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INTERIM REPORT ON GEOLOGY AND GROUND-WATER RESOURCES OF INDIAN RIVER COUNTY, FLORIDA

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Prepared by U. S. Geological Survey
in cooperation with the Florida Geological Survey
and the Central and Southern Florida Flood Control District

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INTERIM REPORT ON GEOLOGY AND GROUND-WATER RESOURCES OF INDIAN RIVER COUNTY, FLORIDA

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ABSTRACT

The most important source of ground water in Indian River County is the Floridan aquifer, which in the county consists of more than 500 feet of limestone of Eocene to Miocene age. The Floridan is the principal artesian aquifer in most of Florida and southeastern Georgia. Rocks of Eocene and Oligocene age contribute most of the water to the flowing artesian wells penetrating the aquifer in the county, but limestone in the lower part of the Hawthorn formation, of Miocene age, supplies a small amount of water and is included in the Floridan aquifer. Pumping-test data show that the ground-water yield from the Floridan aquifer differs from place to place. Generally, where the aquifer produces less water (notably in the southern part of the barrier beach) it includes an appreciable thickness of Oligocene strata, which are less permeable than the Eocene strata.

Water levels in wells penetrating the Floridan aquifer fluctuate principally in response to the starting and stopping of discharge from the many irrigation wells during periods of heavy withdrawal. A cone of depression usually develops southwest of the vicinity of Vero Beach, and there is a general lowering of the piezometric surface in the northern part of the barrier beach. The static water levels in wells, in some areas, suggest an apparent decline in the piezometric surface of about 10 feet since 1934.

No clear evidence of encroachment of sea water into the aquifer has been found. The chloride concentration in the water from some wells has increased substantially, but this is believed to be the result of a mixing of highly mineralized connate water that has never been flushed from the deep parts of the aquifer.

The nonartesian aquifer, of Pleistocene age, yields water of considerably better chemical quality than that from the Floridan aquifer. The City of Vero Beach obtains its water supply from a locally artesian zone in this aquifer. The use of the nonartesian aquifer will increase if the water from the Floridan aquifer becomes highly mineralized.

Appreciable quantities of water are obtained from the nonartesian aquifer only in the eastern part of Indian River County and on the barrier beach. In the southern part of the barrier beach the chloride content of the nonartesian water increases and the iron content is relatively high.

A separate artesian aquifer of relatively minor importance, consisting of beds of limestone in the middle and upper parts of the Hawthorn formation, underlies the western half of the county. The water from this aquifer is less highly mineralized than the water from the Floridan aquifer, but the yield from it is considerably less than that from the Floridan aquifer.

INTRODUCTION

Purpose and Scope of Investigation

This investigation is one of a series on the geology and ground water of Florida being made by the U.S. Geological Survey in cooperation with the Florida Geological Survey and the Central and Southern Florida Flood Control District. The ultimate purpose of these investigations is to provide information on the occurrence, quantity, and quality of ground water, as a basis for a plan for the conservation and development of the water resources of the State. The information is designed to give a qualitative and quantitative evaluation of ground-water recharge, discharge, and storage, especially in areas where ground-water developments are important economically.

In the area of this investigation a partial inventory was made of the estimated 2,000 existing wells to obtain information on location, depth, and yield of representative wells. Also, data were obtained on the quality of water from the various aquifers, and on the fluctuation of water levels in certain wells in the Floridan aquifer. The hydraulic characteristics of the Floridan aquifer at several sites were determined by means of pumping tests.

The investigation was made under the immediate supervision of N. D. Hoy, District Geologist of the Ground Water Branch of the U.S. Geological Survey, Miami, Florida, and under the general supervision of A. N. Sayre, Chief of the Ground Water Branch.

Acknowledgments

The writer is indebted to the residents of the county, especially Mr. E. E. Carter, County Engineer, whose wholehearted cooperation greatly assisted the field studies. The Knight and King Well Drilling Company, the O. F. Pippin Well Drilling Company, the Deerfield Groves Company, the Florida State Board of Health, the Indian River County Health Department, and the Civil Aeronautics Authority contributed basic data.

Mr. R. O. Vernon of the Florida Geological Survey provided logs of wells 24 and 107 and four electric logs.

GEOGRAPHY

Location and General Features of the County

Indian River County is in southern Florida, on the Atlantic Coast. It is bounded by Brevard County on the north, Osceola County on the west, and Okeechobee and St. Lucie counties on the south (fig. 1). The county has an area of 525 square miles and a population of 11,850, according to the 1950 census. Vero Beach, the county seat, is on the Indian River in the eastern part of the county (fig. 2). It is 200

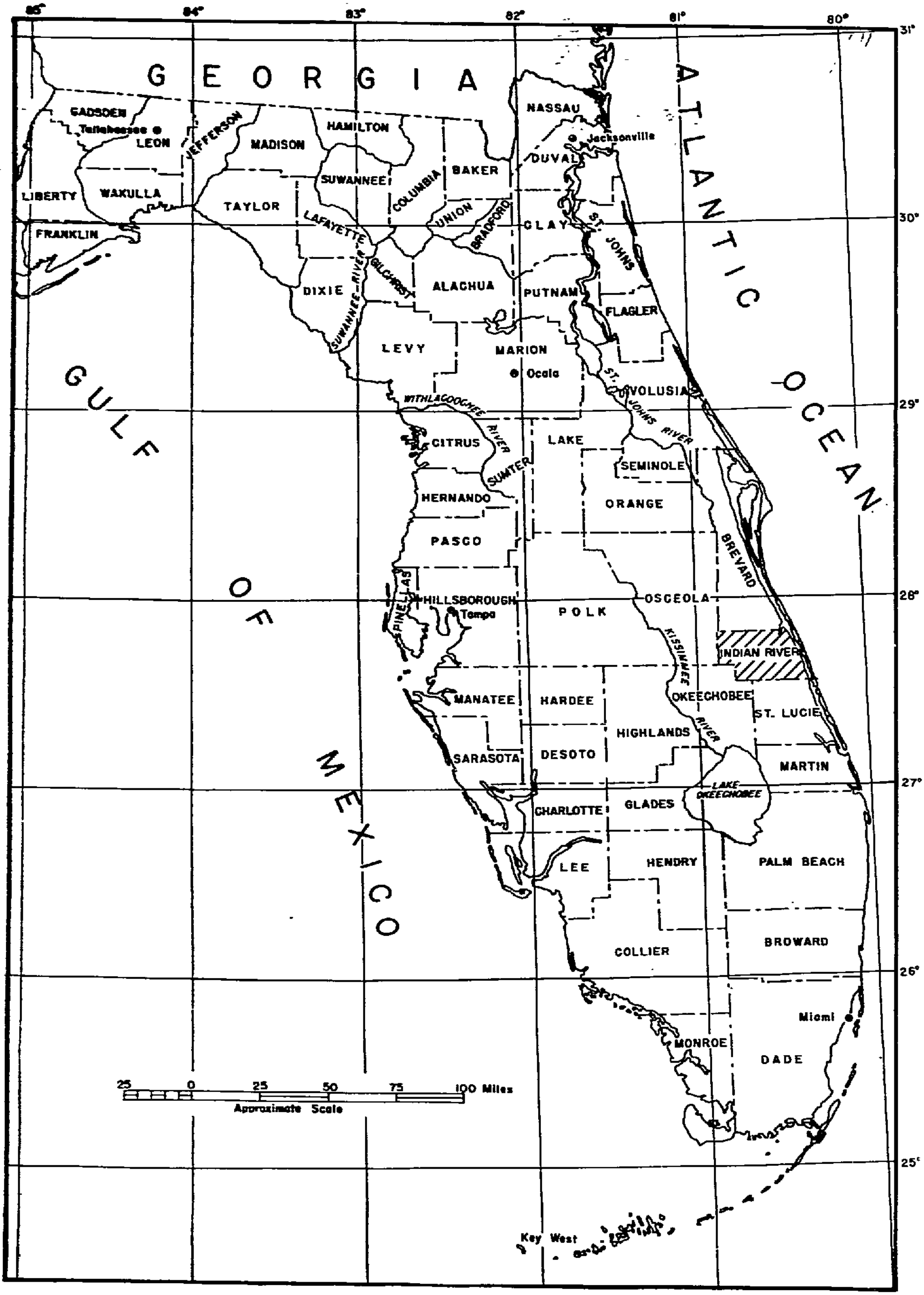

Figure 1. Map of Florida showing the location of Indian River County.

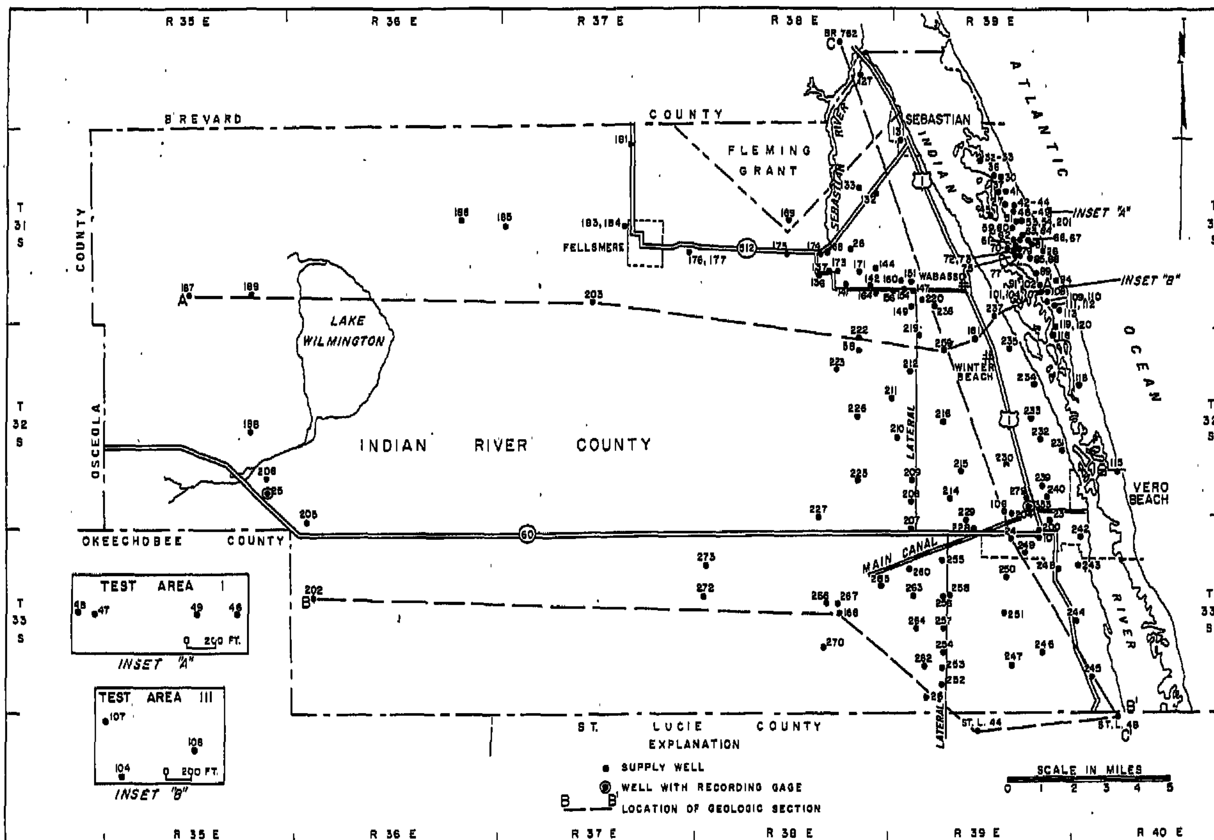

Figure 2. Map of Indian River County showing the locations of wells, pumping-test sites, and geologic cross sections.

miles south of Jacksonville and 140 miles north of Miami.

Climate

The climate in Indian River County is mild, the annual average temperature being 73.4°F. Average monthly temperatures range from 63.4°F in January to 81.3°F in August. The average annual rainfall for the period 1941-49 was 44.86 inches. The rainfall is greatest in the summer and early fall (fig. 3). The minimum for the period was 38.88 inches, in 1942, and the maximum was 62.11 inches, in 1947. Rainfall during the wet months usually occurs in scattered showers.

Agriculture and Industry

Citrus fruit is the principal source of income, and is valued in the county at more than $2,000,000 annually. About 13,075 acres were planted in citrus during 1948-49. Tourists, farming, cattle raising, sugar production, and commercial fishing are other major sources of income.

A 1945 survey showed 150,687 acres of farmland. A refinery processes the sugar from cane grown on approximately 5,000 acres of land. There are 98,300 acres of commercial forest lands in the county. Commercial fishing is an important economic factor; a reported 665,847 pounds of food fish, 628,825 pounds of nonfood fish, and 143,000 pounds of crabs, crayfish, and shrimp were marketed here in 1948.

Topography

Indian River County is in the Coastal Lowlands as designated by Cooke (1939, p. 14-16). The Coastal Lowlands consist of four Pleistocene terraces, two of which, the Pamlico and the Talbot, are present in Indian River County. The 25-foot contour, which crosses the western part of the county, represents approximately the shoreline of the Pamlico sea. West of this shoreline the land rises to the older Talbot terrace, which has an altitude of about 40 feet.

To the east it slopes gradually seaward. The plain formed by the Pamlico sea is modified by ridges which were originally offshore bars built upon the Pamlico sea floor by wave action. The present barrier beach, which rises to an altitude of more than 20 feet, probably had its inception during Pamlico time. At least two ridges parallel the coast in the eastern part of the county: one, about a mile west of the Indian River, reaches a maximum altitude of more than 50 feet; the other, a less distinct one about 10 miles west of the coastline, forms the drainage divide between the St. Johns River marsh and the Sebastian River.

Drainage

The area between the two ridges in the northern part of the county is drained by the Sebastian River, which is diked to prevent flooding. A system of canals and laterals drains

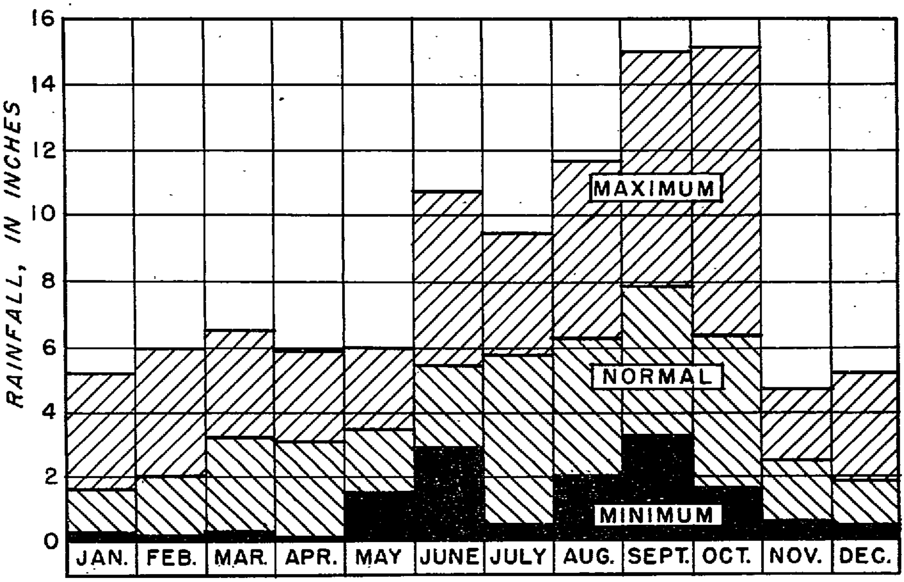

Figure 3. Minimum, normal, and maximum rainfall, in inches, at Vero Beach, 1941-49.

the area east of the dikes in southeast and east-central Indian River County. The central part of the county, west of the dikes of the Indian River Farms Drainage District and east of the Pamlico shoreline, is occupied by the St. Johns River marsh, which drains to the north. Before the beginning of artifical drainage, part of the Sebastian River valley drained eastward through gaps in the coastal ridge.

GEOLOGY

The geologic formations in Indian River County studied during this investigation are generally southeastward-dipping Coastal Plain strata ranging in age from Eocene to Pleistocene. The Tampa formation of early Miocene age and the Caloosahatchee marl of Pliocene age have not been recognized in cuttings from wells in the county.

Throughout most of the county the strata dip to the southeast (fig. 4, 5, 6), conforming with the general structure of the Ocala uplift (Vernon, 1951, p. 53-62). Along the eastern margin of the county, the change in the apparent dip of the Williston formation (fig. 4) from nearly horizontal to more than 70 feet per mile, the thickening of the Ocala group, and the presence of Oligocene rocks, not found elsewhere in the county, are attributed to vertical faults whose strikes are roughly parallel to the present coastline. These faults are shown in figures 4, 5, and 6. Figure 4 shows also the fault indicated by Vernon (1951, pl. 2) in the western part of the county.

