DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

WATER RESOURCES INVESTIGATION NO. 77-101
OPEN-FILE REPORT

WATER RESOURCES OF THE WACCASASSA RIVER BASIN AND ADJACENT AREAS, FLORIDA

By
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U.S. GEOLOGICAL SURVEY
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INTRODUCTION

This map report was prepared in cooperation with the Southwest Florida Water Management District which, with the Waccasassa River Basin Board, had jurisdiction over waters within the Waccasassa River basin, the coastal areas adjacent to the basin, and other adjacent areas outside the basin. New water management district boundaries, effective January 1977, place most of the Waccasassa River basin in the Suwannee River Water Management District. The purpose of the report is to provide water information for consideration in land-use and water development which is accelerating, especially in the northeastern part of the study area. It is based largely on existing data in the relatively undeveloped area.

Of the total area included in the topographic drainage basin for the Waccasassa River about 72 percent is in Levy County, 18 percent in Alachua County, 9 percent in Gilchrist County, and 1 percent in Marion County. The elongated north-south drainage basin is approximately 50 mi in length, averages 13 mi in width, and lies between the Suwannee River, the St. Johns River, and the Withlacoochee River basins (fig. 1). Two intervening coastal areas, mostly heavily wooded swamp, between the Waccasassa River basin and the adjacent Suwannee and Withlacoochee basins, are included as part of this report, a total of about 924 mi². These lowland areas are similar to the lower two-thirds of the Waccasassa River basin. The area which was within the jurisdiction of the Waccasassa River Basin Board extends east of the river basin divide and includes an additional 512 mi² of mostly karst sandy terrain.

Climate

The climate is subtropical, with an average annual temperature of about 69°F and an average annual rainfall of about 54 in. Occasional freezing temperatures occur every year. Rainfall is somewhat better distributed during the year than in most of Florida, however, about 60 percent occurs during June through September; rainfall totals of less than an inch have occurred in some years during the months of April, May, October, and November. Average temperatures, rainfall, and pan evaporation for 1964–74 are shown in figure 2. Monthly rainfall for 1964–74 is shown in figure 3.

Physiography

Land surface altitudes range from sea level to more than 180 ft above msl (mean sea level). Much of the basin below 25 ft in altitude is pine-, cypress-, and palmetto-covered swamp; between 25 and 75 feet the land has a gentle slope and has many small lakes and ponds between 50 and 75 ft. The land above 75 ft consists mostly of well-drained sand hills. Much of the topography near the eastern divide of the river basin is above 100 ft in altitude. Land altitudes are shown in figure 1.

Several low areas without surface outlets form shallow closed basins in the northeastern third of the basin. The largest closed basin, near Newberry, includes about 15 mi².

The topography in the basin is largely the result of erosional effects on the Pamlico and Wicomico terraces (Vernon, 1951) formed during ancient higher sea levels. These shorelines are about 25 and 100 ft above present sea level, respectively. Well-developed escarpments run nearly north-south and represent the landward boundaries of the two ancient seas. Deposits of well to poorly drained post-Miocene sands overlying the limestones of the Williston or Inglis Formations (Vernon and Puri, 1965) are representative of the terrace deposits. A geologic section A-A', along a line from the mouth of the Waccasassa River on the Gulf Coast northeast through Gulf Hammock, is shown in figure 4 (Vernon, 1951). Except for some limestone outcrops, sand and sandy-clay deposits compose the surface throughout the area. These deposits range from absent or very thin along the coast to more than 100 ft thick at higher altitudes. The Alachua Formation, of Miocene age, is uppermost and overlies the Crystal River Formation in the ridge area in a downthrown block of limestone between two fault lines (Vernon, 1951). Several faults extend across the basin, the most prominent one almost northwest-southeast from Long Pond, south of Chiefland, through the southeastern part of the basin near Bonable Lake.

Lakes and sinks have formed along the ancient shorelines where limestone solution has caused depressed areas. The sandy soils are porous and absorb rainfall quickly and the water then moves laterally to low-lying marshes or downward into the underlying limestone. Figure 5 is a general soils map of the basin and adjacent coastal areas and shows drainage conditions within the various land classifications (from U.S. Department of Agriculture, Soil Conservation Service, 1967).

SURFACE WATER

Average discharge of the Waccasassa River near Gulf Hammock, including Otter Creek, is 345 ft³/s for the 11-year period 1964–74. Wekiva Springs, about 4.5 mi northeast of Gulf Hammock, contributes an average of about 56 ft³/s or about 16 percent of the total flow of the Waccasassa River near Gulf Hammock, and Blue Springs, near Bronson, contributes an average of about 8.9 ft³/s or about 2.5 percent of the flow. The springs tend to maintain river flow during the dry seasons.

A runoff value of 0.72 (ft³/s)/mi² of surface area is below the average for Florida of 1 (ft³/s)/mi². This smaller value is probably due to high evapotranspiration in the marshy areas of the basin and to downward movement of water through sinks, depressions, and sand into the underlying limestone, some of which emerges as springs along the adjacent Suwannee River. The upper quarter of the basin contributes little or no surface runoff to the Waccasassa River.

