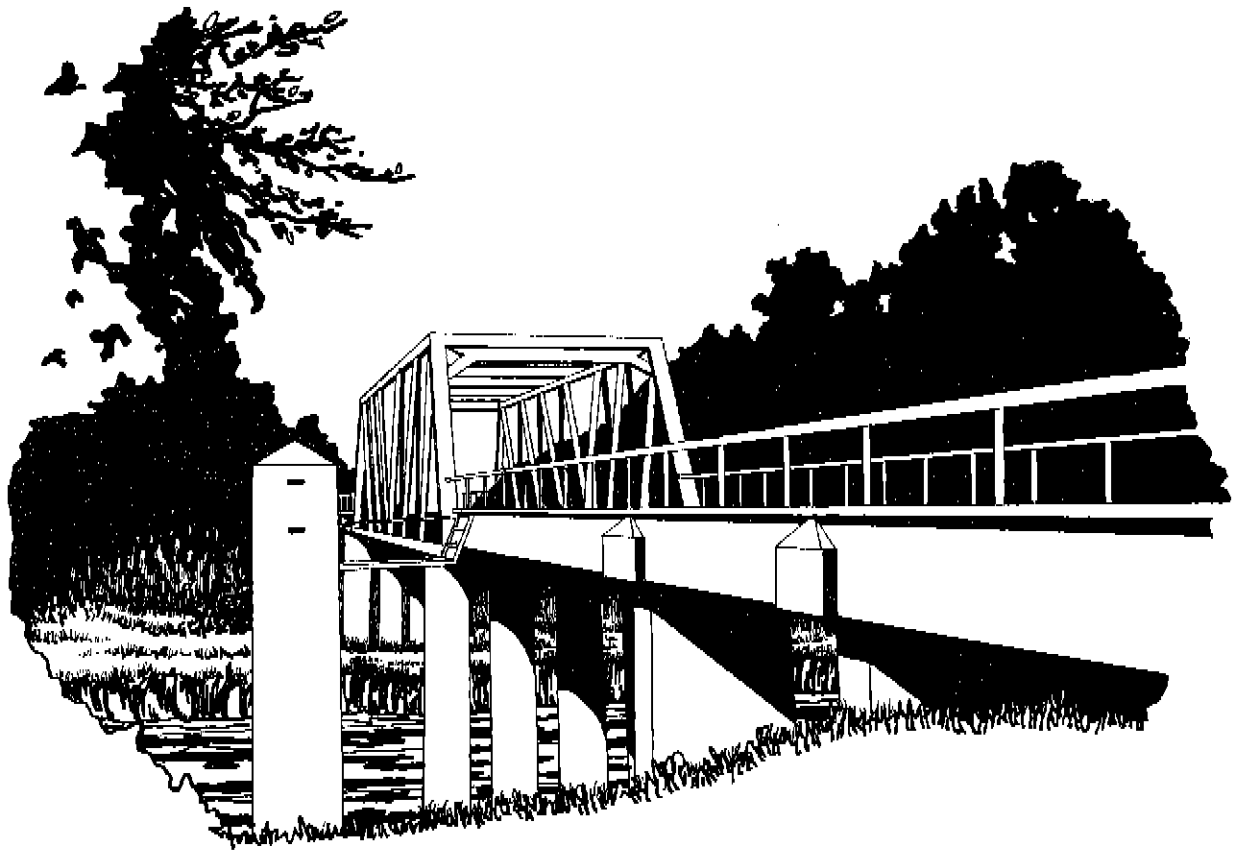
WATER-RESOURCES SETTING, MARTIN COUNTY, FLORIDA

U.S. GEOLOGICAL SURVEY

Water-Resources Investigation 77-68



Prepared in cooperation with
SOUTH FLORIDA WATER MANAGEMENT DISTRICT
and the
BOARD OF COMMISSIONERS, MARTIN COUNTY

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In cooperation with the South Florida Water Management District and the Board of Commissioners, Martin County

16. Abstracts

Various natural features of Martin County such as topography, geology, and phys graphy are described, along with an explanation of the hydrologic cycle, in order explain the interrelationships between the two. Both the surface-water resources a the ground-water resources of the county are presented with the latter being emphas by geologic and water-table data.

17. Key Words and Document Analysis. 17a. Descriptors

Hydrologic cycle, *Hydrogeology, *Water table, saltwater intrusion, Drainage system,

17b. Identifiers/Open-Ended Terms

Martin County, Florida

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by R. Adam Miller

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February 1978

UNITED STATES DEPARTMENT OF THE INTERIOR
CECIL D. ANDRUS, Secretary

GEOLOGICAL SURVEY
W. A. Radlinski, Acting Director

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U.S. Geological Survey
325 John Knox Road, F-240
Tallahassee, Florida 32303

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ILLUSTRATIONS

ILLUSTRATIONS (Continued)

TABLE

METRIC CONVERSION TABLE

Multiply English unit	By	To obtain metric unit
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)
inches (in)	25.4	millimeters (mm)
square feet (ft^2)	.0929	square meters (m^2)
million gallons (Mgal)	3.785	cubic meters (m^3)
square miles (mi^2)	2.59	square kilometers (km^2)
cubic feet (ft^3)	.0283	cubic meters (m^3)
gallons per minute (gal/min)	.06309	liters per second (L/s)
million gallons per day (Mgal/d)	.04381	cubic meters per second (m^3/s)

Data Are Provided Concerning Water Problems in Martin County That Are Associated with the Ever-Increasing Demand for Freshwater

This report describes some basic principles of hydrology as they apply to Martin County. The major land features of the county are described first, then the hydrologic cycle and the county's surface-water and ground-water resource. Specific problems associated with population growth and the county's development, such as saltwater intrusion and water use, are cited and sections have been included in the report to deal with these problems.

The report is intended to provide a background on the water resource of Martin County to those who do not have the time nor the need to delve deeply into the county's hydrologic conditions or its water-management problems. It is freely illustrated and uses a minimum of text to explain the illustrations. General data on the water resource of the county are given, but few specific basic data are presented. For those who wish to obtain additional information, basic data, from which the illustrations were prepared, are available for inspection at the South Florida Subdistrict office of the U.S. Geological Survey, Miami, Florida.

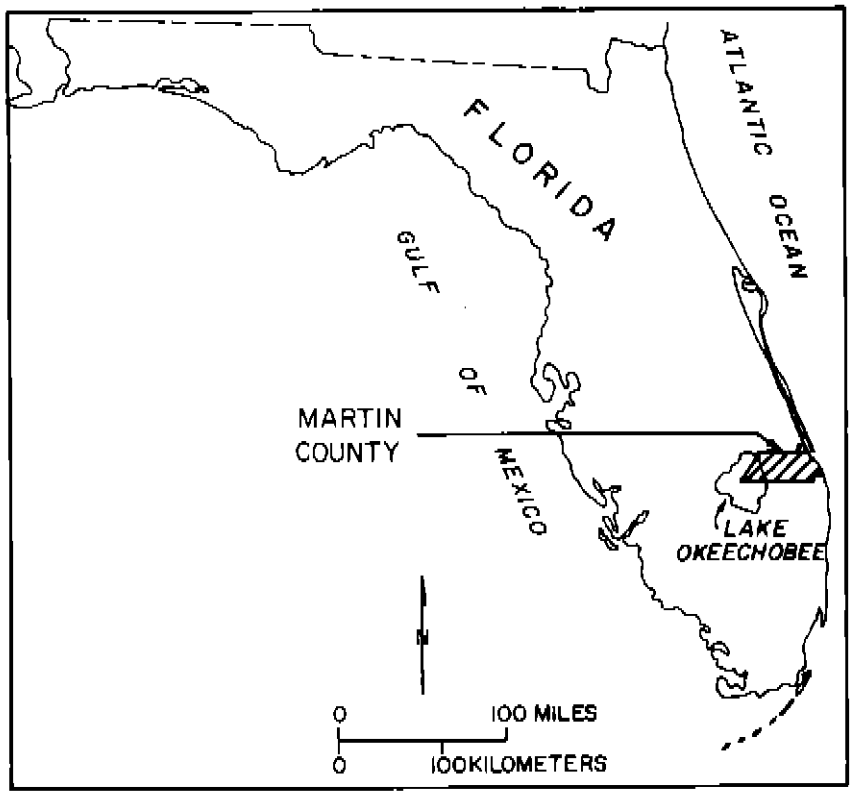
In 1970, Martin County Ranked 34th in Population Among Florida's 67 Counties

Martin County, in the southeastern part of Florida, is bounded on the east by the Atlantic Ocean and on the west by Okeechobee County and Lake Okeechobee. The land area of the county is about 560 mi^2; an additional 92 mi^2 is within Lake Okeechobee.

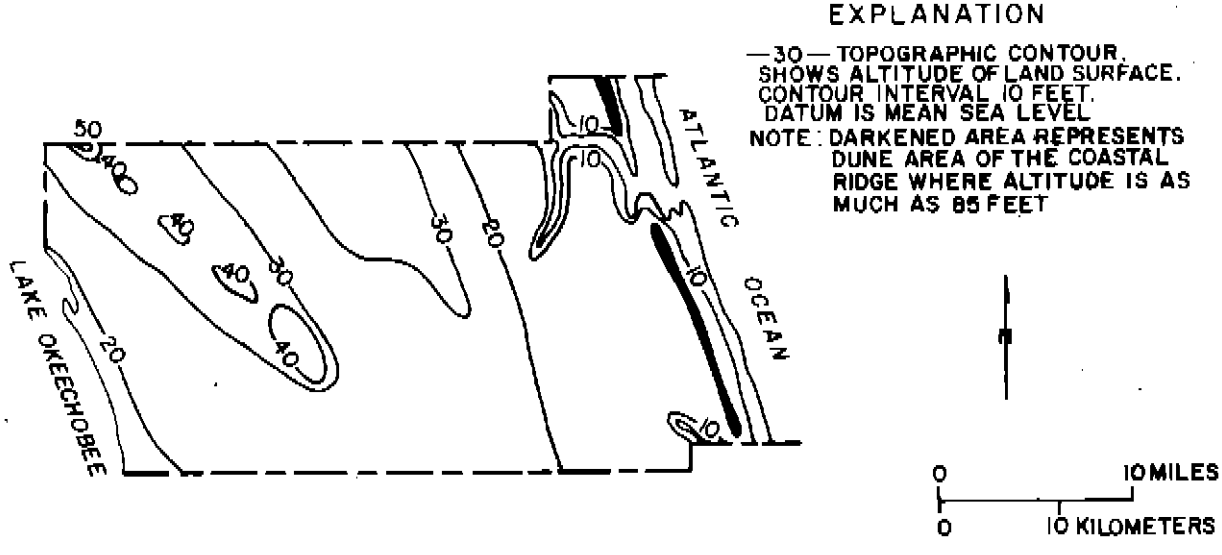
In 1930 the county's population was 2,042. By 1970 the population had increased nearly 14 times, to 28,035. By 1980 the population is expected to reach 50,000 (Sheehan, 1971).

Most of Martin County is Flat: Nearly Everywhere Land-Surface Altitude is Less Than 30 Feet Above Sea Level

Most of the county is nearly flat and ranges in altitude from 10 to 40 ft. The only areas of appreciable relief are a broad, low ridge that extends from the northwest corner of the county toward the west-central part, and a coastal ridge along the ocean. On the ridge in the northwest part of the county, altitudes barely exceed 45 ft. Altitudes on the coastal ridge commonly exceed 25 ft and at one place in Jonathan Dickinson State Park near the southeast corner of the county the altitude is 85 ft.



Location of Martin County.