Eocene Series

Lake City Limestone

The name Lake City limestone was applied by Applin and Applin (1944, p. 1693) to a dark brown chalky limestone of early middle Eocene age; it is the deepest formation penetrated by wells in Indian River County. The limestone, in Indian River County, is made up predominantly of layers of cream-colored to tan hard to soft, porous, chalky limestone

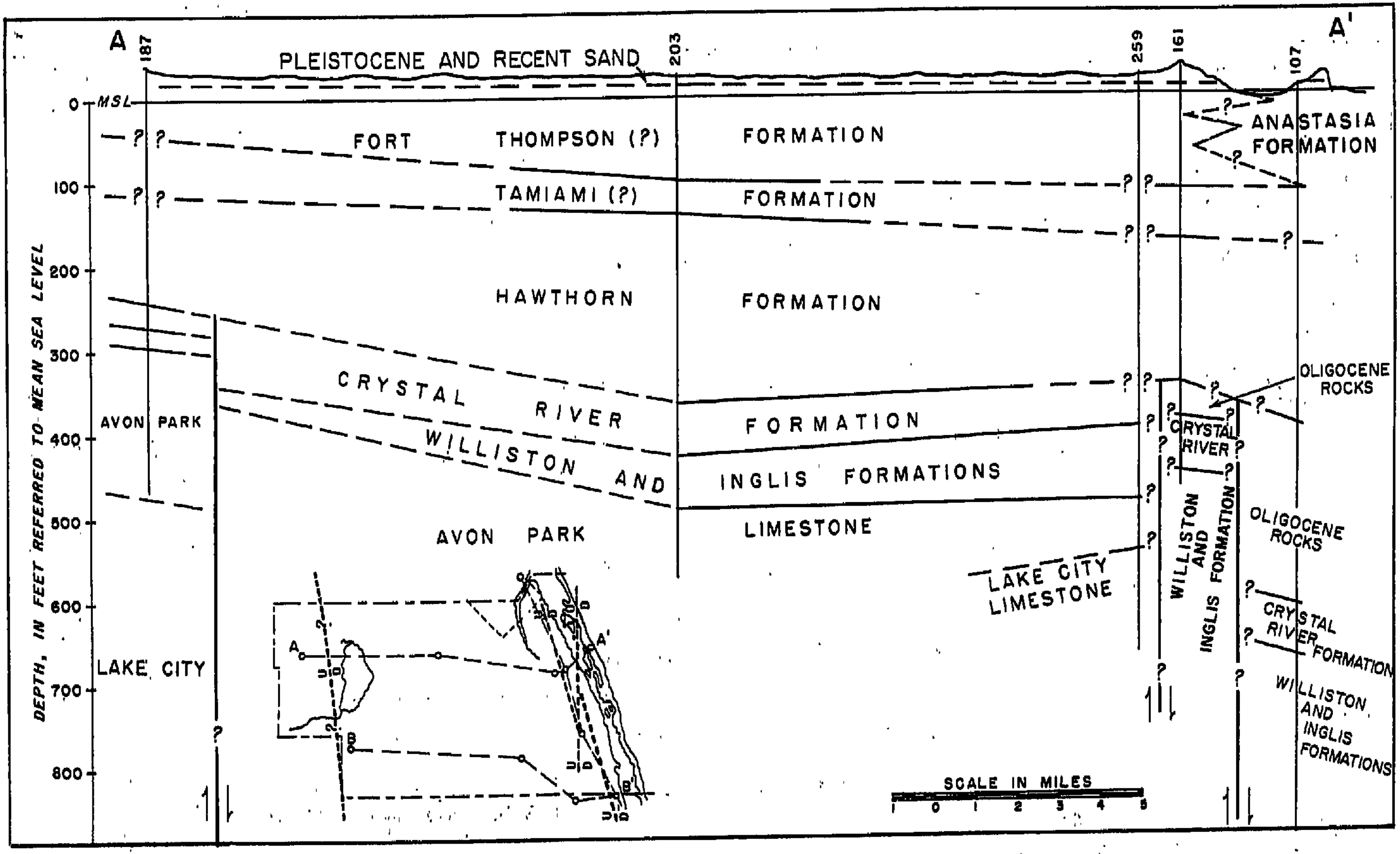

Figure 4. West-east geologic section through northern Indian River County.

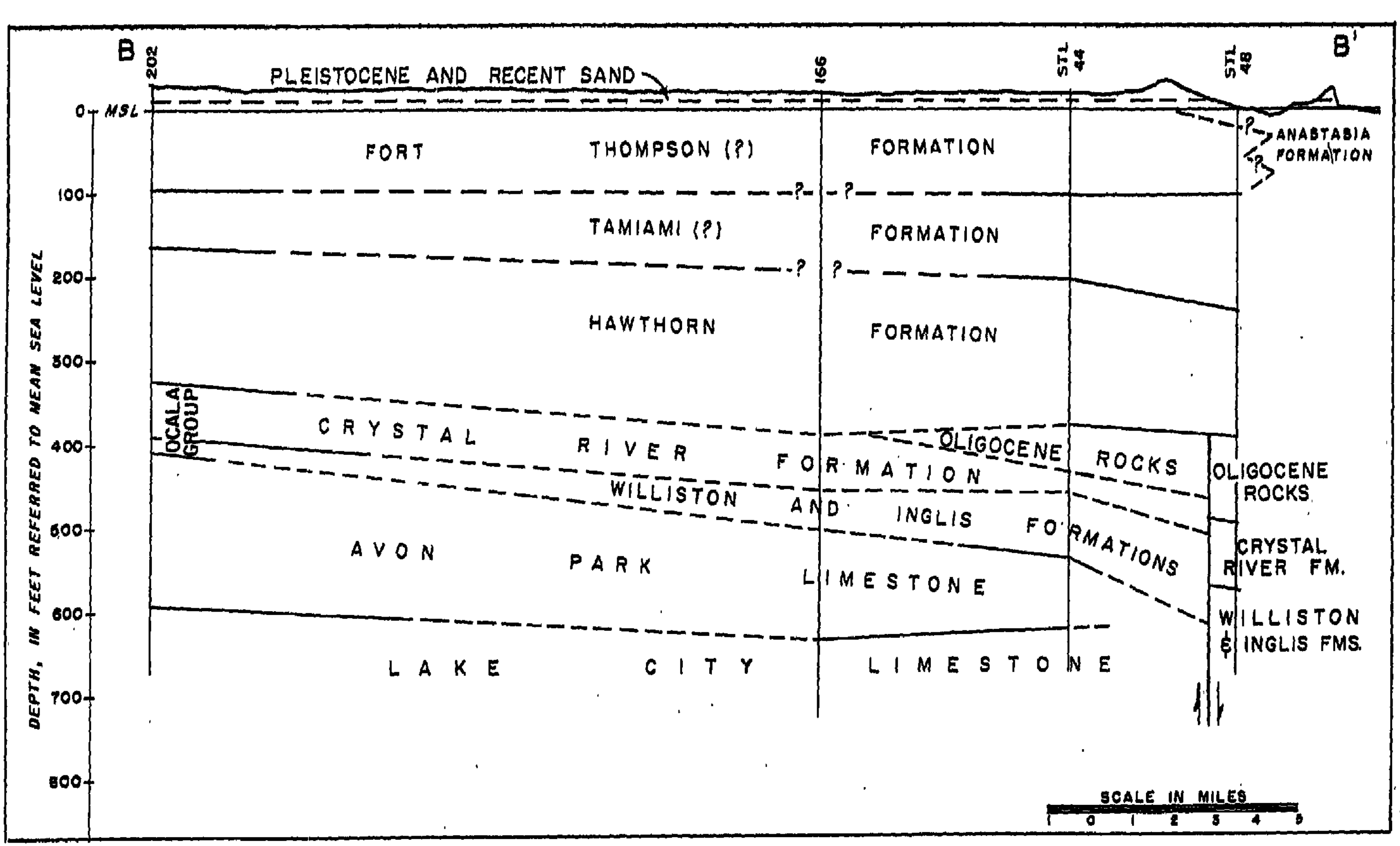

Figure 5. West-east geologic section through southern Indian River County.

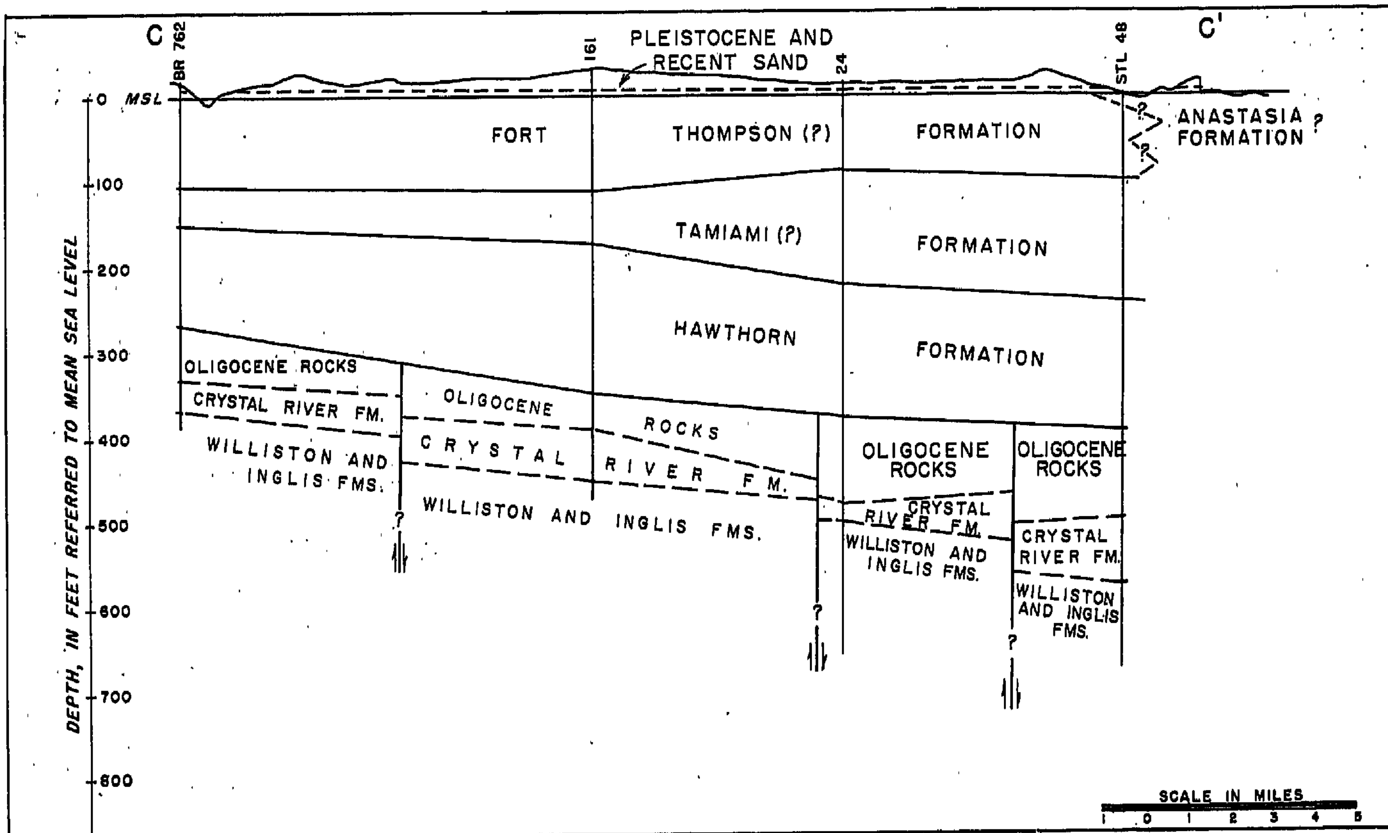

Figure 6. North-south geologic section through eastern Indian River County.

and some hard porous, crystalline limestone. The Lake City, similar in lithology to the overlying Avon Park limestone, is identified by the presence of the foraminifer Dictyoconus americanus (Cushman). Other fossils found in the Lake City limestone are mollusk fragments, echinoid spines, miliolids, and numerous other Foraminifera.

The Lake City limestone probably underlies the entire county. Its thickness has not been determined because no wells in the county are known to penetrate it completely.

Avon Park Limestone

The name Avon Park limestone was applied by Applin and Applin (1944, p. 1686-1687) to the cream-colored highly microfossiliferous chalky limestone of the upper part of the late middle Eocene in the subsurface of Florida. Vernon (1951, p. 95-96) identified the formation at the surface in Citrus and Levy counties. The Avon Park limestone in Indian River County consists of layers of cream-colored to tan hard to soft porous chalky limestone, and cream-colored to tan hard "miliolid" limestone containing crystals of calcite.

The Avon Park is very fossiliferous, containing echinoids, mollusks, and many species of Foraminifera. The following species are characteristic of the formation:

Coskinolina floridana
Cribrobulimina cushmani
Dictyoconus cookei
Lituonella floridana
Spirolina coryensis
Textularia coryensis
Valvulina intermedia

The small echinoid Peronella dalli is locally common in the upper part of the formation.

The Avon Park limestone appears to lie conformably on the older Lake City limestone and probably underlies the entire county. Its thickness ranges from 65 feet in well 259 to 190 feet in well 202 (fig. 4, 5).

Ocala Group[1]

The Ocala limestone was defined by Cooke (1915, p. 117; 1945, p. 53). Applin and Applin (1944, p. 1683-1685) and Applin and Jordan (1945, p. 130) recognized that the Ocala could be differentiated into two members, an upper member and a lower member. The lower member is approximately equivalent to the lower part of the Ocala limestone described and named the Moodys Branch formation by Vernon (1951, p. 115). Vernon also divided the Moodys Branch formation into two members, the Williston and Inglis, which Puri (1953) raised to formation rank. The two formations and the remaining upper part of the Ocala limestone, called the Crystal River formation, were designated the Ocala group by Puri.

Williston and Inglis Formations: The Williston and Inglis formations have not been differentiated in Indian River County. They consist predominantly of cream-colored to tan hard to soft granular, porous limestone with calcite crystals. They contain also soft foraminiferal coquina and hard porous "miliolid" limestone with calcite crystals.

The fossils from the Williston and Inglis consist of molds, casts, and fragments of mollusks, corals, and Foraminifera. *Miliolidae* and *Camerinidae* are the most conspicuous foraminifers.

The upper contact of the undifferentiated Williston and Inglis formations is not clearly defined in many of the sets of well cuttings examined, so the thickness of the unit is not accurately known. The contact with the overlying Crystal River formation appears to be conformable. The thickness probably ranges from 20 feet in wells 187 and 202 to 100 feet

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[1] The stratigraphic nomenclature used in this report conforms to the usage of the Florida Geological Survey. It conforms also to the usage of the U.S. Geological Survey, except that the Tampa limestone is referred to as the Tampa formation and the Ocala limestone is referred to as the Ocala group, with its subdivisions, as described by Puri (1953).

in well 200, which is near the intersection of State Highway 60 and U. S. Highway 1. The Inglis, Williston, or both probably underlie the entire county and presumably lie unconformably upon the Avon Park limestone.

Crystal River Formation: Vernon (1951, p. 156) redefined the Ocala limestone as defined by Cooke (1945, p. 53) and restricted it to the upper part of the formation, excluding a lower part which he named the Moodys Branch formation with its Williston and Inglis members. Puri (1953) renamed Vernon's Ocala limestone (restricted) as the Crystal River formation, raised the Williston and Inglis to formational rank, and thus dropped the Moodys Branch formation; and as stated previously, he raised the Ocala to a group.

The Crystal River formation in Indian River County consists of cream-colored soft porous foraminiferal coquina and some cream-colored to light gray hard to soft porous glauconitic limestone. It is very rich in Foraminifera, especially Orbitoididae. In addition to Foraminifera it contains mollusks, echinoids, ostracods, coral and a species of small brachiopods.

In the extreme eastern part of Indian River County the Crystal River formation is overlain by sediments of Oligocene age. Throughout the remainder of the county it is unconformably overlain by the Hawthorn formation of Miocene age. The Crystal River formation ranges in thickness from 20 feet in well StL 44, in St. Lucie County, to about 380 feet, and perhaps more, in well 107.

Oligocene Series

According to Cooke (1945, p. 75) the lower division of the Oligocene series is not known to be represented in Florida. Cooke recognizes the Byram and Marianna limestone of Vicksburg age and the Suwannee limestone of late Oligocene age in Florida. In Indian River County the sedimentary rocks of Oligocene age are gray to cream-colored soft clayey, granular limestone with calcite crystals and dark chert.

