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Compilation and Review of Information on Neogene Aquifers in Camden and Glynn Counties, Georgia

John P. Hughes and Vernon J. Henry

In cooperation with Minerals Management Service
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GEORGIA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
GEORGIA GEOLOGIC SURVEY

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PROJECT REPORT 23

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1995

This report is preliminary and has not been reviewed for conformity with Georgia Geologic Survey editorial standards and stratigraphic nomenclature.

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LIST OF ILLUSTRATIONS

The U.S. Minerals Management Service, Continental Margins Program.

The preceding report is the final project report of a series of technical investigations funded by the U.S. Department of Interior, Minerals Management Service (MMS), as part of the Continental Margins Program. The Continental Margins Program was created through a Memorandum of Understanding between MMS and the Association of American State Geologists, and was implemented through a Cooperative Agreement between MMS and the University of Texas; the University of Texas served as prime contractor for the Association of American State Geologists. The Continental Margins Program funded investigations by coastal state geological surveys in two areas of research:

(1) Geologic framework and petroleum related studies. The purpose of the framework studies was to develop a better understanding of the coastal-onshore, nearshore and offshore geology of the participating states with an emphasis on potential petroleum resources.

(2) Critical and strategic minerals studies. The purpose of the critical and strategic mineral studies was to identify coastal-onshore, nearshore and offshore areas where there is a potential for commercial deposits of these minerals.

The Georgia Geologic Survey participated in the Continental Margins Program for nine years. The following is a summary of the investigations performed by the Georgia Survey.

1. 1984 Geologic Mapping of the Phosphate-Bearing Strata of the Outer-Continental Shelf Area Off Georgia.

2. 1985 Correlation of Drilling and Core Information with a Seismic Data Base for Miocene-age Strata of the Continental Shelf Area off of Georgia.

   publication Kellam, J.A. and Henry, V.J., 1986, Interpretation of the Seismic Stratigraphy of the Phosphatic Middle Miocene on the Georgia Continental Shelf. Georgia Geologic Survey Geologic Atlas 4, 9 pl.

3. 1986 Preparation of a Georgia Geologic Survey Bulletin on the Phosphate-Bearing, Miocene-age Strata of the Continental Shelf Area off of Georgia.

   publication Henry, V.J., Jr. and Kellam, J.A., 1988, Seismic Investigation of the Phosphate Bearing, Miocene Age Strata of the Continental Shelf of Georgia. Georgia Geologic Survey Bulletin 109, 43 pp.

4. 1987 Preparation of a Georgia Geologic Survey Bulletin on the Distribution of Heavy Mineral Sands in a Tide Dominated Delta, as a Possible Exploration Model: Phase I.

publication Bonn, G.N. and Simonson, D.N., 1990, Evaluation of Heavy Mineral-Bearing Nearshore Sands, Altamaha Sound and the Adjacent Nearshore Zone, Georgia. Georgia Geologic Survey Open File Report 90-3, 41 pp. + appendices.

5. 1988 Preparation of a Georgia Geologic Survey Bulletin on the Distribution of Heavy Mineral Sands in a Tide Dominated Delta, as a Possible Exploration Model: Phase II.

publication Kellam, J.A., Bonn, G.N. and Laney, M.L., 1992, Distribution of Heavy Mineral Sands adjacent to the Altamaha Sound: An Exploration Model. Georgia Geologic Survey Bulletin 110, 61 pp.

6. 1989 Development of a personal computer compatible Geographic Information System for the Coastal Area and Continental Shelf of Georgia.

publication O'Connell, D.B., 1991, Report on the Status of the Georgia Coastal Geographic Information System. Georgia Geologic Survey Open File Report 91-1, 28 pp.

7. 1990 Create Data Bases for the Georgia Coastal Geographic Information System.

8. 1991 Entering of Additional Data Bases into the Georgia Coastal Geographic Information System.

publication Cocker, M.D., 1993, Report on the Georgia Coastal Geographic Information System. Georgia Geologic Survey Open-File Report 93-1, 18 pp, 5 pls.

9. 1992 Shallow Aquifers (the Surficial and Brunswick Aquifers) in Glynn and Camden Counties.

publication Hughes, J. P. and Henry, V. J., in press, Compilation and Review of Information on Neogene Aquifers in Camden and Glynn Counties, Georgia., Georgia Geologic Survey Project Report 23, 56 pp.

ABSTRACT

During the past ten years there has been a significant escalation of ground water withdrawal in the Georgia coastal region as a result of population growth and expanding industrial and agricultural activities. This increase in ground water use has the potential to adversely impact important aquifers in the coastal counties. Also, the possible mining of phosphate deposits on the Georgia continental shelf could seriously impact onshore aquifers. All of these factors have caused the need for a reevalution of the coastal aquifers and the potential impact of continued development on the management of ground water resources in Camden and Glynn counties in particular.

The important aquifers in these counties are: the Neogene-age surficial aquifer and the Lower and Upper Brunswick aquifers, and the Paleogene-age Floridan aquifer system. The Floridan aquifer is the major source of water for these counties. Long-term ground water withdrawal from this aquifer in the St. Marys (Camden County) and Brunswick (Glynn County) areas has resulted in lowered ground water levels and has caused salt water intrusion into the aquifer's fresh water zone. The surficial and Brunswick aquifers have the potential to provide an important supplement to the Floridan aquifer, if properly developed and protected. Depending on well location and construction, yields of 50,000 to 300,000 gallons per day are possible. The use of these supplemental aquifers could prevent or retard salt water

intrusion into the Floridan aquifer by significantly decreasing withdrawal rates. Also, the surface aquifer could also be used as a means of induced recharge for the Floridan aquifer. Because of their shallow depth, these aquifers should be carefully monitored for water quality and provided adequate well-head protection.

ACKNOWLEDGEMENTS

This study was financed through a grant (contract) to Georgia Southern University from the Georgia Geologic Survey, Environmental Protection Division, Department of Natural Resources, funded by the United States Department of the Interior, Minerals Management Service. Appreciation is extended to all those who have assisted the authors in obtaining the data, published and unpublished, that were required for this project. In particular, the authors thank Mark Cocker, Earl Shapiro, Bruce O'Connor, and Paul Huddlestun of the Georgia Geologic Survey; John Clarke, Richard Krause, Mike Peck, and Willis Hester of the U. S. Geological Survey in Atlanta; Alfred Coleman of the Glynn County Health Department-Environmental Health Section; Randy McCall of the Camden County Health Department-Environmental Health Section; Jim Setzer of the Environmental Protection Division of the Georgia Department of Natural Resources; and Tom Turner, Librarian at the Skidaway Institute of Oceanography.

INTRODUCTION

In the coastal counties of Georgia the Paleogene-age Floridan aquifer system, previously known as the Principal Artesian Aquifer, is heavily relied on for most water uses. The recent significant rise in the use of ground water from this system primarily is the result of increased population and industry. Two counties experiencing this increased demand are Camden and Glynn, in which the cities of St. Marys and Brunswick, respectively, and are the most rapidly growing urban areas along the coast of Georgia (Figure 1). For example, the Kings Bay Naval Submarine Base established in the early 1980's near St. Marys greatly added to the water demand in Camden County.

In recognition of the stresses that increased population and industry can place on the coastal Floridan aquifer system, the need has arisen to define alternative water sources and the appropriate ways to utilize them. The purpose of this study, therefore, is to 1) carry out a literature search for published and unpublished data on the Neogene-age surficial and Brunswick aquifers overlying the Floridan aquifer system of Camden and Glynn counties and 2) provide a detailed review and analysis of the Miocene to Holocene stratigraphy of the region in relation to these aquifers. The potential and possible uses of the aquifers, and threats to their water quality also is discussed.

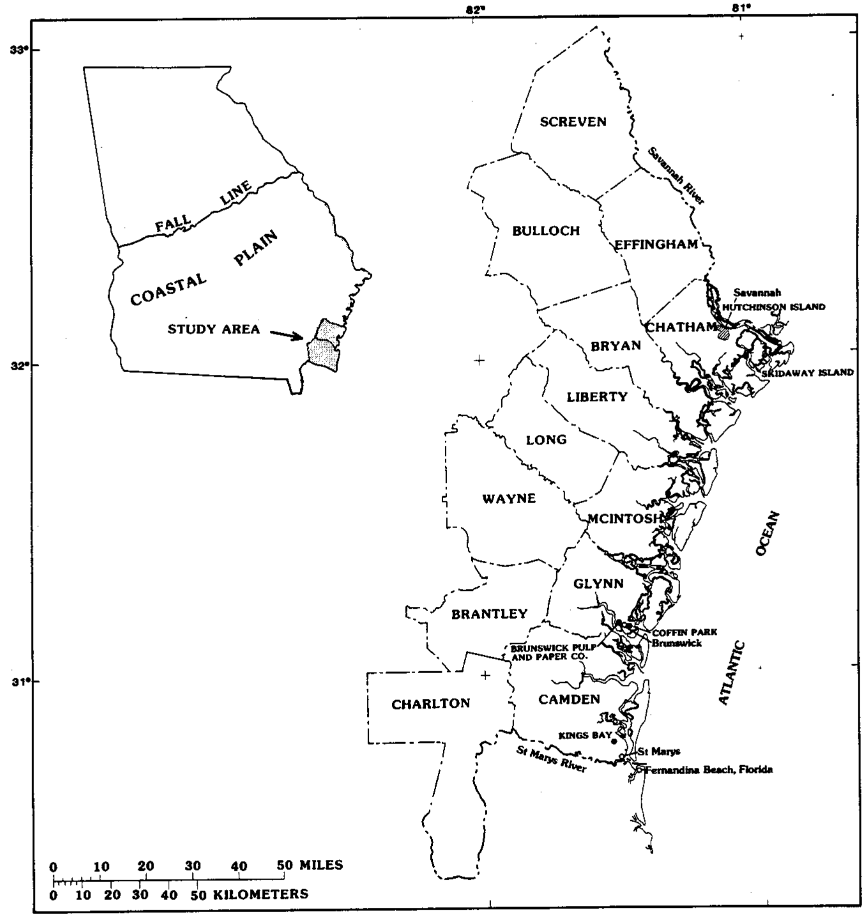

Figure 1. Location of study area in Camden and Glynn Counties, Georgia. Modified from Clarke and others (1990).

Included as appendices to the report is an extensive file which contains information on all available geophysical, lithologic and other types of logs from wells in Camden and Glynn counties, drillers' records, hydrological test data, Intent-to-Drill forms from the Public Health Departments of the two counties, and maps showing the locations of all the wells pertinent to the study area (Appendices A and B); and a bibliography of relevant literature (Appendix C). Hard copies of literature, well logs and other information were presented to the Georgia Geologic Survey under separate cover.

GEOLOGIC SETTING

Structure

The Southeast Georgia Embayment is a major structural feature that appears to have affected the deposition of sediments in the study area (Figure 2). This feature became a depositional basin in the middle Eocene, and was active through Miocene time. (Herrick and Vorhis, 1963).

In addition to the Southeast Georgia Embayment, Clarke and others (1990) identify five local structural features in the study area that have affected the deposition of sediments by causing increased and decreased thicknesses of Miocene units (Figure 2). These features are 1) a dome at Woodbine in Camden County, 2) an east-west, elongated depression in the southern part of Glynn County, 3) an east-west trending arch in east-

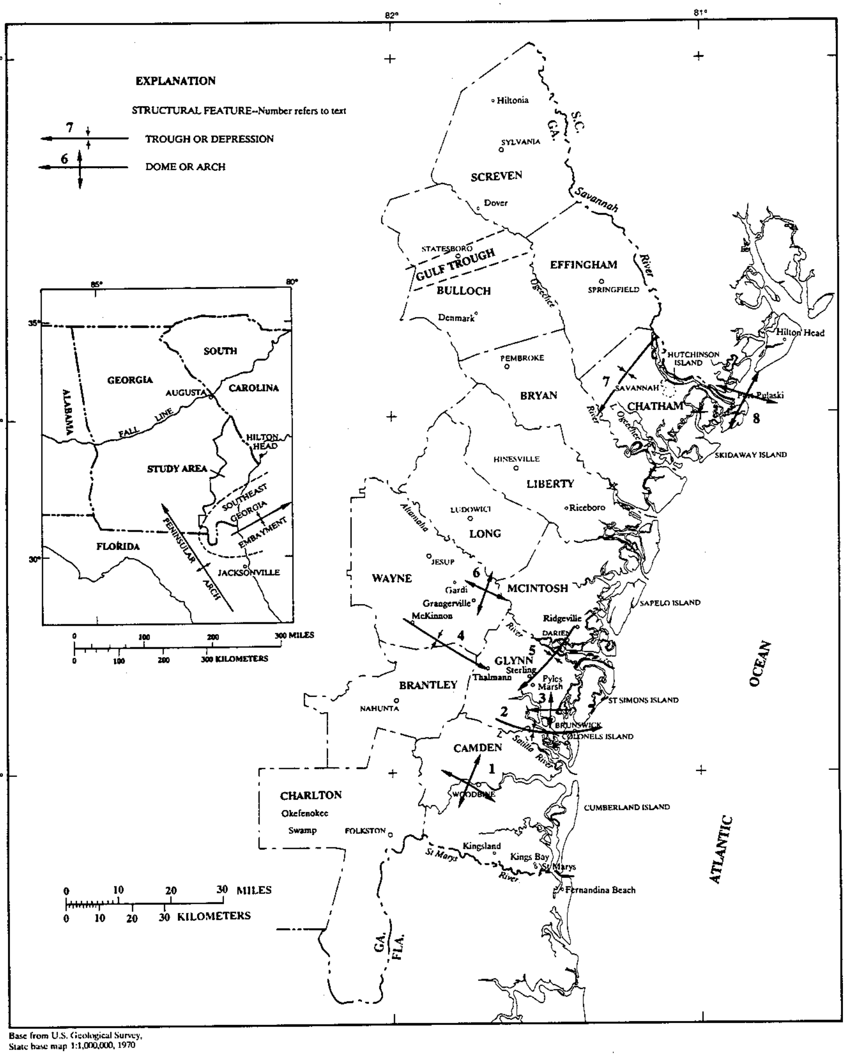

Figure 2. Structural features of study area. Modified from Clarke and others (1990).

central Glynn County, 4) a depression that extends into Glynn County from the northwest, and 5) a depression that trends northeast/southwest under both Glynn and McIntosh counties. Brown (1984) also cites the Ocala uplift as having an effect on the thickness and deposition of middle Eocene and younger sediments.