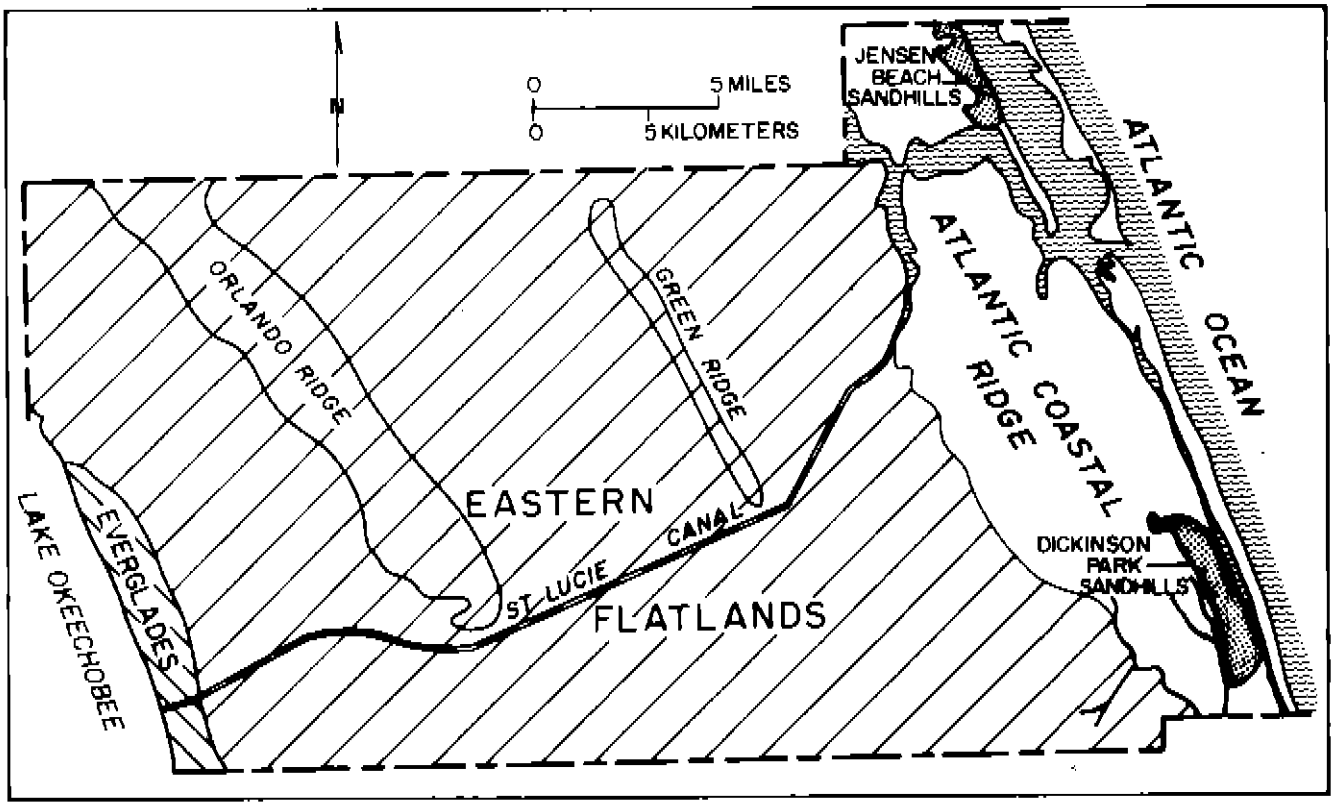
Topography.

Martin County Spans Three Different Physiographic Subdivisions

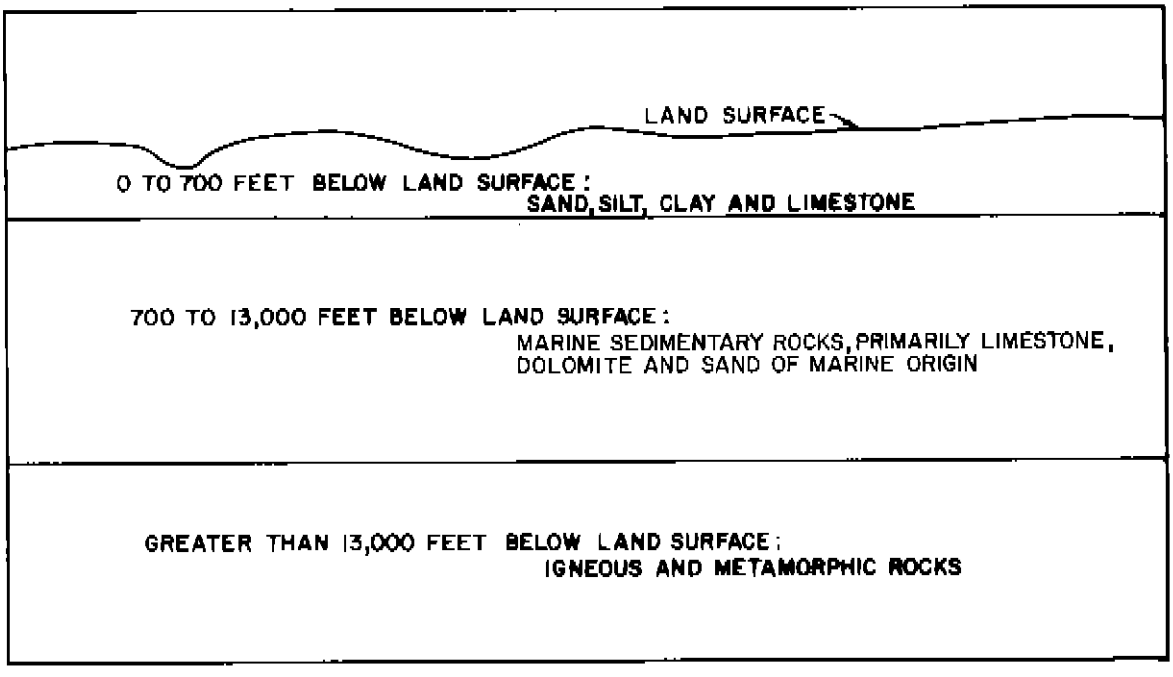
A physiographic subdivision is a land area of similar topography, soils, and vegetation. Martin County includes three physiographic subdivisions: The Everglades adjacent to Lake Okeechobee in the west part, the Eastern Flatlands in the central part, the largest of the three; and the Atlantic Coastal Ridge in the east part. The Coastal Ridge contains the Jensen Beach Sandhills and the Dickinson Park Sandhills. The Eastern Flatlands, which are terraces formed during ancient high stands of the sea, contain the Orlando Ridge and Green Ridge.

Beneath Martin County is a Sequence of Sedimentary Rocks About 13,000 Feet Thick

Three major geologic units lie beneath Martin County. The upper unit, to about 700 ft below land surface, is made up of sand, silt, clay and limestone. Beneath that, to a depth of about 13,000 ft, is a section of marine sedimentary rocks composed mostly of limestone and dolomite. At depths greater than about 13,000 ft lie dense igneous and metamorphic rocks.



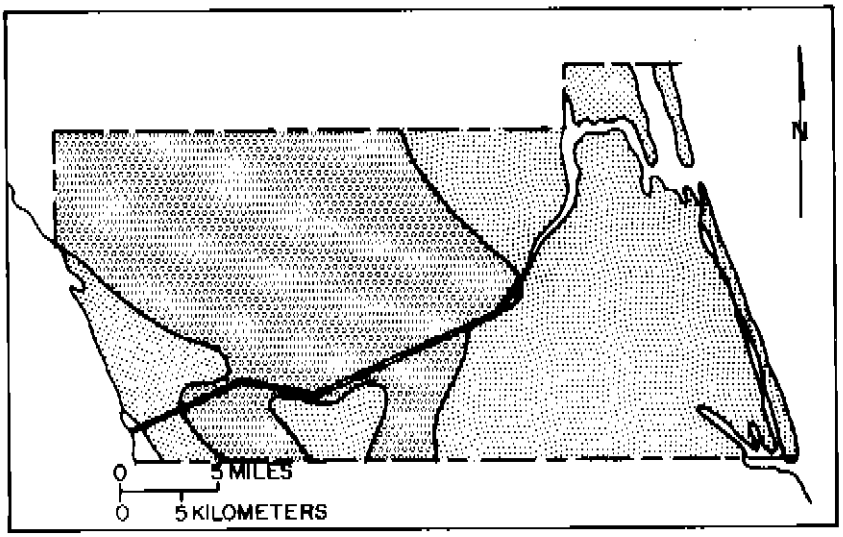
Physiographic subdivisions (after Lichtler, 1960).



Generalized geologic section.

The surficial material is quartz sand. It extends over most of the county as a layer a few feet thick—only in the extreme southwest part of the county is the sand missing. This sand layer is composed of two separate sea-terrace deposits, the Pamlico Sand and the high-terrace deposits.

Beneath the sand layer are the Fort Thompson and Anastasia Formations and the Caloosahatchee Marl. The Fort Thompson Formation, composed of marl, limestone, and shell beds, is the topmost formation in the southwest corner of the county and crops out where the surficial sand is missing. The Anastasia is composed of coquina (limestone composed mainly of shells and shell fragments), sandy limestone, shell marl and sand, in the east half; and the Caloosahatchee consists of sandy to calcareous shell marl, in the west half.

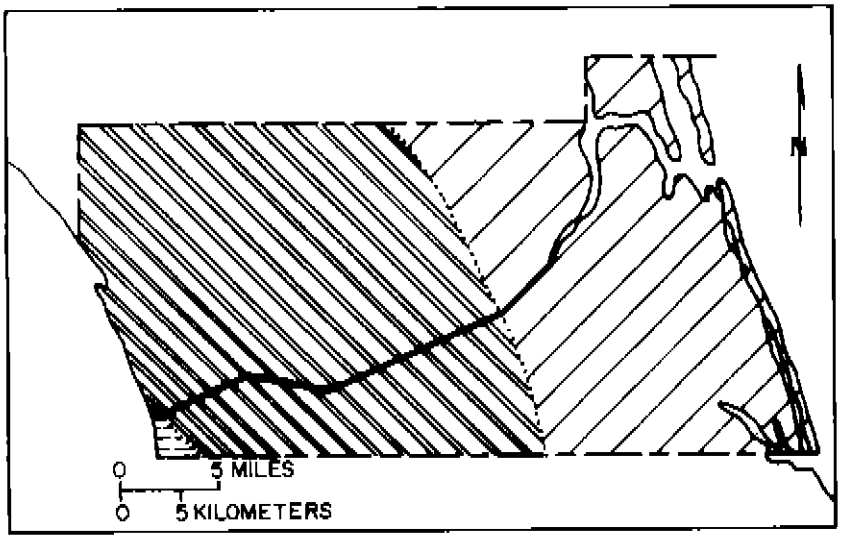


PAMLICO SAND
MARINE QUARTZ SANDS, IN PLACES HARDENED TO A SANDSTONE. SHELLY IN PLACES. OCCUR AT ALTITUDE AS MUCH AS 25 FEET EXCEPT WHERE HEAPED HIGHER INTO DUNES

HIGH-TERRACE DEPOSITS
MARINE QUARTZ SANDS, LOCALLY HARDENED TO FORM A SANDSTONE. OCCUR AT ALTITUDES HIGHER THAN 25 FEET

SAND DEPOSITS MISSING

Surface sand (after Parker and others, 1955).