The fossils in the rocks of Oligocene age include mollusk and echinoid fragments, barnacle plates, sponge spicules, crab claws, ostracods, and foraminifers, of which species of Nodosaria are very conspicuous.

Rocks of Oligocene age were found only in the extreme eastern part of the county, where the formations thicken. They are probably missing in the western part of the county. Rock samples from well 201 indicate that the sediments of Oligocene age are about 280 feet thick in the northeastern part of Indian River County. The Oligocene rocks are unconformably overlain by the Hawthorn formation.

Miocene Series

Hawthorn Formation

The Hawthorn formation, originally defined by Dall (1892) and redefined by Cooke and Mossom (1929) and Vernon (1951, p. 186-187), consists of a thick section of green to brown phosphatic, sandy clay and marl, with interbedded lenses of hard sandy limestone, chert, and phosphorite pebbles. The limestone lenses are most abundant in the middle and upper parts of the formation.

The fauna of the Hawthorn consists of mollusks, shark's teeth, and small, usually well preserved Foraminifera.

The Hawthorn formation underlies the entire county and ranges in thickness from about 115 feet in well BR 762 (Brevard County) to 225 feet in well 203. The Hawthorn rests unconformably on formations of Eocene or Oligocene age and is unconformably(?) overlain by the Miocene Tamiami formation. None of the well cuttings of the material below the Hawthorn formation or in the lower part of the formation were similar to the very sandy limestones which are typical of the Tampa formation, nor did any of them contain the foraminifer Archaias floridanus, often found in the Tampa. It is assumed, therefore, that the Tampa formation is not present in Indian River County.

Tamiami Formation

The Tamiami formation, as described by Parker (1951, p. 823), includes all deposits of late Miocene age in southern Florida. The fossiliferous section that overlies the Hawthorn formation and underlies deposits of Pleistocene age in Indian River County is tentatively referred to the Tamiami formation. These deposits consists of gray to olive-drab sandy very fossiliferous clays.

The fossils of the Tamiami are predominantly mollusks but include some echinoid spines and small Foraminifera. The pelecypods Donax sp. ? and species of Arca are the most conspicuous.

The Tamiami formation probably underlies the entire county. It ranges in thickness from 40 feet in well 203 to 135 feet in well 24. It overlies the Hawthorn formation, probably resting on an erosion surface, and is overlain unconformably by Pleistocene deposits. The boundary between the Tamiami and Hawthorn in Indian River County is based primarily upon minor differences in lithology and, therefore, should be considered subject to modification when more data are available.

Pleistocene Series

Anastasia Formation

The Anastasia formation was named by Sellards (1912, p. 18). Cooke and Mossom (1929, p. 199, 203) defined the Anastasia formation as "all the marine deposits of Pleistocene age that underlie the lowest plain bordering the east coast of Florida north of the southern part of Palm Beach County." This definition takes in the Pamlico sand, which Cooke (1945, p. 265) excluded from the Anastasia.

In Indian River County the Anastasia formation probably occurs only on the barrier beach and along the eastern margin of the mainland. The contacts between the Anastasia formation and the underlying Tamiami formation and the overlying

Pamlico sand are presumed to be unconformities.

The Anastasia is composed chiefly of sand and beds of shelly marl. The fauna consists mainly of mollusks, of which none are known to be extinct.

Because of the difficulty in differentiating the Pliocene and Pleistocene, it is possible that the Caloosahatchee marl (although it has not been recognized) may be present and may be included with the described Pleistocene formations.

Fort Thompson Formation

The Fort Thompson formation was named by Sellards (1919) and was described also by Cooke and Mossom (1929, p. 211, 215). The Fort Thompson formation in Indian River County consists of fossiliferous gray to brown quartz sand and some clay of both marine and fresh-water origin. The marine mollusks of the formation are dark in color, though some have faint traces of their original color. A few fresh-water gastropods are present in the fresh-water beds of the formation. The alternating deposits of marine and nonmarine origin indicate sedimentation during one or more glacial and interglacial stages of the Pleistocene.

The Fort Thompson formation probably underlies all but the extreme eastern part of the county. It lies unconformably on the Tamiami formation and is overlain unconformably by the Talbot formation and the Pamlico sand. The thickness of the formation ranges from 80 feet in well StL 48 to about 110 feet in well 203.

Talbot Formation

The Talbot formation was named by Shattuck (1901) and was described also by Parker and Cooke (1944, p. 75). In Indian River County it consists principally of unconsolidated quartz sand, and the only exposures are west of the Pamlico shoreline, at an altitude of about 40 feet.

Pamlico Sand

The name Pamlico sand was applied to sediments in Florida by Parker and Cooke (1944, p. 74-75). The formation includes all marine Pleistocene deposits younger than the Anastasia formation. In Indian River County it consists of gray to brown medium-grained quartz sand and is exposed throughout that part of the county that lies below the 25-foot shoreline, which is considered to be the shoreline of the Pamlico sea. It ranges from less than one foot in thickness near its edge to a probable thickness of more than 40 feet beneath the coastal ridge.

GROUND WATER

Ground water is the subsurface water in the zone of saturation - the zone in which all pore spaces are filled with water under greater than atmospheric pressure. It is replenished by rain that falls on the earth's surface. Only a part of the rain reaches the zone of saturation, however. Part of it returns to the atmosphere by evapotranspiration, and part drains overland into lakes and streams.

Ground water moves laterally, under the influence of gravity, toward places of discharge such as wells, springs, surface streams, and lakes. Where it is not confined and its surface is free to rise and fall, it is said to be under nonartesian conditions, and its upper surface is called the water table. Where the water is confined in a permeable bed by a relatively impermeable bed, its surface is not free to rise and fall and it is said to be under artesian conditions. The term "artesian" is applied to ground water that is confined under sufficient pressure to rise above the top of the permeable bed that contains it, but not necessarily above the land surface. The height to which water will rise in an artesian well is called the artesian pressure head.

An aquifer is a formation, group of formations, or part of a formation, in the zone of saturation, that is permeable enough to transmit usable quantities of water. Areas in which aquifers are replenished are called recharge areas. Areas in which water is lost from aquifers are called discharge areas.

Nonartesian Aquifer

Ground water in Indian River County occurs under both nonartesian and artesian conditions. The shallow beds of sand and shells of the Pamlico sand and the Anastasia and Fort Thompson formations, of Pleistocene age, constitute an aquifer that contains ground water under nonartesian conditions, except where the beds of sand and shell are overlain locally by clay or fine sand that confine the water under artesian pressure. This aquifer is fairly permeable and is thickest along the crest of the coastal ridge and on the barrier beach. At the Adrianna Ranch, in the St. Johns marsh, the aquifer is composed of surface sand not more than three feet thick.

The nonartesian aquifer is recharged by local rainfall which infiltrates rapidly to the water table. Discharge from the aquifer occurs by evapotranspiration, by seepage into canals, streams, swamps, and lakes, and by pumping.

A few small domestic supplies in populated areas are obtained from shallow sandpoint wells. On the southern part of the barrier beach, the aquifer supplies water for irrigation and for domestic supplies, but wells greater than 50 feet in depth yield water too salty for either purpose. The Vero Beach municipal supply is obtained from the aquifer in an area where a pumping test showed the water to be under artesian conditions.

Few data are available concerning ground-water levels, hydraulic properties, or the quality of the water from the nonartesian aquifer. However, on the barrier beach, the water at shallow depths is known to be moderately high in chloride content.

Shallow Artesian Aquifer

In the central and western parts of the county, an aquifer of minor importance is interbedded with the impermeable deposits that constitute the confining bed of the Floridan aquifer. This aquifer is composed of a bed of limestone in the Hawthorn formation of Miocene age, and it appears to have no direct hydrologic connection with either the nonartesian aquifer above or the Floridan aquifer below.

Well 187, in the western part of the county, well 202 in the southwest, and well 203, two miles southwest of Fellsmere, penetrated a permeable, water bearing shelly limestone representing the shallow artesian aquifer. The limestone was 10 to 20 feet thick and was struck at depths of 190 feet, 278 feet, and 297 feet, respectively, below the surface. When this limestone was penetrated in well 203 the drilling mud was thinned by the inflow of water, but there was no flow of water at the surface. It is reported that some of the older irrigation wells finished in this aquifer yielded water by natural flow, but that after a few years the yield decreased, and the wells were deepened to the Floridan aquifer.

The artesian pressure head in well 176, about 1½ miles east of Fellsmere, was 11 feet above the land surface in October 1951. This well is reported to tap the limestone aquifer in the Hawthorn formation. Well 177, which is 330 feet east of well 176, penetrates the Floridan aquifer, and its artesian pressure head was 22 feet above the land surface in October 1951. The land surface at both wells is at about the same altitude. The water from the two wells differs greatly in chloride content and hardness. Water from well 177 in the Floridan aquifer had a chloride content of 360 ppm and total hardness of 480 ppm, and water from well 176 in the nonartesian aquifer had a chloride content of 155 ppm and total hardness of 230 ppm. These differences in artesian pressure head and quality of water suggest that the aquifers are separate hydrologic units.

Floridan Aquifer

The chief source of ground-water supplies in Indian River County is the thick section of permeable limestones and dolomites underlying, and including some permeable material at the bottom of, the Hawthorn formation. These permeable rocks, from the top down, consist of strata of the Hawthorn formation, rocks of Oligocene age, the Ocala group, the Avon Park limestone, and the Lake City limestone, and they constitute a part of the principal artesian aquifer of Florida and southeastern Georgia, as described by Stringfield (1936, p. 124-130). Parker (1955, p. 188-189) proposed the name "Floridan aquifer" for these sediments, defining the aquifer to include "parts or all of the middle Eocene (Avon Park and Lake City limestones), upper Eocene (Ocala limestone), Oligocene (Suwannee limestone), and Miocene (Tampa limestone and permeable parts of the Hawthorn formation that are in hydrologic contact with the rest of the aquifer)." In Indian River County the Hawthorn probably contributes some water to wells penetrating the Floridan aquifer, but the largest contributions come from strata below the Hawthorn. The Suwannee limestone of Oligocene age and the Tampa limestone of Miocene age apparently are missing in Indian River County.

The regional dip of the Floridan aquifer, in Indian River County, is to the southeast. The top of the aquifer is about 245 feet below sea level in well 187 and about 410 feet below sea level in well StL 48.

Limestone and dolomitic limestone are the chief components of the aquifer. Highly permeable strata are interbedded with materials of lower permeability. Few, if any, of the individual highly permeable or relatively impermeable beds can be traced laterally for great distances, and hence the capacity of the aquifer to transmit ground water may differ considerably throughout the county. However, the permeable zones are hydraulically interconnected and the entire section acts as a hydrologic unit. Because the aquifer is composed of soluble carbonate rock, it is honeycombed with solution cavities through which ground water moves freely. In the eastern part of the county and on the barrier beach, where hundreds of wells have been drilled through the aquifer, the artesian water probably flows vertically from one permeable zone to another through the uncased parts of the wells.

The section of relatively impermeable clays and marls of the Hawthorn formation and, in the eastern part of the county, the Tamiami formation confines the water in the Floridan aquifer. This section ranges in thickness from 150 feet in the northeastern part of the county to 250 feet in the southeastern part. The upper part of the section is usually very sandy and shelly and grades upward into the more permeable parts of the Tamiami formation or the lower part of the formations of Pleistocene age. The base, however, is well marked by a change from impermeable greenish clay above to white to cream-colored limestone below.

The Floridan aquifer is recharged by rainfall in central Florida, where permeable materials overlie the limestones of the aquifer, and in the lake regions around Polk County, where water enters the aquifer through sinkholes that penetrate the Hawthorn formation (Stringfield, 1936, p. 146-148, pl. 12). Water that enters the aquifer in the recharge area moves in the direction of the slope of the piezometric surface and is discharged by submarine springs, by upward leakage, and by flowing wells. Local rainfall in Indian River County does not recharge the Floridan aquifer and neither does the water in the nonartesian aquifer, as the head in that aquifer is lower than that in the Floridan.

In the southern part of the barrier beach the rocks of Oligocene age are relatively thick and constitute an appreciable part of the aquifer, but the yield of ground water from the Oligocene rocks is too small to justify the expense of drilling wells to them. Large flows may be obtained from the Eocene rocks below but the water is too salty for most uses. These facts account for the notable absence of artesian wells in the southern part of the beach. Nonartesian wells supply most of the water, but some water is piped in from wells in more productive areas. Data obtained from discharge tests show that the permeability of the upper part of the aquifer decreases to the southeast, where the Oligocene strata are known to thicken.

Water-Level Data

The Floridan aquifer yields water by artesian flow in all parts of Indian River County except a belt a few miles wide in the western part of the county, where the land rises to an elevation of more than 55 feet above sea level, and in a few isolated places along the sand ridge west of Winter Beach and Wabasso.

Water-level measurements were made in a few wells in the process of being drilled, in order to determine the change in artesian pressure heads at different depths in the aquifer. The artesian pressure heads observed did not represent the heads at isolated depths because the overlying water-bearing beds were not cased off. Most of the heads at the greater depths might have been higher if the well had been cased to those depths. In well 166, at a depth of 220 feet below the top of the aquifer, the head was 13 feet above the land surface, and at a depth of 306 feet it was 13.5 feet above the surface.

The most conspicuous fluctuations in the piezometric surface in Indian River County are those due to the discharge of the wells. When a well starts to discharge the artesian pressure head in the well immediately falls and the head in the vicinity of the well starts to decline. The decline is greatest at the well and decreases as the distance from the well increases. The piezometric surface, the imaginary surface representing the artesian head at wells, assumes approximately the form of an inverted cone, called a cone of depression, having its center at the discharging well. If the well continues to discharge at a constant rate, the piezometric surface declines at a slowly decreasing rate until it becomes essentially stable. While the cone of depression is expanding, water from progressively greater distances from the discharging well begins to move toward the well. In Indian River County, especially in the citrus belt, the simultaneous discharge of scores of wells develops a pattern of intersecting cones wherein the greatest drawdown is near the center of the withdrawal area.

When discharge from a well ceases, the piezometric surface rises, rapidly at first and then at a slowly decreasing rate until it recovers essentially to its original level.

The maximum observed fluctuation of artesian pressure head in wells penetrating the Floridan aquifer during the investigation was one of eight feet in well 49, a well 760 feet deep in the northeastern part of the county, on the barrier beach. The pressure head in a well near Wabasso is reported by the owner to have risen 15 feet immediately after dry periods, but fluctuations in other wells on the mainland are generally not more than about two feet, and the recovery in the well near Wabasso must have been due in large part to a reduction in withdrawal in the vicinity.

A comparison of the measurements of water levels made in previous years with those made during the present investigation indicated that the piezometric surface in a well at Fellsmere was 30 feet above the land surface in 1913. The piezometric surface in the same area was 23 feet above the land surface on October 18, 1951, when the draft of water was at a minimum. Many small domestic supply wells, which are cased only to shallow depths, but extend to the Floridan aquifer are scattered throughout the Fellsmere area, and through these wells water doubtless leaks from the Floridan aquifer into shallow deposits, thus lowering the piezometric surface.

Stringfield (1936, p. 168) reported that the artesian pressure head at well 10 in Vero Beach was 35 feet above the land surface at some unstated time prior to 1936. The head of well 10 could not be measured during the present investigation, but that of well 200, which is nearby and is similar in altitude and depth, was 25 feet above the surface in 1951. The apparent decline of 10 feet is probably due in part to leakage through wells and in part to an increase in withdrawal in the citrus groves southwest of Vero Beach.