The monthly mean discharge of the Waccasassa River near Gulf Hammock is shown in the hydrograph in figure 3 for the 1964–74 water years. Rainfall and water levels in the Floridan aquifer are also plotted for the same period for comparison. The average discharge of 345 ft³/s for the 11-year period is influenced by excessive rainfall in 1964–66; however, it compares well with the discharges from adjacent basins. The maximum discharge of record is 12,200 ft³/s on September 12, 1964, during the passage of Hurricane Dora just north of the basin. Low flows are affected by tides and wind-caused backwater, which sometimes result in reverse (upstream) flow. The highest recorded negative flow was 1,810 ft³/s, on June 9, 1966.

Because the flow of the Waccasassa River at Gulf Hammock is affected by tides a high stage may not indicate a high discharge and similarly a low stage a low discharge. A low stage as a result of very low tide may result in high discharge as water is released from channel storage. The stage at Gulf Hammock frequently drops to less than 2 ft below mean sea level during extreme low tide.

All lands south and west of Gulf Hammock under 25 ft in altitude are flood prone as are the flatlands along streams north of Otter Creek, northwest of Bronson, and near Lebanon Station. In addition, approximately half, the lower lying areas between 25 and 75 ft in altitude throughout the topographic basin are flood prone. Flood-prone areas are shown, only approximately, in figure 1. Flood-prone areas are shown in detail on 1:24,000 (1 in equals 2,000 ft) scale maps available from the U.S. Geological Survey, Tallahassee, Florida.

The 419-mi² area just east of the topographic Waccasassa basin which was within the jurisdiction of the Waccasassa River Basin Board, does not contribute surface water to the Waccasassa River. Rainfall east of the basin divide moves into shallow depressions or enters the limestones as recharge to the Floridan aquifer.

GROUND WATER

The area is underlain by limestones of the Floridan aquifer at depths ranging from near the surface to about 50 ft below land surface, except under the north-south ridge where more than 100 ft of Miocene deposits overlying limestone are present in the downthrown fault block (see fig. 4). The Floridan aquifer is the principal source of water for public and domestic use in the Waccasassa basin.

The Crystal River Formation is at or near land surface in the northern part of the basin but is absent in the southern half of the basin. The Williston Formation, underlying the Crystal River Formation, averages about 20 ft thick but it also has been eroded gulfward from the Gulf Hammock vicinity, where the Inglis Formation becomes the upper member of the aquifer. Miocene and post-Miocene deposits cover the aquifer throughout the basin. Underlying the Ocala Group of limestones (Crystal River, Williston, and Inglis Formations) which has a total thickness of less than 150 ft, is the Avon Park limestone, about 300 ft thick, and the Lake City limestone, which has a thickness of more than 500 ft. The Avon Park and Lake City limestones are dolomitic and more dense than the Ocala Group of limestones.

Ground water occurs both as nonartesian and artesian water. Nonartesian ground water is present in the sandy formations overlying most of the basin and is important to vegetation and for livestock watering. Shallow lakes, ponds, and marshes are formed and maintained by the shallow ground waters as they move through the surface deposits to lower elevations by gravity. The water table, the top of the shallow ground water, is near land surface along streams and on the Wicomico terrace. Only near the divides is the water table normally more than 5 ft below land surface.

Water enters the Floridan aquifer within the Waccasassa basin largely by downward movement of rain and surface water within the basin through the surficial sand into upper layers of limestones. Some Foridan aquifer water flows into the basin from Alachua and Marion Counties, to the east (see potentiometric contours fig. 6). The water in the Floridan in the northern part of the basin moves westerly across the basin toward the Suwannee River, where it discharges from several large springs; the water in the southern half of the basin moves southwesterly toward the Gulf. Along the Waccasassa River and its tributary streams, artesian water from the aquifer is discharged by fissure springs and as seepage through thin confining layers. The potentiometric contours (fig. 6) indicate that all the artesian water is discharged before reaching the Gulf, probably into low marshy areas along the coast. None, apparently, is discharged directly into the Gulf, as submarine springs.

The approximate areas of artesian flow or upward seepage are shown in figure 6. Flowing wells are not common in these areas of potential artesian flow, probably because the potentiometric head is reduced to near land surface by upward seepage into the low marshy areas.

Records indicate that the potentiometric levels have changed little in recent years in the lower part of the basin, near Gulf Hammock, and not at all near Cedar Key and Inglis; however, levels have declined as much as 10 to 16 ft during 1965–68 in the Newberry area (fig. 3). This large change is not indicative of a general progressive lowering of potentiometric levels because the excessive rains and flooding of 1964–65 raised water levels throughout the area to above normal. Long-period records, such as those near Trenton, indicate that the potentiometric levels in 1974 are similar to those of the 1930's and to those before the early 1960's.

WATER USE

Wells tapping the Floridan aquifer supply most of the water for public, domestic, irrigation, and industrial needs. In 1975 Bronson pumped about 50,000 gal/d, and Gainesville, 10 mi east of the basin, pumped 13.8 Mgal/d.

Amounts of water used for irrigation within the basin are not known, but in Levy County 1.16 Mgal/d of ground water was withdrawn for irrigation in 1975. Some of this pumpage was within the Waccasassa River basin. The parts of the basin within Alachua and Gilchrist Counties are agricultural, and pumpage for irrigation from the Floridan aquifer is large. Yields from wells tapping limestones of the Floridan aquifer range from 500 to 1,000 gal/min.

Shallow ground water, from the sands and other deposits overlying the Floridan aquifer is used for domestic supply in some places; the yield, from wells tapping sand or thick phosphate beds of the Alachua Formation, is from 5 to 100 gal/min. Surface supplies are used for livestock watering but usage figures are not available for the basin.