FORT THOMPSON FORMATION: ALTERNATING MARINE, BRACKISH AND FRESHWATER MARLS, LIMESTONE, AND SHELL BEDS

ANASTASIA FORMATION: COQUINA, SANDY LIMESTONE, SHELL MARL, AND SAND

CALOOSAHATCHEE MARL: GRAY, SANDY TO CALCAREOUS SHELL MARL

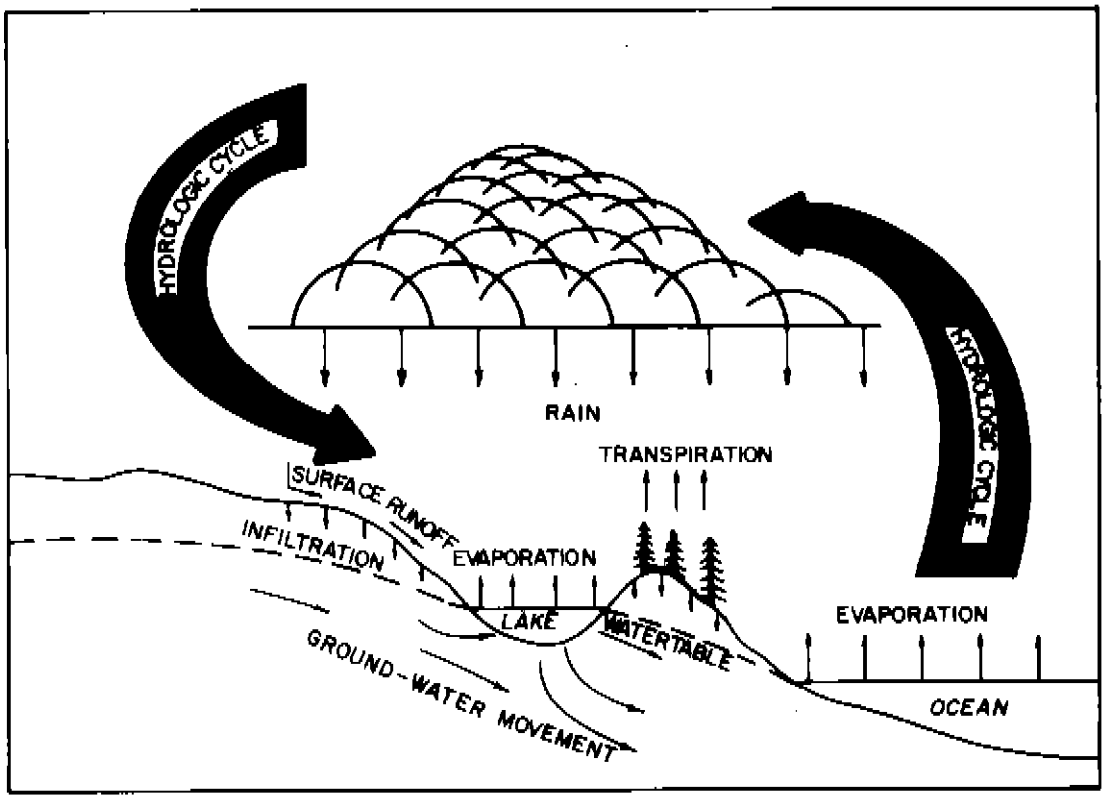
CONTACT, CONCEALED

Topmost consolidated formations (after Parker and others, 1955).

Water, Continuously Cycled, is a Renewable Resource

In the hydrologic cycle water passes through at least two physical states, vapor and liquid. The cycle begins with precipitation, usually rain in Florida. Upon falling to earth the water can infiltrate the ground, travel overland as surface runoff, or return to the atmosphere by evaporation. If it is taken up by plants, it is discharged to the atmosphere by a process known as transpiration. In either process water changes from the liquid state to the vapor state, then is again ready to condense and become precipitation.

Water is a renewable resource because it is continuously being condensed and precipitated to the earth in a relatively fresh condition. But the rate at which it becomes renewable is limited. Knowledge of the renewal rate and of the phases of the hydrologic cycle dealing with surface runoff, infiltration, and groundwater movement in an area, are necessary for effective water management.



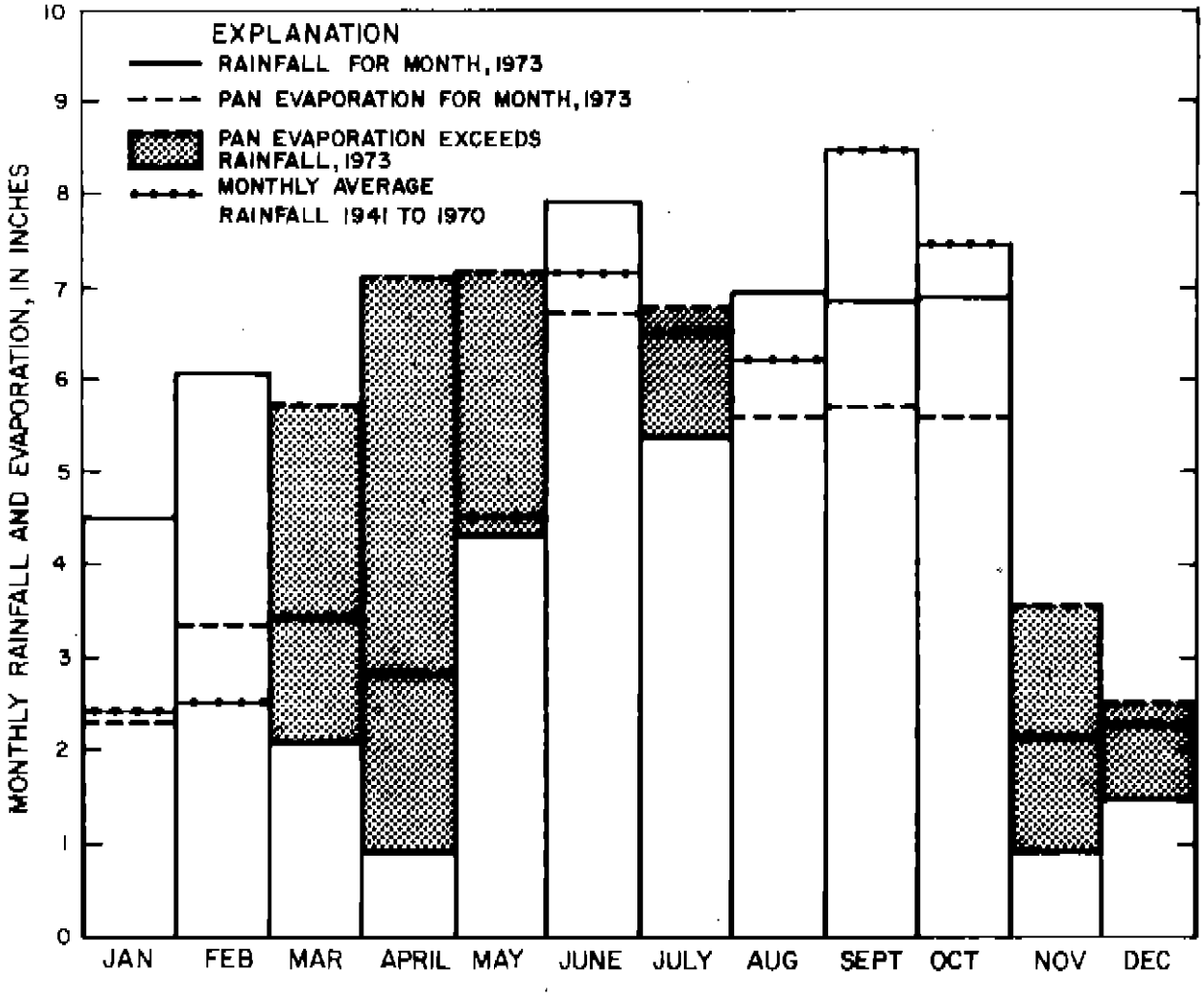
The hydrologic cycle.

On the Average, 51 Inches of Rain Falls on the City of Stuart Each Year, Most During June–October

Southeast Florida experiences a yearly rainfall cycle with a wet season from June through October and a dry season from November through May. During the summer wet season, when the land is warmer than the air masses coming off the ocean, huge convective thunderstorms produce rainfall that is highly variable in quantity from place to place in the county. Therefore, daily rainfall is highly unpredictable with respect to quantity, time, and areal coverage. On a seasonal or annual basis, however, the aggregate rainfall is less variable and forms a more consistent pattern.

The city of Stuart receives, on the average, about 51 in of rain in a year. For June through October, the wet season, the monthly average rainfall is between 6 and 9 in; for November through April, the dry season, the monthly average rainfall is between 2 and 4 in. In 1973 rainfall was 54.3 in, about 3 in above average.

Pan evaporation, the measurement recorded by the National Weather Service, is always greater than evaporation from a lake or open water body. In Martin County, lake evaporation is approximately 78 percent of pan evaporation (U.S. Weather Bureau, 1959). Since evaporation is related directly to solar radiation it is greater in summer than in winter. For example, at Vero Beach, 30 mi north of Stuart, pan evaporation was greater than 5.5 in per month from March through October, 1973, and less than 3.5 in per month from November through February, 1973. During the spring of the year, March through May, pan evaporation generally exceeds rainfall. It is during this period that the water table is lowest and water usage is highest.



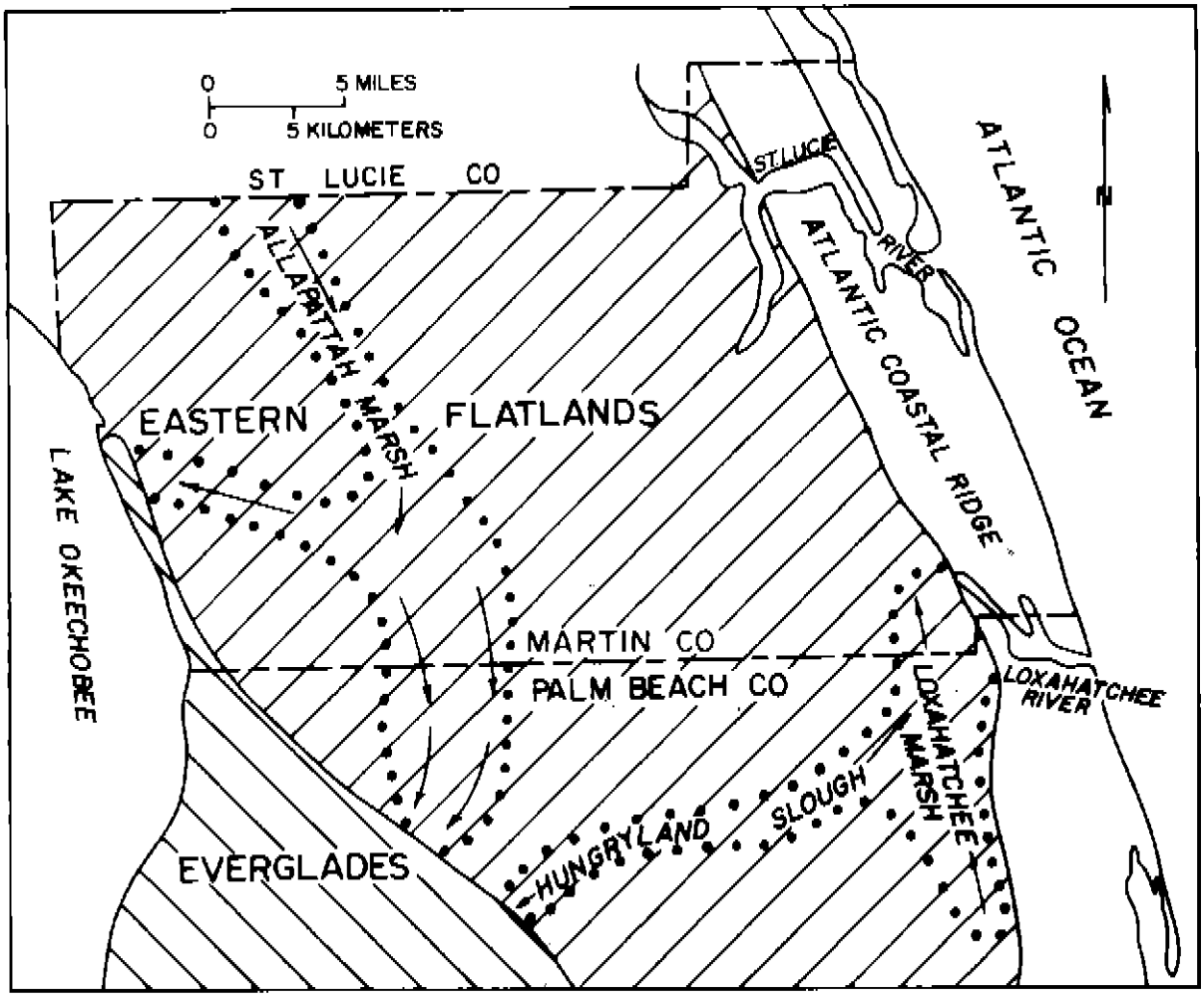
Rainfall and pan evaporation (Pan evaporation at Vero Beach; Rainfall at Stuart. Data from U.S. Department of Commerce, 1973.)