Figure 7 shows the altitude and configuration of the piezometric surface of the Floridan aquifer in Indian River County. The measurements of artesian pressure head on which this map is based were made over a period of several weeks during October 1951. The figure shows that the slope of the piezometric surface increases along the east edge of the county - probably because of faulting along the coastal area (fig. 5). To the north, the increase in the slope of the piezometric surface is accentuated by the withdrawal of water from numerous irrigation wells. In the northern area, artesian

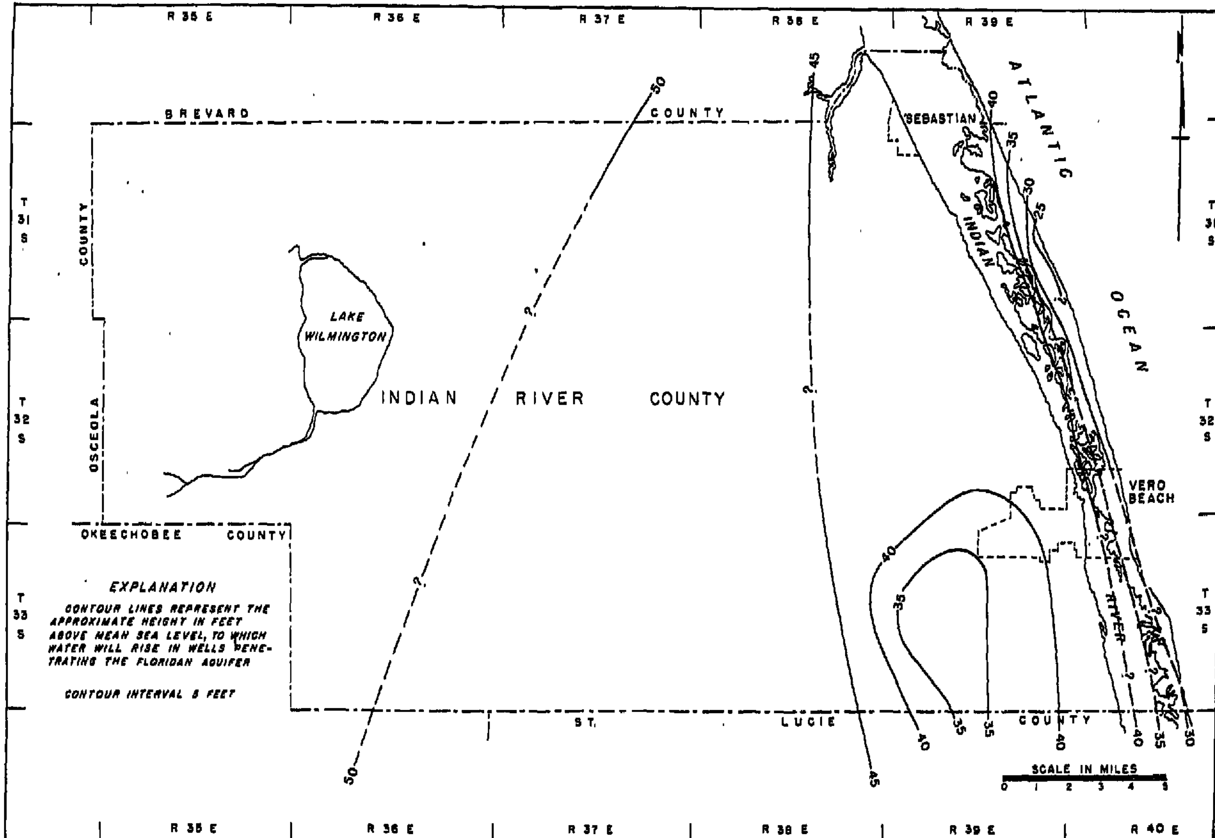

Figure 7. Map representing approximately the piezometric surface in wells penetrating the Floridan aquifer in Indian River County, October 1951.

pressure heads rose more than eight feet immediately after a rain. The rise represented a recovery of pressures after irrigation wells were turned off.

The cone of depression southwest of Vero Beach is not a permanent feature. Its depth and expanse vary in response to the withdrawal of water for irrigation. After long periods of heavy withdrawal, the cone may extend as far north as Wabasso. Measurements of the artesian pressure heads in the citrus belt were made over a period of four weeks, during which time the piezometric surface was relatively stable. The measurements show that the drawdowns in the southern part of the citrus belt are greater than those in the northern part, possibly because of differences in withdrawal. However, discharge tests suggest that the permeability of the aquifer in the southern part of the area is relatively low, which may account at least in part for the fact that the drawdowns are greater there than in the northern part.

Quality of Water

A few chemical analyses were made of water from the nonartesian aquifer and the Floridan aquifer as a part of the investigation. The results of these analyses are shown in table 1. In addition, numerous samples of water from wells throughout Indian River County were analyzed for chloride content only. These analyses are given in table 4.

Nonartesian Aquifer

Ground water from the nonartesian aquifer in Indian River County is moderately mineralized, much less so than that from the Floridan aquifer (p. 32). Table 1 shows a comparison of the water from the two aquifers. The shallow water at Vero Beach meets the standards for an acceptable public water supply but is very hard and contains an objectionable quantity of iron. Most of the hardness is due to a relatively high content of calcium. The nonartesian aquifer probably will supply moderate quantities of water of low chloride content throughout the county, except in the areas immediately

Table 1. Chemical Analysis of Ground Water from Indian River County
(Results in parts per million except color, pH, and specific conductance)

	Nonartesian aquifer		Floridan aquifer		
	Composite 4 wells Vero Beach[1] 60 ft.	Well 25 19 ft.	Well 10[1] 660 ft.	Fellsmere supply[1] 500 ft.	Well 202 730 ft.
Dissolved solids	375	376	1,475	1,230	974
Total hardness as $CaCO_3$	282	286	450	468	382
Alkalinity as $CaCO_3$	272	---	154	158	---
Noncarbonate hardness as $CaCO_3$	10	1	296	310	228
Silica (SiO_2)	---	18	---	---	16
Iron (Fe)	1.5	.19[2]	.05	8.0	.00[2]
Calcium (Ca)	110	109	82	89	74
Magnesium (Mg)	2	3.4	60	60	48
Sodium (Na)	---	17	---	---	153
Potassium (K)	---	.7	---	---	5.2
Bicarbonate (HCO_3)	332	348	188	192	188
Carbonate (CO_3)	---	0	---	---	0
Sulfate (SO_4)	0	5.5	150	117	155
Chloride (Cl)	35	26	550	440	285
Fluoride (F)	.3	.2	.8	.9	.6
Nitrate (NO_3)	---	.5	---	---	.3
Color	30	40	5	5	5
pH	---	7.7	---	---	7.9
Specific conductance (micromhos)	---	582	---	---	1,460
Temperature (°F)	70	---	74	75	---
Date of collection		May 8, 1953			May 8, 1953

[1]Analysis by Florida State Board of Health.
[2]Iron in solution at time of analysis.

adjacent to bodies of salt water. Table 4 shows that water from wells 88, 94, and 111, which draw from the nonartesian aquifer on the barrier beach, had chloride contents of 242, 325, and 205 ppm respectively.

Shallow Artesian Aquifer

The water in the artesian aquifer within the Hawthorn formation in central and western Indian River County also is of better quality than that in the Floridan aquifer. Well 176, east of Fellsmere, is believed to draw water from this aquifer. The water from this well has a chloride content of 155 ppm and a total hardness of 230 ppm. The water from well 177, which is 330 feet east of well 176 and which penetrates the Floridan aquifer, has a chloride content of 360 ppm. The total hardness of the water from the Floridan aquifer in the Fellsmere area is about 480 ppm. The concentration of dissolved solids in the water from the shallow artesian aquifer is considerably lower than that in water from the Floridan aquifer. Water from the shallow artesian aquifer is much less hard than water from the Floridan aquifer.

Many wells penetrating the Floridan aquifer do not have casings set deep enough to seal off the limestone aquifer within the Hawthorn formation. Thus, vertical flow through the wells, as a result of the greater pressure in the deeper strata, may cause the shallower water to become more mineralized.

Impermeable clay underlying the shallow artesian aquifer will act as a barrier against vertical salt-water encroachment in areas where no leakage occurs through uncased wells. The probable lenticular nature of the aquifer, plus the surrounding clayey material, will offer protection also from lateral encroachment of water of high chloride content.

Floridan Aquifer

Chemical analyses of water from three wells penetrating the Floridan aquifer indicate that the water is hard and relatively high in dissolved solids. The results from these few analyses are no true indication of the overall quality of the water, but they suggest a coastward increase in mineralization.

A progressive change, with time, in the quality of the water from well 10 (660 feet deep) is shown in the following table:

	1921		1924	1949	1950	1951
	Aug.	Oct.		Oct.	Jan.	Dec.
Dissolved solids	1,000		1,050		1,475	1,560
Total hardness		335		250	450	442
Chloride	270	291	455	625	550	630
Sulfate	70	83	143		150	

Analyses made by the Deerfield Groves Company during a 7-year period (table 2) show increases in the chloride content of the water in some of the company's wells. These increases may be the result of increased withdrawal from the aquifer in the eastern part of the county in recent years. Such increased withdrawal and consequent lowering of the piezometric surface could cause salt-water encroachment from the deeper zones. The increased chloride content may be due also to upward movement of salty water through the uncased well bores of many deep wells that have been drilled, as the artesian head in the deep zones is probably higher than it is in the shallow zones.

Wells penetrating more than about 275 to 300 feet into the Floridan aquifer probably yield water containing more than 100 ppm of chloride. Determinations of the chloride content of water samples taken at intervals of 20 feet during the drilling of wells show that the content increases gradually with depth in most wells (fig. 8). These analyses, which give the chloride content of mixtures of water from all producing zones, show that water in some zones is more highly mineralized than that in others. Table 3 shows that there is not much lateral change in the chloride content of the water in different areas in the eastern part of the county. The gradual increase in the chloride content of the water with depth and its fairly uniform lateral distribution suggest that it does not originate from recent salt-water encroachment. Recent salt-water encroachment should bring about a nonuniform lateral distribution of chloride content.

The occurrence of zones of salty water within the Floridan aquifer (fig. 8) suggests that the relatively high chloride content of the water is caused by a residue of sea water. The sea water either was contained in the sediments when they were deposited or entered the aquifer later when it was covered by ancient seas. The movement of artesian water through the aquifer from areas of recharge to areas of discharge has flushed out most of this salt water.

The available data are insufficient to permit evaluation of the danger that heavy withdrawals of ground water might cause with respect to salt-water encroachment into the Floridan aquifer. More geologic information is needed concerning the presence or absence of impermeable beds and more data are needed on the salinity of water in other parts of the aquifer.

QUANTITATIVE STUDIES OF FLORIDAN AQUIFER

Theory

The ability of an aquifer to transmit and store water is expressed in terms of the coefficients of transmissibility and storage. The coefficient of transmissibility is defined by Theis (1938, p. 894) as the number of gallons of water, at the prevailing water temperature, that will move in one day through a vertical strip of the aquifer, having a width of one foot and a height equal to the full thickness of the aquifer, under a unit hydraulic gradient. The coefficient of storage of an aquifer is defined as the volume of water it releases from or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface.

Pumping tests were made on wells tapping the Floridan aquifer, to determine the coefficients of transmissibility and

Table 2. Change in Chloride Content of Water in Selected Wells from 1940 to 1947. (Analysis made by Deerfield Groves)

Well No.	Depth (feet)	Date	Chloride ppm
51	800	2-15-40	255
		9-12-47	710
59	650	2-15-40	576
		9-12-47	724
60	550	2-15-40	255
		9-12-47	326
66	600	2-15-40	213
		9-12-47	440
69	550	2-15-40	497
		9-12-47	553
70	500	2-15-40	326
		9-12-47	440

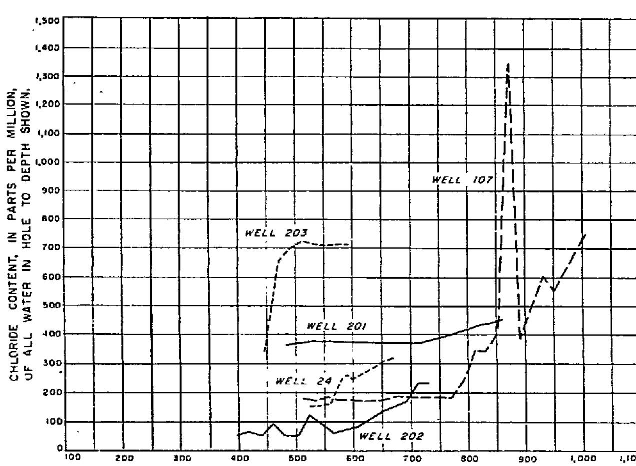

Figure 8. Graph showing the general increase in chloride concentration with depth in certain wells penetrating the Floridan aquifer.

Table 3. Lateral Distribution of Chloride Content of Water in Wells ending in the Floridan Aquifer

Description of area (see figure 2)	Average depth of wells (feet)	Average depth to top of aquifer (feet)	Average penetration of aquifer (feet)	Average chloride (ppm)
Along Lateral "B" from Florida State Highway 60 to St. Lucie County line	708	400	308	387
Along Lateral "A" from Wabasso to Florida State Highway 60	634	400	234	353
On mainland along Indian River from Wabasso to St. Lucie County line	625	400	225	303
Along road from Wabasso to Florida State Highway 512	627	350	277	327
Sebastian	*	*	*	442
On barrier beach, from Wabasso south	870	390	480	554

*Insufficient data on depth

storage. In these tests, the lowering of the artesian pressure head (caused by a well flowing at a known rate) was measured periodically in observation wells at known distances from the discharging well. Plots of these water-level data (figs. 9, 10) were used to determine the transmissibility and storage coefficients by means of equations which express the relationship between the coefficients and the measured quantities.

The basic formula used is the Theis nonequilibrium formula (Wenzel, 1942, p. 87):

$$s = \frac{114.6Q}{T} \int_{\frac{1.87r^2S}{Tt}}^{\infty} \frac{e^{-u}}{u}\,du$$

where s is the drawdown, in feet, at any point in the vicinity of

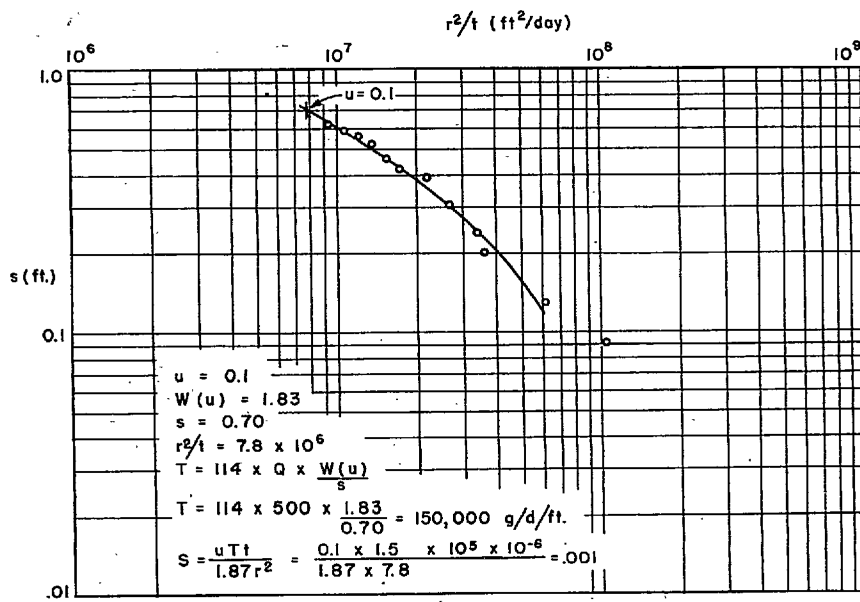

Figure 9. Logarithmic plot of s against $\frac{r^2}{t}$ for well 46, well 48 discharging.

a well discharging at a uniform rate; Q is the rate of discharge, in gallons per minute; T is the coefficient of transmissibility of the aquifer, in gallons per day per foot; r is the distance, in feet, from the pumped well to the point of observation; S is the coefficient of storage; and t is the time, in days, that the well has been discharging. The formula is used to determine the coefficients of transmissibility and storage graphically by the superposition of a plot of the observed data upon a type curve (fig. 11) by the method devised by Theis and described also by Jacob (1940).

The method is based on several simplifying assumptions, including the following: (1) The aquifer is of infinite areal extent and is uniform in thickness, (2) the aquifer is homogeneous and isotropic (transmits water with equal ease in all directions), (3) T and S are constant, and (4) water is released from storage instantaneously with a decline in artesian head.

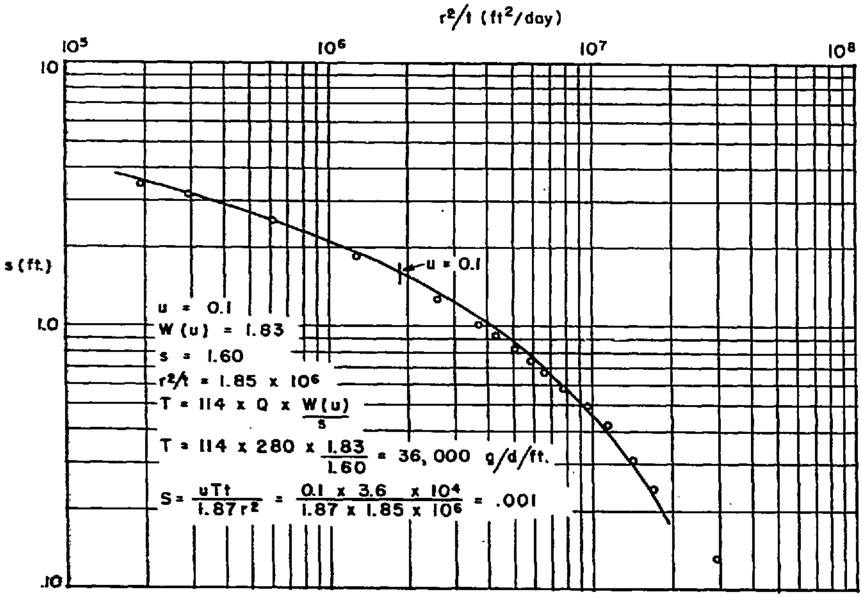

Figure 10. Logarithmic plot of s against $\frac{r^2}{t}$ for well 108, well 107 discharging.

