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REPORT OF INVESTIGATIONS

NO. 1

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GROUND WATER IN SEMINOLE COUNTY, FLORIDA

By

V. T. Stringfield

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Prepared in cooperation between
the United States Geological Survey
and the Florida State Geological Survey.

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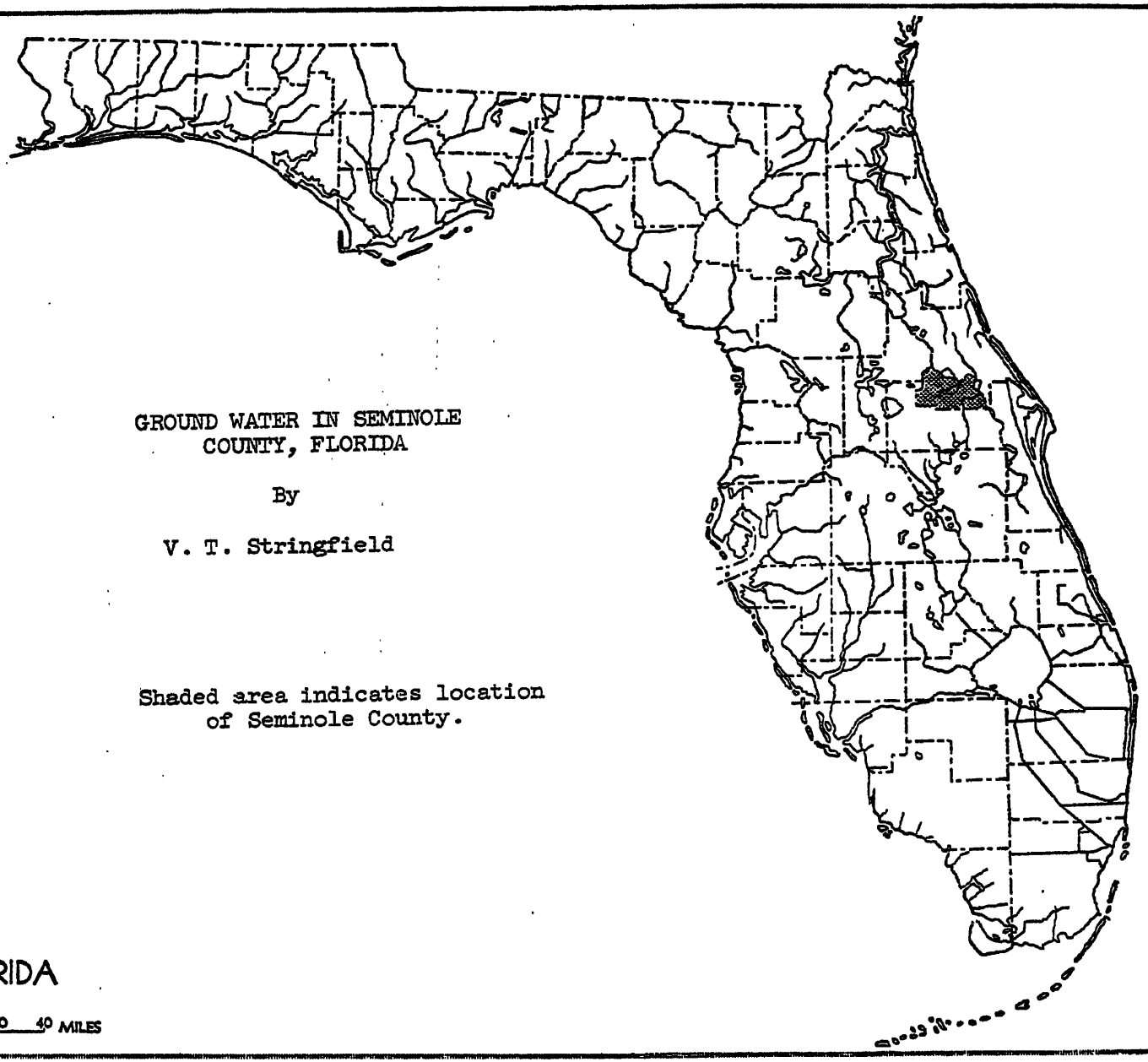
Fourth mimeographing August 1, 1951.