Allapattah Marsh and St. Lucie and Loxahatchee Rivers Provide Natural Drainage for Martin County

Before man began to develop the county with canals and pumps, nature had its own system of surface drainage. It consisted of the Allapattah Marsh in the west part of the county, the St. Lucie River in the northeast, and the Loxahatchee River in the southeast.

The western half of the county was drained by the Allapattah Marsh, a low shallow feature extending southward from the St. Lucie County Line to the Palm Beach County Line. Part of the water flowed southward into Palm Beach County and eventually left the Eastern Flatlands to spread out over the Everglades; the rest flowed westward into Lake Okeechobee.

Surface water in the eastern half of the county drained northward by way of St. Lucie River and southward by way of the Loxahatchee River and the Loxahatchee Marsh.



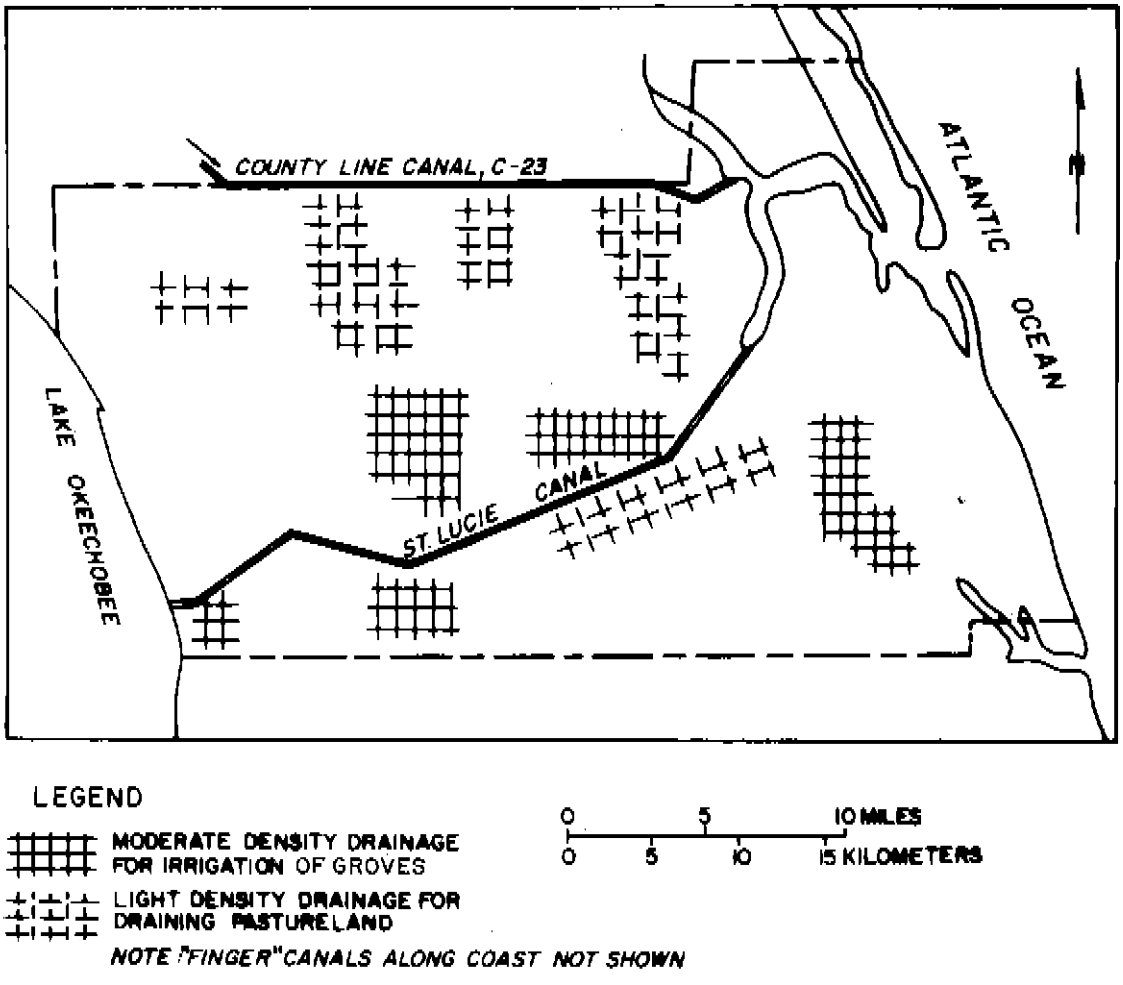
Pre-development surface drainage (after Parker and others, 1955): arrows indicate directions of drainage.

Man Has Further Drained the County, by Means of the St. Lucie and County-Line Canals and Many Secondary Canals.

The biggest man-made drainage feature in the county is the St. Lucie Canal, constructed by the U.S. Army Corps of Engineers in 1916 to provide additional drainage from Lake Okeechobee. The average outflow from the lake through the canal was 1,105 ft^3/s during 1952–74.

In addition to the primary drainage by the St. Lucie Canal, many secondary canals drain the interior parts of the county. Most of these secondary canals are connected to the St. Lucie Canal, to the County Line Canal of the South Florida Water Management District, or to natural streams. The secondary canals drain land in the north part of the county, making it suitable for grazing, and also drain and provide irrigation water for citrus groves in the central and south parts of the county. The coastal area is marked by many "finger" canals connected to the ocean. These provide waterfront property and recreation for coastal residents.

Optimum lake levels for Lake Okeechobee have been determined for various hydrologic conditions by the Corps of Engineers. Flow from the lake into the St. Lucie Canal is regulated by a control structure near the head of the canal so that the optimum lake levels are met. If the lake should attain a higher-than-optimum level, water is released to the ocean by way of the St. Lucie Canal. Water is released from the lake also during the dry season for irrigation of groves and pastures.



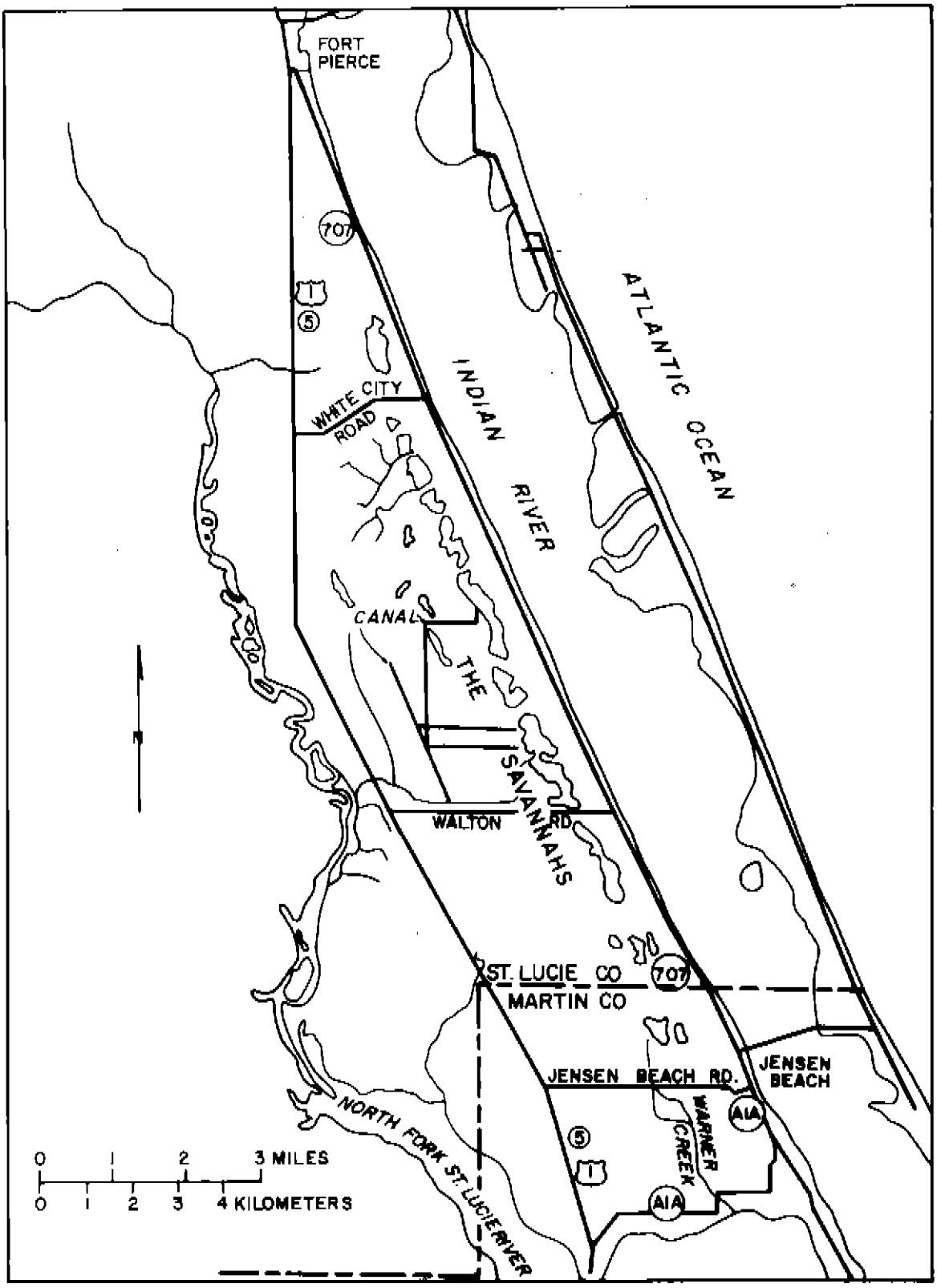
Manmade drainage.

In the Northeast Part of, and to the North of, Martin County Lies a Natural Wetlands Area, The Savannahs

These Savannahs, in the northeast corner of Martin County and the adjacent coastal part of St. Lucie County, are flat wetlands covered with sawgrass. Lying between the Indian River and the North Fork St. Lucie River, they are about 2 mi wide and 10 mi long. From the east edge of The Savannahs where there are many lakes, land surface rises gently westward. On the west edge pine trees are the dominant form of vegetation.