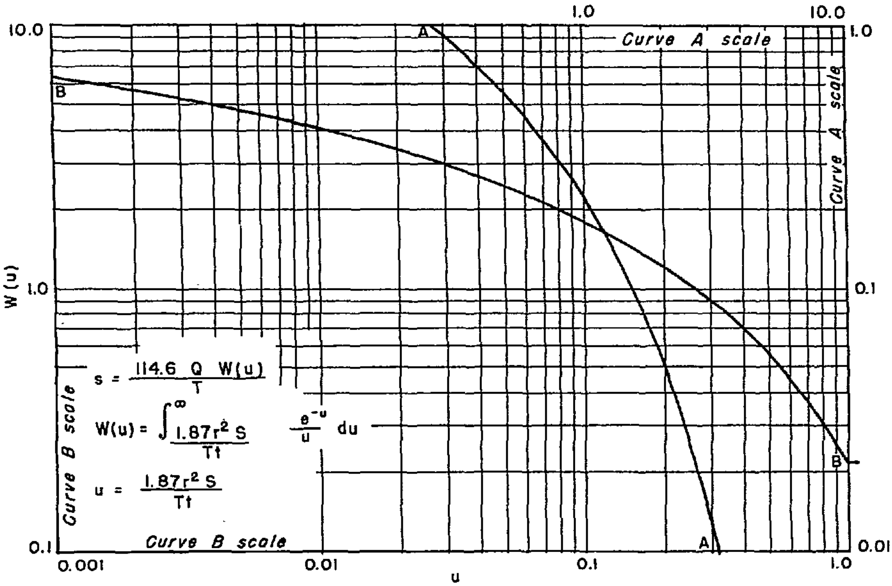

Figure 11. Logarithmic graph of the type curve.

Discussion of Tests

Several pumping tests were made on wells in the Floridan aquifer on the barrier beach. (See fig. 2 for locations.) The results of two tests are given below:

	Observation well	Depth, feet	Distance from discharging well, feet (r)	Coefficient of transmissibility (T)	Coefficient of storage (S)
Test No. 1	47	700	116	150,000	0.0014
	49	760	860	145,000	.0014
	46	850	1,230	150,000	.001
Test No. 3	108	860	730	36,000	.001
	104	990	740	56,000	.0005

In test No. 1, well 48 (700 feet deep) discharged at a rate of 500 gpm for 95 hours. In test No. 3, well 107 (990 feet deep) discharged at 280 gpm for 67 hours.

Discharge rates were measured with an orifice meter in all tests. Drawdowns in the most distant observation wells were measured with a mercury manometer, and those in other observation wells were measured with a pressure gage calibrated in feet of water. All tests were made during periods when other wells in the area were not discharging and the piezometric surface had reached essential equilibrium.

Electric Logs

Figure 12 shows the electric logs of four flowing wells and various geologic contacts based on well cuttings. These logs were made by the single-point resistance method (Guyod, 1944) and show only the relative changes in apparent resistivity and self-potential with depth. These logs are, therefore, most useful for correlation purposes and cannot be used

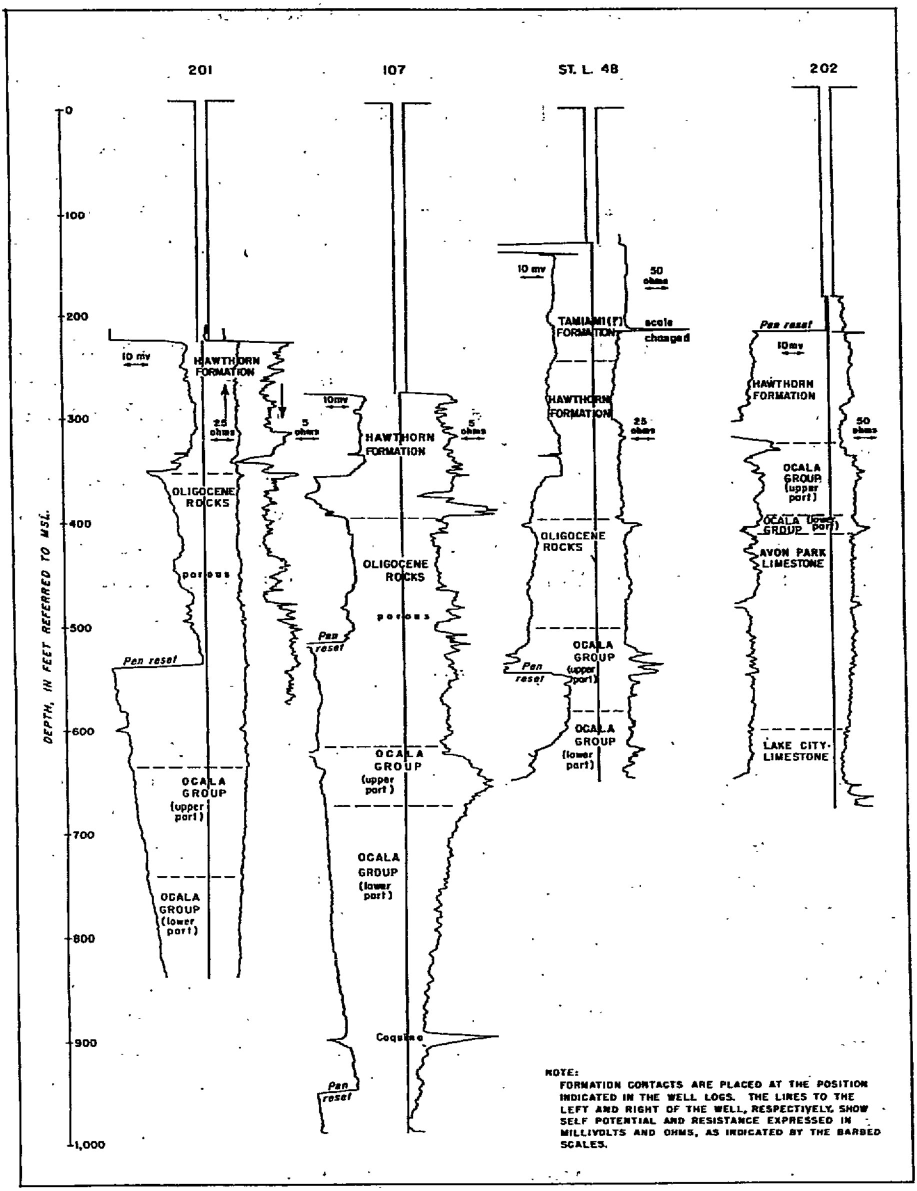

Figure 12. Electric logs of selected flowing wells in Indian River County, showing correlation with rock cuttings.

by themselves for a quantitative determination of the fluid content or water-bearing properties of the rocks.

The only parts of the geologic section that are correlative from well to well, on the basis of the electric logs, are the horizons where a very sharp shift in negative self-potential is noted, at a depth of about 340 feet, and where a characteristic resistance occurs at 360 to 400 feet below the land surface in wells 201, 107, and StL 48, on the barrier beach.

The increases in self-potential that occur above the top of the limestone, at the contact between the Hawthorn formation and the Oligocene rocks and between the Hawthorn and the Ocala limestone, may mark the top of the Floridan aquifer at those places. Well cuttings show sandy limestones and sandy clays at the unconformity that are more permeable than the overlying clays and are more properly considered a part of the aquifer than a part of the confining beds.

Ground-Water Use

Most of the water withdrawn from the Floridan aquifer in the county is used for irrigation of citrus crops, which are grown in relatively small areas. These areas include the northern part of the barrier beach opposite Wabasso and a belt a few miles wide, on the mainland, paralleling the coast and extending from the headwaters of the Sebastian River to the St. Lucie County line. The barrier beach is the only part of the county where the well inventory is complete. The withdrawal of water in this area is probably typical of that in all the citrus-producing areas; therefore, a discussion of water use in this area is given in the following paragraphs.

There are 96 flowing wells on the barrier beach, all of which are north of Vero Beach. Of these, 91 are north of the old Winter Beach bridge, in an area of about six square miles. In these six square miles, half the land is under cultivation; thus, there is about one well for every 20 acres of cultivated land.

The total discharge from 91 wells is more than 23 million gpd when all wells are in use. Ground water is in greatest demand when the fruit trees are in bloom and there are no rains to hold the bloom. The time depends upon the weather, but, in general, the draft is heaviest in late winter and early spring. One citrus producer estimates that, on the average, his wells discharge about two weeks out of the month during January, February, March, and April and about one week out of the month during the remainder of the year. If all the wells were to discharge 16 weeks a year, the annual discharge would amount to about 2.5 billion gallons. In exceptionally dry weather, however, heavy irrigation starts as early as September; thus, the annual discharge differs greatly from year to year.

The flow from wells is used also to lift water to drain lowlands near the Sebastian River, by means of a venturi tube on the discharge pipe of the well. In some installations the venturi tube is submerged so that the water to be drained enters the tube directly. In others the venturi tube is mounted above the water, and water is drawn into the tube through a lift pipe. Flowing wells used for drainage are known locally as siphon wells.

A small quantity of water is taken from the Floridan aquifer for use in cooling generators in the power plant of the city of Vero Beach. The temperature of the water in Vero Beach is not know, but in the Wabasso area the average temperature is 76°, 77°, 78°, and 79°F in wells that are 500, 600, 700 and 1,000 feet deep, respectively.

Water from the Floridan aquifer is used for domestic purposes in rural areas, usually after aeration to remove hydrogen sulfide gas. A relatively small amount of water is taken from the Floridan aquifer for the watering of stock, because ponds of surface water are usually available in the grazing areas and because there is a belief that hydrogen sulfide in the water contributes to the severity of the effect of liver flukes in cattle.

Comparisons of the chloride contents of the raw water from the nonartesian aquifer and the Floridan aquifer with that of the treated mixture from the water plant at Vero Beach indicates that the quantities of the two waters used in December 1952 were about equal. According to the water plant operator's estimate, about 800,000 gallons of water were treated per day; thus, about 400,000 gpd were drawn from the nonartesian aquifer. The yields of individual wells are not known.

A few shallow sandpoint wells obtain water from the nonartesian aquifer for small domestic supplies in populated areas. On the southern part of barrier beach, the nonartesian aquifer supplies water for irrigation and domestic supplies and the deeper wells in the nonartesian aquifer in this area (approximately 50 feet deep) supply water for swimming pools. The water from these deeper wells is not very satisfactory because it is salty and high in iron content.

Few data are available concerning the utilization of water from the shallow artesian aquifer within the Hawthorn formation, in the western part of the county. If water from the Floridan aquifer becomes too highly mineralized to be potable, the shallow artesian aquifer may become the main source of supply in that area. More data should be obtained concerning recharge, water levels, and the quality of water from this aquifer, in order to determine its potentialities.

SUMMARY AND CONCLUSIONS

Most of the ground water in Indian River County is obtained from the Floridan aquifer, which underlies most of Florida and southeastern Georgia. This aquifer yields water to more than 2,000 irrigation and domestic wells in the county, and supplies some water for municipal systems. The Lake City limestone, Avon Park limestone, and Ocala group, of Eocene age, and rocks of Oligocene age contribute most of the water to wells penetrating the Floridan aquifer, although a small quantity is obtained from the lower part of the Hawthorn formation. In the southern part of the barrier beach, rocks of Oligocene age of relatively low permeability thicken considerably and the highly permeable Eocene rocks are relatively deep and yield only salty water. In this area, the yield from Oligocene and Miocene rocks is too small to warrant the drilling of wells. Pumping-test data for two areas on the barrier beach indicate that the permeability of the Floridan aquifer decreases southward.

Measurements of water levels in wells show that the piezometric surface in the county has declined several feet during the past two or three decades. The maximum fluctuation of water level observed in any well during the period April 1951 to July 1952 was eight feet. The declines were generally greatest in the areas southwest of Vero Beach and in the northern part of the barrier beach where large amounts of water were withdrawn for irrigation. The progressive lowering of the piezometric surface is due partly to irrigation pumping and partly to upward leakage, through wells, into shallower sediments.

The Floridan aquifer could become contaminated by sea water, owing to the lowering of the piezometric surface, but no evidence of this type of contamination has yet been noted. The only observed increase in chloride content seems to have been caused by the rise of highly mineralized water from deep parts of the aquifer, in response to the lowering in head caused by irrigation withdrawals.

The nonartesian aquifer is capable of yielding moderate amounts of water, and the water is of better quality than that from the Floridan aquifer. Vero Beach obtains its water supply from an artesian zone in the nonartesian aquifer at a depth of about 60 feet.

More quantitative and qualitative data are required in order to evaluate the potential of the Floridan aquifer and the shallower aquifers and to delineate the areas in which the quality of water is or may become poor because of contamination by water of high chloride content.

WELL LOGS

The differentiation of the formations in the following logs is based upon lithology, lithologic sequences, and foraminiferal faunas. As with many wells logs, the exact point of contact between two formations may be interpreted differently by various workers. Stratigraphic determinations were most difficult in the post-Oligocene sediments. The Tampa limestone is apparently missing. The Hawthorn formation is present, but the boundary between it and the overlying Tamiami formation cannot be determined exactly. Similarly, the boundary between the upper Miocene and post-Miocene sediments cannot be determined exactly. However, the contacts within these post-Oligocene sediments have been placed at definite points in both the well logs and geologic cross sections. These tentative stratigraphic determinations may need some revisions in the future, when more well cuttings are available from the area. The post-Miocene deposits have been identified as Pleistocene, but part of them may be of Pliocene age.

Description	Depth, in feet, below land surface
Well BR 762 - SE$\frac{1}{4}$SW$\frac{1}{4}$ sec. 25, T. 30 S., R. 38 E., Brevard County. Land surface altitude is about 15 feet above mean sea level.	
Fort Thompson(?) formation	
No sample........................	0 - 105
Sand and shells; sand, gray, fine to very coarse, with some phosphorite.	105 - 121
Tamiami(?) formation	
Clay, green, with sand and phosphorite as above and some white to light green silt. Shark's teeth.........	121 - 142
Clay, dark green, finely sandy, hard. Mollusk fragments...............	142 - 163
Hawthorn formation	
Sand, olive-drab, quartz, coarse to very coarse, averaging coarse, clayey, with phosphorite pebbles. Mollusk fragments...............	163 - 184

Description	Depth, in feet, below land surface
Clay, bluish-green to gray, finely phosphatic, with some white to light brown sandy, silty, phosphatic limestone	184 - 199
Clay, olive-drab, phosphatic. Mollusk fragments........................	199 - 219
Clay, blue-green, phosphatic; green shale; olive-drab chert...........	219 - 238
Clay, brown to light green, with pebbles of phosphorite...............	238 - 280
Rocks of Oligocene age	
Limestone, cream-colored to tan, soft, porous, granular, calcitic, silty, clayey, phosphatic, slightly glauconitic. Mollusk fragments, echinoid spines, Foraminifera, (_Nodosaria_ sp. ?, _Lepidocyclina_ sp. ?, _Operculinoides_ sp.)........	280 - 341
As above, plus crab claws, fish bones, and barnacle plates	341 - 346
Crystal River formation	
Limestone, white, hard to soft, chalky, glauconitic. _Discocyclina (Asterocyclina) georgiana_, _Operculinoides ocalanus_........................	346 - 350
Limestone, white, softer than above, chalky, Foraminifera coquina in lower part, contains above forms plus _Lepidocyclina ocalana_, some echinoids and brachiopods	350 - 361
Limestone, cream-colored, soft. Fauna as above plus miliolids.....	361 - 382
Williston and Inglis formations, undifferentiated	
Limestone, gray-buff, very hard. Fauna as above..................	382 - 403
As above, plus some cream-colored miliolid limestone	403 - 408