Gregg and Zimmermann (1974) also describe three structural features in the Brunswick area that may be coincident or relate to the previously mentioned features. They also report five faults in the Brunswick area that may have resulted in some post-Miocene movement.

Neogene Geology

The sedimentary units underlying coastal Georgia range in age from Cretaceous to Recent and attain a maximum thickness of approximately 1300 meters where the axis of the Southeast Georgia Embayment intersects the present coastline (Figure 2). The units dip and thicken seaward (easterly) and pinch-out toward and at the Fall Line. Pre-Neogene deposits generally are carbonates, whereas Neogene-age deposits consist primarily of sands, silts and clays.

The geologic and stratigraphic relationships described in this report are based mainly on reports by Huddlestun (1988) and Clarke and others (1990), and to a lesser extent by Herrick and Vorhis (1963) and Miller (1986). Publications concerning site specific studies in Camden and Glynn counties include those of Wait (1965) and Gregg and Zimmerman (1974) for the Brunswick area and Glynn County; Environmental Science and Engineering, Inc. (1980) for the Kings Bay area in Camden County; Soil and Material Engineers, Inc. (1986a) for Colonels Island in Glynn County; and Westinghouse Environmental Services (1989) for the Osprey Cove Subdivision in Camden County. The Neogene stratigraphic nomenclature of the Georgia lower coastal plain is presented in Figures 3 and 4.

Miocene-Age Deposits

The Miocene-age Hawthorne formation in Camden and Glynn counties was raised to the rank of group by Huddlestun (1988). Based on this classification scheme the Hawthorne Group includes all deposits previously called Hawthorne Formation in Georgia exclusive of those strata now included in the Altamaha Formation.

The Hawthorne Group, which in Camden and parts of Glynn County overlies the Ocala Group of Eocene age, consists of three main formations: the Parachucla Formation, which is the basal unit and early Miocene in age; the late early Miocene Marks Head Formation which disconformably and paraconformably overlies the Parachucla Formation; and the middle Miocene-age Coosawhatchie Formation which disconformably overlies the Marks Head Formation.

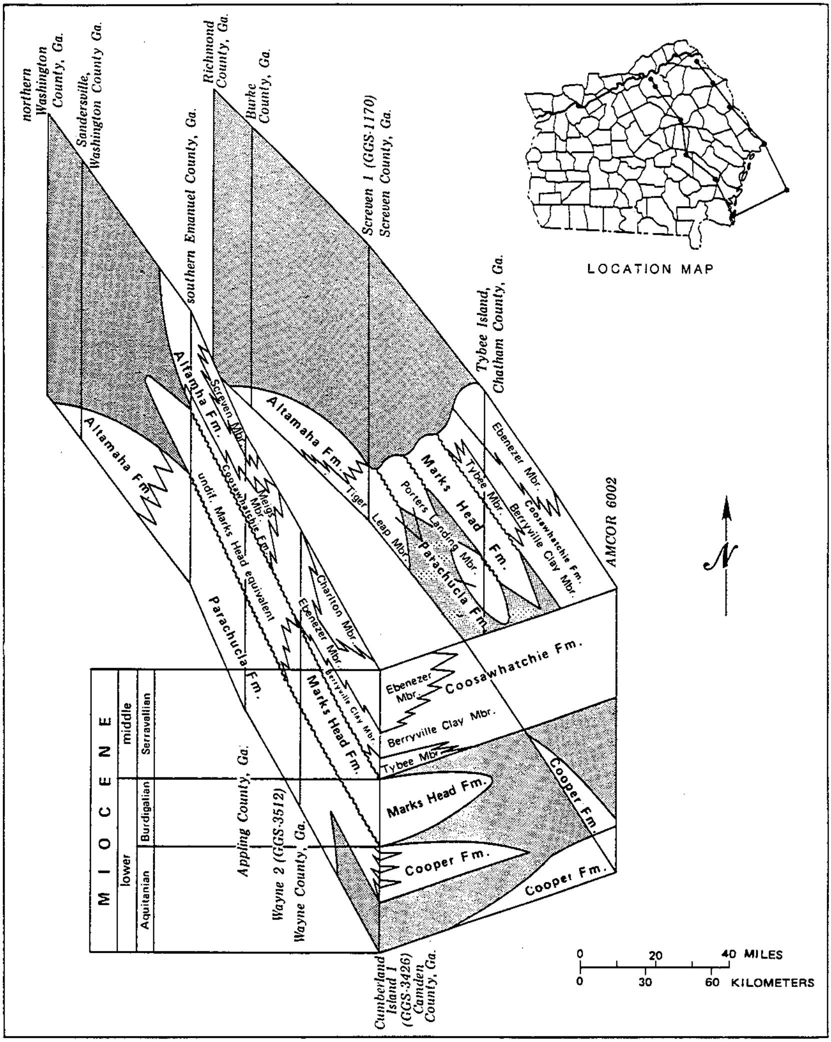

Figure 3. Fence diagram showing stratigraphic relationships of Miocene deposits of eastern Georgia (from Huddlestun, 1988).

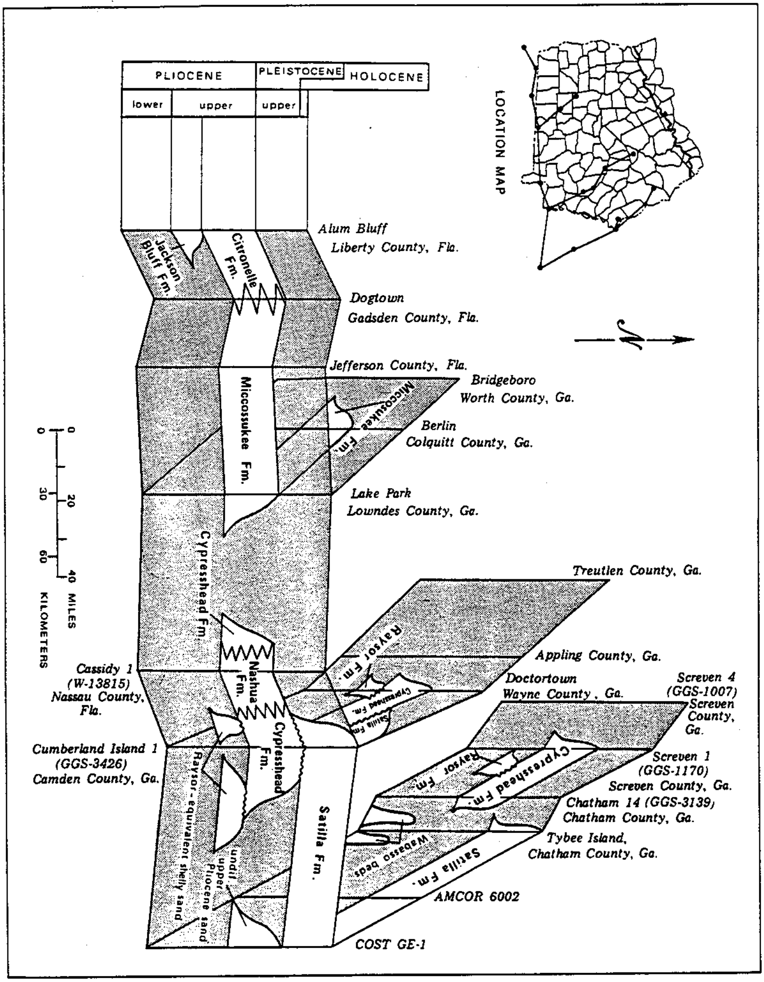

Figure 4. Fence diagram showing stratigraphic relationships of Pliocene, Pleistocene, and Holocene deposits in Georgia (from Huddlestun, 1988).

The three Hawthorne Group formations correlate with the three depositional sequences of Clarke and others (1990) as shown in Figures 5 and 6. The Parachucla formation correlates to the C unit, the Marks Head formation to the B unit, and the Coosawhatchie formation to the A unit. The units are based on geophysical markers found in natural gamma, point resistance electric, and neutron porosity logs. The markers distinguishing each unit are the result of the phosphatic components (a characteristic feature of the Miocene) within the basal carbonate layers of the units. Along with the basal carbonate layer, all three Miocene units have a middle clay layer, and an upper sand layer. According to Clarke and others (1990) the three layers in each of the three Miocene units are evidence of depositional sequences that are the result of cyclic transgression and regression of the seas.

Miller (1986) identifies the Miocene units as being more than 150m thick in southeastern Georgia. Soil and Material Engineers, Inc. (1986a) report the Miocene as having a thickness of 115m to 140m under Colonels Island in Brunswick.

Post-Miocene-Age Deposits

The post-Miocene deposits in the study area, according to Huddlestun (1988), consists of six main units. These are the Pliocene-age Raysor Formation (Duplin?), a Raysor equivalent sand, the Cypresshead Formation, the Satilla Formation, undifferentiated alluvial deposits, and the undifferentiated surficial sand.

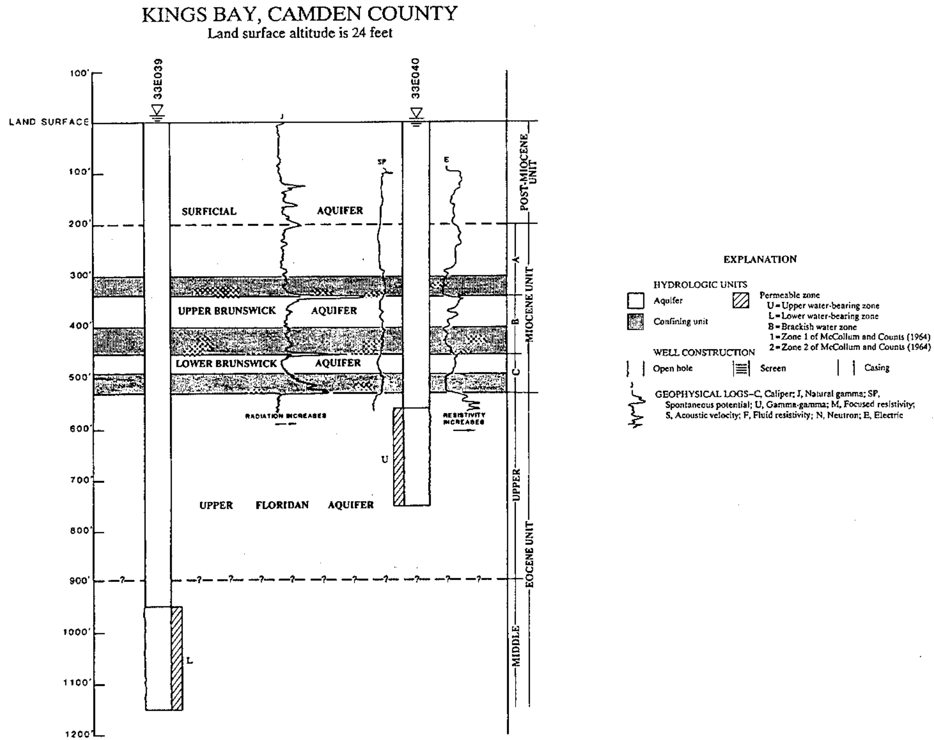

Figure 5. Example of relationships among stratigraphic units, aquifers, and geophysical markers in Camden County. Modified from Clarke and others (1990).