Two improved channels drain The Savannahs. One just north of Walton Road drains westward to North Fork St. Lucie River; the other, Warner Creek, at the south end of The Savannahs, drains southward to the St. Lucie River. Although no measurements of flow have been made in either of the two channels, observations indicate that substantially more water is discharged by the westward draining channel than by the south channel.

Water levels of the lakes along the east edge of The Savannahs range from 13 to 16 ft above mean sea level during an annual cycle. This fluctuation causes a proportional fluctuation in the rate of surface outflow from The Savannahs.



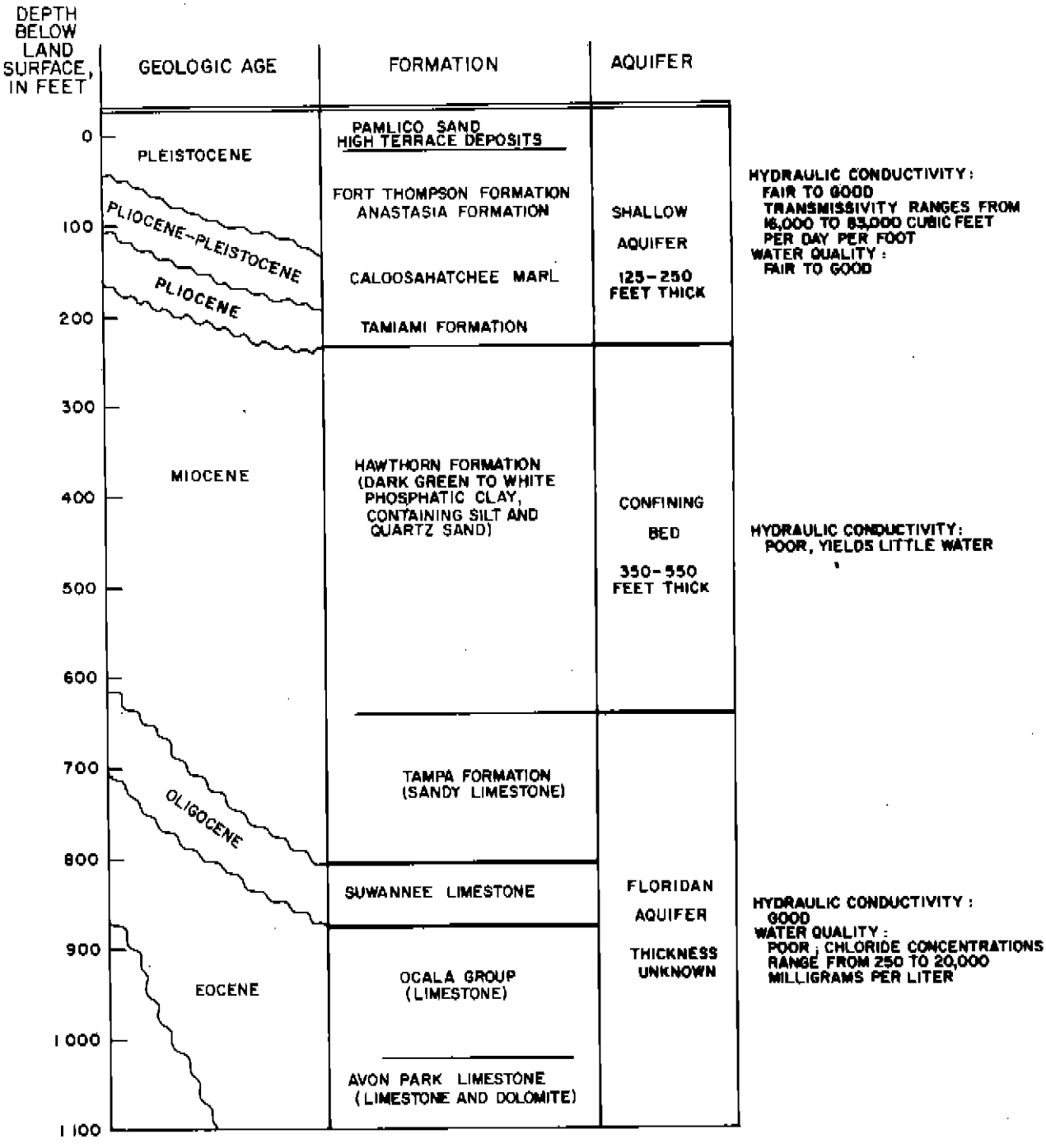
The Savannahs of Martin and St. Lucie Counties.

The Shallow Aquifer is the Source of All Public Water Supplies for Martin County

The "shallow" aquifer and the Floridan aquifer underlie Martin County. The two are separated by a confining bed known as the Hawthorn Formation. The shallow aquifer, source of water for all the municipalities in Martin County, is composed of the Pamlico Sand, of Pleistocene age, Fort Thompson Formation, Anastasia Formation, Caloosahatchee Marl, of Plio-Pleistocene age, and possibly the Tamiami Formation, of Pliocene age. Usually the largest yields of water are from the Anastasia Formation and Caloosahatchee Marl which are made of thin marly permeable beds of shells, limestone, and sand. Water in the shallow aquifer is unconfined; the surface of the saturated zone is called the water table.

The transmissivity, or ability of the aquifer to transport water, is fair to good. Lichtler (1960) reports a transmissivity range of 16,000 to 83,000 cubic feet of water per day for each foot of water-table drawdown. On the basis of his tabulated data, the following generalizations can be made concerning yields of wells that tap the shallow aquifer:

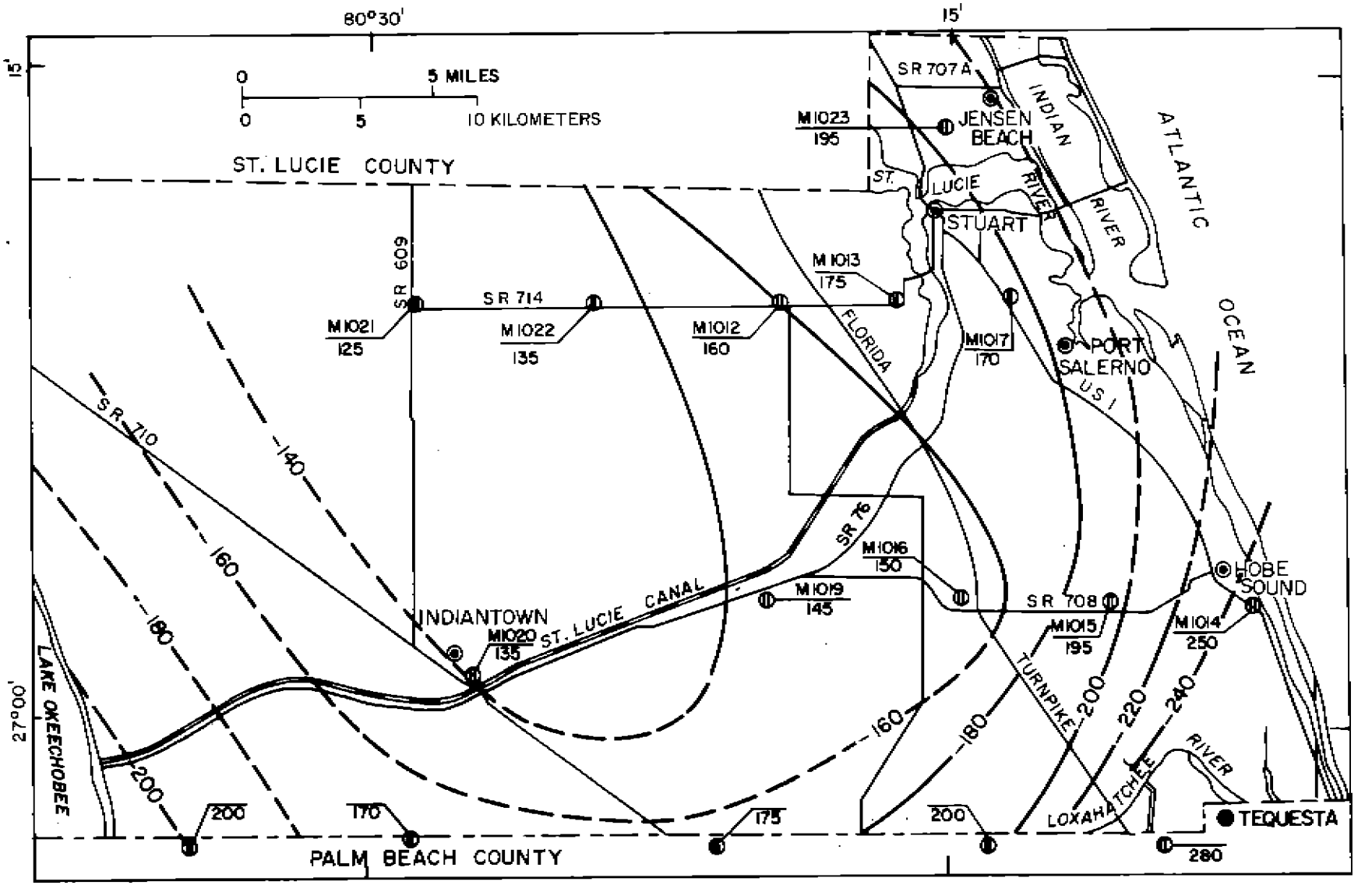
Well diameter (inches)	Well yield (gallons per minute)
1½–2	10–25
4	100–125
6–8	100–1,000



The shallow aquifer and confining bed.

Drilling Test Wells Effective in Locating Vertical Position of the Shallow Aquifer

The Geological Survey constructed 15 test wells mostly in the central and eastern parts of Martin County, and just south of the boundary, in Palm Beach County. These 4-in wells were drilled by the rotary method through the shallow aquifer into the confining bed below. By examining the drill cuttings the base of the shallow aquifer was easily identified at most test-well sites. As the map shows, the base of the aquifer is within the depth range 125–250 ft below sea level.



EXPLANATION

—180— STRUCTURE CONTOUR. SHOWS ALTITUDE OF BASE OF SHALLOW AQUIFER. DASHED WHERE APPROXIMATELY LOCATED. CONTOUR INTERVAL 20 FEET. DATUM IS MEAN SEA LEVEL.

M1019 / 135 TEST HOLE. UPPER NUMBER IS MARTIN COUNTY WELL NUMBER; LOWER NUMBER IS DEPTH TO BASE OF SHALLOW AQUIFER, IN FEET BELOW MEAN SEA LEVEL.

Location of test holes and altitude of base of the shallow aquifer in Martin County (after Earle, 1975).