WATER QUALITY

The chemical quality of ground water in the basin, except for water from wells within about 5 mi of the Gulf, is satisfactory for most uses. Wells near the Gulf yield water with chloride concentrations in excess of 250 mg/L. Ground water within the eastern one-third of the basin contains sulfate concentrations in excess of 50 mg/L. Total dissolved solids are generally less than 500 mg/L except in water from wells along the coast. Specific conductance and chloride concentrations were within approximately the same ranges in 1974 as in 1966, when sampling of water from the wells began.

The graphs in figure 7 show the ranges of temperature, dissolved oxygen, pH and total dissolved solids for five surface water sampling points and the temperature, chloride concentration, and specific conductance of water from two wells tapping the Floridan aquifer. Specific conductance is an indication of the dissolved minerals concentration in water. High dissolved solids concentrations at times, as in the Waccasassa River near Gulf Hammock, are caused by upstream flow of Gulf water during high tides.

The approximate depth to the base of potable water in the Floridan aquifer (defined as not exceeding 250 mg/L chloride and 500 mg/L dissolved solids) is shown in figure 6. The depth to the base of potable water ranges from zero along the Gulf to more than 800 ft in the northern part of the Waccasassa River basin.

AVAILABILITY OF DATA

The collection of hydrologic records is based on the need for the data by water management districts, the public, industry, agriculture, or other users. A basic data network for surface and ground water is needed to ascertain natural trends and the effects of man's activities on the waters in an area, which usually tend to change quality or quantity while accentuating the extreme water conditions. Table 1 lists surface-water stations and table 2 lists ground-water (well) data sites in and adjacent to the Waccasassa River basin for which records are available.

Data-collection sites on streams appear to be sufficient for present needs as use of surface water is presently minimal within the basin. Additional data on surface waters will be desirable where the quality of lakes and ponds may deteriorate as a result of residential and industrial developments. Some background data on the quality of water in Bonable Lake, Waccasassa Lake, and Watermelon Pond was collected and is shown in table 3.

Information on ground water in the basin is a continuing need because new residents and industry in the basin will undoubtedly obtain water from the Floridan aquifer. Water-level data for wells at Bronson, Gulf Hammock, and Newberry show no detrimental trend, in potentiometric levels, or water quality. However, water-level and water-quality monitoring are essential in order to learn of possible detrimental changes which may occur so that prompt remedial action can be taken.

SELECTED REFERENCES

Klein, Howard
1971 Depth to base of potable water in the Floridan aquifer: Florida Dept. Nat. Resources, Bur. Geol. Map Series 42.

U.S. Dept. of Agriculture, Soil Conservation Service
1967 General Soil Maps, Alachua, Gilchrist and Levy Counties.

U.S. Dept. of Commerce, NOAA
National Weather Service Climatological Data Reports.

U.S. Geological Survey
1974 and earlier Water Resources Data for Florida, Part 1, Surface Water Records; Part 2, Water Quality Records.

Vernon, R.O.
1951 Geology of Citrus and Levy Counties: Florida Geol. Survey Bulletin No. 33.

Vernon, R.O., and Puri, H.S.
1965 Geologic Map of Florida: Florida Dept. Nat. Resources, Bur. Geol. Map Series 18.