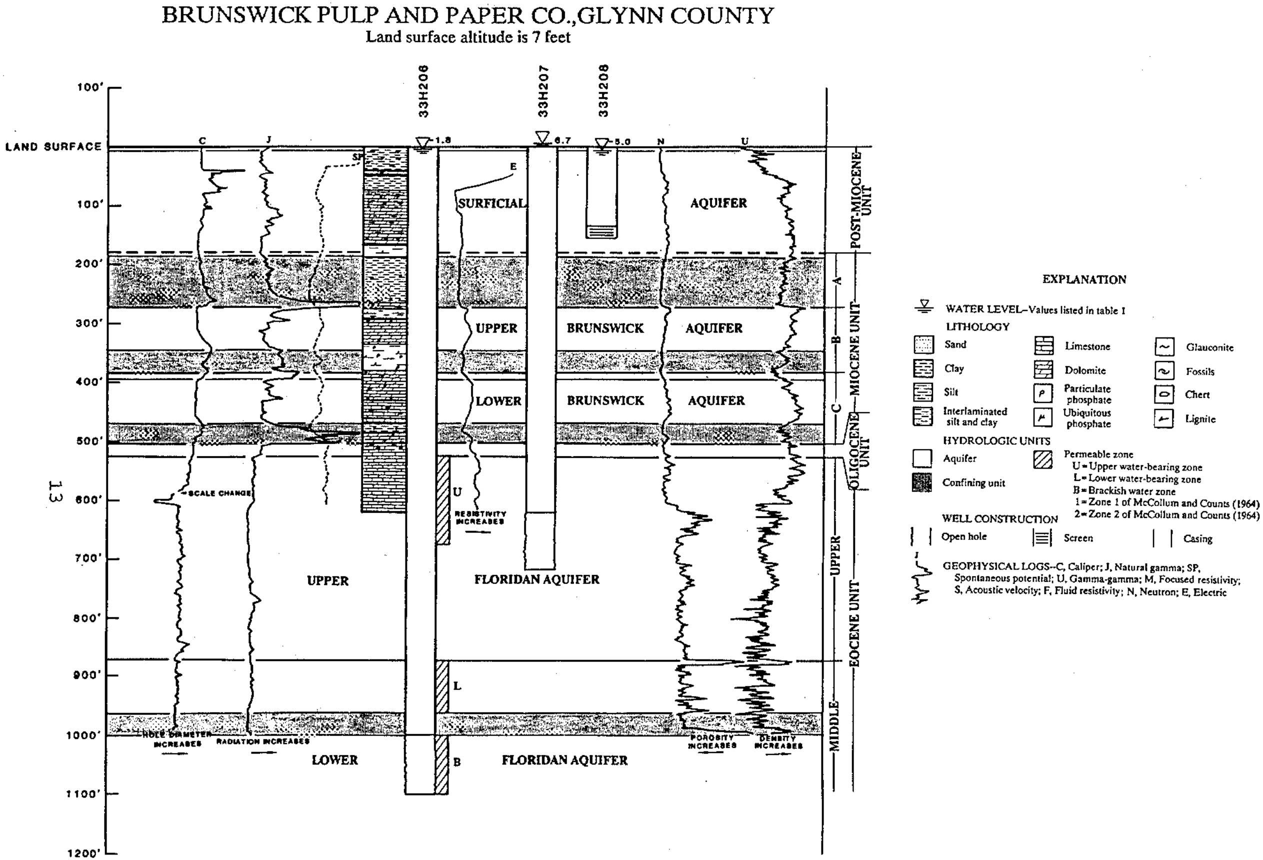

Figure 6. Example of relationships among stratigraphic units, aquifers, and geophysical markers in Glynn County. Modified from Clarke and others (1990).

The Raysor equivalent shelly sand of early late Pliocene age disconformably overlies the Coosawhatchie Formation of the Hawthorn Group. Locally, the Cypresshead Formation of late Pliocene to early Pleistocene age disconformably overlies the Coosawhatchie Formation. The Satilla Formation of late Pleistocene and Holocene age overlies the Cypresshead Formation. At the top of the stratigraphic column are the undifferentiated alluvial deposits of unresolved age, and the undifferentiated surficial sands of Pleistocene to Holocene age. These units are all dominated by sand. All, with the exception of the undifferentiated surficial sands, are interbedded with clays, calcareous material, and other subordinate constituents.

In Camden County Environmental Science and Engineering, Inc. (1980) carried out a detailed study of the surface and shallow subsurface sediments in the Kings Bay area. The study revealed that from the land surface down to 18m there is a variance of loose, fine-grained sands to very dense, fine- to medium-grained sands, with firm, fine-grained sands and interfingering sandy to muddy limestones. Post-Miocene units are shown by Clarke and others (1990) to reach a thickness of approximately 60m at the Brunswick Pulp and Paper Company site in Glynn County (Figures 5 and 6) and at Kings Bay in Camden County.

HYDROLOGIC SETTING

The study area is generally subtropical, receiving yearly average rainfall of 130 to 135cm (Brown, 1984). Seventy-five to 100cm of the rain water is lost in evapotranspiration; and 12 to 25cm is lost to runoff, which is shown by Krause and Randolph (1989) as generally being lowest along the coast. The remainder recharges the surficial aquifer through seepage into the water table. This infiltration generally occurs at a high rate, due to the sandy soils in the study area (Watson, 1982).

According to Krause and Randolph (1989) the water table, which is generally a subdued replica of the land surface, fluctuates with seasonal fluctuations in rainfall. The majority of rainfall occurs in July and August in most of Georgia, with the least amount in October and November. In southeast Georgia, the rainy season extends into December. Clarke and others (1990) describe how the coastal surficial aquifer can fluctuate as a tidal response, and the Upper Brunswick aquifer fluctuates with pumping of the Upper Floridan aquifer. The fluctuations in the water table are generally less than 1.5m in Southeast Camden County (Brown, 1984). Although Brown (1984) stated that the water table is approximately 1.5m below land surface in Southeastern Camden County, Krause and Randolph (1989) report that it is generally found to be much nearer the land surface in low-lying areas, such as along streams and in marshes and swamps.

According to Krause and Randolph (1989) water is introduced into and the surficial aquifer through infiltration from direct rainfall, as well as from lateral movement of water or seepage from surficial bodies of water. Once in the surficial aquifer, the water moves down gradient and is discharged into streams, ponds, and other surface-water bodies (Krause and Randolph, 1989). The water from the surficial aquifer can recharge underlying confined aquifers by seepage through the upper confining layers. This occurs where the water table is above the potentiometric surface of the lower aquifers. They also cite the condition where the surficial aquifer can be recharged from the underlying confined aquifers when the head gradient is reversed. Similarly, Soil and Material Engineers, Inc. (1986a) state that the Floridan aquifer possibly supplies recharge to the Miocene aquifer system due to greater head in the Florida aquifer. The interaquifer dynamics described above are supported by Watson (1979), and Clarke and others (1990) whose studies indicate that the lower portion of the Miocene aquifer system is hydraulically connected to the upper Floridan aquifer.

COASTAL NEOGENE AQUIFER SYSTEM

Clarke and others (1990) provide a detailed discussion of the shallow aquifers within the thirteen coastal counties of Georgia. Their study is one of the principle references cited in this report. An earlier study by Watson (1979) discusses the potential and lithostratigraphic relationship of the shallow aquifers in coastal Georgia. A generalized north/south cross section of the coastal aquifer is shown in Figure 7.

Ground water withdrawal rates in the Brunswick area have been estimated as being between 85 and 105 million gallons per day (Johnston, 1978; Peck and others, 1992), with chloride concentrations exceeding state and federal drinking-water standards. According to Brown (1984) ground water withdrawal rates for Camden County dropped from 40 million gallons per day in 1977 to 37 million gallons per day in 1980, with 98% of the use in the St. Marys area. Withdrawal rates in 1990, however, are cited by Peck and others (1992) as being approximately 42 million gallons per day. This increased use was due to the development of Kings Bay Submarine Base. Krause and Gregg (1972) show that between 1880 and 1971 the potentiometric surface of the principle artesian aquifer had dropped over 23m in the St. Marys area apparently due to high water use by paper mills at St. Marys and at Fernandina, Florida.

Miocene Aquifers

According to Krause and Randolph (1989) and Miller (1986), the Miocene sediments of the Georgia coastal plain are the "upper confining unit" for the Upper Floridan aquifer, because the permeability of the Miocene units is much less than that of the Floridan aquifer system. In a later report, Clarke and others (1990) designated two aquifers in the Miocene as the Lower and Upper Brunswick aquifers.

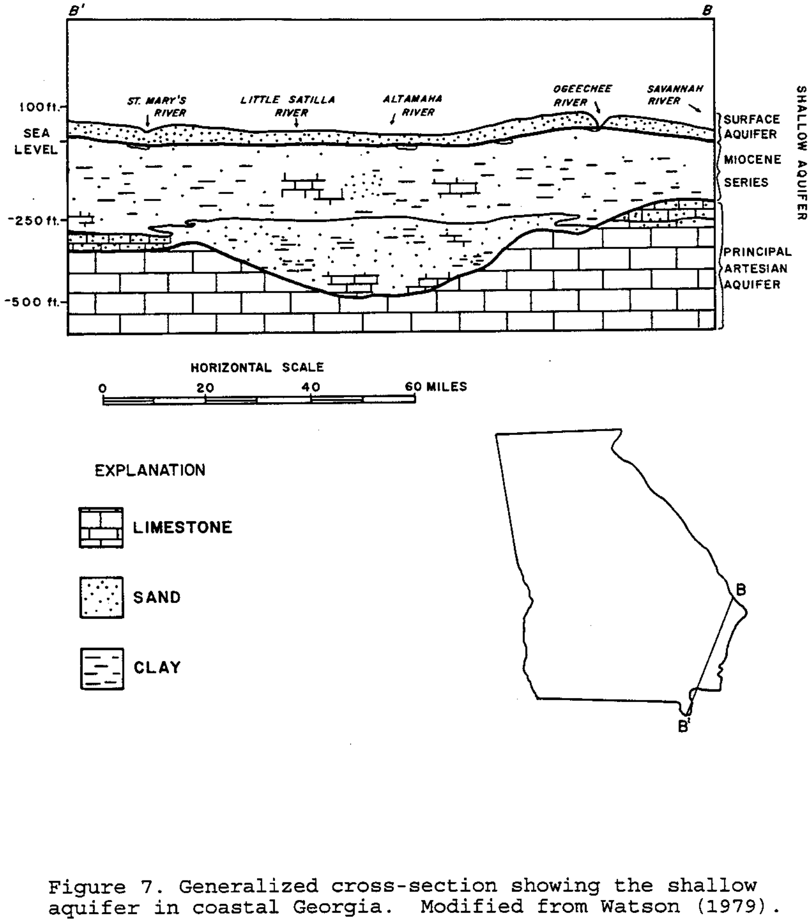

Figure 7. Generalized cross-section showing the shallow aquifer in coastal Georgia. Modified from Watson (1979).

The Lower and Upper Brunswick aquifers are being used by industry, mainly in multi-aquifer wells, and some are capable of yielding up to 200 gallons per minute. In the majority of cases, the Lower and/or Upper Brunswick aquifers are used in conjunction with the Upper Floridan aquifer. Also, the two Brunswick aquifers are used in conjunction with each other, and/or with the surficial aquifer. Because of this, little work has been done concerning the Brunswick aquifers as separate and distinct aquifers.

The Lower Brunswick aquifer was identified from deposits encountered in well 33H206 (see Figure 6 and Appendix B). Here the aquifer consists of poorly sorted, fine to coarse, phosphatic, slightly dolomitic sand of Miocene unit C. According to Clarke and others (1990) the aquifer's lower confining unit correlates with geophysical marker C, and its upper confining unit correlates with geophysical marker B. They also show in that report that the thickness of the Lower Brunswick aquifer does not include that of the confining units or the intermittent clay layers found in Miocene unit C. This would make the thickness of the aquifer less than Miocene unit C. Two maps in the report by Clarke and others show the thickness of Miocene unit C, the depths (mean sea level is datum) to geophysical marker B, the upper confining unit of the Lower Brunswick aquifer, and the lower confining unit of the Upper Brunswick aquifer.

The Upper Brunswick aquifer was named for deposits also found in well 33H206 (see Figure 6 and Appendix B) that consist of poorly sorted, fine to coarse, slightly phosphatic and dolomitic quartz sand contained in unit B. The aquifer's upper and lower confining units correlate with geophysical markers A and B, respectively. In defining the thickness of the aquifer, the confining units or the intermittent clay layers in unit B are not included. Therefore, the thickness of the aquifer is slightly less than the stratigraphic unit itself. Clarke and others (1990) show depths (mean sea level is datum) to geophysical marker A, which is the upper confining unit of the Upper Brunswick aquifer, and the lower confining unit of the surficial aquifer in Pliocene to recent sediments.

Pliocene to Recent Aquifers

According to Clarke and others (1990), the aquifers in the Pliocene to recent series consist of sands with interfingering layers of limestones and clay layers that can act as confining units. Clay is the confining unit for the deeper portions of the surficial aquifer in the Brunswick area, while in Camden County the deeper portions are confined by a carbonate and clay layer. Environmental Science and Engineering, Inc. (1980) designated the aquifer in this stratigraphic series as the water table aquifer, while Westinghouse Environmental Services (1989) named it the Plio-Pleistocene aquifer. Clarke and others (1990) named it the surficial aquifer.

According to Clarke and others (1990) the surficial aquifer is found above geophysical marker A, and includes the upper sand of Miocene unit A, as well as interfingering sand, clay, and limestone of the post-Miocene units. The overall thickness of the aquifer is slightly less than the combined thicknesses of the Miocene unit A and the post-Miocene unit. The surficial aquifer is confined at the bottom by limestone, dolomite, and clay of the Miocene unit A. The aquifer is mainly under water-table conditions, but artesian flow can be caused by locally occurring, upper confining units of clay layers or thin limestone beds. This is usually found where the aquifer is thickest due to the greater extent of the clay layers within the thicker areas.