In Most of the County, Water From the Shallow Aquifer is of Good Chemical Quality. In Some Places, Chloride, Iron, and Sulfate Concentrations are High

The quality of the water generally meets the standards recommended for public water supplies as defined by the Environmental Protection Agency (National Academy of Sciences and National Academy of Engineering, 1973). However, Lichtler (1960) reports that iron, chloride, and sulfate concentrations are high in the shallow aquifer at various locations throughout the county and exceed the recommended maximum concentrations for these three constituents:

chloride -250 mg/L
iron–0.3 mg/L
sulfate–250 mg/L

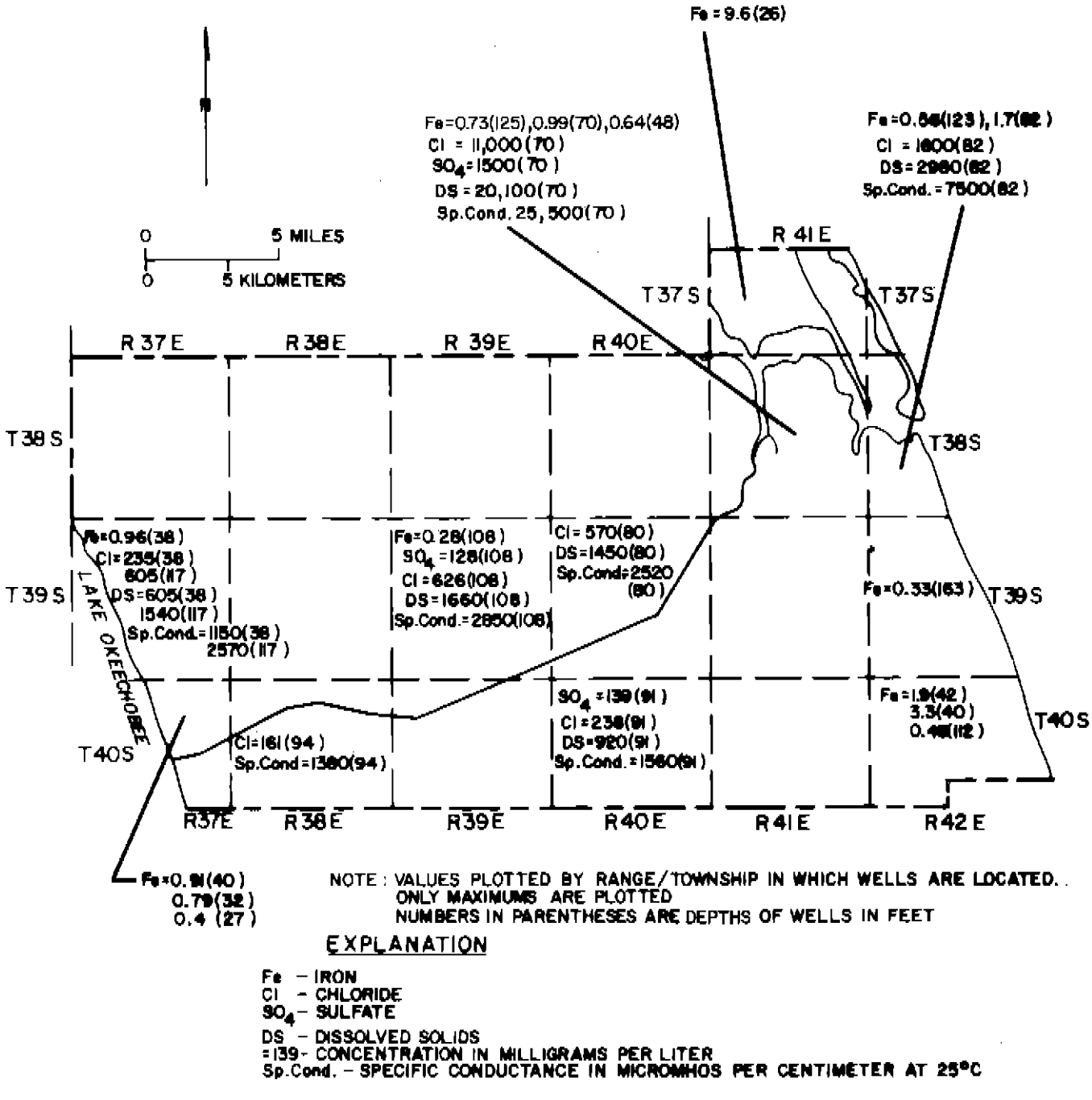
Chloride and iron concentrations in the water exceed these maxima in the western part of the county near Lake Okeechobee where as much as 0.96 mg/L iron and 605 mg/L chloride have been recorded.

In water in the central part of the county, iron, sulfate, and chloride concentrations may be high. But of the three constituents only chloride—with recorded values of 626 mg/L and 570 mg/L—exceeds recommended standards.

In water from the shallow aquifer along the coast, iron, chloride, and sulfate concentrations may exceed the recommended standards. Highest recorded are iron 9.6 mg/L, chloride 11,000 mg/L, and sulfate 1,500 mg/L.

The high chloride in ground water along the coast probably is caused by saltwater intrusion. In the central part of the county high chloride may be caused by (1) residual salts in fine sediment, derived from inundations by ancient seas; (2) upward leakage of saline artesian water; or (3) use of artesian water for irrigation.

Although sulfate is not a major problem in water anywhere in the county, sulfur in the form of hydrogen sulfide, a gas, is prevalent throughout the shallow aquifer, and does constitute a problem. Simple spray aeration will remove virtually all the hydrogen sulfide.

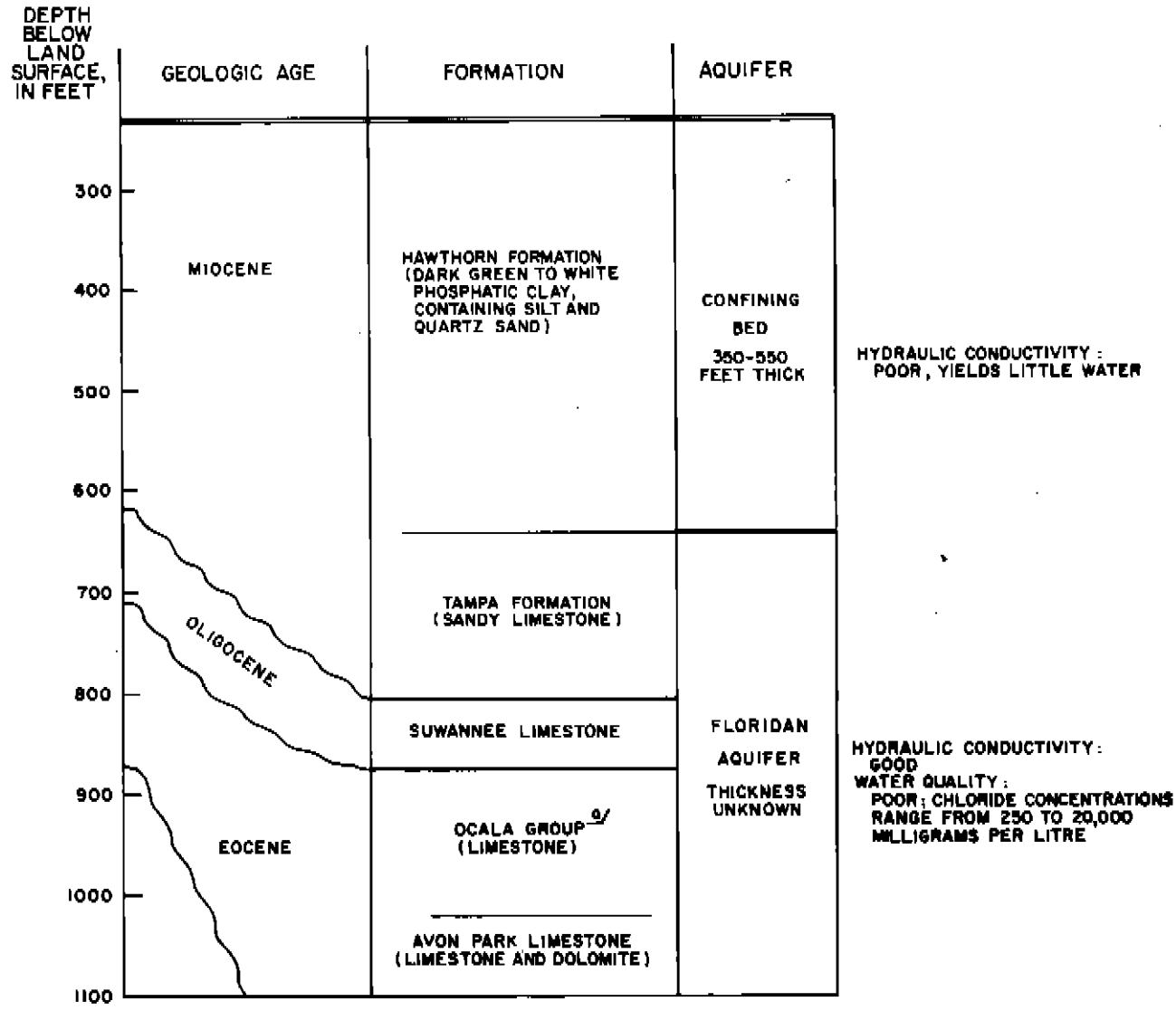


Maximum values for selected water quality parameters at various depths in the shallow aquifer.

In Martin County The Floridan Aquifer is Capable of Yielding Large Quantities of Water But Because of the High Salinity of Water It is Generally Not Potable. Some of the Water is Used for Irrigation

The Tampa Formation forms the uppermost part of the Floridan aquifer. The remainder of the aquifer is composed of the Suwannee Limestone, the Ocala Group, and the Avon Park Limestone. These formations are of Miocene, Oligocene, and Eocene age.

The hydrostatic pressure of water in the Floridan aquifer is high. Water levels in wells tapping the Floridan aquifer in Martin County rise above the top of the aquifer and wells will flow in all parts of the county except in the high coastal dunes. The transmissivity of the material is good. Although the water is generally nonpotable--chloride concentrations range from 250 to 20,000 mg/L—the water in the upper part of the aquifer is less saline than in the lower part. Some irrigation wells in the west and north parts of the county tap the upper part of the aquifer.



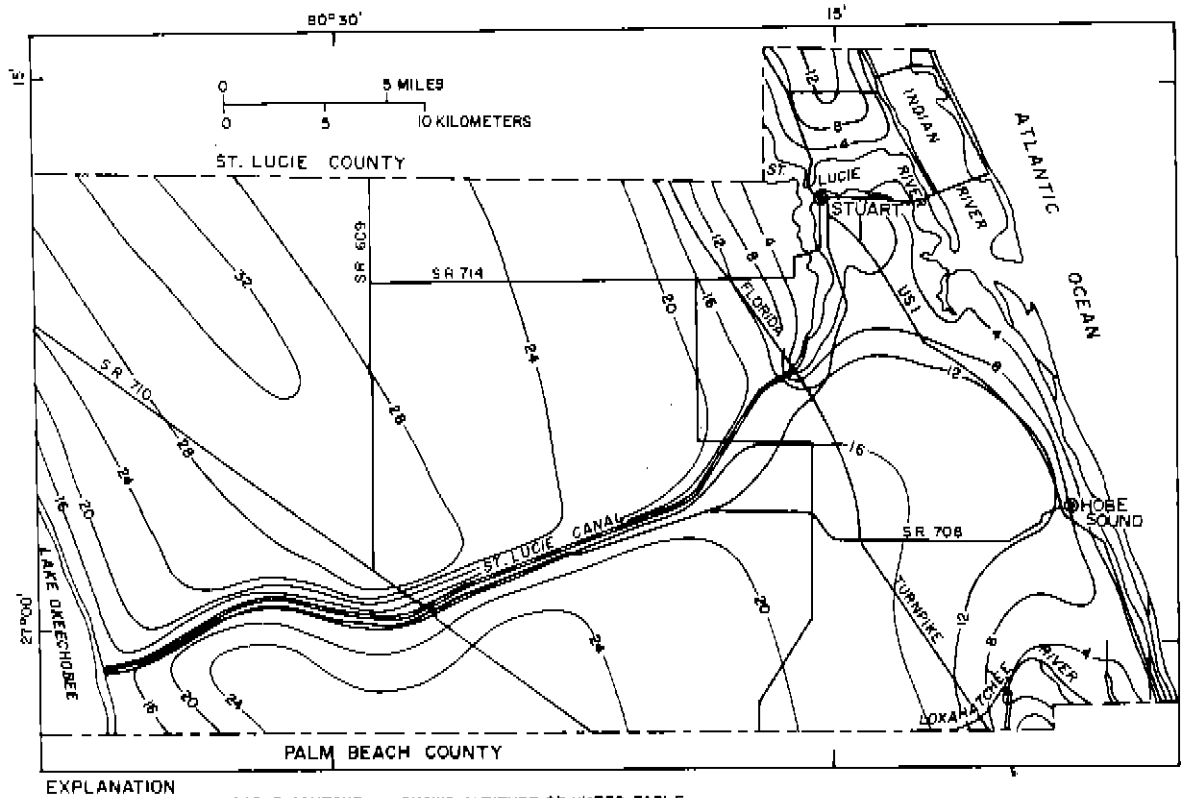
a/ GEOLOGIC NOMENCLATURE IS THAT USED BY THE FLORIDA DEPARTMENT OF NATURAL RESOURCES, BUREAU OF GEOLOGY.