Description	Depth, in feet, below land surface
Well 24 - SE$\frac{1}{4}$NE$\frac{1}{4}$ sec. 3, T. 33 S., R. 39 E., Indian River County. Land surface altitude is about 22 feet above mean sea level. (Adapted from a log by R. O. Vernon)	
Pleistocene deposits, undifferentiated	
Sand, fine to medium, curvilinear, quartz in which numerous mollusk shells retaining much of their original lustre are present	0 - 61
Coquina, a broken, loose mass of mollusk shells as above, containing loose grains of quartz sand as above.	61 - 81
Coquina as 61-81, shells larger and more massive structures. Very little sand	81 - 95
Coquina, a broken, loose mass of mollusk shells, the majority being medium gray, eroded, lustreless and some being phosphatic. A few pebbles of phosphorite and quartz sand grains. <u>Elphidium gunteri</u>, <u>Rotalia beccarii</u> var., <u>Elphidium incertum</u>......................	95 - 100
Coquina, as 95-100; light brown sandy, phosphoritic, dense, soft marl...	100 - 102
Tamiami(?) formation	
Coquina, a loose mass of broken mollusk shells, retaining their original lustre - and set in a light brownish-gray, sandy, dense, soft marl. <u>Elphidium gunteri</u>, <u>Amphistegina lessoni</u>, <u>Rotalia beccarii</u>, <u>Eponides</u> sp., <u>Elphidium incertum</u>, <u>Sorites</u> sp., <u>Cythereis exanthemata</u> var.; Bryozoa; some quartz sand and the marl of 100-102	102 - 121
Marl, light brownish-gray, sandy, phosphatic shelly	121 - 127

Description	Depth, in feet, below land surface
Limestone, marly, as 121-127; border of mollusks leached to a calcite dust. Crystalline calcite indicates a minutely vuggy porosity. Well preserved oyster shells	127 - 141
Limestone, marly, light brownish-green, soft. *Textularia agglutinous*, *Planulina depressa*, *Planularia* sp., *Robulus* sp., *Robulus* sp. cf. *R. floridanus*, *Elphidium poeyanum*, *Nonion pizarrensis*, *Bulimina gracilis*, *Bolivina marginata multicostata*	141 - 160
Sand, black to gray, medium to coarse, clear quartz and polished phosphorite	160 - 178
No sample.......................	178 - 181
Clay, light brownish-green, calcareous, soft, massive, granular, phosphoritic. Fish teeth and scales fairly common. Foraminifers and large fragments of an oyster; calcareous sandstone; gray phosphatic limestone......................	181 - 237
Hawthorn formation	
Sand, clear and gray, coarse to medium, subrounded quartz; black to gray phosphorite. Fragments of an oyster; white calcareous sandstone.	237 - 269
Sand as above; light tan marl; coquina of small foraminifers; quartz and phosphorite sand grains in a soft, poorly porous marly matrix. *Textularia articulata*, *T. mayori*, *Planulina depressa*, *Cibicides floridana*, *Dyocibicides biserialis*, *Robulus* sp., *Textulariella* sp., *Cythereis garreti*, *Hemicythere*	

Description	Depth, in feet, below land surface
conradi, Cythereis exanthemata, and others......................	269 - 286
Limestone, light tan, marly, crystalline, fairly hard, sand sized phosphorite grains 25 percent of the rock. Medium gray marly, very hard, brittle, sandy, clayey limestone; phosphorite pebbles, black to gray, 30 percent of sample.............	286 - 305
No sample........................	305 - 317
Clay, light greenish-gray, hard, dense; brittle, indurated silicified fuller's earth; phosphorite and quartz sand	317 - 363
Marl, light tan, phosphoritic, sandy, granular, soft, dense	363 - 383
Phosphorite, tan to brown, radiolarian casts, sandy, probably held in a light tan, crystalline marl; tan hard dense sandy, phosphoritic limestone; oyster fragments; fuller's earth.........................	383 - 394
Rocks of Oligocene age(?)	
Limestone, cream-colored, yellowish, fragmental, marine, porous, soft; Grains of calcite, star fish and brittle star plates, loosely set in a calcite paste; brown hard dense cryptocrystalline, sandy, phosphoritic limestone (cavings?). Robulus sp., Eponides sp. Anomalina cf. mississippiensis, Cythereis sp., Cytheridea sp.	394 - 500
Crystal River formation	
Limestone, cream-colored, porous, soft, fragmental, marine, a coquina of large foraminifers, mollusks and	

Description	Depth, in feet, below land surface
small foraminifers loosely held in calcite paste. Lepidocyclina sp., Camerina sp., common	500 - 517
Williston and Inglis formations, undifferentiated	
Limestone, cream-colored, fragmental, porous, friable, marine. Grains of calcite and microfossils in calcite paste. First Camerina moodybranchensis, Operculinoides ocalanus, Amphistegina pinarensis common. First Fabiania cubensis fragments at 568-580.............	517 - 580
Limestone, cream-colored, porous, friable, fragmental, marine, a miliolid-rich, granular rock with few large foraminifers. Fabiania cubensis, Amphistegina pinarensis	580 - 671

Well 107 - NW$\frac{1}{4}$NE$\frac{1}{4}$ sec. 35, T. 31 S., R. 39 E., Indian River County. Land surface altitude is about five feet above mean sea level. (Adapted from a log by R.O. Vernon)

Hawthorn formation	
No sample......................	0 - 235
Sand, medium to coarse, subrounded quartz and phosphorite, containing fragments of mollusk shells; greenish-gray very argillaceous marl ..	235 - 246
Limestone and marl, cream-colored to green, hard, dense, sandy	246 - 267
Marl, tan to light greenish-gray, sandy, phosphoritic, foraminiferal. Contains Miocene Foraminifera from in the Cancellaria and Arca zones of western Florida, including Textulariella sp., Textularia agglutinans, T. gramen?, Cibicides	

Description	Depth, in feet, below land surface
americana, Lenticularia sp., and Robulus sp.	267 - 287
Marl, light greenish-gray, finely crystalline, pasty; sand grains of phosphorite, quartz, fish bone and teeth; many foraminifers, and scattered radiolarians	287 - 308
Fuller's earth, light greenish, hard, dense, phosphoritic..............	308 - 400
Rocks of Oligocene age	
Limestone, cream-colored, granular, porous, soft, composed of detrital grains of calcite, foraminifers, echinoid plates and broken mollusks, loosely set in a pasty calcite matrix.	400 - 432
Limestone as above, a few microfossils, abundant fragments of mollusks and echinoids; dark gray dense chert fragments. Pterygocythereis (?) alexanderi, Cibicides mississippiensis and fossils above...........	432 - 474
Limestone, white to cream-colored, pasty, porous, soft. Sample contains abundant fragments of barnacle plates and scattered mollusk fragments. Operculinoides sp., Lepidocyclina sp., and smaller foraminifers from above.................	474 - 515
Limestone, cream-colored, finely granular, soft, fairly porous, fine calcite grains in pasty matrix. Coffee-colored chert 10-15 percent of sample......................	515 - 520
Sample as above, chert up to 60 percent of sample.....................	520 - 557
Limestone, cream-colored, soft, porous, microfossiliferous; very	

Description	Depth, in feet, below land surface
finely granular calcite grains. Foraminifera and mollusk fragments set in a pasty matrix. Scattered chert fragments. A fauna found in the Red Bluff clay and Marianna limestone and ranging into the Byram formation including Liebusella byramensis, (abundant), Textularia subbauerii, T. conica, Lenticulina rotulata, Nodosaria sp., and common ostracods..................	557 - 618
Crystal River formation	
Limestone as above, but with Eponides carolinensis, Gyroidina sp., of the Ocala limestone	618 - 638
Coquina, cream-colored, soft, porous, pasty. Foraminifera: Operculinoides sp., and Lepidocyclina sp., prominent, includes some of the Foraminifera above, Asterocyclina sp., Gypsina sp., Operculinoides mariannensis	638 - 676
Coquina, cream-colored, soft, porous. Foraminifera: Asterocyclina common, Gypsina, Amphistegina pinarensis, Camerina moodybranchensis (?)............................	676 - 754
Limestone, cream-colored to gray, coquinoid, porous, soft, friable grains of calcite, and Foraminifera in a pasty matrix. Fossil mixture of all Eocene above. More granular than sample from 676-754	754 - 910
Coquina of large Foraminifera, largely Lepidocyclina ocalana (about 95 percent) and rare smaller Foraminifera	910 - 1010

Description	Depth, in feet, below land surface

Note: Robert O. Vernon (personal communication, 1951) indicates that this well definitely penetrated a section of limestones of Oligocene age having characteristics of the Oligocene of western Florida, the Byram formation and Marianna limestone. The samples from 676-754 feet contain elements of the basal Ocala group (Williston and Inglis formations), but the samples from 910-1010 feet are typical of the uppermost Ocala group (Crystal River formation).

The depth measured during electric logging of this well is about 20 feet short of the reported depth and may be the result of caving. The location of the possible top of the Ocala group can be interpreted from the electric log as occurring at the same depth as that indicated in this lithologic log. The electric log suggests that the top of the Vicksburg group may be 20 feet higher than indicated in this log. The thickness of the lower part of the Ocala appears excessive in this well. The occurrence of a Foraminifera fauna typical of the upper part of the Ocala group below the lower part of the Ocala group may indicate caving, although E. W. Bishop (personal communication, 1953) and M. C. Schroeder (personal communication, 1953) have noted similar occurrences in the cuttings from wells in other parts of southern Florida. There is an anomaly on the electric log of this well at 895 feet in depth which may correspond to an anomaly recorded in the Avon Park limestone on the electric log of well 202.

Well 161 - NE$\frac{1}{4}$SE$\frac{1}{4}$ sec. 4, T. 32 S., R. 39 E., Indian River County. Land surface altitude is about 33 feet above mean sea level.

Pleistocene deposits, undifferentiated	0 - 105
Fort Thompson formation	
Sand, gray-brown, quartz, fine to coarse, average medium, with many light to dark colored mollusk fragments	105 - 126
Limestone, light gray to dark gray,	

Description	Depth, in feet, below land surface
hard to soft, sandy; light olive-drab clay with phosphorite pebbles and white to dark colored mollusk fragments, _Chione cancellata_?........	126 - 147
Tamiami(?) formation	
Limestone as above; light to dark olive-drab phosphatic clay, containing numerous small Foraminifera .	147 - 189
As above, plus much more clay and some quartz sand................	189 - 210
Hawthorn formation	
Fuller's earth, dark olive-drab, finely phosphatic; cream-colored very hard, sandy limestone. The clay part of the sample contains numerous well preserved, small Foraminifera	210 - 231
No samples.......................	231 - 378
Rocks of Oligocene age	
Limestone, cream-colored, hard, clayey, slightly glauconitic, with some crystalline calcite and gray chert, fossiliferous (mollusk fragments, molds and casts). _Lepidocyclina_ sp. ?, and small Foraminifera	378 - 400
Limestone, tan, soft, granular, clayey; light blue chert. Fauna as above..	400 - 420
Crystal River formation	
Limestone, cream-colored, soft, porous, very glauconitic. Echinoids, _Lepidocyclina ocalana_, _Heterostegina ocalana_, _Operculinoides ocalanus_, _Discocyclina (Asterocyclina) mariannensis_...................	420 - 482

Description	Depth, in feet, below land surface
Williston(?) and Inglis(?) formations, undifferentiated	
As above, plus brown very calcitic limestone	482 - 504

Well 116 - $SE\frac{1}{4}SE\frac{1}{4}$ sec. 14, T. 33 S., R. 38 E., Indian River County. Land surface altitude is about 20 feet above mean sea level.

Description	Depth, in feet, below land surface
Avon Park limestone	
No sample	0 - 610
Limestone, light gray to cream-colored, soft to hard, chalky, porous, calcitic, fossiliferous. _Peronella dalli_, _Coskinolina floridana_, _Dictyoconus cookei_, _Lituonella floridana_, several species of _Lepidocyclina_ and miliolids	610 - 672
Lake City limestone	
Lithology as above. Mollusk fragments, echinoid spines, _Dictyoconus americanus_	672 - 693
Limestone, white to light gray to brown, hard, argillaceous, porous. Fossiliferous, numerous _Dictyoconus americanus_	693 - 746

Well 187 - $NE\frac{1}{4}NE\frac{1}{4}$ sec. 33, T. 31 S., R. 35 E., Indian River County. Land surface altitude is about 40 feet above mean sea level.

Description	Depth, in feet, below land surface
Hawthorn formation	
No sample	0 - 284
Fuller's earth, tan-gray to gray-green; white to tan hard sandy, phosphatic, finely crystalline limestone, phosphorite pebbles and quartz sand.	

Description	Depth, in feet, below land surface
mollusk fragments, shark's teeth..	284 - 287
Crystal River formation	
Limestone, foraminiferal coquina, cream-colored, soft, porous, chalky. Composed almost entirely of specimens of *Lepidocyclina ocalana*....	287 - 315
Williston and Inglis formations, undifferentiated	
Limestone, cream-colored, "miliolid", harder than above, porous. *Camerina moodybranchensis*?.....	315 - 336
Avon Park limestone	
Limestone, reddish-brown, "miliolid", hard, very crystalline; white soft chalky porous fossiliferous limestone. *Peronella dalli*, numerous *Coskinolina floridana*, *Spirolina coryensis*, *Valvulina intermedia*, *Bulimina* sp.	336 - 347
Limestone, cream-colored, "miliolid", hard to soft, porous, chalky, with crystalline calcite. Fauna as above..........................	347 - 389
Limestone, cream-colored, soft, porous, chalky, calcitic..........	389 - 420
Limestone, cream-colored to light brown, soft to hard, granular, porous, very calcitic. *Textularia coryensis*......................	420 - 473
Limestone, cream-colored to light brown, soft, chalky, porous. Avon Park fauna......................	473 - 493
As above, but harder and calcitic...	493 - 504

Well 200-- SE$\frac{1}{4}$NE$\frac{1}{4}$ sec. 2, T. 33 S., R. 39 E., Indian River County. Land surface altitude is about 15 feet above mean sea level.

Description	Depth, in feet, below land surface
Rocks of Oligocene age	
No sample........................	0 - 410
Limestone, gray, soft, silty, granular, calcitic. Echinoid and mollusk fragments, Ostracoda, Foraminifera - Nodosaria praecatesbyi? and others	410 - 441
Limestone, cream-colored to gray, hard, granular, calcitic, with material as above, very fossiliferous. Coral, mollusk and echinoid fragments, Foraminifera - Lepidocyclina? and others...........	441 - 462
As above, plus tan glauconitic clay containing numerous small Foraminifera......................	462 - 482
Crystal River(?) formation	
Limestone, light gray to tan, hard to soft, glauconitic, chalky to granular. Fossiliferous Operculinoides floridensis.....................	482 - 515
Limestone, light gray to cream-colored, hard, chalky to granular, slightly glauconitic, porous, calcitic. Fossiliferous	515 - 525
Limestone, cream-colored, hard, granular, glauconitic, porous, fossiliferous. Discocyclina (Asterocyclina) mariannensis and others.	525 - 546
As above, but hard to soft..........	546 - 588
Limestone, cream-colored, hard to medium hard, chalky, dense. Mollusk fragments, coral, and Foraminifera	588 - 591
Williston(?) and Inglis(?) formations, undifferentiated	
Limestone, cream-colored, hard, granular to chalky, slightly, crystalline, fossiliferous. Coral and	

Description	Depth, in feet, below land surface
molds of mollusks	591 - 620
As above, plus numerous Foraminifera. Lepidocyclina ocalana	620 - 641
No sample.......................	641 - 650
Coquina, cream-colored, hard, porous; slightly porous limestone. Coral, Foraminifera, mostly Helicolopidina? paucispira?	650 - 700

Well 201 - SW$\frac{1}{4}$SW$\frac{1}{4}$ sec. 14, T. 31 S., R. 39 E., Indian River County. Land surface altitude is about seven feet above mean sea level.

Hawthorn formation	
No sample.......................	0 - 200
Clay, dark green, sandy (medium to very coarse), shelly. Donax varibilis?, Arca (Anadara) sp., Phacoides sp., and others........	200 - 221
Sand, phosphorite and shells; sand is olive-drab, quartz, medium to very coarse, average coarse. Marginella cf. M. bella hosfordensis and others.	221 - 224
Clay, dark green to gray, sandy, with phosphorite pebbles. Mollusk fragments, shark's teeth.............	224 - 286
Clay, light green, hard, dense, phosphatic; dark translucent chert.....	286 - 349
As above, plus limestone, cream-colored, chalky, soft, silty.......	349 - 360
Rocks of Oligocene age	
Limestone, cream-colored, soft, chalky, silty, with small grains of calcite. Barnacle plates, mollusk fragments, echinoid fragments....	360 - 438
Limestone, cream-colored, harder than above, calcitic, with material	

Description	Depth, in feet, below land surface
as above and brown chert. Numerous mollusk fragments	438 - 444
Coquina, cream-colored, with some glauconite. Echinoid fragments, Operculinoides sp. ?, and Lepidocyclina sp. ?	444 - 454
Limestone, cream-colored to light gray, hard, chalky. Numerous molds and casts of mollusks	454 - 465
Limestone, cream-colored, soft, chalky, silty. Mollusk fragments .	465 - 485
As above, plus brown to olive-drab chert. Nodosaria sp. ?...........	485 - 505
Limestone, tan, soft, clayey, sandy, cherty. Mollusk fragments, echinoid spines, ostracods, Foraminifera..	505 - 600
Limestone, cream-colored, soft, clayey, glauconitic, very fossiliferous. Mollusk fragments, echinoid spines, ostracods and numerous small Foraminifera, Nodosaria sp., Dentalina sp.....................	600 - 642
Crystal River formation	
Limestone, tan, soft, very fossiliferous, Operculina mariannensis, several species of Lepidocyclina, miliolids and others..............	642 - 747
Williston(?) and Inglis(?) formations, undifferentiated	
As above, plus Camerina moodybranchensis?....................	747 - 843

Note: The electric log suggests that the top of the rocks of Vicksburg age and the Ocala group possibly occurs about 15 and 35 feet higher, respectively, than indicated in this log.