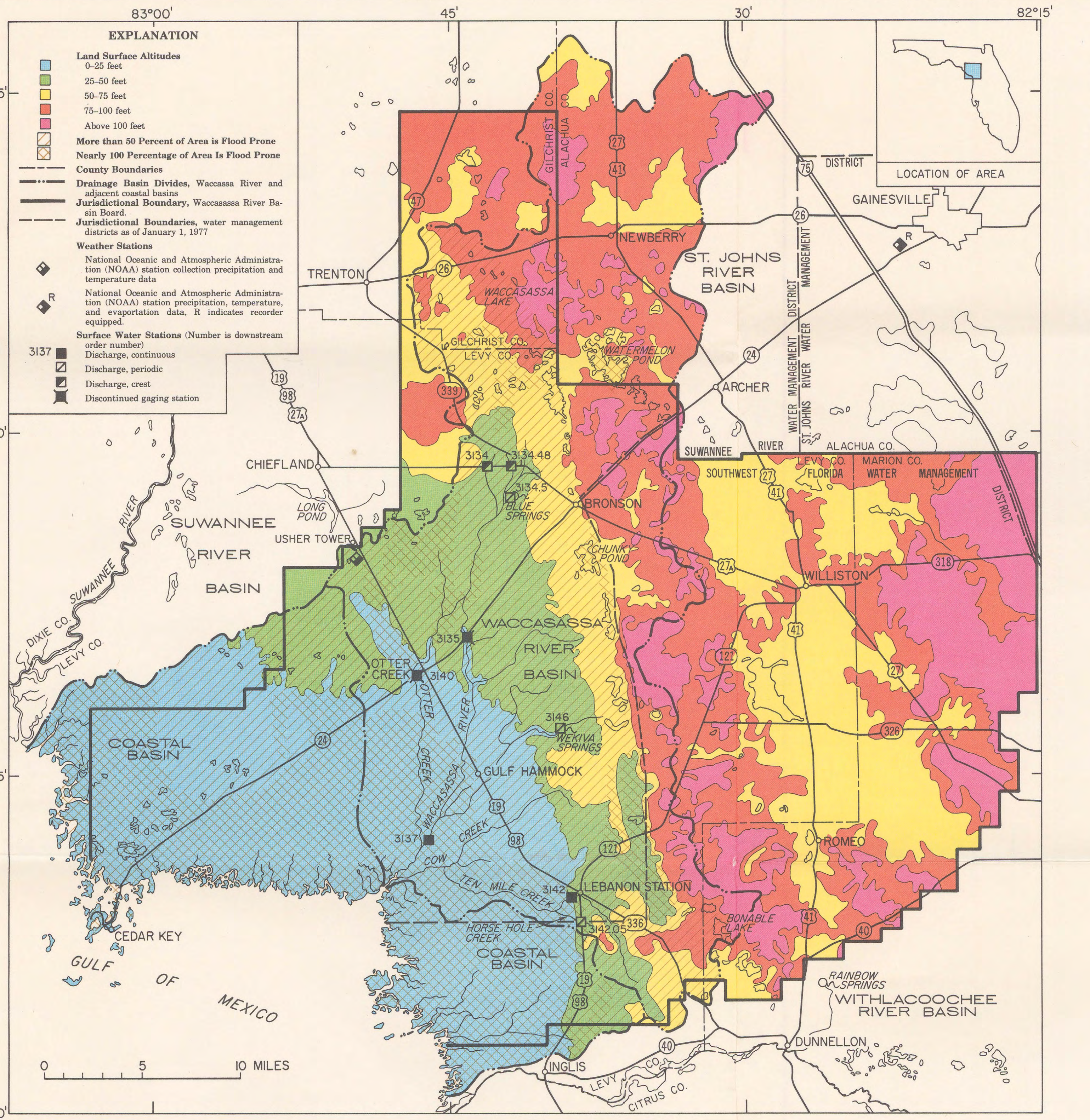

Figure 1–Hydrologic map of the Waccasassa River basin and similar adjacent areas showing land altitudes, surface-water data collection sites, flood-prone areas, and jurisdictional boundaries of the Waccasassa River Basin Board and water management districts.