C O N T E N T S



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Shaded area indicates location
of Seminole County.

FLORIDA

SCALE 0 20 40 MILES

I N T R O D U C T I O N

Location and area

Seminole County is in the east-central part of the Florida peninsula. It is bounded on the north and east by the St. Johns River, on the south by Orange County, and on the west by Orange County and the Wekiva River. It has a land area of 321 square miles.

Population and development

The population of the county, in 1930, according to the Federal Census, was 18,735. Sanford, the county seat and the largest town, is in the northern part of the county, on Lake Monroe. In 1930 it had a population of 10,000. Oviedo, in the south-central part of the county about 2 miles south of Lake Jessup, had a population of 1,042. The other towns in the area had less than 1,000 each.

The county leads in the production of celery in Florida and is one of the chief vegetable-growing centers of the State. During 1929 the value of the celery crop from farms with a total of 3,736 acres was reported by the United States Department of Commerce to be $2,889,673. Although the rainfall is fairly large, the vegetable crops, especially celery, require irrigation, and the water used for this purpose is obtained from artesian wells.

Previous investigations

The geology and ground water of Florida are described in several reports prepared by the State Geological Survey of Florida or by the United States Geological Survey. The ground water of Seminole County is mentioned in a number of these reports. In 1913 Matson[1] described briefly the geology and ground water of Orange County, which then included the area known as Seminole County. The same year a report by Sellards and Gunter[2] included a statement concerning the wells in Seminole County. A report by Mossom[3] in 1926 described the general features of the geologic structure of the State. The most recent detailed description of the geology of the State is given in a report by Cooke and Mossom[4], which includes a map showing the distribution of the geologic formations at or near the surface. Analysis of water samples from several wells in Seminole County are included in a report by Collins and Howard[5].

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1. Matson, G. C., and Sanford, Samuel, Geology and ground waters of Florida: U. S. Geol. Survey Water-Supply Paper 319, pp. 376-381, 1913.

2. Sellards, E. H., and Gunter, Herman, The artesian water supply of eastern and southern Florida: Florida Geol. Survey 5th Ann. Rept. p. 113, 1913.

3. Mossom, Stuart, A review of the structure and stratigraphy of Florida: Florida Geol. Survey 17th Ann. Rept. pp. 171-268, 1926.

4. Cooke, C. W., and Mossom, Stuart, Geology of Florida: Florida Geol. Survey 20th Ann. Rept., pp. 29-228, 1929.

5. Collins, W. D., and Howard, C. S., Chemical character of the waters of Florida: U. S. Geol. Survey Water-Supply Paper 596, p. 228, 1928.

Present investigations

The work whose results are here recorded was undertaken as a part of a comprehensive investigation of the ground-water resources of the State, provided by a cooperative agreement made in 1930 between the Florida Geological Survey and the United States Geological Survey. The work is under the supervision of O. E. Meinzer, geologist in charge of the division of ground water, United States Geological Survey, and Herman Gunter, state geologist of Florida. On June 30, 1933, the cooperative work was discontinued because of lack of funds. Several reports[1] on the investigation in other parts of the State have been prepared under this cooperative agreement.

During May 1933 observations were made in Seminole County in connection with the investigation of ground water started in Orange and Seminole counties in 1930.[2] The work in Orange County was principally concerned with the problems relating to drainage wells. A few drainage

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1. Thompson, D. G., and Stringfield, V. T., Ground-Water Resources of Florida: Florida Geol. Survey Press Bull. 13, April 1931.

   Thompson, D. G., Problems of ground-water supply in Florida: American Water Works Assoc. Jour. Vol. 23, No. 12, pp. 2085-2100, December 1931.

   Stringfield, V. T., Ground-water resources of Sarasota County, and exploration of artesian wells in Sarasota County, Florida: Florida Geol. Survey 23rd and 24th Ann. Repts., 1933.

   Stringfield, V. T., Ground-water investigations in Florida: Florida Geol. Survey Bull. 11, 1933.