Well 202 - SW$\frac{1}{4}$NE$\frac{1}{4}$ sec. 18, T. 33 S., R., 36 E., Indian

Description	Depth, in feet, below land surface
River County. Land surface altitude is about 30 feet above mean sea level.	
Fort Thompson(?) formation	
No sample........................	0 - 30
Sand, light to dark gray, quartz, fine to coarse. Mollusk fragments....	30 - 42
As above, but with numerous dark colored shells....................	42 - 63
Shell marl, gray to green, sandy, gray-green crystalline limestone. Marine mollusks, echinoid spines, fresh-water gastropods...........	63 - 125
Tamiami(?) formation	
Clay, olive-drab, sandy, very shelly.	125 - 195
Hawthorn formation	
Sand, gray to olive-drab, quartz, fine to coarse; phosphorite and shell fragments.......................	195 - 200
Clay, light green to white, phosphatic; quartz sand; gray to white soft sandy limestone. Mollusks fragments, coral, small Foraminifera........	200 - 300
Clay, gray to blue-green, very phosphatic. Mollusk fragments	300 - 355
Crystal River formation	
Coquina, tan to white, foraminiferal, fairly hard, slightly porous. *Lepidocyclina ocalana*, *Heterostegina ocalana*........................	355 - 418
Williston and Inglis formations, undifferentiated	
Limestone, cream-colored, miliolid, hard, porous. Echinoid spines, mollusk fragments, *Camerina moodybranchensis?*....................	418 - 439

Description	Depth, in feet, below land surface
Avon Park limestone	
Limestone as above, plus hard gray to brown carbonaceous limestone. Dictyoconus cookei, Valvulina intermedia, Coskinolina floridana, Textularia coryensis..................	439 - 460
Limestone, gray to tan, soft, carbonaceous; brown, hard, porous, dolomitic limestone. Fauna as above..	460 - 494
Limestone, buff to dark gray, soft, porous.........................	494 - 499
Limestone, white to brown, soft to hard, slightly clayey, chalky. Miliolids, Spirolina coryensis, Lituonella floridana..................	499 - 604
Limestone, tan, hard, porous, dolomitic..........................	604 - 625
Lake City limestone	
Limestone, tan, soft, porous, argillaceous, carbonaceous, dolomitic. Echinoid fragments, Dictyoconus americanus	625 - 645
Limestone, white to tan, soft, porous; brown hard porous to dense limestone. Fossiliferous.............	645 - 672
Chert, brown, hard, plus material as above..........................	672 - 678
Limestone, cream-colored, soft, porous; brown hard limestone. Fossiliferous......................	678 - 683
Limestone, brown, hard to soft, crystalline, dolomitic, porous	683 - 700

Well 203 - SE$\frac{1}{4}$NE$\frac{1}{4}$ sec. 33, T. 31 S., R. 37 E., Indian River County. Land surface altitude is about 33 feet above mean sea level.

Description	Depth, in feet, below land surface
Pamlico sand	
Sand, brown, quartz, coarse to very coarse, average coarse	0 - 10
Fort Thompson(?) formation	
Sand, brown, quartz, coarse to very coarse, average coarse; phosphorite pebbles; a few shell fragments....	10 - 41
Sand, gray, quartz, fine to medium.	41 - 51
Sand, gray, coarse, clayey; white to dark gray shells	51 - 61
Sand, gray, fine to coarse, average medium, clayey; white to dark gray shells	61 - 82
Clay, gray, very sandy, very shelly.	82 - 123
Tamiami(?) formation	
Clay, gray-green, very sandy; fine to coarse sand, average medium; shell fragments......................	123 - 143
Clay, dark blue-green, finely sandy, numerous shell fragments	143 - 163
Hawthorn formation	
Fuller's earth, dark olive-drab, finely sandy, with some hard white clay and phosphorite pebbles; shells fragments	163 - 205
Marl, green to gray, clayey, sandy; fine to coarse, phosphatic sand; tan finely crystalline hard phosphatic limestone; brown chert; numerous phosphorite pebbles. Foraminifera.	205 - 246
Marl, gray-brown, clayey; white hard sandy, phosphatic limestone; very dark sandy phosphatic limestone; phosphorite pebbles. Mollusk fragments, shark's teeth, Foraminifera.	246 - 266

Description	Depth, in feet, below land surface
Fuller's earth, gray-brown to white, very phosphatic. Fauna as above..	266 - 287
Limestone, white, hard to soft, sandy, phosphatic; medium to coarse sand; light gray clay. Mollusk fragments.	287 - 307
Fuller's earth, olive-drab, finely sandy, with material as above.....	307 - 389
Crystal River formation	
Limestone, cream-colored, soft, porous, glauconitic. Very fossiliferous, Lepidocyclina ocalana, Heterostegina ocalana, Camerina sp., and other Foraminifera, echinoid spines......................	389 - 447
No sample........................	447 - 451
Williston and Inglis formations, undifferentiated	
Limestone, cream-colored, miliolid, hard to soft, porous, calcitic.....	451 - 512
Avon Park limestone	
Limestone, light gray, has purplish tinge, hard to soft, chalky, porous, to dense. Echinoid fragments, mollusk fragments, Lituonella floridana, Cribrobulimina cushmani.........	512 - 533
Limestone, cream-colored, soft, granular, porous. Fauna as above, plus numerous specimens of Coskinolina floridana and Dictyoconus cookei..........................	533 - 553
Limestone, lighter than above, soft, chalky, not as porous as above. Very fossiliferous	553 - 574
Limestone, light gray, slightly clayey, soft, porous. Very fossiliferous. Avon Park fauna.................	574 - 594

Description	Depth, in feet, below land surface
Well 248 - SW$\frac{1}{4}$NE$\frac{1}{4}$ sec. 12, T. 33 S., R. 39 E., Indian River County. Land surface altitude is about 10 feet above mean sea level.	
Crystal River formation	
No sample........................	0 - 492
Limestone, cream-colored, soft, slightly glauconitic, chalky, porous, with some material from above. Mollusk fragments, echinoid spines, brachiopods, and numerous Foraminifera - *Lepidocyclina ocalana*, *Camerina* sp. ?, and others.......	492 - 554
Limestone, light cream-colored, harder than above, slightly calcitic. Coral, ostracods and a few large Foraminifera....................	554 - 635
Williston (?) and Inglis (?) formations, undifferentiated	
Coquina, cream-colored hard, porous, some secondary calcite. Foraminifera, mostly small circular *Lepidocyclina*................	635 - 677
Well 259 - SE$\frac{1}{4}$SE$\frac{1}{4}$ sec. 5, T. 32 S., R. 39 E., Indian River County. Land surface altitude is about 22 feet above mean sea level.	
Crystal River formation	
No sample........................	0 - 377
Limestone, cream-colored, hard to soft, chalky, porous to dense, glauconitic. Mollusk fragments, echinoid fragments, coral, brachiopods, bryozoa, ostracods, and Foraminifera. *Lepidocyclina ocalana*, *Discocyclina (Asterocyclina) georgiana*, *Operculinoides ocalanus*, *Heterostegina ocalana*.................	377 - 419

Description	Depth, in feet, below land surface
Williston(?) and Inglis(?) formations, undifferentiated	
Limestone, cream-colored, hard, granular. Fossiliferous, as above.	419 - 440
Limestone, as in 377-419, plus many specimens of Helicolepidina? pauci-spira?........................	440 - 461
Limestone, as in 419-440, plus some crystalline calcite	461 - 483
Limestone, cream-colored, soft, chalky, porous, very fossiliferous. Camerina moodybranchensis?.....	483 - 504
Avon Park limestone	
Limestone, tan, hard, granular, porous, calcitic; cream-colored medium hard, fossiliferous miliolid limestone. Coiled worm tubes, numerous Peronella dalli.........	504 - 525
Limestone, cream-colored to light gray, hard, chalky, calcitic, fossiliferous as above...............	525 - 546
Coquina, cream to tan, soft, granular, foraminiferal. Camerina? ...	546 - 567
Lake City limestone	
Limestone, cream-colored, tan to white, hard to soft, chalky, calcitic. Dictyoconus americanus, Coskinolina floridana, Textularia coryensis, Spirolina coryensis, Lituonella floridana........................	567 - 630
Limestone, cream-colored, hard, chalky, porous; brown, hard, porous, "miliolid" limestone	630 - 651

Well StL 44 - SW$\frac{1}{4}$NW$\frac{1}{4}$ sec. 3, T. 34 S., R. 39 E., St. Lucie County. Land surface altitude is about 20 feet above mean sea level.

Description	Depth, in feet, below land surface
Fort Thompson(?) formation	
No sample........................	0 - 37
Sand, brown to gray, fine to some very coarse. Worn fragments of light to dark colored gastropods and pelecypods	37 - 100
As above, plus tan to gray very sandy limestone......................	100 - 121
Tamiami(?) formation	
Clay, gray, to dark olive-drab, finely sandy; olive-drab hard sandy, crystalline, phosphatic? limestone ...	121 - 226
Hawthorn formation	
Clay, dark olive-drab, very coarsely sandy. Mollusk fragments and shark's teeth....................	226 - 247
Sand, olive-drab, quartz, coarse to very coarse, average coarse; clay, as above; phosphorite. Mollusk fragments and shark's teeth.......	247 - 268
As above; plus gray to brown hard sandy limestone	268 - 289
Clay, gray-green to white, coarsely sandy, phosphatic; dark translucent chert. Mollusk fragments........	289 - 310
As above, but clay is very hard.....	310 - 332
As above, but with many mollusk fragments, and some light colored chert...........................	332 - 395
Rocks of Oligocene age	
Limestone, cream-colored soft to medium hard, slightly glauconitic, clayey, granular (composed of small grains of calcite and bits of shell material). Mollusk fragments, echinoid spines, barnacle plates,	

Description	Depth, in feet, below land surface
ostracods, Foraminifera, *Bolivina ariana*?, *Lepidocyclina* sp.?. *Operculinoides* sp. ? in lower part	395 - 454
Crystal River formation	
Coquina, cream-colored soft, porous, foraminiferal. Small echinoids, *Lepidocyclina ocalana* and *Heterostegina ocalana*..................	454 - 475
Williston(?) and Inglis(?) formations, undifferentiated	
Limestone, cream-colored, soft to hard, glauconitic, granular. Numerous Foraminifera, *Camerinidae* and miliolidae.......................	475 - 496
Coquina, tan, soft. Foraminifera (mostly small), numerous miliolids.	496 - 539
As above, plus cream-colored soft chalky limestone. More large Foraminifera than above.............	539 - 560
Limestone, cream-colored, hard, chalky. Foraminifera, *Camerina moodybranchensis*? and others....	560 - 581
Avon Park limestone	
Limestone, tan, hard, chalky. Foraminifera numerous, *Coskinolina floridana*, *Dictyoconus cookei*, *Lituonella floridana*, *Valvulammina minuta*, several well preserved charophyte oogonia...............	581 - 661
Lake City limestone	
Limestone, cream-colored to white, argillaceous, hard, porous, fossiliferous. *Dictyoconus americanus* .	661 - 691

Well StL 48 - NE$\frac{1}{4}$NW$\frac{1}{4}$ sec. 5, T. 34 S., R. 40 E., St. Lucie

Description	Depth, in feet, below land surface
County. Land surface altitude is about two feet above mean sea level.	
Anastasia(?) formation	
No sample.	0 - 3
Limestone, brown to cream-colored, very sandy, shelly, hard, porous.	3 - 4
No sample.	4 - 21
Fort Thompson(?) formation	
Sand, gray to brown, quartz, fine to coarse. Fragments of gastropods and pelecypods, numerous Donax sp. ?	21 - 101
Tamiami(?) formation	
Clay, dark gray to dark olive-drab, phosphatic, finely sandy; gray dense crystalline limestone.	101 - 246
Hawthorn formation	
As above, plus coarse sand	246 - 284
As above, plus gray hard sandy limestone	284 - 302
Sand, olive-drab, quartz, coarse to very coarse, average coarse; clay, as above; phosphorite pebbles. Mollusk fragments and shark's teeth	302 - 318
As above, plus dark translucent chert; white clay.	318 - 340
Clay, olive-drab to light green, light green clay is dense and hard; brown to white sandy limestone, plus material as above	340 - 360
Clay, olive-drab, coarsely sandy, phosphatic. Mollusk fragments	360 - 380
As above, but lighter in color	380 - 400
Rocks of Oligocene age	
Limestone, cream-colored to light	

Description	Depth, in feet, below land surface
brown, soft to medium hard, granular; white very sandy limestone; brown chert; phosphorite and sand; Ostracods, sponge spicules	400 - 442
As above, plus some glauconite, and secondary calcite. Numerous mollusk fragments, and echinoid spines, Lepidocyclina sp. ?	442 - 484
Limestone and clay, cream-colored to olive-drab; soft chalky limestone; dark chert. Fossiliferous, as above.	484 - 505
Crystal River formation	
Limestone, cream-colored, soft, chalky, glauconitic, very fossiliferous. Lepidocyclina ocalana. Operculinoides ocalanus, mollusk fragments......................	505 - 521
Limestone, tan-gray, hard, chalky, very fossiliferous. Mollusk fragments, star fish ossicles, several varieties of Lepidocyclina ocalana, Discocyclina (Asterocyclina) georgiana...........................	521 - 542
Limestone, cream-colored, hard, porous, slightly crystalline. Fauna as above, plus some coral........	542 - 584
Williston(?) and Inglis(?) formations, undifferentiated	
As above, plus cream-colored chert. Camerina moodybranchensis ?.....	584 - 605
Limestone, cream-colored, hard, porous, chalky, slightly crystalline. Fossiliferous....................	605 - 642
As above, but cream to tan in color.	642 - 663
As above, but slightly glauconitic ...	663 - 684

Table 4. Records of Selected Wells in Indian River County

Well No.	Location Sec.	T.S.	R.E.	Owner	Depth (ft)	Diameter (in)	Casing depth (ft)	Chloride (ppm)	Water level (ft)[1]	Date measured and sampled	Est. flow (gpm)	Use[2]	Temperature (°F)	Remarks
10	2	33	39	City of Vero Beach	667	8	---	620	---	1- 4-52	550	A.	---	Water level 35 ft. in Water-Supply Paper 773-C
23	1	33	39	E. Soppitt	690	4	132	259	---	4-14-49	440	Irr.	76	
24	2	33	39	F. Pollock	671	4	126	320	---	4-17-49	375	Irr.	78	Log included. See fig. 8
								310		8-20-51				
25	36	32	35	U.S. Geological Survey	19	6	---	---	---	---	---	Obs.	---	Water-level recording gage
26	23	31	39	J. Cates	600	4	---	470	14	3-13-51	15	Dom.	76	
									19	2-15-52				
27	15	31	39	J. Balbora	700	5	220	---	30	3-13-51	165	Irr.	77	
30	10	31	39	Parish & Whaley	590	6	204	492	37	3-14-51	600	Irr.	77	
32	9	31	39	A. Byrd	590	6	---	438	38	3-14-51	1,500	Irr.	77	
33	9	31	39	A. Byrd	540	4	---	390	37	3-14-51	330	Irr.	76	
36	10	31	39	Lier & Michael	680	6	230	485	32	3-15-51	500	Irr.	78	
37	15	31	39	J. Balbora	750	5?	220	548	33	3-15-51	---	Irr.	78	
41	15	31	39	J. Balbora	---	5	---	580	21	3-19-51	110	Irr.	77	
42	15	31	39	J. Balbora	750	4	220	---	31	3-19-51	150	Irr.	78	
43	15	31	39	J. Balbora	850	5	220	738	24	3-19-51	215	Irr.	78	
44	15	31	39	J. Balbora	960	5	220	710	22	3-19-51	170	Irr.	79	
45	15	31	39	B. Bailey	---	4	---	620	34	3-19-51	---	Irr.	78	
46	15	31	39	B. Bailey	850	4	---	615	24	3-20-51	120	Irr.	79	See fig. 9
47	15	31	39	B. Bailey	700	4	---	660	27	3-20-51	120	Irr.	78	
48	15	31	39	J. Balbora	700	6	---	---	29	3-20-51	400	Irr.	78	
49	15	31	39	B. Bailey	760	4	---	---	24	3-20-51	130	Irr.	78	
									32	4-11-51				
51	15	31	39	Michael	800	4	---	---	27	3-20-51	150	Irr.	77	
53	14	31	39	T. Vincent	700±	5	200	495	27	3-20-51	---	Irr.	77	
54	14	31	39	T. Vincent	850	4	200	495	27	3-20-51	---	Irr.	77	Connected in manifold with well 53
									32	4-11-51				
58	1	32	38	Graves Bros.	400?	3	---	505	---	3-21-51	65	A.	---	
59	22	31	39	Deerfield Co.	650	3	---	724	---	9-12-47	---	Irr.	78	
60	22	31	39	Deerfield Co.	550	3	---	280	---	3-22-51	120	Irr.	76	