The surficial aquifer is extensively used. This aquifer is utilized mainly for domestic use by private well owners, probably due to the greater cost of drilling deeper wells. Wait (1965) reports that wells (less than 15m deep) in the "Pleistocene sands" yield water that is used primarily for watering lawns and irrigation. Watson (1979) states that 80% of private homes in the study area receive water from the Neogene aquifer system.

NEOGENE AQUIFER SYSTEM IN CAMDEN COUNTY

Miocene Aquifers

A study by Westinghouse Environmental Services (1989) shows that the Miocene aquifers are not greatly developed in Camden County where the system includes strata from approximately 34m to about 152m. In a test well in the Osprey Cove Subdivision (OC-1), they identified three main zones capable of yielding significant amounts of water, as well as several minor zones. The three main zones were reported as being artesian and are at depths of 73-82m, 102-113m, and 129-142m, respectively. The "secondary artesian aquifer" of Environmental Science and Engineering, Inc. (1980) consists of a group of isolated, Miocene-age limestone lenses of variable thickness and extent that roughly correlate with the zones of Westinghouse Environmental Services (1989). These lenses fall within depths of approximately 30m to approximately 165m in the Kings Bay area.

In Camden County the depth to geophysical marker A varies from 55m near Woodbine to 109m on Cumberland Island. The depth to geophysical marker B varies from 91m near Woodbine to 133m in Northern Camden County along the Little Satilla River and to approximately 127m in the St Marys area (Figure 5). Thickness of unit B varies from 30m to 42m. The thickness of unit C varies from 15m to 18m in the St Marys area to 33m just north of White Oak and on the northern tip of Cumberland Island.

Westinghouse Environmental Services (1989) do not recommend the use of the Miocene aquifers for the Osprey Cove Subdivision, citing low permeability, high variability of hydrogeologic characteristics in the St. Marys area, and the more complex construction methods needed (screens, gravel packing, etc.) for proper implementation. They reported transmissivities of 30 to

150 square feet per day in the clearer sand portion (76-78m) in zone 1 and a transmissivity of 80 square feet per day in zone 2 and 3 combined. A hydraulic conductivity was reported by Herndon (1990) that varied from 34 to 94 feet per day.

Pliocene to Recent Aquifers

Of the three aquifers identified in the Kings Bay area by Environmental Science and Engineering, Inc. (1980), the top aquifer is the water table aquifer. In the west of their study area this aquifer has sands 12 to 90m thick. In the east of their study area it consists of sands 12 to 18m thick, underlain by 18m of limestone which thins in a westerly direction. This aquifer is generally a low-yield aquifer, with pumping capacities of 10 to 15 gallons per minute. According to that report the water is being used only for showers and latrines, and not as a potable source. The report shows five shallow wells (A,B,C,D, and E) that were set up in the Kings Bay area, at depths of 5m to 6m, to monitor the water table aquifer.

In their Plio-Pleistocene aquifer, Westinghouse Environmental Services (1989) cites water-bearing sand and shell beds and low permeability clays that are confining beds, with a lower confining unit of thick green phosphatic clay (characteristic of the Miocene). They report two permeable zones in this aquifer, with the lower being confined, and having a higher permeability (both have relatively low permeability).

The first zone is mainly under water table conditions and is between the depths of 0 and 12m. This zone consists of 9-12m of tan to gray very fine to fine quartzose sand; clayey quartzose sand; and tan and gray, silty sandy, and plastic gray clay. The lower zone is under confined conditions and is between depths of 25 to 34m. This zone consists of clayey, quartzose sand and sandy and clayey limestone and shells. In that report these two permeable zones are shown to be separated by a clay-bearing zone of low permeability that is 12m thick.

The hydraulic properties of aquifers in the Pliocene to recent series in Camden County are cited in a number of reports. Brown reports a transmissivity in the surficial aquifer near Kingsland of approximately 700 square ft per day. Westinghouse Environmental Services (1989) shows a transmissivity of 27 square ft per day, and a hydraulic conductivity of 0.9 ft per day in their 25-34m zone in the St. Marys area. Herndon (1990) reports hydraulic conductivity values of 21 ft per day in the surficial aquifer on Cumberland Island. That same report shows a transmissivity of 235 to 650 square ft per day in the Pliocene-Miocene aquifer (18m below land surface and 10m thick). A hydraulic conductivity of 100 ft per day in the Pliocene sand is also reported.

NEOGENE AQUIFER SYSTEM IN GLYNN COUNTY

Miocene Aquifers

In an early study, McCallie (1908) reported artesian flow from a well in Brunswick coming from depths of 92m and 130m, which correlate with the Miocene section in that area. Wait (1965) identified three zones of flow in wells in the Brunswick area. Of these three zones, the first flow and the second flow occur in sediments approximately 106m and 132 to 144m deep, respectively. These depths also fall within Miocene strata in the study area. The depths appear to correlate with the artesian zones of McCallie (1908), the Upper and Lower Brunswick aquifers, and with zones 2 and 3 of the OC-1 test well in Camden County. In 1986 Soil and Material Engineers, Inc. (1986a), reported, along with less significant aquifers in the upper 30m of the Miocene section, the presence of confined aquifers within the Miocene under Colonels Island. These are the "upper Hawthorne aquifer" (10 to 15m thick), and the "basal Miocene aquifer" (25 to 35m thick), which appear to correlate with the Upper and Lower Brunswick aquifers also.

Based on the maps in Clarke and others (1990), the thickness of unit C ranges from 30m in an area between Pyles Marsh and Thalmann to 48m on Jekyll Island. In the Brunswick area the thickness varies from 36 to 39m. The depth to geophysical marker B varies from 109m in the Brunswick area to 152m north of Sterling. The thickness of unit B varies from approximately 33m in the Brunswick area to 55 to 60m in West Glynn County. Depths to geophysical marker A range from about 67m in the Brunswick area to 109m in two areas, near Pyles Marsh and just north of Sterling.

Values on hydraulic conductivity of the aquifers within the Miocene are provided in a report on two wells by Soil and Material Engineers, Inc. (1986a). The Miocene aquifers (their Basal Miocene aquifer) under Colonels Island show a permeability of 50 feet per day and a transmissivity of 2000 and 4700 square ft per day. Values for their Upper Hawthorne aquifer include an estimated permeability of 25 to 50 ft per day and a transmissivity of 900 square ft per day.

Pliocene to Recent Aquifers

In the Brunswick area, Wait (1965) identified the sediments that yield water in the first 15m as medium-grained sand found at depths of 4 to 5m and 11 to 15m. That report also recognizes wells approximately 30 to 55m deep as being in post-Hawthorne sediments. Some of these wells were under artesian conditions, with water coming from gravelly sand and thin limestone beds.

The deeper aquifers in this series were identified by Soil and Material Engineers, Inc. (1986a) as being the Pliocene aquifer system, which they found to underlie all of Colonels Island in Glynn County. This aquifer, which they stated as not being utilized as a source of ground water, has a thickness ranging from 12 to 21m. They cited the Pliocene at Colonels Island as consisting of interbedded and alternating beds of fossiliferous sandy limestone, calcareous sand and sandy-marly clays. The Pliocene aquifer system is recharged by the overlying Pleistocene aquifer system, which is in turn recharged by rainfall.

The sediments of the Pleistocene aquifer system are relatively thin and also were reported as not being used as a source of water on Colonels Island. The Pleistocene sediments, which have a thickness of about 8 to 14m, are unconsolidated fine- to medium sands and shell beds with thin discontinuous beds consisting of clay and silt. Watson (1979) reported a layer of coarse and fine gravel at the base of surface sediments in the majority of Glynn County. That report identifies the layer as being 9 to 50m below land surface, with a thickness varying from 2 to 5m. In the report by Clarke and others (1990) the combined thickness of Miocene unit A and the post-Miocene unit varies from approximately 70m in the Brunswick area to 121m in the Pyles Marsh area, where there is an east-west trending structural depression (Figure 2).

Very little work on the hydraulic properties of the aquifers in the Pliocene to recent series in Glynn County has been reported. Both the shallower (4 to 5m and 11 to 15m) and deeper (30 to 55m) wells in the report by Wait (1965) were found to give yields of 5 to 20 gallons per minute. In the Brunswick area, Gregg and Zimmerman (1974) show a transmissivity of 6700 square ft per day in the Pliocene.

GUIDELINES FOR AQUIFER USE

The shallow aquifers have been noted as possible alternatives to the Floridan aquifer system, if properly developed and used to a greater extent. Their further development and use could aid in redistributing stresses placed on the coastal aquifer systems, which would possibly help minimize cones of depression in the upper Floridan aquifer (Watson, 1979). The possible use of water in the shallow aquifers for induced recharge to hinder saltwater encroachment in certain coastal areas was recognized by Callahan (1964) and is illustrated in Watson (1979). This is accomplished by using gravity connector wells. The shallower aquifers are connected to lower aquifers (e.g. Floridan aquifer system) by these wells, allowing water to flow from shallower to deeper aquifers under the force of gravity.

The ground water in the study area is generally considered to be suitable for most uses, including irrigation and as a potable source. However, due to the shallow nature of these aquifers, they are vulnerable to water quality degradation from pollution from sources associated with industry and agriculture. It is most important, therefore, that wells be closely monitored for possible contamination to prevent the spread of pollutants within the aquifer. The sources of contaminants are numerous and include infiltration of irrigation water and water from septic tanks (Brown, 1984). Although such pollution is a greater threat to the surficial aquifer than to the aquifers in the Miocene, induced recharge, poor quality water or contaminants may be introduced from the surficial aquifer into a deeper aquifer. Conversely, water quality in the shallow aquifers near the coast and on barrier islands may be harmed through the lateral or upward migration of saltwater underlying the freshwater parts of the aquifer (Brown, 1984). Miller and others (1978) recognize the problem of contamination and also show that ground disturbance, by phosphate mining, "borrowing", and other excavating activities can affect the water table. Although the water table would readjust to the new topography after disturbance, seasonal fluctuations would be greater under the new conditions.

Another important factor in dealing with shallow aquifers is that of proper well construction. Special considerations must be given the shallow aquifers in Glynn and Camden counties because of the unconsolidated sediments that compose these aquifers and their general low productivity. As stated by Watson (1979), these problems can be overcome by the use of well screens to prevent well collapse in unconsolidated sediments, and the technique of filter packing, which is helpful in increasing well yield in very fine grained sediments. Another way of enhancing well yield in the shallow aquifers is that of tapping several permeable zones with one well.

SHALLOW WELLS IN THE STUDY AREA

The shallow wells in Glynn and Camden counties provide for a variety of uses ranging from public supply to irrigation, most wells are used for domestic purposes. According to Watson (1979), the most common type of well in the surficial sediments is the driven or jetted well. While this type of well is economically advantageous to the private homeowner, it is very vulnerable to surface contamination.

Based on information gathered from federal, state, and county agencies, this report probably accounts for a majority of the existing shallow wells in the study area. However, it is suspected that many more shallow wells are unreported. The majority of information for this report is from the Atlanta (Doraville) office of the U.S. Geological Survey (USGS). Some 264 wells were identified as shallow wells in the USGS files. Forty-four of these are in Camden County, and 220 are in Glynn County. The information on these wells is given in Appendix A, and the locations of these wells are shown on the two maps included with Appendix B in this report. Due to overlapping locations of some wells, not all are shown on the map (mainly in the Brunswick area). Those that are not shown on the map are listed in Appendix A.

In addition to those on file at the USGS, 17 wells with Georgia Geologic Survey (GGS) identification numbers are listed in Appendix A. Nine of these are in Camden County, and 8 are in

Glynn County. Also, 1,034 copies of intent to drill forms for shallow wells were obtained from the Glynn and Camden County Public Health Departments. Six hundred three were obtained from Camden County, and 431 were obtained from Glynn County. These forms are provided to the GGS under separate cover. Included in the information on the intent to drill forms are: owner, driller, size and depth of well, depth of casing, drilling date, and location by street address.

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Appendix A. Information on wells tapping Neogene aquifers

APPENDIX A. Inf. on wells tapping Neogene aquifers. (From USGS GWSI, 1989). Aq.: S–surf. ,UB–upper Brunswick, LB–lower Br. Log types: C–caliper, D–driller's, E–elec., G–geologist's, J–nat. gamma, T–temp., Z–other, -- not available.