   Stringfield, V. T., Ground-water in the Lake Okeechobee area, Florida (unpublished).

2. Stringfield, V. T., Ground-water investigations in Florida: Florida Geol. Survey Bull. 11, 1933.

wells have been constructed in the southern part of Seminole County, but the principal ground-water problem in that county relates to the water available for irrigation and public supplies. In two irrigation districts, those of Sanford and Oviedo, where large supplies of water for irrigation are obtained from artesian wells, some of the water is highly mineralized. This is significant, because the highly mineralized water is undesirable for irrigation and because with heavy draft the water from many of the wells now yielding water of comparatively low mineral content may become more highly mineralized. Moreover, with increased draft from wells the artesian pressure may be lowered to such an extent that many of the wells will stop flowing.

In May 1933 data relating to wells, ground water, and the formations penetrated by wells were obtained, and field tests of the chloride content of samples of water from representative wells were made.

The writer is indebted to the well drillers, owners of wells, and other citizens who have contributed information to this investigation. J. Clarence Simpson, of the State Geological Survey, assisted in the field work.

Topography

Relief

Seminole County lies partly in an upland known as the lake region that extends northward and eastward toward the St. Johns River, where it is succeeded by a broad comparatively flat lowland. Surface altitudes

range from more than 100 feet in the upland to less than 25 feet in the lowland. In the northeastern and eastern part of the county and along the south shore of Lake Jessup the land rises abruptly into the upland area. The upland area is undulating and has many lakes that occupy depressions, probably formed by the solution of the underlying limestone. Lake Jessup, Lake Monroe, and Lake Harney are the largest lakes in the county and probably fill original depressions in the floor of the sea that once covered this area. It has been suggested[1] that the depression in which Lake Jessup lies was formed in part by old stream meanders, antedating the last invasion of the sea. Lake Jessup, about 9 miles long and 3 miles wide, extends from the central part of the county northward to the St. Johns River, Lake Monroe, and Lake Harney are the course of the St. Johns.

Drainage

The St. Johns River controls the drainage of the county. It forms the east and north boundary and flows northward to the northeastern part of the State and thence into the Atlantic Ocean. The Wekiva River forms part of the west boundary of the county and flows northward into the St. Johns River. The Little Wekiva River rises in the southwestern part of the county and flows northward into the Wekiva. Palm Spring and Sanlando Springs are the tributaries to it. Lake Jessup and the creeks that empty into it afford drainage for the central part of the county.

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[1]Leverett, Frank, The Pensacola terrace and associated beaches and bars in Florida: Florida Geol. Survey Bull. 7, p. 12, 1931.

The Econlockhatchee River rises in Orange County, flows northward into Seminole County for a distance of about 5 miles, and thence eastward and northeastward to the St. Johns River. The Econlockhatchee River and its tributaries together with a few creeks flowing into the St. Johns River afford drainage for the southeastern part of the county. Sweetwater Branch appears to have been formerly a "lost stream" or "disappearing stream" such as might be expected in areas where sink holes are present. It rose about 2 miles north of Oviedo, flowed southward and drained into a sink hole that formerly existed just north of Oviedo. At the present time Sweetwater Branch drains northward through a ditch into Lake Jessup.

Climate

Climatic observations by the United States Weather Bureau were begun at Sanford in 1883, but apparently no temperature records were kept between 1887 and 1913.

Monthly and annual temperature, in degrees Fahrenheit, at Sanford.

(U. S. WEATHER BUREAU)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1932	67.6	71.0	64.2	70.8	76.6	81.2	86.2	83.4	79.8	75.0	64.6	66.2	73.9
1913 to 1932	60.1	62.7	65.8	70.4	75.6	79.7	81.4	81.6	79.8	74.2	66.4	60.8	71.6

The season of heavy rainfall usually includes the summer and early fall. In this season the rainfall comes in showers and may be irregularly distributed. The average annual precipitation[1] is 50 to 55 inches except in the northwestern part of the county where it is less than 50 inches.

Monthly and annual precipitation, in inches, at Sanford.