Confining bed and Floridan aquifer.

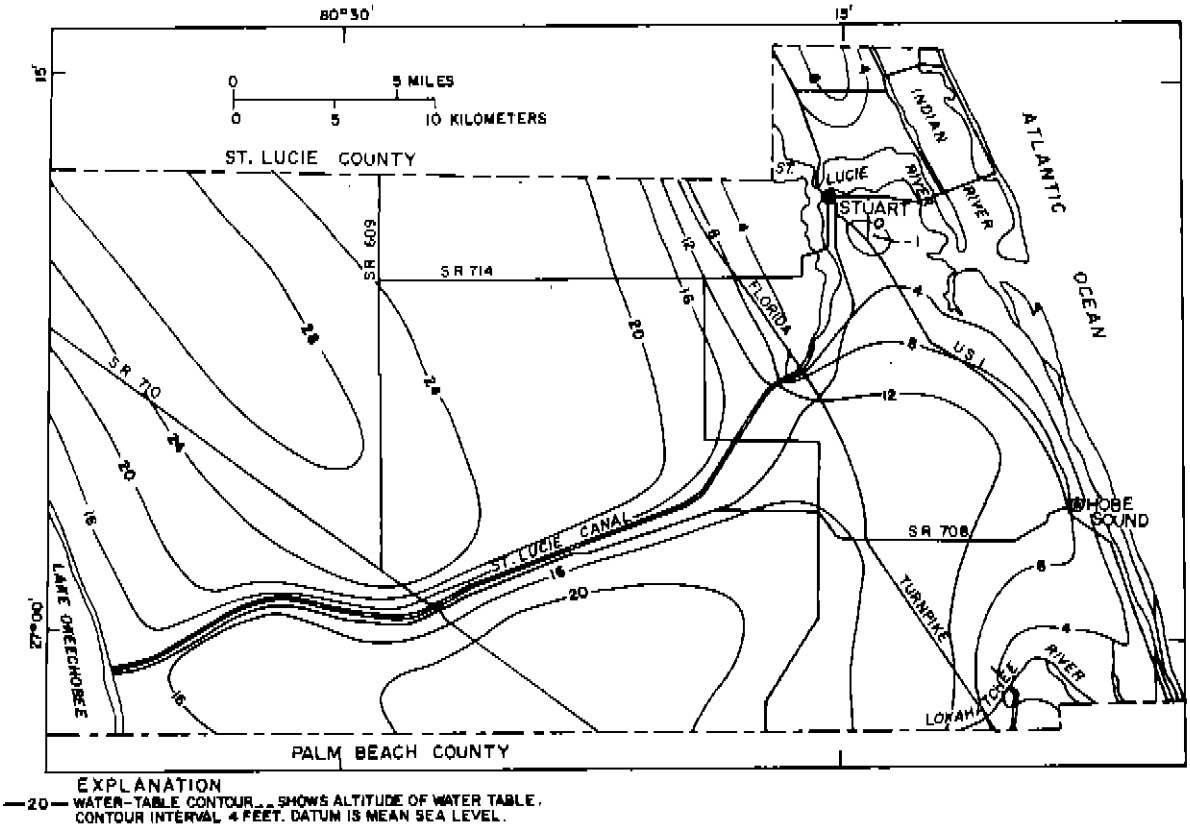
The Water Table Fluctuates in Response to Seasonal Rainfall; It is Generally Highest in October and Lowest in May

In October 1974 the altitude of the water table ranged from 24 ft south of the St. Lucie Canal and 32 ft north of the St. Lucie Canal, to sea level along the Atlantic Coast. In May 1974, altitudes were 2 to 4 ft lower throughout the county except for the coastal areas.

Ground water flows from areas where the water table is high to areas where it is low, along lines perpendicular to the water-table contours. In Martin County, flow is generally eastward and westward from the Orlando Ridge to points of discharge in streams, along the coast, and in Lake Okeechobee. Some flow is also northward and southward toward the St. Lucie Canal, the main drainage for the interior areas.



Water-table contours in Martin County, October 1974.

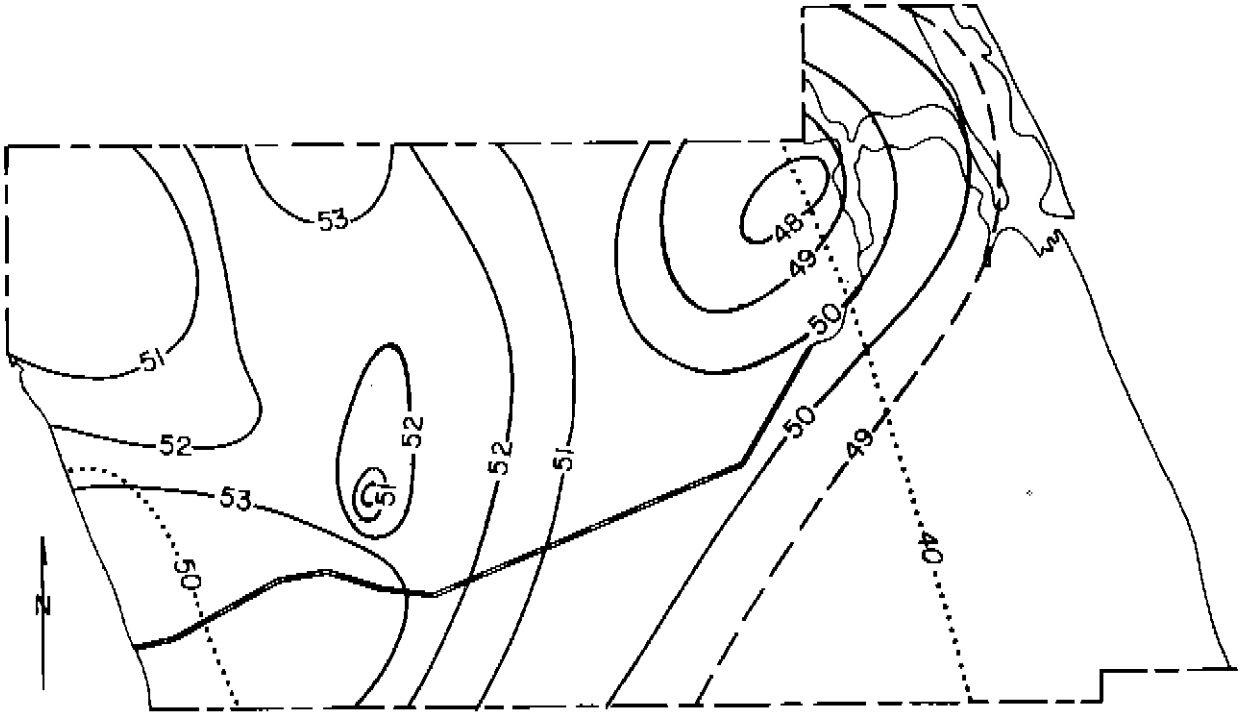


Water-table contours in Martin County, May 1974.

The Potentiometric Surface of the Floridan Aquifer is Sufficiently High That Most Wells Tapping the Aquifer in Martin County Will Flow at Land Surface

As indicated previously, wells that tap the Floridan aquifer will flow. In April 1957 the potentiometric surface of the Floridan aquifer was 51 to 53 ft above mean sea level in the west part of Martin County and 48 to 50 ft in the east part. Locally, in the northeast and west parts of the county, water levels have declined slightly because of discharging wells.

In May 1974, on the basis of sparse data, the potentiometric surface ranges from about 50 ft above mean sea level in the west part of the county to about 40 ft in the east part. In the 17-year span, the potentiometric surface in the east part of the county declined about 10 ft and in the west part, 3 ft. This decline probably is related to increased discharge from the aquifer for irrigation.



EXPLANATION

—52— POTENTIOMETRIC CONTOUR__SHOWS ALTITUDE AT WHICH WATER LEVEL WOULD HAVE STOOD IN TIGHTLY CASED WELLS, APRIL 1957 (AFTER LICHTLER, 1960.) CONTOUR INTERVAL 1 FOOT. DASHED WHERE APPROXIMATELY LOCATED. DATUM IS MEAN SEA LEVEL.

·····40····· POTENTIOMETRIC CONTOUR__SHOWS ALTITUDE AT WHICH WATER LEVEL WOULD HAVE STOOD IN TIGHTLY CASED WELLS, MAY 1974. CONTOUR INTERVAL 10 FEET. DATUM IS MEAN SEA LEVEL.

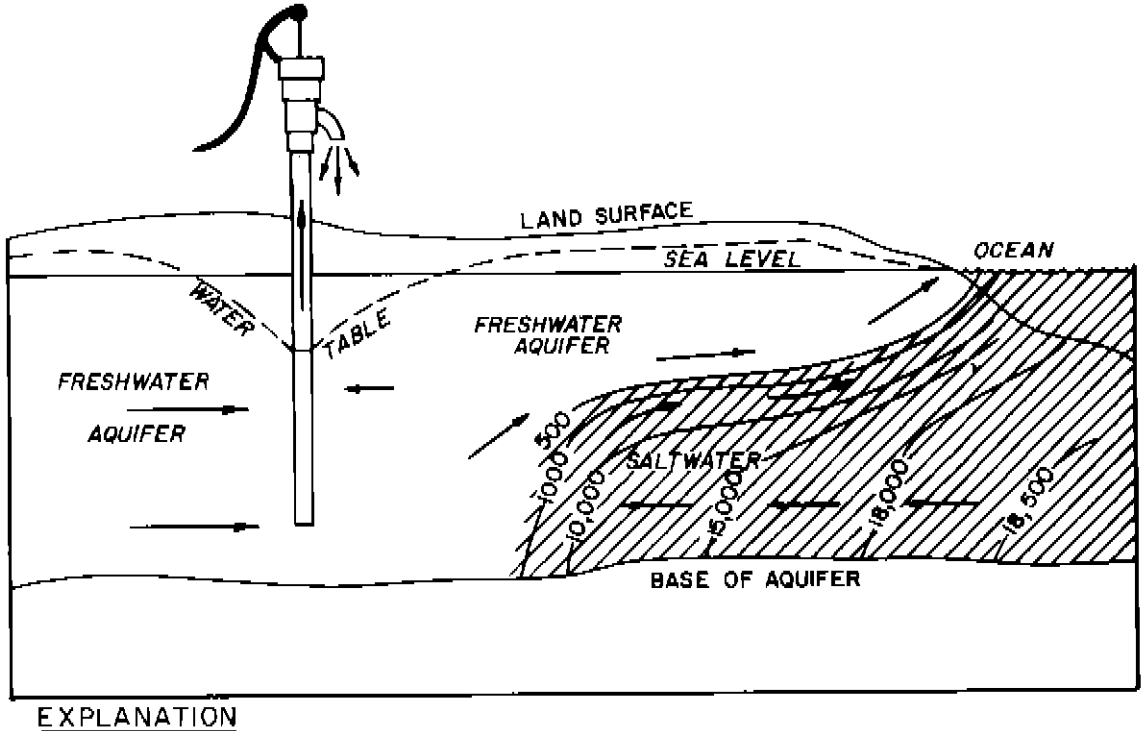
0 5 MILES
0 5 KILOMETERS

Potentiometric surface of Floridan aquifer, April 1957 and May 1974.