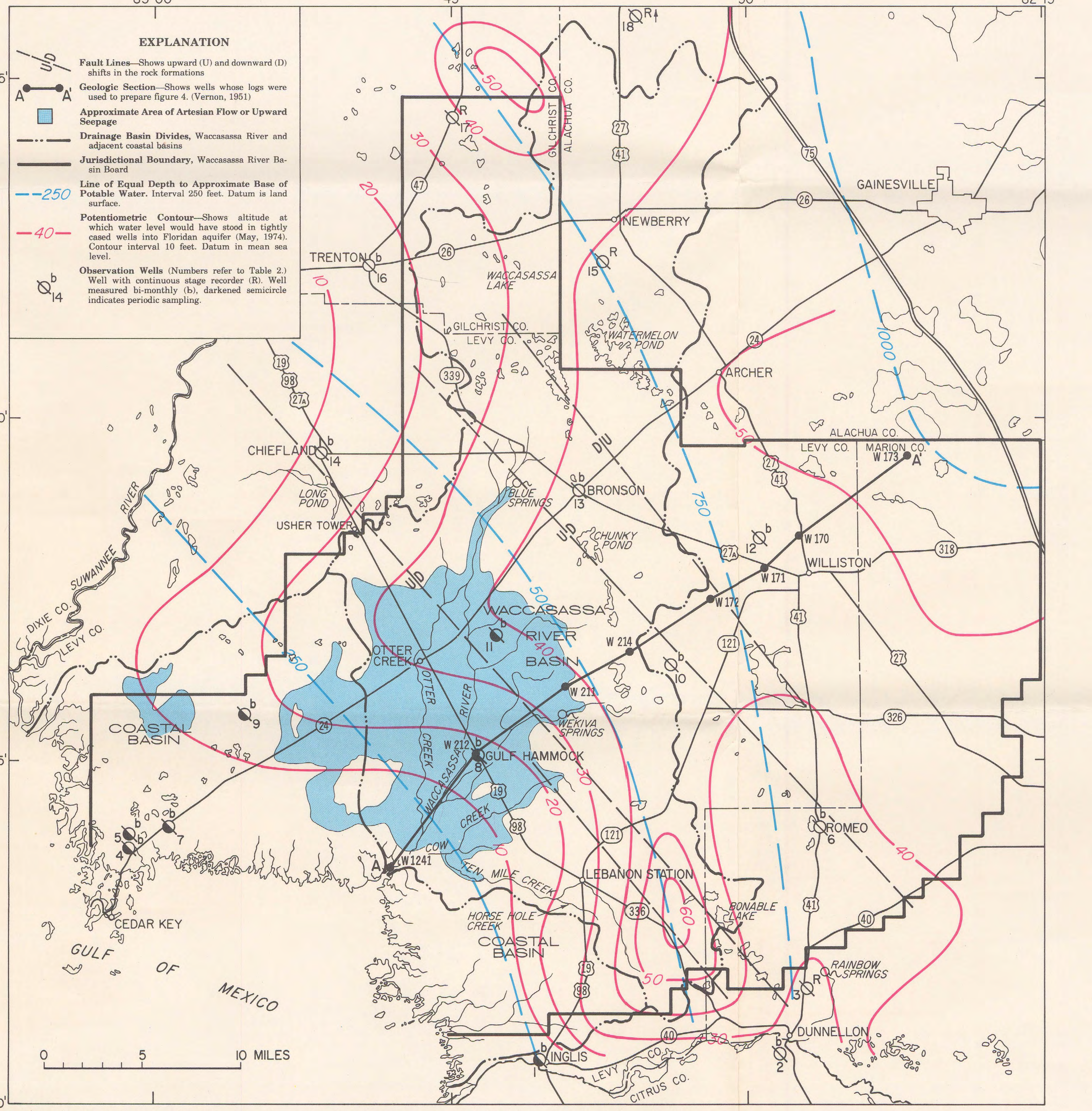

Figure 6–Geologic and hydrologic map of the Waccasassa River and similar adjacent areas showing fault lines, location of geologic section A-A', approximate areas of artesian flow, drainage basin divides, jurisdictional boundary of the Waccasassa River Basin Board, depth to base of potable water, potentiometric contours in the Floridan aquifer, and the location of observation wells.

Table 1.—*Surface-Water Stations in Waccasassa River Basin*

Downstream order no.	Location	Type and frequency of data collection	*Period of record	Drainage area
02-3134	Waccasassa River near Bronson	D, K, DO(p)	1962	220
02-3134.48	Little Waccasassa River near Bronson	D, K, DO(p); BOD, TOC(s)	1966	
02-3134.5	Blue Springs near Bronson	D, K, DO(p)	1966	—
		BOD, TOC(s)	1966	—
02-3135	Waccasassa River near Otter Creek	D(r)	1945–53	300
02-3135.1	Chunky Pond near Bronson	S(w); K(p)	1967	23
02-3136	Wekiva Springs near Gulf Hammock	D, K, DO(s); BOD, TOC(s)	1967	
02-3137	Waccasassa River near Gulf Hammock	D(r); K, CO(p); A, H, N, pH, BOD, TOC(s)	1963	480
02-3140	Otter Creek at Otter Creek	D(r)	1945–53	—
02-3142	Tenmile Creek at Lebanon Station	D(r); BOD, TOC(s); K, DO(p)	1963	26
02-3142.05	Horse Hole Creek near Lebanon Station	D(p)	1963	8.1
02-3142.085	Mouth of Tenmile Creek (at Cow Creek)	—	—	46
02-3142.105	Mouth of Waccasassa River	—	—	610

Note.—All drainage areas are approximate. Drainage areas computed August 1972 by U.S. Geological Survey. Downstream order number is as used by U.S. Geological Survey.

*Period of record is to present except where indicated.

Type of data
D—discharge
S—Stage
A—Standard analysis
C—Chloride
H—Heavy metals
K—Specific conductance
N—Nutrient
BOD—Biochemical oxygen demand
DO—Dissolved oxygen
TOC—Total organic carbon

Frequency of analysis
b—Bimonthly
p—Periodic
r—Continuous
s—Semiannual
w—Weekly

Table 2.—*Ground-Water Data Sites*

Location number	Local number	Location	Record type and frequency	*Period of record	County
290202NO824039.1	(902-240-343)	Inglis	S(b); K, C(b)	1961–	Levy
290213NO822841.1	(902-228-341)	Dunnellon	S(b)	1935–	Citrus
290514NO822707.1	(905-227-1)	Rainbow Springs	S(r)	1964–	Marion
291048NO830118.1	(910-301-212)	Cedar Key	S(b); K, C(b)	1970–	Levy
291118NO830106.1	(911-301-1)	Cedar Key	S(b); K, C(b)	1970–	Levy
291207NO822616.1	(912-226-432)	Romeo	S(b)	1961–74	Marion
291208NO825926.1	(912-259-431)	Cedar Key	S(b); C(s)	1961–	Levy
291508NO824329.1	(915-243-431)	Gulf Hammock	S(b); C(s)	1961–	Levy
291806NO825456.1	(918-254-331)	Southwest Chiefland	S(b); C(s)	1961–	Levy
291910NO823411.1	(919-234-1)	Southwest Williston	S(b)	1974–	Levy
292109NO824229.1	(921-242-431)	Otter Creek	S(b); C(s)	1963–	Levy
292426NO822836.1	(924-228)	Williston	S(b)	1935–44, 1966–	Levy
292640NO822812.1	(926-238-241)	Bronson	S(b)	1961, 1963–	Levy
292843NO825142.1	(928-251-141)	Chiefland	S(b)	1961–65, 1969–	Levy
293622NO823623.1	(936-236-1)	Newberry	S(r)	1958–	Alachua
293653NO824932.2	(936-249-220A)	Trenton	S(b)	1961–	Gilchrist
294330NO824450.1	(943-244-310)	North Trenton	S(r)	1964–	Gilchrist
294328NO823553.1	(949-235-2)	High Springs	S(r)	1970–	Alachua

Note.—All listed wells are into the Florida aquifer.

*Period of record is to present except where indicated.