(U. S. Weather Bureau)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
1932	1.48	0.34	3.07	0.99	5.25	8.03	0.85	8.45	4.27	1.53	5.09	0.06	39.41
1883 to 1932	2.21	2.11	3.08	2.80	4.02	7.21	7.57	6.31	5.99	5.46	1.70	2.58	51.04

Geology

The geologic formations that underlie Florida are described in a report by Cooke and Mossom[2], which includes a map showing the distribution of the formations at or near the surface. In Seminole County the Ocala limestone, of Eocene age, is present about 50 to 150 feet below the surface. The formation is underlain by undifferentiated

[1]Map showing normal annual temperature and precipitation as compiled from all available records to 1920, inclusive: U. S. Weather Bureau Climatological Data, Florida section, Vol. 34, No. 13, opposite p. 52, 1930.

[2]Cooke, C. W., and Mossom, Stuart, op. cit., pp. 31-227.

Eocene sediments and is overlain by the Hawthorn formation, of Miocene age, which in turn is overlain by a mantle of undifferentiated Pleistocene and Recent materials. The total thickness of the Ocala formation is not known, but it is estimated to be about 500 feet. It is the oldest formation penetrated by wells drilled for water in the county. In parts of Florida the Tampa limestone, of Miocene age, lies between the Ocala limestone and the Hawthorn formation, but in Seminole County the Tampa is believed to be absent, and the upper surface of the Ocala is apparently an irregular eroded surface on which the Hawthorn rests. The Ocala underlies all of the Florida peninsula and is at or near the surface in Sumter County, about 35 miles west of Seminole County, and in other counties in the west-central part of the peninsula.

The Ocala formation consists of almost pure limestone with some chert. Parts of the limestone are porous and contain solution channels that permit free circulation of ground water. According to the reports of drillers, many of the wells penetrating the Ocala limestone in Seminole and Orange counties encounter cavities with vertical dimensions of as much as 20 feet, whereas in other parts of the peninsula where the formation is deeply buried no cavities have been reported. It thus appears that solution channels occur in the limestone where it is or has been at the surface or at moderate depths below the surface. Old solution channels now filled with sand or clay are exposed in some of the quarries in the

Ocala limestone in Marion County. Numerous sink holes that formerly connected underground channels with the surface are now filled with sand and clay. These filled sinks are reported by drillers to be common in parts of Seminole County, and in selecting locations for wells depressions resembling old sinks are avoided, because in some of them sand has been encountered to a depth of more than 200 feet, whereas normally limestone that yields water may be encountered at a depth of about 50 feet. Such a condition is reported to exist in the topographic depression just north of Oviedo.

In Seminole County the Hawthorn formation consists of interbedded marl, clay, and sand. The surficial Pleistocene and Recent material consists chiefly of sand, marl, clay, or muck.

Ground Water

Developments

Small domestic supplies of water are obtained in Seminole County from shallow wells that end in the surficial sands. Most of these are driven wells that are equipped with hand pumps. A few supplies are also obtained from wells that yield water from the Hawthorn formation. The chief source of ground water, however, consists of drilled wells that extend into the Ocala limestone and yield water that is under artesian pressure. It is estimated that there are about 1,500 drilled wells in the county, most of which are in the celery districts, near Sanford and Oviedo. Some of the fields have an average of one well for each acre of

land under cultivation; others may average only one well for as much as 5 acres. These wells range from about 2 to 8 inches in diameter and from about 50 to more than 300 feet in depth. However, most of them are between 2 and 5 inches in diameter and between 75 and 250 feet in depth. They are cased to depths of about 20 to 80 feet. Most of the wells will flow under artesian pressure with yields ranging from only a few gallons to more than 100 gallons a minute. The wells on higher ground do not flow, but the water rises in them to a level within a few feet of the surface. Two wells of this type at Oviedo and a few in the southwestern part of the county are used for drainage. Nonflowing wells yield water from the Ocala limestone for the public water supply of Sanford.

Palm and Sanlando Springs, in the southwestern part of the county, have been developed for swimming and recreation. These springs are the largest in the county. It appears that their water is derived from the Hawthorn formation, but some of it may be coming from the Ocala limestone. There are a few small springs on the south side of Lake Jessup and in the valley of the St. Johns River. Water from Elder Spring, a few miles south of Sanford is soft and is bottled and sold for drinking. It comes from the surficial sands.