NUMBER	ID NO.	OWNER/NAME OF WELL	DRILLER	LAT	LONG	DATE CONSTR.	WELL DEPTH BELOW LS (FEET)	CASING DEPTH (FEET)	CASING DIAMETER (INCHES)	AQUIFER	AVAILABLE LOGS	WELL TYPE/ USE OF WATER	LAND SURFACE ELEVATION (FEET)	DISCHARGE (GPM)
	CAMDEN													
1	31G011	Bule Estate, J. A.	--	310044	814819	06-15-39	360	--	6	LB	E,J	U	11	600
2	31G017	Clark, Alex and Dave	Creasy Drlng	310529	814934	04-03-66	250	65	4	S	--	H	42	
3	32E004	Gross, E. (1956)	Joyce	304804	814054	01-01-56	450	--	--	LB	--	H	26	
4	32E010	Hercules Inc., Seals	--	305217	814218	00-00-68	350	340	3	LB	E,J	U	17	
5	32E030	Standard Oil Kingsland	B. Ellis	304737	814119	06-00-59	70	70	2	S	--	N	31	
6	32E035	Howards Mobile Home Park	W. Gay	305056	813938	00-00-73	75	45	2	S	--	P	12	
7	32E036	Pounds Mobile Home Park	J. Pounds	305056	813852	00-00-73	350	325	2	UB	--	P	16	
8	32F041	Hamilton, Fred Sr.	--	305810	814343	--	26	--	--	S	--	H	12	
9	32F052	Bp & P Seals Swamp No. 1	--	305250	814012	--	435	--	--	LB	J	--	20	
10	32G036	Powers, Mr.	--	310542	814325	00-00-68	424	292	2	S,UB,LB	E,J	H	20	
11	32G037	Middleton, O. P.	Woodrow Sapp	310354	814242	06-00-68	366	316	2	UB,LB	E,J	S	15	
12	33D047	St Marys Kraft-Bag 1	Layne-Atl	304454	813417	00-00-59	125	76	6	S	--	N	20	115
13	33D057	St Marys Kraft-Bag 3	Layne-Atl	304453	813429	00-00-64	114	79	8	S	--	N	15	108
14	33E002	Rayonier, Inc.	R. Lizzamore	304627	813712	00-00-30	474	80	4	S,UB	E,J	U	22	
15	33E038	Brunswick Pulp and Paper	--	305157	813156	00-00-00	340	66	--	S,UB	E,J	U	12	
16	33E041	USN Kings Bay Well A	--	304730	813425	12-14-76	18.08	18.08	--	S	--	U	30	
17	33E042	USN Kings Bay Well B	--	304700	813223	12-17-76	14.92	14.92	--	S	--	U	18	
18	33E043	USN Kings Bay Well C	--	304838	813158	12-17-76	18.92	18.92	--	S	--	U	16	
19	33E044	USN Kings Bay Well D	--	304854	813315	12-15-76	19.42	19.42	--	S	--	U	23	
20	33E045	USN Kings Bay Well E	--	304810	813351	12-17-76	17.5	17.5	--	S	--	U	25	
21	33E047	Osprey Cove Golf Course	Woodrow Sapp	304515	813657	06-12-89	111	87	4	S	D,J	--	13.12	27.3
22	33F014	Brunswick Pulp and Paper	--	305428	813104	00-00-00	306	180	--	S,UB	E,J	--	6	
23	33F015	Brunswick Pulp and Paper	--	305530	813536	00-00-00	332	169	--	S,UB	E,J	U	28	
24	33F016	Brunswick Pulp and Paper	--	305718	813244	00-00-00	306.5	90	--	S,UB	J	--	20	
25	33G011	Hardy Swamp 01	--	310208	813546	--	456	243	2	S,UB,LB	E,J	U	21	
26	33G012	W. Piney Bluff 01	--	310111	813323	--	449	186	3	S,UB,LB	E,J	U	10	
27	33G013	Dover Bluff 01	--	310122	813049	--	320	225	2	S,UB	E,J	U	10	
28	33G029	Golden Isles (shop well)	Golden Isles	310525	813457	00-00-85	190	93	4	S	--	H	21	
29	33G030	Paula Enrich	Golden Isles	310514	813451	11-00-90	210	123	4	S	--	H	21	
30	33G031	Willard Boslet	Sapp	310522	813359	03-20-90	190	140	4	S	--	H	10	25
31	33G032	Randy Dyson, Sr.	Sapp	310523	813400	06-07-89	200	140	4	S	--	H	10	
32	34D003	Cumberland Island No. 01	--	304448	812804	00-00-00	368	--	--	UB	--	--	20	
33	34D006	KBMP No. 11	--	304451	812801	--	95	--	--	S	--	U	19.73	
34	34D007	KBMP No. 1	Corps of Eng	304311	812813	06-14-89	146	136	4	S	J,Z	U	6.1	
35	34D008	KBMP No. 2	Corps of Eng	304311	812813	06-14-91	23	13	4	S	--	U	5.66	
36	34D009	KBMP No. 3	Corps of Eng	304311	812813	06-27-89	94	79	4	S	--	U	5.5	
37	34D010	KBMP No. 4	Corps of Eng	304310	812726	06-15-89	94	79	4	S	J,Z	U	4.84	
38	34D011	KBMP No. 5	Corps of Eng	304310	812726	06-17-89	44	34	4	S	--	U	4.96	
39	34D012	KBMP No. 6	Corps of Eng	304310	812726	06-21-89	71	61	4	S	--	U	4.86	
40	34D013	KBMP No. 7	Corps of Eng	304450	812800	06-22-89	89	82	4	S	--	U	16.05	
41	34D014	KBMP No. 8	Corps of Eng	304450	812800	06-23-89	30	20	4	S	--	U	15.96	
42	34D015	KBMP No. 9	Corps of Eng	304450	812800	06-23-90	72	62	4	S	--	U	16.26	
43	34D016	KBMP No. 10	Corps of Eng	304450	812800	06-25-89	132.4	122.4	4	S	J,Z	U	16.06	
44	3476 (GGS)	Camden A	State of GA	310544	813513	04-18-78	64	--		S		--	25	
45	3477 (GGS)	Camden B	State of GA	310625	813934	04-19-78	40	--		S		--	16	
46	3478 (GGS)	Camden C	State of GA	314138	814150	04-20-78	38	--		S		--	22	
47	3479 (GGS)	Camden D	--	310821	814739	04-20-78	80	--		S		--	35	
48	3480 (GGS)	Camden E	State of GA	315838	814337	05-30-78	100	--		S		--	5	
49	3481 (GGS)	Observation Well No. 2	State of GA	304728	813443	08-29-78	45	--		S		--	19	
50	3482 (GGS)	Camden F	State of GA	305537	814144	05-09-78	32	--		S		--	23	
51	3483 (GGS)	Camden G	State of GA	305014	815301	05-11-78	50	--		S		--	10	
52	3484 (GGS)	Camden H	State of GA	305409	814733	05-11-78	50	--		S		--	22	
	GLYNN													
53	32H001	Brunswick Pulp and Paper Bladen	--	311445	814238	00-00-38	500	298	2	UB,LB	E,J	U	19.18	30
54	32H017	Roads End Camp	Perry	311155	814252	00-00-48	442	245	2	UB,LB	E,J	R	20.17	
55	32H024	Lamar, Stafford	J. L. Perry	310918	814008	02-00-39	518	214	2	S,UB,LB	E,J	H	18.48	
56	32H026	Osborn, N. B.	Granville Nix	311053	813812	03-11-57	445	20	3	S,UB,LB	E,J	H	20.92	
								292	2					
57	32H036	Livingston, J. L.	--	311130	813932	00-00-10	318	260	3	S,UB	E,J	U	16	

NUMBER	ID NO.	OWNER/NAME OF WELL	DRILLER	LAT	LONG	DATE CONSTR.	WELL DEPTH BELOW LS (FEET)	CASING DEPTH (FEET)	CASING DIAMETER (INCHES)	AQUIFER	AVAILABLE LOGS	WELL TYPE/ USE OF WATER	LAND SURFACE ELEVATION (FEET)	DISCHARGE (GPM)
58	32H037	Curry, C. K.	Crews Plumbing	310739	813739	00–00–62	570	97	3	S,UB,LB	C,E,J	H	31	
59	32H046	Steve Mosley	Sapp	311055	813741	10–30–85	200	170	4	S	--	H	31	
60	32H047	Bullock, Jim	Sapp	310805	813744	06–08–90	190	152	4	S	--	H	19	
61	32J015	Arnett Field (Paulks Past)	--	311840	814058	00–00–00	483	314	--	UB	E,J	--	15	
62	32J017	Charles Jones	Sapp	311654	814045	03–29–88	185	123	4	S	--	--	20	
63	32J018	Butler Blount	Popeye Gordn	311704	814028	00–00–76	137	80	2	S	--	--	15	
64	32J019	Danny Howe	Jack Price	311653	814029	08–19–89	150	102	4	S	D	H	17.5	
65	33G027	GPA–2	Layne Atl.	310519	813141	06–24–86	555	69	10	LB	D,G,E,J	U	10	
								503	4					
66	33G028	GPA–3	Layne Atl.	310629	813233	07–04–86	475	75	12	UB,LB	D,G,J,E	U	10	
								390	6					
67	33H003	Madge Merritt Garden Club	--	310759	813554	00–00–59	480	147	3	S,UB	E,J	U	9.62	
68	33H006	Scarlett, R.	Perry	310902	813523	01–01–16	480	180	3	S,UB	--	H	17	2
69	33H008	Hosmer, H.	R. M. Scarlett	310839	813439	00–00–39	470	350	3	UB,LB	--	H	14	5
70	33H010	Cowan, George	F. L. Perry	310900	813415	02–01–37	414	127	3	UB,LB	E	H	6.3	
71	33H017	Massey, Roy	--	310748	813216	09–00–00	333	224	4	S,UB	E,J	U	12	
72	33H046	American Creosoting	Woodrow Sapp	311429	813157	01–01–58	80	50	4	S	--	N	11	
73	33H121	Palmetto Cemetary S.	--	311029	813031	--	164	--	--	S	E,J	C	11.1	
74	33H138	Zell, Richard	Woodrow Sapp	310826	813326	00–00–66	460	408	2	UB	E,J	H	7.81	
75	33H150	Havenwood Nursery	--	311331	813031	00–00–68	501	146	3	UB,LB	E,J	C	15	
								490	2					
76	33H166	Holtzendorf, R.	Gerald Nix	311454	813318	03–01–71	168	122	4	S	--	P	11	30
77	33H169	Brunswick Pulp and Paper 02 Shallow	Woodrow Sapp	311022	813113	01–01–67	200	92	6	S	--	N	13	300
78	33H194	Hatfield, Maurice W.	So GA Pump	311205	813111	01–01–77	180	88	3	S	--	H	10	
79	33H195	Pineridge Baptist Church	So GA Pump	311233	813019	01–01–00	155	135	3	S	--	H	20	
80	33H196	Brunswick Concrete Co.	So GA Pump	311326	813047	01–01–72	200	87	3	S	--	N	16	
81	33H198	H. O. Nail	W. Sapp	311326	813205	04–01–82	180	152	4	S	--	H	20	
82	33H201	Buddy Carlin	W. Sapp	311441	813237	01–01–00	240	176	3	S	--	U	20	
83	33H202	Carl E. O'Neal	W. Sapp	310823	813328	11–01–81	200	142	--	S	--	H	9	
84	33H203	Jack's Minit Market	So GA Pump Co	310829	813507	01–01–80	230	180	4	S	--	Z	15	
85	33H205	Aaron Lamar Harris	So GA Pump Co	310847	813707	01–01–79	222	168	--	S	--	H	30	
86	33H208	USGS GGS BP&P South TW 03	GGS	310925	813122	02–24–83	155	133	6	S	--	U	7	0.2
								135	4					
87	33H223	GPA–1	Layne Atl.	310741	813227	06–11–86	548	70	10	LB	D,G,E,J	U	12	
								498	4					
88	33H228	Tait Feed and Seed	Sapp	311426	813233	12–20–88	125	86	4	S	--	H	16	
89	33H229	Virginia Bates	Sapp	311107	813328	11–08–90	160	125	4	S	--	H	10	
90	33H230	Henry Harper	Sapp	311410	813522	08–17–88	185	132	4	S	--	H	5	
91	33H231	Neal Jump	Sapp	311420	813245	03–30–88	200	128	4	S	--	H	10	
92	33H232	James Lovett	Sapp	311032	813227	10–24–88	180	145	4	S	--	H	10	
93	33H233	Randy McDonald	Sapp	311259	813209	01–22–90	200	152	4	S	--	H	10	
94	33H234	James K. Pipkin	Sapp	311424	813249	08–19–88	155	105	4	S	--	H	10	
95	33H235	Herman Diestel	Sapp	311123	813313	00–00–89	160	105	4	S	--	H	10	
96	33H236	Joe Mumford	Sapp	310954	813519	07–29–88	200	150	4	S	--	H	16	
97	33H237	Ray Moody	Sapp	311400	813150	05–20–89	200	158	4	S	--	H	16	
98	33H238	Harvey Crosby	Sapp	311336	813152	08–10–88	180	132	4	S	--	H	24	
99	33H239	Dominey Machine Shop	Sapp	311223	813003	05–05–88	220	185	4	S	--	H	16	
100	33H240	J. H. McLain	Sapp	311330	813158	01–22–88	195	160	4	S	--	H	19	
101	33H241	Adie Allen	Sapp	311206	813033	06–29–90	180	145	4	S	--	H	12.3	
102	33H242	Bobby Sapp	Sapp	311327	813225	11–03–88	200	158	4	S	--	H	10	
103	33H243	Thomas Boyd	Sapp	310907	813536	09–19–88	165	147	4	S	--	H	20	
104	33H244	Rusty Cody	Sapp	311239	813104	02–12–88	200	142	4	S	--	H	10	
105	33H245	Delmer McCil	Sapp	311220	813051	04–14–88	180	124	4	S	--	H	13	
106	33H246	Rob Anglin	Sapp	310901	813534	09–21–88	185	152	4	S	--	H	20	
107	33H247	Bruce Bliss	Sapp	311124	813325	12–05–89	160	105	4	S	--	H	10	
108	33H248	Cecil Andrew DeJournett	Sapp	311040	813227	08–11–88	150	105	4	S	--	H	10	
109	33H249	Jennings Overstreet	Sapp	311407	813150	04–28–88	160	128	4	S	--	H	16	
110	33H250	Ricky Daniels (Builder)	Sapp	310914	813529	11–09–89	210	155	4	S	--	H	18	
111	33H251	John F. Hardman	Sapp	311230	813134	05–16–90	160	120	4	S	--	H	12.5	
112	33H252	John Finleyson	Sapp	311406	813237	05–04–90	160	121	4	S	--	H	9	
113	33H253	Randall Howell	Sapp	311301	813158	07–26–90	180	151	4.5	S	--	H	20	
114	33H254	Terry Rape	Sapp	311307	813153	07–20–90	220	156	4.5	S	--	H	20	
115	33H255	L. A. Carrol	Sapp	311453	813213	12–11–90	180	123	4.5	S	--	H	19.6	
116	33H256	Kermit Bule	Sapp	311041	813024	03–07–91	280	140	4	S,UB	--	H	12.5	

Well type/use of water: C–commercial, H–domestic, I–irrigation, N–industrial, P–public supply, R–recreational, S–stock, U–unused, Z–other, -- information not available.