Saltwater Intrusion Can Occur When Freshwater Levels Are Lowered

In coastal aquifers where freshwater comes in contact with the saltwater of the ocean a condition of dynamic equilibrium exists. This equilibrium requires that the freshwater level be higher than the saltwater level. If freshwater levels are lowered significantly by drainage or pumpage, saltwater will migrate inland through the aquifer. As water levels are stabilized the interface between the freshwater and the saltwater is stabilized. Similarly, as freshwater levels are raised, the interface will retreat seaward.

Intrusion of saltwater from the ocean into the coastal aquifer, or the opposite action, the flushing of the saltwater from the aquifer, usually is slow owing to the slow movement of ground water within the aquifer. But the contamination of the aquifer by saltwater is facilitated when canals are dug which connect the ocean to inland areas. In a comparatively short time the saltwater may travel to the farthest inland extent of the canal that is at or below sea level. Where the pressure level of saltwater is higher than that of the adjacent freshwater aquifer, the saltwater will migrate into the aquifer.



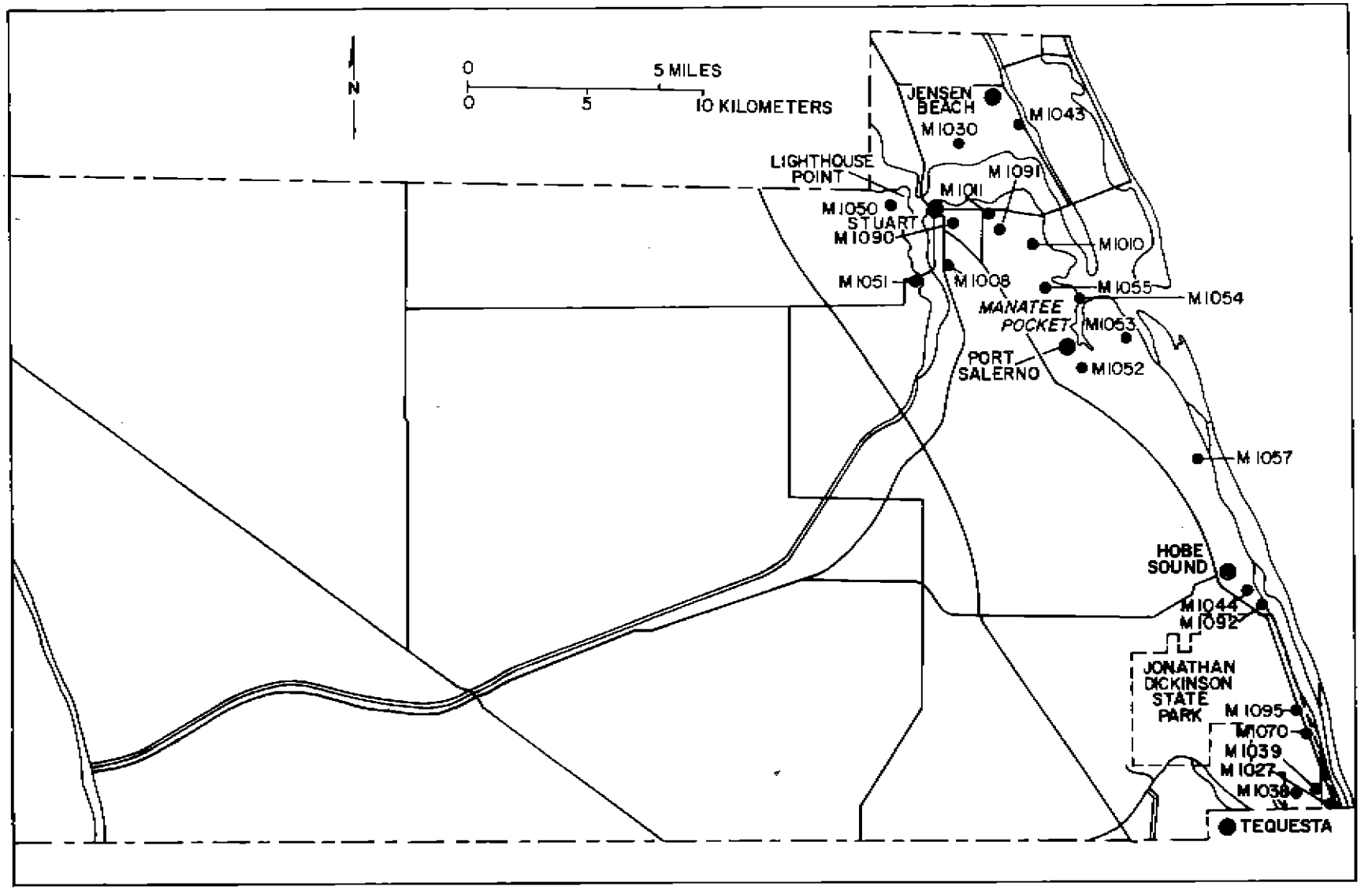
Freshwater-saltwater dynamics of a coastal aquifer.

Saltwater Intrusion Has Occurred in Several Areas of Martin County

In Martin County, samples of water are collected periodically from salinity-observation wells located between well fields and the coast. Observation wells have been located in Jensen Beach, several places around Stuart, Port Salerno, Hobe Sound, and Tequesta. Normal background chloride concentrations have been observed in the wells at Jensen Beach, Stuart, and Hobe Sound.

Indications of saltwater intrusion have been found at Lighthouse Point (well M 1050), the Manatee Pocket area (wells M 1054, M 1053, and M 1052), along U.S. 1 near Jonathan Dickinson State Park (well M 1070), and Tequesta (wells M 1039 and M 1027). The samples collected in the spring of 1976 contained the following concentrations of chloride:

Area	Well	Chloride (mg/L)
Lighthouse Point	M 1050	80
Manatee Pocket	M 1054	10,600
Do.	M 1053	3,100
Do.	M 1052	98
Jonathan Dickinson State Park	M 1070	750
Tequesta	M 1039	5,400
Do.	M 1027	20,000



Salinity-data network.

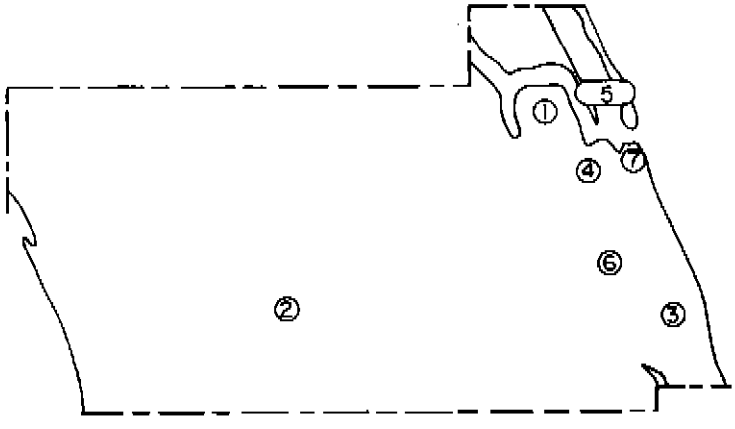
Public Water Supply Totaled About 1,500 Million Gallons for Martin County During 1974

In 1957, of the three suppliers of ground water for municipal use—City of Stuart, Indiantown Co., and Hobe Sound Water Co.—Stuart pumped 103 Mgal and Indiantown Co. pumped 3.5 Mgal. The quantity pumped by Hobe Sound Water Co. is not known.

In 1974, Stuart pumped 824 Mgal, of which 143 Mgal were purchased by Southern Utilities; and Indiantown Co. pumped 115 Mgal. Records are incomplete for the five other major water suppliers in the county but it is reasonable to assume that they pumped about 500 Mgal during the year. That would make the 1974 pumpage for the seven largest water suppliers in Martin County total about 1,500 Mgal, at least 10 times the quantity pumped in 1957.

SITE NUMBER	AREA SERVED	NAME OF UTILITY	CUSTOMERS SERVED 1974 *	PRESENT PLANT CAPACITY (Mgd)	PUMPAGE 1974 (MILLION GALLONS)	PUMPAGE 1957 (MILLION GALLONS)	NUMBER OF WELLS IN USE	OWNERSHIP OF SYSTEM
1	STUART	STUART WATER DEPT.	7,000	4.0	824	103	22	PUBLIC
2	INDIANTOWN	INDIANTOWN CO.	823	0.65	115	3.5	6	PRIVATE
3	GOMEZ AND HOBE SOUND	HOBE SOUND WATER CO.	650	—	300	—	10	PRIVATE
4	PORT SALERNO, GOLDEN GATE YACHT CLUB	TREATMENT SYSTEMS INCORPORATED	DATA UNAVAILABLE					PRIVATE
5	SEWALLS POINT, HUTCHINSON ISLAND	SOUTHERN GULF UTILITIES	417 *	0	143 †	—	0	PRIVATE
6	RIDGEWAY VILLAGE	(SELF)	550	0.5	80	—	5	PRIVATE
7	MILES GRANT	(SELF)	250	0.36	40	—	3	PRIVATE

† WATER BOUGHT FROM STUART
* INCLUDES CONDOMINIUMS AS 1 CUSTOMER



UTILITY LOCATION MAP

Water used by seven areas, 1957 and 1974.

SUMMARY

Martin County, an area of 560 mi² with a population of nearly 40,000 people, used about 1,500 Mgal of water in 1975 for non-agricultural purposes. This is an average of 103 gallons per person per day. Agricultural uses would increase this estimate considerably.

The average rainfall in Martin County is about 50 in per year. In 1973 pan evaporation at Vero Beach, north of the county, totaled 62.1 in. Actual evapotranspiration is unknown but is estimated to be from 60 to 80 percent of pan evaporation. The rainfall which is not lost to evapotranspiration is available to become surface runoff or ground-water recharge. The amount of ground-water recharge depends on ground-water levels, rainfall amount and intensity, type of surface material, extent of drainage and development, and other factors.

The shallow aquifer, the main source of freshwater in Martin County, is 150 to 250 feet thick and is made up of the Pamlico Sand, Fort Thompson Formation, Anastasia Formation, Caloosahatchee Marl, and possibly the Tamiami Formation. Usually the largest yields are from the Anastasia Formation and the Caloosahatchee Marl. The quality of the water in the shallow aquifer meets Environmental Protection Agency recommended standards for public water supplies, except locally for iron, chloride, and sulfate. Water-level altitudes may reach 24 ft south of the St. Lucie Canal and 32 ft north of the canal in October, the seasonal high. In May the seasonal low levels may be 2 to 4 ft lower.

The Hawthorn Formation, made up of a high percentage of clay, underlies the shallow aquifer and is the upper confining bed for the artesian Floridan aquifer. Except for the high coastal areas, the Floridan aquifer contains water under sufficient pressure to cause deep wells to flow. Water in the Floridan aquifer is generally nonpotable since chloride concentrations range from 250 to 20,000 mg/L. Water in the upper part contains less chloride than that in the lower part.

The availability and quality of the fresh ground-water resources in the county will be affected by agricultural and urban development. Usually concomitant with development is drainage and increased water use, both of which will affect ground-water levels. Reduced water levels near the coast may cause saltwater intrusion into water-supply sources.

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