Artesian conditions

The Ocala limestone contains water under artesian pressure throughout Seminole County and supplies many flowing wells in the low

parts of the county. Water enters the formation in areas where it is at or near the surface in the central part of the peninsularand in places where it is overlain by permeable rocks that permit free downward percolation. Water also enters the formation through drainage wells in Orange and Seminole counties. The Hawthorn formation contains relatively impervious strata that prevent or retard upward percolation of water from the Ocala. In some parts of the county this impervious material is absent or comparatively thin, or it may be fractured, permitting water from the Ocala limestone to reach the surface. On the development of one of the drainage canals north of Oviedo water under artesian pressure was encountered at a depth of about 15 to 20 feet. Water under artesian pressure is also encountered at depths of less than 50 feet under spring mounds in that locality. The spring mounds are domes about 50 to 100 feet in diameter and extending about 4 to 5 feet above the surface. They appear to be formed in places where the confining beds do not prevent some seepage of the artesian water to the surface. The water thus appearing at the surface supplies the overburden of peat with moisture in excess of that in adjacent areas and thereby retards the rate of shrinkage in the peat at the spring, as compared with the shrinkage in adjacent areas.

The area in which flowing wells may be obtained includes all of the lowland bordering the St. Johns River, the Econlockhatchee River, Lake Monroe, Lake Jessup, and Lake Harney. In the vicinity of Sanford the

artesian head is about 30 feet with reference to sea level. In the southwestern part of the county and in the adjacent part of Orange County the artesian head is somewhat higher, indicating that there is a movement of the water toward the northeast and that the intake area is southwest or west of Seminole County.

Fluctuation of head

Fluctuation of artesian head may be caused by a number of conditions. According to reports of well owners the largest fluctuations occur during the irrigation seasons in periods of heavy draft. These are caused in part by opening and closing of many wells and pumping of wells in irrigation districts. When a large number of wells are in use there is a lowering of the artesian head, and when the wells are closed there is and increase in head. Increase in head is especially noticeable after rains, not because of recharge produced by the rains but because the wells used for irrigation are closed in rainy weather and the draft of water is in consequence greatly reduced. There are also fluctuations caused chiefly by recharge in the intake area.

Quality

In general the water from shallow wells terminating in the surficial sands is reported to be soft and low in mineral content except in

certain localities in the eastern and northeastern parts of the county. Water from the Ocala limestone and Hawthorn formation is hard, and some of it in the eastern and northeastern parts of the county is highly mineralized and harmful to crops irrigated with it.

Field tests of the chloride content of samples of water from numerous wells were made in order to indicate the relative saltiness. Water has a distinct salty taste if it contains as much as 1,000 parts per million of chloride, and in order to be acceptable to most people for drinking it should contain less than 250 parts per million. The field tests indicate that the chloride content of ground water in Seminole County ranges from less than 50 parts per million in the southwestern part of the county to more than 5,000 parts in some wells in the northeastern part. The area in which the water is relatively high in chloride includes a large part of the Sanford and Oviedo celery districts. A few measurements of the artesian head in different parts of the county indicate that the highly mineralized water is found in a general way in areas of relatively low head.

Conclusions

The preliminary work shows that a detailed investigation is needed to determine the proper course to follow in the protection, conservation and further development of the artesian water supply, which is very valuable for irrigation and for public and domestic use. In

part of the county the artesian water is already too highly mineralized to be suitable for irrigation or for domestic or public water supplies. These areas of high mineralization should be definitely outlined, and the adjacent districts should be carefully studied to determine whether the highly mineralized water is encroaching on the areas of low mineralization. If encroachment caused by draft from wells is taking place, methods can be adopted for preventing or retarding the process. A careful study of the pressure heads or water levels in wells throughout the county will give much needed information regarding the fluctuation of water levels, the extent of the permanent loss of head that is taking place, the direction of flow of the artesian water, and the effect of withdrawals of water on the mineralization.