APPENDIX A. Inf. on wells tapping Neogene aquifers. (From USGS GWSI, 1989). Aq.: S–surf. ,UB–upper Brunswick, LB–lower Br. Log types: C–caliper, D–driller's, E–elec., G–geologist's, J–nat. gamma, T–temp., Z–other, –– not available.

NUMBER	ID NO.	OWNER/NAME OF WELL	DRILLER	LAT	LONG	DATE CONSTR.	WELL DEPTH BELOW LS (FEET)	CASING DEPTH (FEET)	CASING DIAMETER (INCHES)	AQUIFER	AVAILABLE LOGS	WELL TYPE/ USE OF WATER	LAND SURFACE ELEVATION (FEET)	DISCHARGE (GPM)
117	33H257	David Sapp	Sapp	311343	813157	04–12–91	180	125	4	S	––	H	19.6	
118	33H258	R. L. Newborn	Sapp & Sons	311331	813157	05–25–90	180	153	4.5	S	––	H	19	
119	33H259	Johnny Simpson	Sapp	311342	813159	06–23–89	170	125	4	S	––	H	17.6	
120	33H260	Mark Smith	Sapp	311240	813108	04–03–89	165	125	4	S	––	H	10	
121	33H261	Jarvis Mason	Sapp	311147	813032	08–03–89	200	156	4	S	––	H	14.8	
122	33H262	Shannon Cox	Sapp	311238	813018	08–08–89	200	141	4	S	––	H	20	
123	33H264	Mrs. W. H. Crooms	Sapp	311238	813012	08–23–89	180	140	4	S	––	H	20	
124	33H265	Idell Harvey	Sapp	311319	813020	01–06–89	155	110	4.5	S	––	H	12.5	
125	33H266	Earl Millan	Sapp	311413	813059	04–14–89	220	185	4	S	––	H	27.5	
126	33H267	Gene Reynolds	Sapp	311341	813158	05–23–89	165	125	4	S	––	H	17.5	
127	33H268	Texaco Food Mart	Sapp	311330	813030	11–27–89	180	138	4	S	––	H	14	
128	33H269	Olin Poppell	Sapp	311303	813006	07–18–87	170	135	4.5	S	––	H	14	
129	33H270	John Hiland	Sapp	311428	813447	11–14–89	180	120	4	S	––	H	7.5	
130	33H271	Tom Williamson	Sapp	311312	813444	11–22–89	160	120	4	S	––	H	6	
131	33H272	J. J. Ross	Sapp	311220	813348	02–28–90	160	110	4.5	S	––	H	7	
132	33H273	C. R. Proudfoot	Sapp	311419	813251	02–27–89	140	118	4	S	––	H	10	
133	33H274	Cliff Holcomb	Sapp	311408	813232	03–29–89	150	90	4	S	––	H	12.5	
134	33H275	Curtis Gowen	Sapp	311348	813255	10–27–89	160	118	4	S	––	H	7.5	
135	33H276	Richard Edgy	Sapp	311355	813231	11–16–89	140	110	4	S	––	H	12	
136	33H277	Bo Cowley	Sapp	311409	813216	05–24–89	145	105	4	S	––	H	10	
137	33H278	Miller	Sapp	311407	813219	10–19–89	160	120	4	S	––	H	12.5	
138	33H279	Joyce Googe	Sapp	311306	813204	09–09–89	200	166	4	S	––	H	17	
139	33H280	Bob Bowers	Sapp	311258	813153	05–04–89	200	153	4	S	––	H	17.5	
140	33H281	Stan Boatwright	Sapp	311324	813211	08–05–89	200	156	4	S	––	H	20	
141	33H282	W. B. Lambert	Sapp	311356	813110	05–26–89	200	165	4	S	––	H	25	
142	33H285	Pete Ward	Jack Price	310953	813512	00–00–90	201	102	4	S	D	H	13	
143	33H286	Johnny Hickox	Sapp	311025	813713	07–24–86	180	145	4	S	––	H	32	
144	33H287	Pattie Wilcox	Jack Price	310911	813657	11–10–89	162	137	4	S	D	––	28	
145	33H288	DOT Hwy. 303 – Tril Rvr. Brg.	Jack Price	311104	813200	04–28–90	181	134	4	S	D	––	7	
146	33H289	Jeff Counts	Sapp	311236	813141	03–24–88	185	122	4	S	––	I	17.5	
147	33H290	Geoffrey May	Sapp	311239	813142	03–23–88	185	120	4	S	––	I	12.5	
148	33H291	Bill Smith	Sapp	311241	813143	01–27–88	200	125	4	S	––	H	12.5	
149	33H292	John Martin	Sapp	311350	813232	05–30–90	160	118	4.5	S	––	H	12.5	
150	33H293	John H. Patterson	Sapp	311356	813229	03–26–91	160	120	4	S	––	H	10	
151	33H294	Michael Dowdy	Sapp	311338	813254	05–09–90	160	120	4.5	S	––	H	5	
152	33H295	Ron Wood	Sapp	311359	813249	02–07–91	160	115	4	S	––	H	12.5	
153	33H296	Carter	Sapp	311357	813231	03–08–90	160	120	4	S	––	H	12.5	
154	33H297	K. E. Kub	Sapp	311358	813235	03–12–90	160	120	4	S	––	H	10	
155	33H298	John Rinnier	Sapp	311344	813247	04–04–90	160	121	4.5	S	––	H	298	
156	33H299	William Wiggins	Sapp	311348	813247	02–04–91	160	115	4	S	––	H	12.5	
157	33H300	John Wittingslow	Sapp	311350	813247	03–21–90	160	120	4.5	S	––	H	12.5	
158	33H301	Larry Rodgers	Sapp	311417	813232	01–08–90	150	120	4.5	S	––	H	15	
159	33H302	Johhnny Dills	Sapp	311352	813243	02–08–90	150	118	4	S	––	H	12.5	
160	33H303	John Blackney	Sapp	311420	813451	06–18–90	160	120	4	S	––	H	10	
161	33H304	Bo Bennett	Sapp	311158	813355	06–14–90	180	130	4.5	S	––	H	5	
162	33H305	D. Higgins	Sapp	311119	813323	11–23–90	180	121	4.5	S	––	H	10	
163	33H306	A. R. Brown	Sapp	311040	813323	02–14–91	180	123	4	S	––	H	7	
164	33H307	James R. Benton	Sapp	311042	813325	08–14–90	180	120	4.5	S	––	H	8	
165	33H308	Hertha Carter	Sapp	311301	813026	10–05–90	180	135	4.5	S	––	H	12	
166	33H309	Horton	Sapp	311232	813019	12–04–90	180	140	4	S	––	H	19	
167	33H310	Lambert	Sapp	311245	813024	07–27–90	180	141	4	S	––	H	15	
168	33H311	Tony Nelson	Sapp	311233	813003	06–12–90	200	140	4.5	S	––	H	15	
169	33H312	Alex Livingston	Sapp	311257	813130	08–07–90	160	115	4.5	S	––	H	16	
170	33H313	. Phillip Simpson	Sapp	311318	813152	07–15–90	160	120	4.5	S	––	H	24	
171	33H314	Roger Burnem	Sapp	311242	813045	02–09–91	200	151	4	S	––	H	13	
172	33H315	A. R. Sadtler	Sapp	311322	813206	07–11–90	200	157	4.5	S	––	H	20	
173	33H316	Lorraine Wiggins, WXMK FM	Sapp	311214	813000	01–14–91	180	135	4.5	S	––	H	15	
174	33H317	Grady Transmission	Nix	311241	813049	00–00–00	180	––	––	S	––	N	11.5	
175	33H319	Sammy Tostersen	Sapp	310806	813343	01–11–88	200	130	4	S	––	H	11.5	
176	33H320	Mrs. Edra Fulford	Sapp	311418	813114	07–01–88	250	214	4	S	––	H	26	
177	33J013	Glynn Farms – Pond	––	311524	813646	––	487	226	3	UB,LB	E,J	S	13	
178	33J033	Glynn Farms	W. Sapp	311915	813511	––	395	212	3	S,UB	E,J	U	22	
179	33J035	Knight, James	––	311619	813113	10–15–73	576	570	3	LB	E,J,T	H	25	
180	33J036	Haven Manufacturing	––	311652	813317	––	100	––	––	S	––	––	18	

NUMBER	ID NO.	OWNER/NAME OF WELL	DRILLER	LAT	LONG	DATE CONSTR.	WELL DEPTH BELOW LS (FEET)	CASING DEPTH (FEET)	CASING DIAMETER (INCHES)	AQUIFER	AVAILABLE LOGS	WELL TYPE/ USE OF WATER	LAND SURFACE ELEVATION (FEET)	DISCHARGE (GPM)
181	33J046	Jack's Minit Mart, Sterling	S GA Pump Co	311619	813341	01–01–77	175	126	3	S	--	Z	12	
182	33J047	Jimmy Jones	W. Sapp	311830	813314	04–01–82	179	159	4	S	--	H	20	
183	33J048	Charlie Gibbs	W. Sapp	311827	813441	11–01–81	200	154	4	S	--	H	16	
184	33J049	Norman Stewart	W. Sapp	311512	813032	06–01–79	280	195	4	S	--	H	31	
185	33J051	L. E. Thomas	Sapp	311558	813059	03–21–91	200	142	4	S	--	H	27.5	
186	33J052	Mark McMillan	Sapp	311508	813107	07–07–89	185	125	4	S	--	H	21	
187	33J053	Ricky Beck	Sapp	312035	813307	02–27–90	160	122	4.5	S	--	H	17.5	
188	33J054	E. W. Lewis	Sapp	311924	813340	02–10–88	160	120	4	S	--	H	22.5	
189	33J055	Lee Witters	Sapp	311520	813538	04–16–90	180	140	4.5	S	--	H	6	
190	33J056	GA Power Co.	Sapp	311648	813332	10–07–88	160	145	4	S	--	H	12.5	
191	33J057	Guy Bunckley	Sapp	311937	813518	09–26–89	200	141	4	S	--	H	17.5	
192	33J058	Linda Taylor	Sapp	311600	813103	11–17–88	180	135	4	S	--	H	25	
193	33J059	Maxine Davis	Sapp	311638	813445	12–20–86	140	120	4	S	--	H	12	
194	34G006	Jeckyll Island 20	Woodrow Sapp	310249	812538	--	464	200	3	UB,LB	E,J	C	10.85	
								370	2					
195	34G007	Jeckyll Island 15	Unknown	310115	812558	--	393	173	4	UB	E,J	R	12.75	
								380	3					
196	34G025	Jeckyll Island 16	Unknown	310334	812519	--	480	--	6	LB	--	R	10	
197	34G026	Jeckyll Island 14	Unknown	310334	812510	--	480	300	6	UB,LB	--	U	10	
198	34G034	Quarantine Island	--	310653	812820	09–27–83	462	231	3	S,UB,LB	E,J	U	7	
199	34H061	Benton Brothers Storage	Morgan Wade	311010	812838	00–00–17	520	152	4	S,UB	E,J	H	9.68	
200	34H088	Knight, Ann	--	310839	812910	--	427	316	3	UB,LB	E,J	U	7.79	
201	34H104	Royalls, Ed	--	310817	812941	00–00–00	404	188	4	S	E,J	H	5	
								358	3					
202	34H119	Brunswick Old J49	--	310859	812949	00–00–18	428	380	8	UB,LB	E,J	U	16.73	
203	34H126	McGarvey	--	310907	812946	--	178	172	4	S	E,J	S	10	
204	34H135	Sorrow, N.	Hoke Smith	311157	812917	08–01–59	165	135	2	S	--	H	14	
205	34H136	Ramsey, Ben	Nix	311159	812915	08–01–59	692	186	3	S,UB,LB	E,J	H	13.37	
								526	2					
206	34H144	J. Torras Cswy. Maint. Shop	F. L. Perry	310947	812652	01–01–25	300	--	--	S,UB	--	H	11	
207	34H145	Bennett, George	Woodrow Sapp	311005	812615	00–00–48	430	120	3	UB,LB	E,J	U	5.64	
								391	2					
208	34H146	Wilson, Arthur	Unknown	311015	812542	00–00–39	453	131	3	UB,LB	E,J	C	8.38	
								362	2					
209	34H193	Mallory Park	--	310820	812337	--	437	435	3	LB	E,J	U	10	
210	34H261	Fred Shearouse (1960)	W. Sapp	310948	812244	03–14–60	428	--	--	LB	J	H	8	
211	34H364	Kennedy, R. L.	Unknown	310819	812940	--	402	234	3	S	E,J	U	9.55	
212	34H379	Harris, A. M., Sr.	Unknown	310805	812916	00–00–67	500	16	3	S,UB,LB	C,E,J	I	11	
								140	2					
213	34H380	McGraw, R.O.	Unknown	310928	812944	--	440	348	3	UB,LB	E,J	I	15	
214	34H387	College Pl. Methodist Church	McDuffy	311115	812913	00–00–64	120	100	3	S	--	I	16	50
215	34H390	Hercules Inc. Parking Lot	--	310947	812838	00–00–68	409	110	3	LB	E,J	N	10	
								407	2					
216	34H416	Lewis Crab Co. 6	Woodrow Sapp	310827	812943	08–15–69	240	117	8	S	--	N	8	180
217	34H417	Bricker, O.	--	311332	812818	--	16	--	--	S	--	--	18	
218	34H418	Brunswick Junior College	--	311051	812920	--	8	--	--	S	--	U	13	
219	34H420	McCann, H. T.	McCann	310826	812908	00–00–72	72	70	1.5	S	--	I	10	
220	34H428	UGA Marine Extension Service	W. Sapp	310816	812939	05–21–80	180	152	4	S	--	Z	10	
221	34H429	First Baptist Church (shallow well)	S GA Pump Co	310851	812932	01–01–81	200	140	4	S	--	H	9	
222	34H430	E. M. Champion (shallow well)	S GA Pump Co	311016	812942	00–00–77	200	100	6	S	--	I	15	
223	34H431	Joe Riley	S GA Pump Co	311220	812852	01–01–72	180	113	3	S	--	H	16	
224	34H432	Fred Griffin	S GA Pump Co	311139	812255	01–01–77	260	140	3	S	--	H	12	
225	34H437	Coffin Park TW 2	GGS	310901	812844	11–01–83	328	25	10	UB	--	U	7	0.2
								315	4					
226	34H438	Coffin Park TW 3	GGS	310901	812844	11–09–83	202	188	6	S	--	U	7	30
								192	4					
227	34H443	Lewis Crab Co. 7	Sapp & Sons	310828	812942	03–01–86	450	115	10	S,UB,LB	--	N	8	180
								236	6					
228	34H446	East Coast Ice Co.	Sapp & Sons	310829	812945	01–01–82	450	380	4	UB,LB	--	C	8	180
229	34H447	Glynn County Courthouse	Sapp & Sons	310911	812941	01–01–82	180	130	6	S	--	U	10	
230	34H448	East Coast Ice No. 2	Sapp & Sons	310830	812943	08–10–88	266	156	8	S	--	N	9	130
231	34H451	Jack Price, Jr.	Golden Isle	311335	812847	07–00–90	102	82	4	S	--	H	21.3	
232	34H452	Theron McIntosh	Woodrow Sapp	310950	812944	02–17–88	180	125	4	S	--	H	11.5	
233	34H453	Scott Brandels	Woodrow Sapp	311427	812718	09–06–90	160	160	4	S	--	H	11.5	

