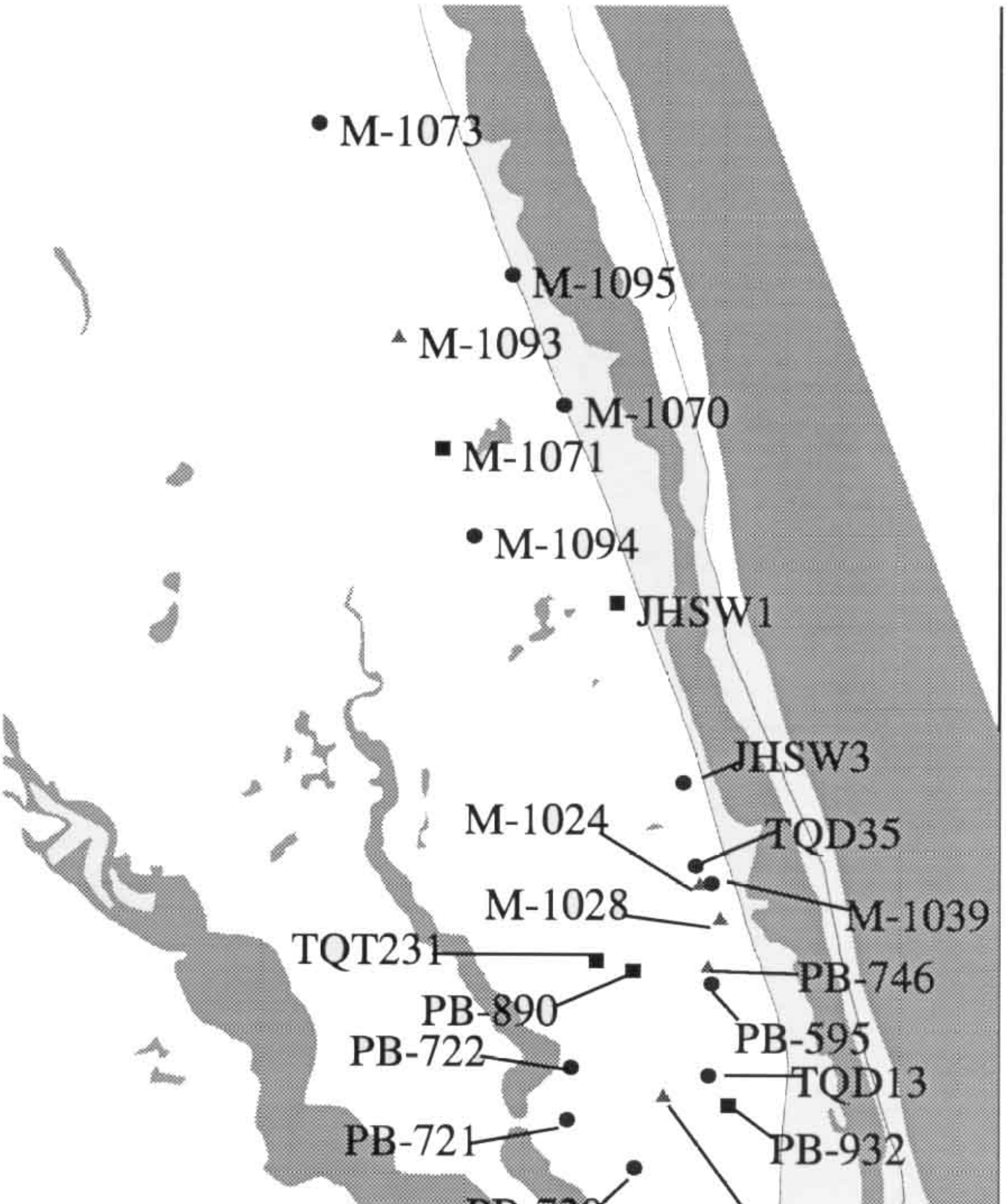


Figure 6. Layer 2 - Inset 2

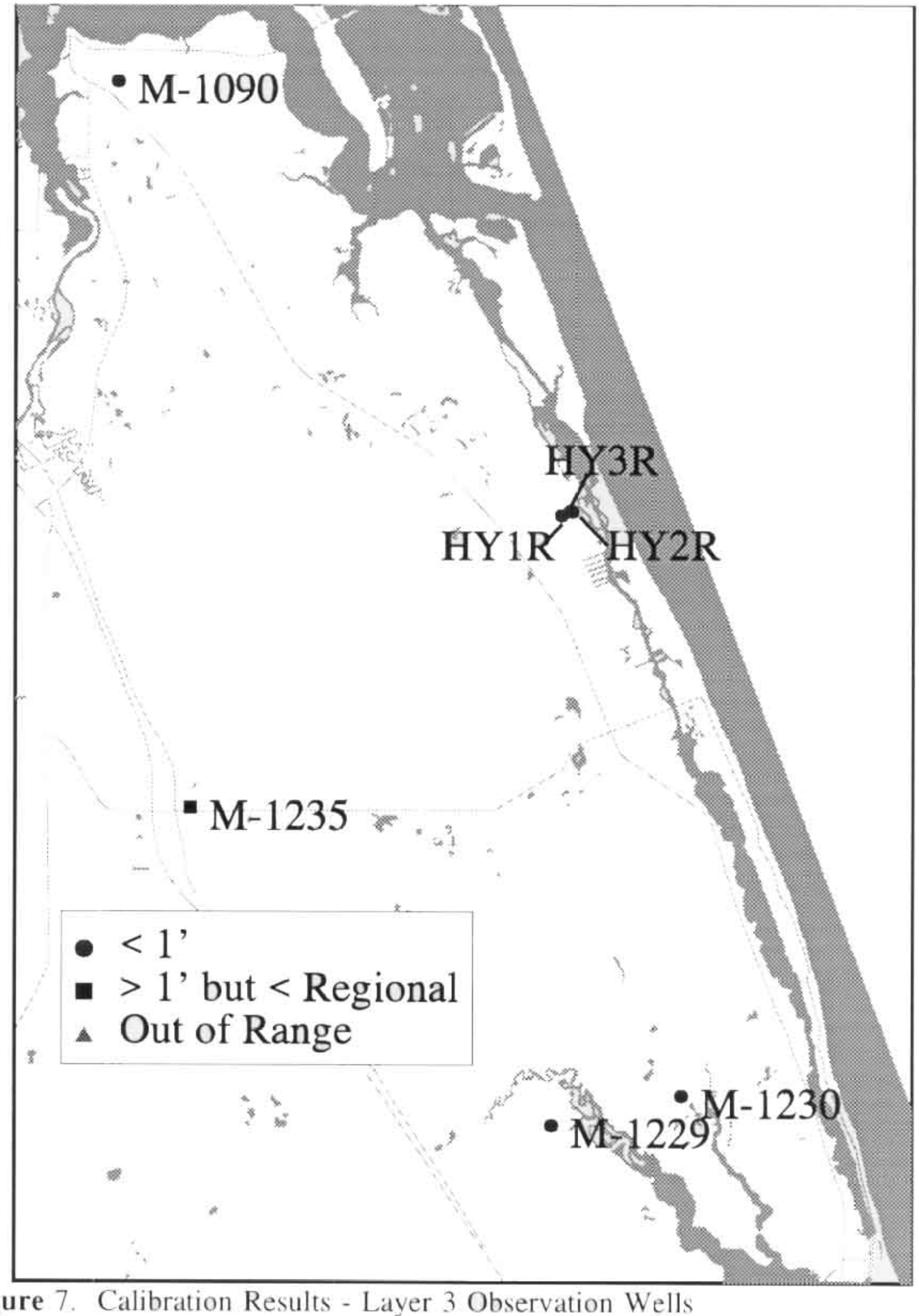


Figure 7. Calibration Results - Layer 3 Observation Wells

References

Adams, Karin, ***A three-dimensional finite difference flow model of the surjicial aquifer in Martin county, Florida.*** South Florida Water Management District Technical Publication 92-02, 220 pp., 1992

Lukasiewicz, J, and K. A. Smith, ***Hydrogeologic data and information collected from the surficial and Floridan aquifer systems, Upper East Coast planning area. South*** Florida Water Management District Technical Publication 96-02, 224 pp., 1996

APPENDIX K

Regional Attenuation Facility Task Force

Executive Summary

EXECUTIVE SUMMARY

The St. Lucie and Martin County Commissions created the Regional Attenuation Facility Task Force (RAFTF) by resolution in Spring 1995. The purpose was to study the 775 square mile St. Lucie River Water shed and make recommendations as to “the most appropriate sites and locations for one or more regional attenuation facilities (RAFs) to address the much-needed upland retention of fresh water to supplement the drainage canals that make up the Central and Southern Florida Project in the upper east coast region, and to prevent further degradation of the Indian River Lagoon and St. Lucie River.” Regional attenuation facilities, more recently termed “Water Preserve Areas” (WPAs) by the U.S. Army Corps of Engineers, are large multi-purpose water management areas.

The Task Force created three committees that worked simultaneously to: 1) identify potential locations; 2) classify locations according to environmental and design variables; and 3) estimate the costs and benefits of establishing WPAs. This effort by the Task Force initially resulted in identification of 20 potential WPA sites totaling over 65,000 acres, and this Task Force Report summarizing its work.