Type of data
D—Discharge
S—Stage
A—Standard analysis
C—Chloride
H—Heavy metals
K—Specific conductance
N—Nutrient
BOD—Biochemical oxygen demand
DO—Dissolved oxygen
TOC—Total organic carbon

Frequency of data collection
b—Bimonthly
p—Periodic
r—Continuous
s—Semiannual
w—Weekly

Table 3.—*Chemical analyses of water in Bonable and Waccasassa Lakes and Watermelon Pond for June and September 1975; values in milligrams per liter except where noted.* Analyses by U.S. Geological Survey

Property	*Waccasassa Lake* June	*Waccasassa Lake* Sept.	*Bonable Lake* June	*Bonable Lake* Sept.	*Watermelon Pond* June	*Watermelon Pond* Sept.
Chloride	6.4	4.2	11.0	7.1	14.0	8.8
Dissolved solids (sum)	48	33	43	30	30	21
Total hardness (as $CaCO_3$)	40	26	27	14	10	6.0
Alkalinity (as $CaCO_3$)	30	22	11	2	0	0
pH	6.7	7.0	6.5	5.8	4.3	4.4
Specific conductance (μmho)*	85	78	75	65	70	63
Color (color units)	25	40	50	70	35	50
Turbidity (JTU)	7	9	8	6	20	6
Dissolved oxygen	7.2	7.5	7.2	6.9	4.7	6.8
Dissolved oxygen percent saturation	95	98	98	94	61	89
Biochemical oxygen demand	1.2	3.0	0.3	3.2	0.6	6.0
Nitrogen (total N)	1.39	1.03	1.23	0.72	2.14	1.43
Carbon total	17	17	20	11	22	15
Iron (μg/L)**	0	21	30	40	10	31
Coliform total per 100 mL		90	0	80	630	900
Coliform fecal per 100 mL		10	0	30	490	5
Streptococci per 100 mL		0		10		5

*μmho = micromhos per centimeter at 25°C
**μg/L = micrograms per liter
Waccasassa Lake and Bonable Lake are near subdivisions; Watermelon Pond is in a low pasture.

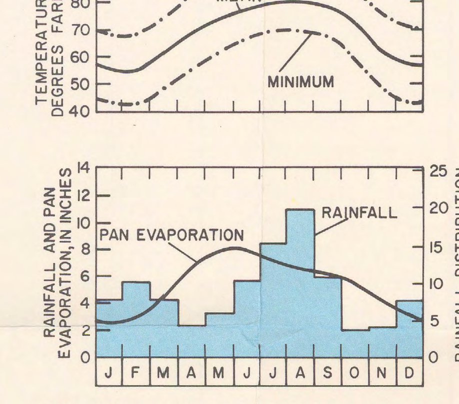

Figure 2–Average maximum, minimum and mean temperature, average monthly rainfall at Usher Tower and average monthly pan evaporation at Gainesville, 1964 through 1974.