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NUMBER	ID NO.	OWNER/NAME OF WELL	DRILLER	LAT	LONG	DATE CONSTR.	WELL DEPTH BELOW LS (FEET)	CASING DEPTH (FEET)	CASING DIAMETER (INCHES)	AQUIFER	AVAILABLE LOGS	WELL TYPE/ USE OF WATER	LAND SURFACE ELEVATION (FEET)	DISCHARGE (GPM)
234	34H454	Stewart Nelson	Sapp	311434	812948	01–18–89	150	110	4	S	––	H	24	
235	34H455	Ralph Guaracino	Sapp	311459	812934	04–12–89	150	125	4	S	––	H	25	
236	34H456	Roger Gatch	Sapp	311404	812931	04–04–91	160	120	4	S	––	H	16	
237	34H457	Roger Gatch	Nix	311403	812934	00–00–72	110	50	2	S	––	Z	17	
238	34H458	St. Francis Catholic Church	Sapp	310841	812936	04–06–90	160	110	4.5	S	––	H	10	
239	34H459	Cordell Collins	Sapp	311356	812719	03–13–90	160	125	4	S	––	H	12.5	
240	34H460	Mitch Sweenie	Sapp	311425	812730	02–15–90	160	137	4	S	––	H	16	
241	34H461	Donovan Strickland	Sapp	311429	812729	02–13–90	160	136	4	S	––	H	16	
242	34H462	Justin Hollington	Sapp	311427	812713	08–14–90	180	162	4	S	––	H	16	
243	34H463	John R. Chancy	Sapp	311343	812958	10–22–90	180	135	4	S	––	H	11	
244	34H465	Cecil Clements	Sapp	311459	812655	10–04–90	144	144	4	S	––	H	12.5	
245	34H467	Henry Melluish	Sapp	311322	812733	06–24–88	200	140	4	S	––	I	10	
246	34J055	Bob Sylvia	S GA Pump Co	311540	812620	01–01–78	220	144	3	S	––	U	15	
247	34J056	Wiseman	Sapp & Sons	311548	812601	05–24–90	160	124	4	S	––	H	7.5	
248	34J057	Timothy Smith	Sapp & Sons	311546	812605	03–14–90	160	123	4	S	––	H	10	
249	34J058	Hugo Van Camp	Sapp & Sons	311607	812558	03–23–91	180	138	4	S	––	H	12.5	
250	34J059	Charles Dunca	Sapp & Sons	311630	812546	10–09–90	160	120	4	S	––	H	17	
251	34J060	Bailey	Sapp & Sons	311605	812602	02–02–90	180	120	4	S	––	H	12	
252	34J061	Canine and Cattery Country Club	Sapp	311530	812631	01–19–88	200	120	4	S	––	H	14.8	
253	34J062	Allen Anders	Sapp	311527	812604	10–11–90	160	120	4	S	––	H	8.2	
254	34J063	David Brewer	Sapp	311551	812559	03–10–89	160	125	4	S	––	H	10	
255	34J064	Smith	Sapp	311553	812601	11–02–89	180	125	4	S	––	H	11	
256	34J065	Chris Ramsey	Sapp	311553	812604	05–05–89	165	124	4	S	––	H	12.5	
257	34J066	Melanie Johnson	Sapp	311629	812557	03–22–89	200	140	4	S	––	H	8.5	
258	34J067	Aligood	Sapp	311639	812551	06–06–90	180	140	4	S	––	H	9.5	
259	34J068	Nick and Diane Dosfer	Sapp	311638	812555	11–06–90	160	120	4	S	––	H	7.5	
260	34J069	Gange	Sapp	311638	812553	08–20–90	180	121	4	S	––	H	7.5	
261	34J070	Robert Keene	Sapp	311637	812547	08–28–90	160	130	4	S	––	H	12.5	
262	34J071	Don Hedick	Sapp	311638	812558	06–26=90	180	140	––	S	––	H	6	
263	34J072	Bob Hill	Sapp	311838	812743	01–16–91	180	135	4.5	S	––	H	19	
264	34J073	Denny Thompson	Sapp	311604	812536	08–11–90	160	120	4	S	––	H	5	
265	34J074	John K. Thompson	Sapp	311533	812610	11–28–90	180	119	4	S	––	H	13	
266	34J075	H. D. Trice	Sapp	311524	812605	08–17–90	160	120	4	S	––	H	7	
267	35H053	Phillip Churchill	S GA Pump Co	311140	812212	01–01–77	360	147	3	S	––	H	10	
268	35H054	B. E. Bledsoe	S GA Pump Co	311158	812212	01–01–79	100	80	4	S	––	H	15	
269	35H056	Chloister Hotel	Employee	311051	812058	00–00–00	20	––	2	S	––	Z	10	
270	35H057	Mr. Santon	Sapp	311130	812223	01–18–91	150	150	4	S	––	I	20	
271	35J006	Hampton Group	Sapp & Sons	311700	812041	09–16–88	540	404	10	UB,LB	D	I	10	600
272	35J007	Hampton Group	Sapp & Sons	311714	812044	10–12–88	540	408	10	UB,LB	D	I	10	600
273	3491 (GGS)	Glynn Co. A	State of GA	321923	812651	11–15–77	28	––		S	E	––	23	
274	3492 (GGS)	Glynn Co. B	State of GA	322532	813632	11–16–77	62	––		S	E	––	10	
275	3493 (GGS)	Glynn Co. C	State of GA	312123	813654	12–06–77	90	––		S	E	––	11	
276	3494 (GGS)	Glynn Co. F	State of GA	311609	812951	06–21–78	20	––		S	E	––	30	
277	3495 (GGS)	Glynn Co. G	State of GA	311443	812727	06–21–78	20	––		S	E	––	11	
278	3496 (GGS)	Glynn Co. D	State of GA	311850	811323	01–11–78	31	––		S	E	––	20	
279	3497 (GGS)	Glynn Co. E	State of GA	311424	812730	01–12–78	61	––		S	E	––	13	

Well type/use of water: C–commercial, H–domestic, I–irrigation, N–industrial, P–public supply, R–recreational, S–stock, U–unused, Z–other, –– information not available.

Appendix B. Location of deep wells from which additional geophysical and other logs were obtained

APPENDIX B. Locations of deep wells from which additional geophysical and other logs were obtained. (from USGS GWSI, 1989)

WELL ID NUMBER	LATITUDE	LONGITUDE
CAMDEN		
30G004	310230	815248
31E005	304814	815109
31E012	305107	815130
31F022	305623	814835
31G015	310130	814705
31G018	310657	814809
32E023	304751	814127
32E032	304807	814046
32E033	304516	813859
32E037	305041	813806
32F001	305546	814225
32F008	305804	814413
32F051	305542	814020
32G004	310413	814335
32G015	310648	814151
32G016	310419	814405
32G017	310658	814348
32G038	310557	814251
32G039	310203	814432
32G042	310434	814135
32G044	310627	813944
33D006	304426	813234
33D022	304401	813237
33D030	–	–
33D031	–	–
33D048	304406	813235
33D049	304413	813325
33D050	304411	813319
33D051	304407	813257
33D053	304411	813232
33D054	304450	813334
33D055	304330	813248
33D058	304408	813235
33D061	304401	813237
33D062	304433	813232
33D063	304432	813233
33E003	304751	813201

WELL ID NUMBER	LATITUDE	LONGITUDE
33E004	304910	813238
33E008	305037	813323
33E018	304800	813105
33E027	304756	813111
33E032	304739	813431
33E033	304743	813342
33E034	304752	813112
33E035	304759	813119
33E037	304913	813531
33E039	304749	813353
33E040	304749	813353
33E050	304551	813429
33F002	305514	813056
33F003	305710	813155
33F003	305710	813155
33F004	305611	813028
30F017	305538	813054
33G005	310312	813225
34E001	304522	812813
34E003	304646	812809
34E009	–	–
34E010	304610	812809
34F002	305614	812445
34F004	305630	812443
34F005	305709	812441
34F007	305739	812436
34F008	305745	812524
34F009	305803	812436
34F010	305659	812516
34F011	305813	812505
34F012	305824	812435
34F013	305438	812441
34G040	310036	812755

WELL ID NUMBER	LATITUDE	LONGITUDE	WELL ID NUMBER	LATITUDE	LONGITUDE
GLYNN					
31H006	310913	814532	33H116	311020	813054
31H007	311051	814558	33H117	311018	813039
31H008	311216	814547	33H118	311008	813058
31H009	311353	814536	33H120	311036	813026
32H033	311443	813758	33H127	311006	813016
32H038	311003	814149	33H130	311021	813031
32H039	310924	814008	33H131	311429	813426
32H040	311211	814324	33H132	311323	813203
32H041	311254	814025	33H133	311006	813016
32H042	311343	813921	33H134	311212	813024
32H043	310820	813813	33H135	311100	813012
32H045	311444	813758	33H136	311249	813003
32J001	311812	814125	33H137	311223	813114
32J012	311559	813837	33H139	310738	813327
32J013	311644	814027	33H140	310846	813529
32J014	311504	814351	33H141	311044	813231
33G002	310711	813240	33H144	311212	813033
33G003	310646	813224	33H145	311003	813003
33G008	310701	813202	33H146	311048	813008
33H021	310946	813325	33H147	310956	813511
33H035	311119	813402	33H148	311345	813127
33H038	311239	813405	33H149	311432	813141
33H041	311451	813247	33H152	311328	813032
33H061	311311	813136	33H153	310852	813356
33H079	311233	813110	33H154	311022	813029
33H095	311156	813041	33H155	311246	813048
33H100	311129	813021	33H165	311110	813237
33H101	311117	813029	33H167	311030	813011
33H102	311111	813019	33H168	311217	813002
33H103	311104	813030	33H173	311309	813037
33H106	311046	813117	33H174	311408	813057
33H108	311027	813113	33H175	311255	813123
33H109	311023	813112	33H176	310842	813452
33H111	311039	813118	33H178	311036	813117
33H112	311007	813113	33H184	311353	813653
33H113	310955	813117	33H185	311433	813046
33H114	311027	813106	33H186	310817	813539
33H115	311036	813055	33H187	311000	813613
			33H188	310809	813235