The South Florida Water Management District (SFWMD) estimates that storage of an additional 180,000 acre-feet of fresh water in the watershed is necessary to accomplish environmental restoration goals for the Indian River Lagoon and St. Lucie River systems. The total land required to store this fresh water, at an average of four feet in depth, is approximately 45,000 acres or about 9 percent of the watershed’s total land area.

The Task Force Report reaches four major conclusions. First, environmental restoration of the Estuary and Lagoon does not adequately reflect the total benefits of WPAs, such as:

- Water conservation
- Recreation
- Water supply for municipal, industrial and agricultural users
- Wildlife habitat restoration and mitigation
- Sediment control
- Augmentation of minimum low flows during the dry season to important estuarine resources
- Climatic benefits
- Aquifer recharge
- Flood protection

Second, the value of the total benefits of WPAs have been previously underestimated, and the costs over-estimated. The “benefit-cost ratio” for construction of WPAs looks very favorable.

Third, there are only a few “good” sites (i.e., those which can combine economically adequate size with low environmental impacts); and there are no sites which can provide all the benefits of a WPA without some adverse direct environmental impacts.

Fourth, based on the two design charrettes and other public input received, the citizens are in favor of integrating uplands, restored/preserved wetlands and deep water storage areas for multiple water resource and recreational benefits as the main design objective for WPAs.

The Task Force recommends that: 1) the Counties endorse this Report and use it to build consensus among the public for the establishment of WPA; and, 2) the Task Force be continued to encourage the Corps and SFWMD to establish WPAs as an important component of the overall system for preserving and restoring the Region's water resources.