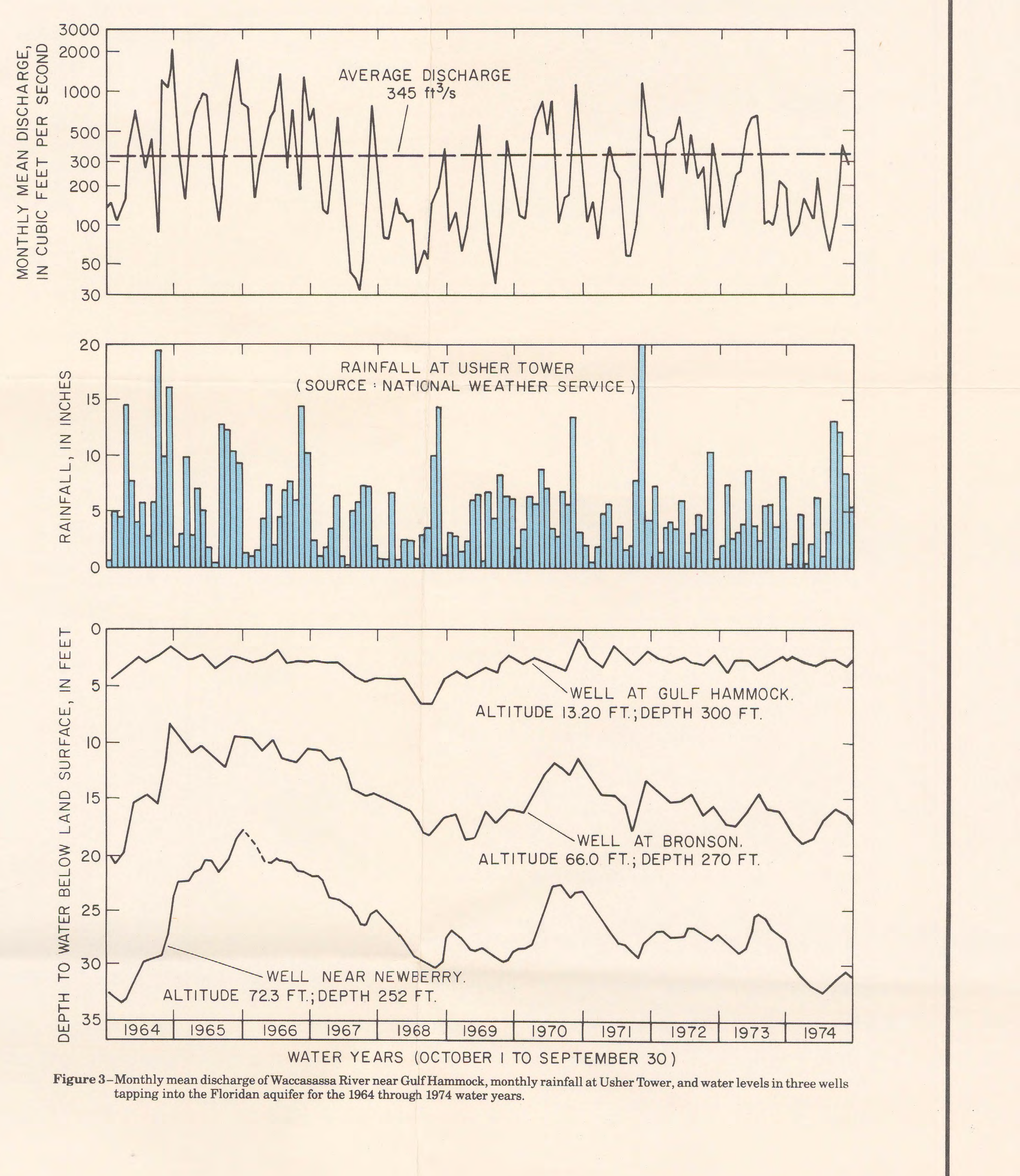

Figure 3–Monthly mean discharge of Waccasassa River near Gulf Hammock, monthly rainfall at Usher Tower, and water levels in three wells tapping into the Floridan aquifer for the 1964 through 1974 water years.

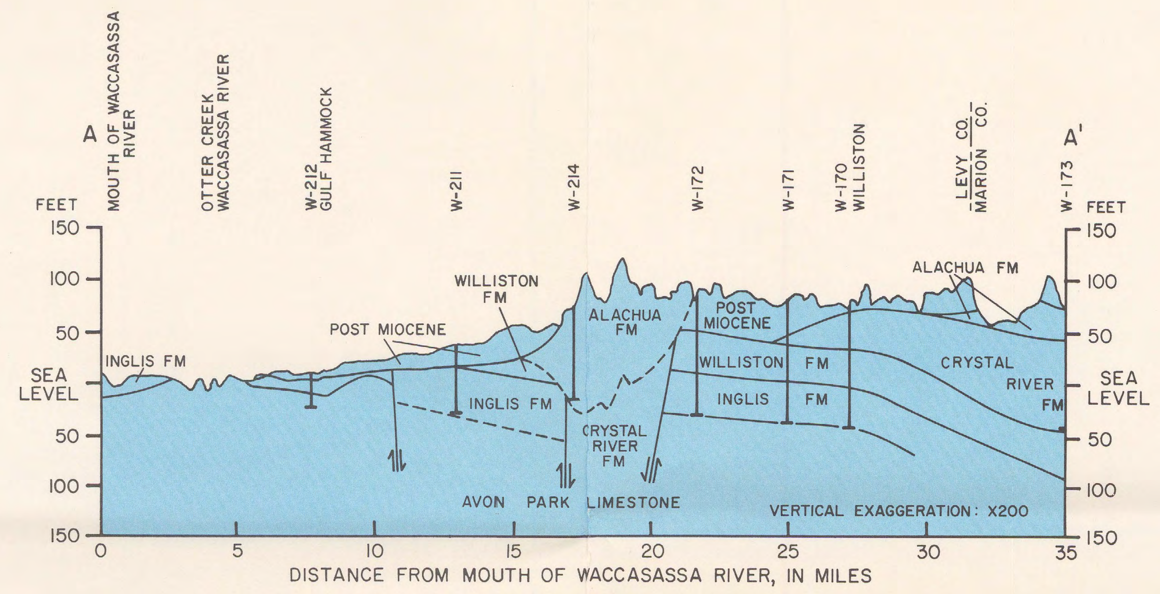

Figure 4–Geologic section extending northeast from mouth of Waccasassa River (Vernon, 1951 and Vernon and Puri, 1965). Location of A-A' is shown on Figure 6.