WELL ID NUMBER	LATITUDE	LONGITUDE
33H189	311014	813108
33H192	311345	813704
33H206	310925	813122
33H207	310925	813122
33H209	310912	813253
33H211	311027	813113
33H212	311008	813058
33H214	311020	813054
33H216	311018	813039
33H217	311018	813039
33H219	311349	813152
33H220	310739	813231
33H221	311027	813104
33H222	311038	813055
33H225	310757	813516
33J008	311906	813338
33J017	311618	813345
33J026	311741	813409
33J027	312000	813535
33J028	311506	813342
33J038	312000	813212
33J039	311748	813124
33J040	311916	813509
33J041	311524	813607
33J042	312222	813728
33J043	311633	813241
33J044	311633	813240
33J045	312155	813414
33J060	311501	813111
33K005	312521	813609
34G001	310726	812858
34G002	310727	812853
34G003	310610	812928
34G004	310331	812647
34G009	310103	812540
34G011	310241	812448
34G013	310315	812435
34G015	310403	812422
34G016	310607	812415

WELL ID NUMBER	LATITUDE	LONGITUDE
34G017	310658	812501
34G020	310510	812516
34G024	310339	812513
34G029	310509	812439
34G030	310342	812450
34G031	310403	812422
34G032	310413	812520
34G033	310418	812447
34G035	310134	812508
34G036	310643	812920
34H003	311432	812653
34H010	311344	812731
34H013	311354	812818
34H025	311326	812826
34H038	311155	812824
34H060	311016	812834
34H062	311005	812827
34H064	311003	812824
34H065	310950	812851
34H066	310951	812849
34H070	310955	812850
34H071	310951	812846
34H073	310951	812857
34H074	310959	812844
34H075	311002	812837
34H076	310959	812901
34H077	311007	812903
34H078	310948	812852
34H082	310927	812859
34H085	310906	812846
34H089	310830	812904
34H090	310822	812913
34H091	310753	812901
34H094	310731	812913
34H097	310755	812927
34H098	310801	812934
34H100	310806	812925
34H110	310827	812943
34H112	310841	812941

WELL ID NUMBER	LATITUDE	LONGITUDE
33H189	311014	813108
33H192	311345	813704
33H206	310925	813122
33H207	310925	813122
33H209	310912	813253
33H211	311027	813113
33H212	311008	813058
33H214	311020	813054
33H216	311018	813039
33H217	311018	813039
33H219	311349	813152
33H220	310739	813231
33H221	311027	813104
33H222	311038	813055
33H225	310757	813516
33J008	311906	813338
33J017	311618	813345
33J026	311741	813409
33J027	312000	813535
33J028	311506	813342
33J038	312000	813212
33J039	311748	813124
33J040	311916	813509
33J041	311524	813607
33J042	312222	813728
33J043	311633	813241
33J044	311633	813240
33J045	312155	813414
33J060	311501	813111
33K005	312521	813609
34G001	310726	812858
34G002	310727	812853
34G003	310610	812928
34G004	310331	812647
34G009	310103	812540
34G011	310241	812448
34G013	310315	812435
34G015	310403	812422
34G016	310607	812415

WELL ID NUMBER	LATITUDE	LONGITUDE
34G017	310658	812501
34G020	310510	812516
34G024	310339	812513
34G029	310509	812439
34G030	310342	812450
34G031	310403	812422
34G032	310413	812520
34G033	310418	812447
34G035	310134	812508
34G036	310643	812920
34H003	311432	812653
34H010	311344	812731
34H013	311354	812818
34H025	311326	812826
34H038	311155	812824
34H060	311016	812834
34H062	311005	812827
34H064	311003	812824
34H065	310950	812851
34H066	310951	812849
34H070	310955	812850
34H071	310951	812846
34H073	310951	812857
34H074	310959	812844
34H075	311002	812837
34H076	310959	812901
34H077	311007	812903
34H078	310948	812852
34H082	310927	812859
34H085	310906	812846
34H089	310830	812904
34H090	310822	812913
34H091	310753	812901
34H094	310731	812913
34H097	310755	812927
34H098	310801	812934
34H100	310806	812925
34H110	310827	812943
34H112	310841	812941

WELL ID NUMBER	LATITUDE	LONGITUDE
34H113	310852	812951
34H117	310852	812954
34H118	310859	812949
34H120	310858	812952
34H122	310859	812941
34H125	310906	812931
34H128	310919	812935
34H129	310922	812936
34H132	311020	812952
34H134	311051	812955
34H160	310840	812421
34H205	310801	812337
34H238	310825	812300
34H266	310926	812309
34H289	311021	812233
34H318	311212	812237
34H320	311224	812231
34H334	310938	812853
34H337	310824	812942
34H338	311227	812830
34H339	311306	812755
34H341	311232	812230
34H343	311324	812318
34H344	310938	812852
34H345	310857	812935
34H346	310952	812444
34H347	310949	812806
34H348	311024	812932
34H350	311059	812404
34H351	310956	812949
34H354	310924	812952
34H355	310924	812952
34H356	310827	812942
34H357	311342	812701
34H359	311224	812837
34H361	311120	812248
34H362	311024	812419
34H363	310822	812958

WELL ID NUMBER	LATITUDE	LONGITUDE
34H366	310848	812932
34H368	311347	812720
34H369	311437	812842
34H370	311028	812739
34H371	310818	812936
34H372	310832	812921
34H373	310940	812933
34H374	310953	812959
34H376	310841	812938
34H377	311108	812829
34H378	310915	812307
34H381	310959	812325
34H382	311032	812841
34H383	311154	812300
34H384	311319	812758
34H385	311016	812942
34H386	310907	812907
34H388	311419	812319
34H389	310852	812951
34H391	310818	812942
34H392	311108	812910
34H393	310825	812942
34H395	311032	812243
34H397	310839	812422
34H398	310749	812904
34H399	310749	812920
34H400	310936	812949
34H401	310945	812955
34H402	310945	812955
34H403	310822	812942
34H405	311422	812654
34H406	311354	812236
34H408	311200	812945
34H409	311346	812644
34H410	311211	812746
34H411	311003	812857
34H412	311019	812922
34H413	310951	812846
34H414	310938	812350

WELL ID NUMBER	LATITUDE	LONGITUDE
34H424	311011	812931
34H426	310938	812852
34H433	310824	812942
34H434	310911	812941
34H435	311121	812811
34H436	310901	812844
34H445	310902	812843
34H449	311036	812857
34H450	310956	812831
34H468	310931	812910
34J009	311811	812651
34J021	311525	812717
34J025	312007	812939
34J029	311854	812751
34J048	311509	812641
34J049	311557	812746
34J050	311939	812846
34J051	311647	812925
34J052	311745	812709
34J054	311539	812615
35H012	311049	812129
35H014	311053	812102
35H016	311054	812104
35H037	310845	812226
35H040	311331	812119
35H042	311146	812013
35H044	311049	812128
35H045	311200	812212
35H046	311123	812218
35H047	311102	812228
35H048	311054	812058
35H050	311220	811927
35H055	311342	812143
35J003	311516	812058
35J005	311653	812028
35J008	311513	812110

Appendix C. Bibliography of hydrologic literature

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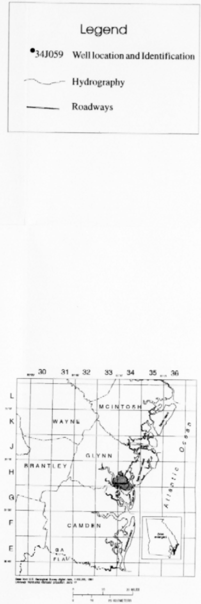

Plate 1. Well locations for City of Brunswick and surrounding area.

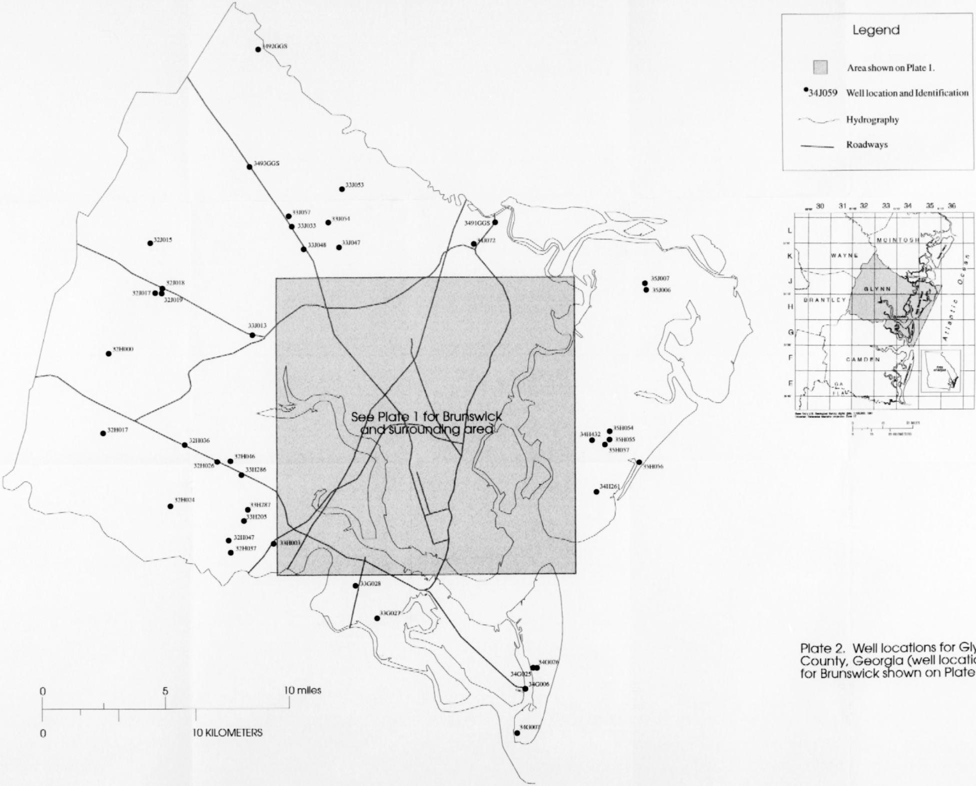

Plate 2. Well locations for Glynn County, Georgia (well locations for Brunswick shown on Plate 1).

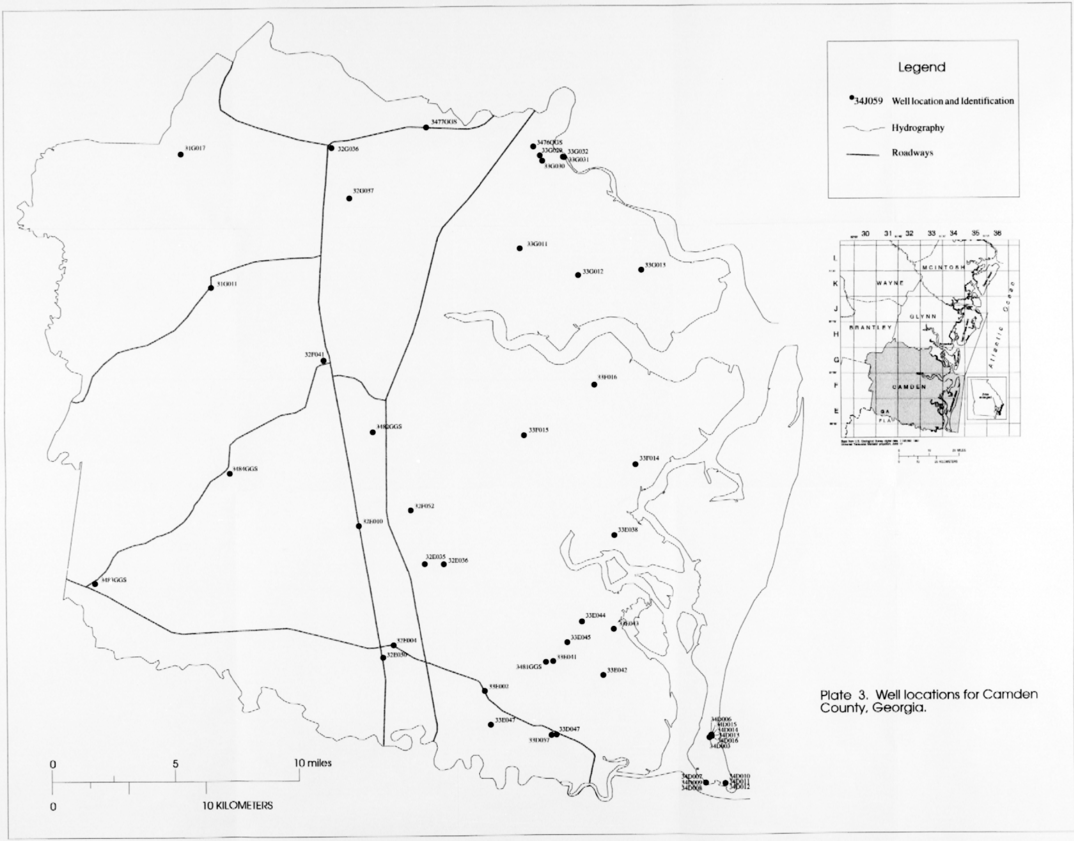

Plate 3. Well locations for Camden County, Georgia.

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Editor: Melynda Lewis

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