Table 4. Records of Selected Wells in Indian River County (continued)

Well No.	Location Sec.	T.S.	R.E.	Owner	Depth (ft)	Diameter (in)	Casing depth (ft)	Chloride (ppm)	Water level (ft)[1]	Date measured and sampled	Est. flow (gpm)	Use[2]	Temperature (°F)	Remarks
61	22	31	39	Deerfield Co.	550	6	---	635	37	3-22-51	500	Irr.	78	
62	23	31	39	Deerfield Co.	1,050	4	---	500	---	3-22-51	---	Irr.	78	
66	23	31	39	Deerfield Co.	600	4	---	440	---	9-12-47	10	Irr.	77	
									23	3-22-51				
67	23	31	39	Deerfield Co.	1,050	5	---	---	28	3-22-51	220	Irr.	78	
69	22	31	39	Deerfield Co.	550	4	---	553	---	9-12-47	25	Irr.	77	
70	22	31	39	Deerfield Co.	500	3	---	440	---	9-12-47	10	Irr.	76	
72	22	31	39	Deerfield Co.	800	6	---	420	38	3-22-51	450	Irr.	---	Siphon well
73	22	31	39	Deerfield Co.	800	6	---	550	40	3-23-51	900	Irr.	78	Siphon well
75	27	31	39	Deerfield Co.	700	6	---	570	38	3-26-51	720	Irr.	78	Siphon well
77	26	31	39	Deerfield Co.	550	3	---	354	---	9-12-47	100	Irr.	---	
79	23	31	39	Deerfield Co.	1,050	5	---	885	34	3-26-51	280	Irr.	79	Siphon well
81	23	31	39	J. Balbora	1,150	5	---	786	18	3-26-51	120	Irr.	79	
83	23	31	39	J. Balbora	1,000	5	---	422	18	3-27-51	125	A.	79	
									22	2- 8-52				
84	23	31	39	J. Balbora	1,000	4	---	308	16	3-27-51	80	A.	78	
85	26	31	39	J. Balbora	1,100	5	---	605	23	3-28-51	250	Irr.	79	
88	26	31	39	J. Balbora	---	1¼	---	242	---	3-28-51	---	Dom.	73	Shallow well
89	26	31	39	W. Stahl	800	3	---	390	27	3-28-51	---	Dom.	72?	
91	26	31	39	F. Eakin	650	3	---	208	25	3-28-51	---	Dom.	78	
94	25	31	39	P. Laird	17	1¼	---	325	---	3-28-51	---	Dom.	76	Nonartesian sand-point well
101	35	31	39	G. Dales	750	3½	320	475	30	3-29-51	---	Dom.	78	
102	26	31	39	G. Dales	850	4	300	655	32	3-29-51	---	Dom.	77	
104	35	31	39	Deerfield Co.	1,000	5	---	695	33	3-29-51	200	Irr.	79	Siphon well
106	34	32	39	City of Vero Beach	700	4	---	208	21	4-12-51	120	Irr.		
107	35	31	39	Deerfield Co.	991	5	---	755	37	4-26-51	300	Irr.	79	Log included. See figs. 8, 12
108	35	31	39	Deerfield Co.	860	3	---	690	32	4-27-51	50	Irr.	---	See fig. 10
109	35	31	39	Deerfield Co.	1,000	---	---	---	24	5-16-51	---	Dom.	---	
110	35	31	39		---	4	---	518	33	5-16-51	---	Dom.	---	
111	36	31	39		25	2	---	205	---	5-16-51	---	Dom.	---	
112	36	31	39	J. Corrigan	1,000	5?	---	565	28	5-16-51	---	Dom.	---	
									27	2- 8-52				

Table 4. Records of Selected Wells in Indian River County (continued)

Well No.	Location Sec.	T.S.	R.E.	Owner	Depth (ft)	Diameter (in)	Casing depth (ft)	Chloride (ppm)	Water level (ft)[1]	Date measured and sampled	Est. flow (gpm)	Use[2]	Temperature (°F)	Remarks
113	36	31	39	J. Corrigan	800	---	---	590	24	5-16-51	---	Dom.	---	
115	29	32	40	U.S. Coast Guard	640	3	140	970	21	5-16-51	5	A.	---	
116	1	32	39		650	4	260	260	36	5-16-51	---	Dom.	---	
118	7	32	40	Dr. Bush	---	4	---	890	25	5-17-51	---	Dom.	---	
									25	2- 8-52				
119	1	32	39		---	---	---	315	27	5-29-51	20	Irr.	---	
120	1	32	39		---	4	---	405	31	5-29-51	---	Irr.	---	
131	6	31	39	P. Stevenson	---	4	---	265	32	8- 2-51	---	Dom.	---	
132	13	31	38	R. Chesser	800	4	---	215	23	8- 2-51	---	Dom.	---	
133	12	31	38	C. Smith	---	4	---	340	23	8- 2-51	120	Irr.	---	
136	27	31	38		---	6	---	360	21	8- 6-51	450	Dom.	---	
137	26	31	38		---	4	---	388	24	8- 6-51	250	Dom.	---	
141	26	31	38		---	4	---	715	25	8- 6-51	---	Irr.	---	
142	25	31	38		---	4	---	435	26	8- 6-51	---	Dom.	---	
144	25	31	38		---	4	---	350	26	8- 7-51	300	Irr.	---	
147	31	31	39	A. Pfarr	620	4	---	298	22	8-10-51	---	Irr.	---	
149	31	31	39	A. Pfarr	625	4	---	320	24	8-10-51	200	Irr.	---	
151	30	31	39	Carter	625	4	---	292	20	8-16-51	---	Irr.	---	
154	31	31	39		---	4	---	282	19	8-16-51	180	Irr.	---	
156	31	31	39		---	4	---	362	25	8-16-51	250	Irr.	---	
160	30	31	39		600	4	220	362	20	8-16-51	300	Irr.	---	
161	4	32	39		580	4	---	---	4	9- 4-51	80	Irr.	---	Log included
164	36	31	38	R. Stough	640	4	---	382	26	9- 4-51	---	Irr.	---	
166	14	33	38	Commander Groves	746	6	---	---	---	---	---	Irr.	---	Log included
168	23	31	38	Davis	500	4	---	448	29	10-15-51	350	Irr.	---	
169	26	Fleming Grant		Widner	525	4	---	645	29	10-15-51	130	Irr.	---	
171	25	31	38	R. Stough	---	3	---	392	31	10-16-51	90	Irr.	---	
173	26	31	38	Massey	400?	4	120	360	28	10-16-51	310	Irr.	---	
174	22	31	38	Davis	540	4	180	472	---	10-17-51	200	Stock	---	
175	21	31	38	Davis	600	4	190	492	27	10-17-51	240	Stock	---	
176	24	31	37	F. Mett	---	3	---	155	11	10-17-51	10	Dom.	---	
177	24	31	37	F. Mett	---	4	---	360	22	10-17-51	150	Stock	---	

Table 4. Records of Selected Wells in Indian River County (continued)

Well No.	Location Sec.	T.S.	R.E.	Owner	Depth (ft)	Diameter (in)	Casing depth (ft)	Chloride (ppm)	Water level (ft)[1]	Date measured and sampled	Est. flow (gpm)	Use[2]	Temperature (°F)	Remarks
181	3	31	37	C. Platt	600	3	220	---	24	10-18-51	---	Dom.	---	
183	22	31	37	J. Screws	640	3	220	---	25	10-18-51	---	Dom.	---	
184	22	31	37	R. Harvey	640	3	220	---	25	10-18-51	---	Irr.	---	
185	19	31	37	Fellsmere Sugar Co.	---	---	---	320	33	10-18-51	---	Dom.	---	
186	14	31	36	Fellsmere Sugar Co.	---	6	---	598	32	10-19-51	700	A.	---	
187	33	31	35	F. Mitchell	505	4	---	285	---	11-15-51	60	Stock	---	Log included
188	23	32	35	W. Surrency	700	3	---	1,110	18	11-12-51	---	Dom.	---	
189	35	31	35	F. Mitchell	630	4	---	350	16	11-13-51	---	Stock	---	
200	2	33	39	City of Vero Beach	700	8	274	1,060	25	1- 8-52	---	Irr.	---	Log included
201	14	31	39	A. Vincent	843	6	230	378	22	11- 9-51	360	Irr.	---	See figs. 8, 12
202	18	33	36	Maxcey	700	6	209	237	22	12-27-51	440	Irr.	---	Log included. See figs. 8, 12
203	33	31	37	Dietz	590	6	162	715	25	12-15-51	360	Irr.	---	Log included. See fig. 8
204	35	32	39	City of Vero Beach	640	3	---	---	---	---	60	A.	---	
205	6	33	36	K. Prince	---	6	---	560	22	12-27-51	300	Irr.	---	
206	25	32	35	W. Surrency	600	4	---	362	20	12-27-51	200	Irr.	---	
207	6	33	39		775	5	---	425	23	12-28-51	350	Irr.	---	
208	31	32	39		700	5	---	328	24	12-28-51	---	Irr.	---	
209	30	32	39		700	4	---	315	23	12-28-51	380	Irr.	---	
210	19	32	39		650	5	240	440	22	12-28-51	---	Irr.	---	
211	18	32	39		540	4	---	388	23	12-28-51	330	Irr.	---	
212	7	32	39		---	4	---	320	22	12-28-51	200	Irr.	---	
214	33	32	39		550	2½	---	305	19	12-28-51	---	Dom.	---	
215	28	32	39	J. Fink	660	3	210	415	21	12-28-51	---	Irr.	---	
216	20	32	39	B. Potter	635	4	211	342	21	12-28-51	260	Irr.	---	
219	5	32	39	L. Butzman	550	4	---	308	18	1- 2-52	---	Stock	---	
220	32	31	39		520	---	---	302	20	1- 2-52	---	Irr.	---	
222	1	32	38	Graves Bros.	760	5	---	395	22	1- 2-52	360	Irr.	---	
223	11	32	38		700	5	---	438	23	1- 2-52	360	Irr.	---	
225	25	32	38	Sexton	750	5	---	590	21	1- 2-52	500	Irr.	---	
226	13	32	38	P. Gardner	750	5	---	505	21	1- 2-52	600	Irr.	---	
227	3	33	38	J. Towns	750	4	---	605	22	1- 3-52	350	Irr.	---	

Table 4. Records of Selected Wells in Indian River County (continued)

Well No.	Location Sec.	T.S.	R.E.	Owner	Depth (ft)	Diameter (in)	Casing depth (ft)	Chloride (ppm)	Water level (ft)[1]	Date measured and sampled	Est. flow (gpm)	Use[2]	Temperature (°F)	Remarks
228	4	33	39		750	4	220	265	16	1- 3-52	200	Irr.	---	
229	4	33	39		660	3	---	---	16	1- 3-52	---	Dom.	---	
230	27	32	39	Brown	720	4	270	188	22	1- 3-52	---	Dom.	---	
231	24	32	39	D. Hepner	1,165	5	---	620	39	1- 3-52	330	Dom.	---	
232	23	32	39		750	6	---	388	38	1- 3-52	550	Irr.	---	
233	14	32	39		635	6	---	265	36	1- 3-52	800	Irr.	---	
234	11	32	39		500?	4	110	185	39	1- 3-52	430	Irr.	---	
235	3	32	39	G. Hamilton	500	3	100	178	37	1- 3-52	---	Irr.	---	
237	34	31	39		485	4	---	230	36	1- 3-52	---	Irr.	---	
238	32	31	39		400	3	---	255	35	1- 3-52	---	Irr.	---	
239	35	32	39		700?	6	---	165	32	1- 4-52	---	Irr.	---	
240	36	32	39	Royal Palm Golf Course	500?	3	---	235	37	1- 4-52	---	Irr.	---	
242	6	33	40		970	3	---	498	38	1- 4-52	---	Dom.	---	
243	7	33	40		900	6	---	452	41	1- 4-52	450	Irr.	---	
244	19	33	40	Indian River Produce Co.	720	---	---	240	37	1- 4-52	---	Irr.	---	
245	30	33	40		850	4	---	232	37	1- 4-52	330	Irr.	---	
246	25	33	39		600	3	---	290	18	1- 7-52	90	Dom.	---	
247	26	33	39		---	4	---	278	16	1- 7-52	---	Irr.	---	
248	12	33	39		677	3	---	392	---	1- 7-52	---	Dom.	---	Log included
249	11	33	39		600	4	---	482	18	1- 7-52	---	Irr.	---	
250	10	33	39		760	4	---	392	16	1- 7-52	---	Irr.	---	
251	15	33	39		700	4	---	378	16	1- 7-52	200	Stock	---	
252	32	33	39		660	4	---	425	16	1- 7-52	---	Irr.	---	
253	29	33	39		800	5	---	535	14	1- 7-52	240	Irr.	---	
254	29	33	39		760	4	---	445	13	1- 7-52	170	Irr.	---	
255	8	33	39	Young	575	5	---	310	13	1- 9-52	180	Irr.	---	
256	17	33	39	A. Lockwood	700	4	---	352	15	1- 9-52	---	Irr.	---	
257	20	33	39		---	4	---	---	15	1- 9-52	---	Irr.	---	
258	17	33	39	A. Lockwood	760	4	---	338	14	1-11-52	400	Irr.	---	
									12	1-16-52				
259	5	32	39		651	4	---	---	---	---	---	Irr.	---	Log included
260	7	33	39	F. Schroth	700?	4	---	328	14	1-21-52	---	Irr.	---	
261	32	33	39		---	6	---	560	19	1-21-52	---	Irr.	---	

Table 4. Records of Selected Wells in Indian River County (continued)

Well No.	Location Sec.	T.S.	R.E.	Owner	Depth (ft)	Diameter (in)	Casing depth (ft)	Chloride (ppm)	Water level (ft)[1]	Date measured and sampled	Est. flow (gpm)	Use[2]	Temperature (°F)	Remarks
262	29	33	39		---	---	---	482	13	1-21-52	---	Irr.	---	
263	18	33	39	Robertson	---	---	---	460	14	1-22-52	---	Irr.	---	
264	20	33	39		650?	---	---	365	14	1-22-52	---	Irr.	---	
265	13	33	38	Knight & Parrish	---	---	---	245	14	1-22-52	---	Irr.	---	
266	14	33	38	Commander Groves	---	4	---	295	23	1-22-52	---	Irr.	---	
267	14	33	38	Commander Groves	---	---	---	328	22	1-22-52	---	Irr.	---	
270	23	33	38		---	6	---	215	23	1-22-52	---	Irr.	---	
272	18	33	38		---	6	---	515	20	1-23-52	---	Irr.	---	
273	7	33	38	D. Sawyer	---	6	---	370	21	1-23-52	---	Irr.	---	
279	35	32	39	City of Vero Beach	65	8	55	---	---	---	---	A.	---	Screen from 55-65 ft.
353	35	32	39	U.S. Geological Survey	67	6	---	---	---	---	---	Obs.	---	Water-level recording gage
BR 762	23	30	38	Henry Robbins	408	3	185	---	26	4-26-51	120	Dom.	---	Brevard County
StL 44	3	34	39	McDonald	691	5	125	450	15	4- 5-51	350	Irr.	---	St. Lucie County
StL 48	5	34	40	Dolenick	714	6	134	248	42	12-17-51	---	Irr.	---	St. Lucie County

[1]Indicates water level above land surface.
[2]P.S. - Public supply; Irr. - Irrigation; Obs. - Observation; Dom. - Domestic; Ind. - Industrial; A. - Abandoned.

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