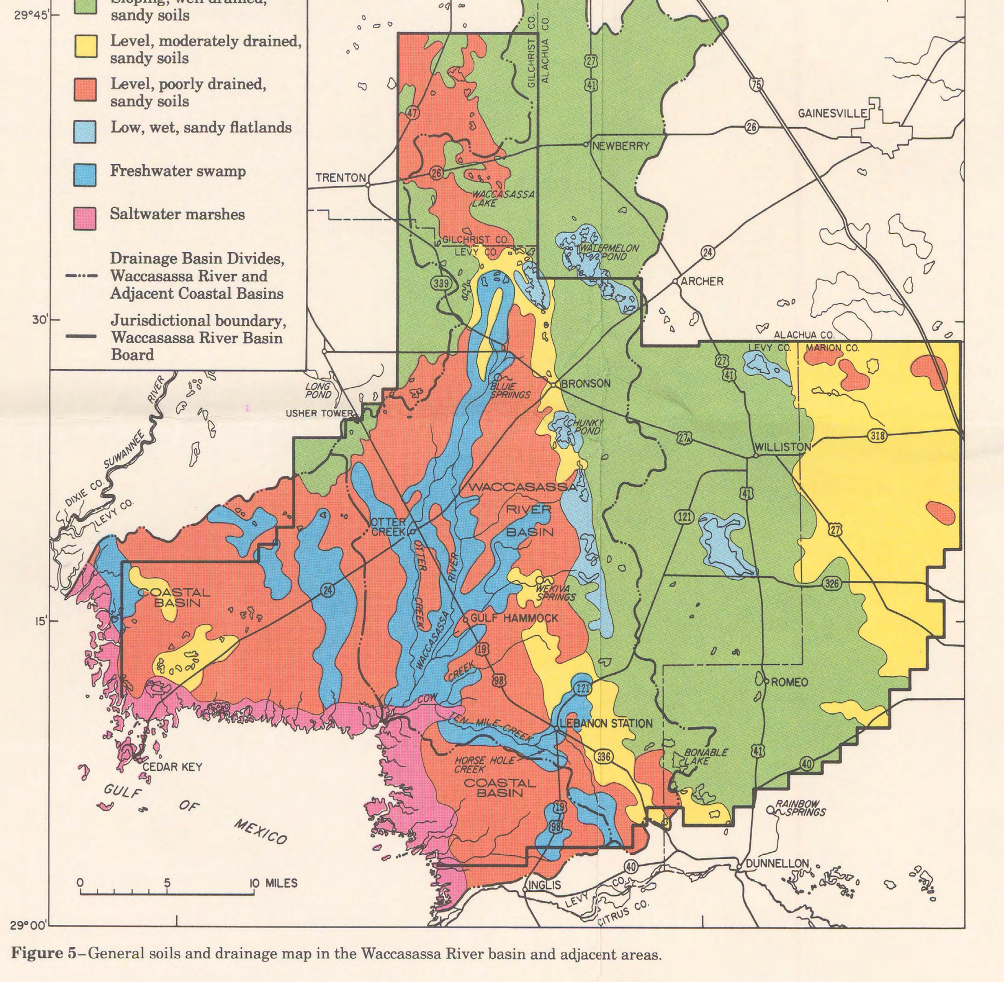

Figure 5–General soils and drainage map in the Waccasassa River basin and adjacent areas.

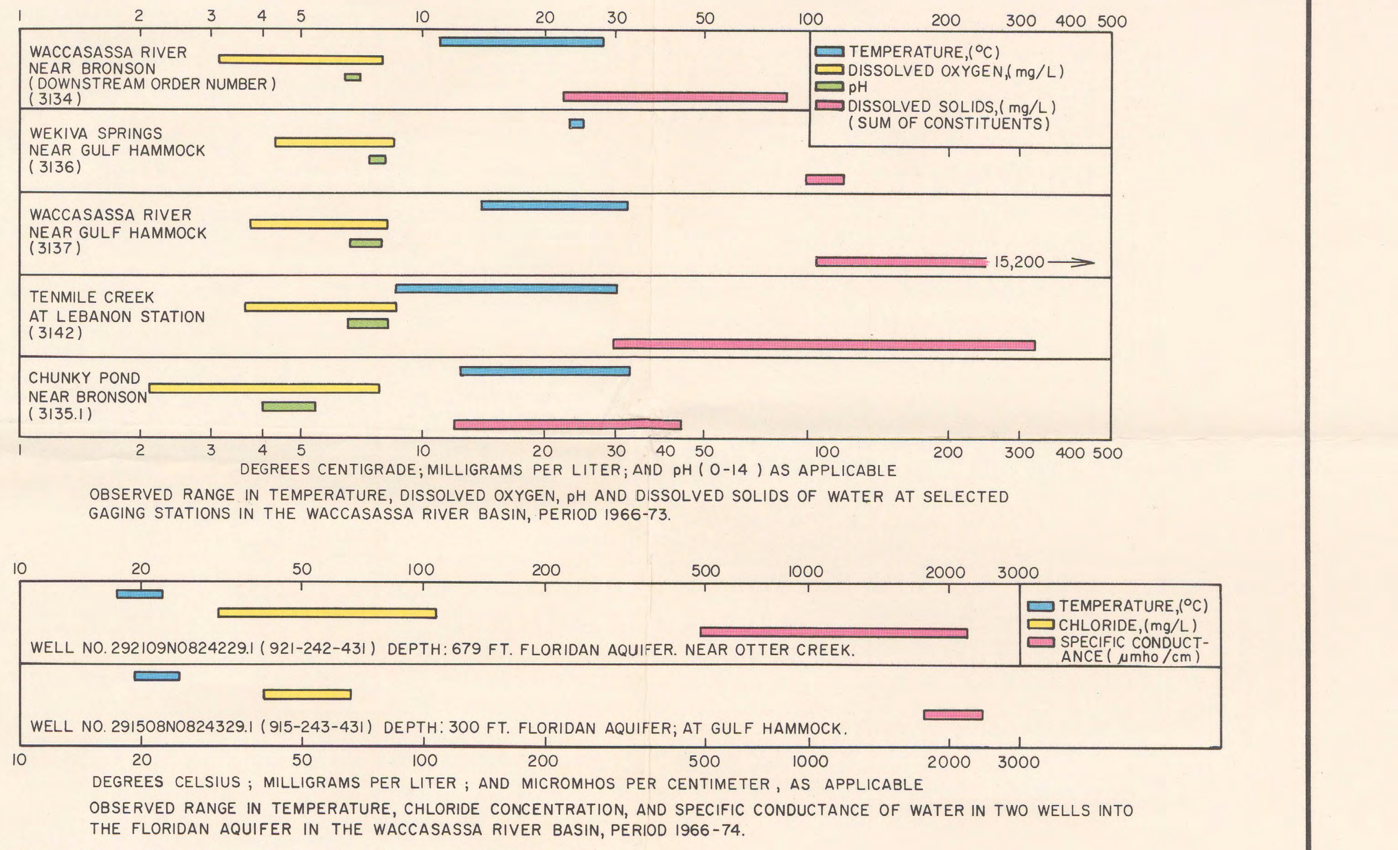

Figure 7–Observed ranges in selected properties of waters within the Waccasassa River basin.

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