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OPEN FILE REPORT 86

GEOLOGY OF SUWANNEE COUNTY, FLORIDA

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FLORIDA GEOLOGICAL SURVEY
Tallahassee, Florida
2003
ISSN 1058-1391

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The following overview of the geology of Suwannee County was prepared for the United States Department of Agriculture, Natural Resources Conservation Service, for inclusion in their Soil Survey of Suwannee County, Florida. Included are sections on: 1) geomorphology, describing the shape and origin of the land surface, 2) stratigraphy, describing the underlying rock strata, 3) ground water, providing an overview of the aquifer systems in Suwannee County, and 4) mineral resources present in the county.

GEOMORPHOLOGY

Suwannee County encompasses portions of two broad geomorphic zones (Figure 1). The western two-thirds of the county lies within the Gulf Coastal Lowlands geomorphic zone (White, 1970). This zone is characterized as a low, flat, frequently swampy, westward-sloping plain that extends from east-central Suwannee County to the Gulf of Mexico. Land surface elevations generally range between about 35 and 100 feet above mean sea level (msl). Most of the lowlands area is ancient marine terrace terrain. Plio-Pleistocene seas alternately flooded and retreated from this region, depositing a step-like series of marine terraces, which generally parallel the modern Florida coastline. Healy (1975) recognizes three marine terrace elevation zones in Suwannee County. The Wicomico Terrace (70 to 100 feet above msl) corresponds to the Gulf Coastal Lowlands zone, while the older Sunderland/Okeefenokee Terrace (100-170 feet above msl) and the Coharie Terrace (170 to 215 feet above msl) cover the remainder of the county. Imposed on these terrace surfaces in the western part of the county are relict marine features such as bars, dunes, and beach ridge systems. Such relict features, composed principally of quartz sand, may be observed far inland from the modern coastline.

Land surface slope in the Gulf Coastal Lowlands zone ranges between 1 and 4 feet per mile southwestward. The highly karstic Oligocene and Eocene carbonates underlying this area are masked by a blanket of undifferentiated sand. Solution sinkholes are common features throughout this region. Scott (in preparation) includes the local portion of the Gulf Coastal Lowlands in his Branford Karst Plain zone of the Ocala Karst District.

The Gulf Coastal Lowlands extend eastward across the county to approximately the 100 feet above msl elevation line. At this elevation a relict marine escarpment named the Cody Scarp forms a topographic break between the Gulf Coastal Lowlands on the west and the elevationally higher Northern Highlands in the eastern third of the county. The Cody Scarp is a former shoreline associated with the Wicomico sea level highstand of the Pleistocene Epoch. Erosion and dissolution of the underlying carbonate rocks have modified the escarpment into a series of coalesced sand hills snaking northwest-southeast along the irregular edge of the Northern Highlands zone.

The Northern Highlands (White, 1970) are a series of uplands comprising the northern and eastern edge of the county. They extend from the Cody Scarp, at elevation of about 100-125 feet above msl, northward into Hamilton County and eastward into Columbia County. Miocene and Pliocene siliciclastic sediments, resting on carbonate bedrock, form the core of the uplands. The highlands have been modified largely by stream-dissection and land sur-

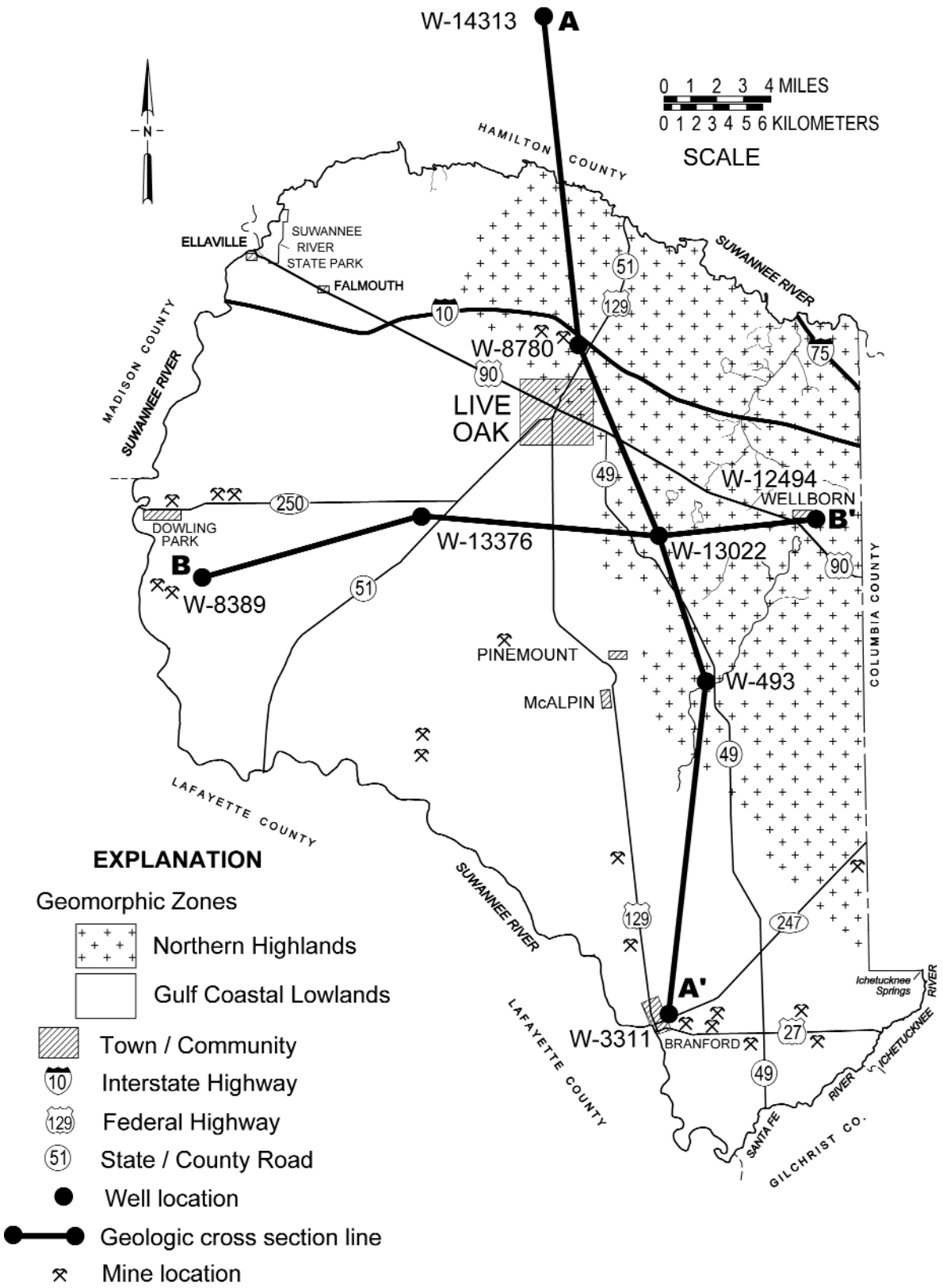

Figure 1. Geomorphic and geologic cross section location map.

face lowering due to dissolution of the underlying bedrock. Scott (in preparation) has applied the name Alachua-Lake City Karst Hills to this local portion of the Northern Highlands. Land surface elevations are mostly less than 150 feet above msl. The maximum elevation attained is about 200 feet above msl, on a hilltop about a mile north of McAlpin in southeastern Suwannee County.

River Valley Lowlands

The Suwannee River is the largest river in Suwannee County, and forms the northern and western county boundaries. It flows southwestward from Georgia to the Gulf of Mexico in a dissolutional valley, carved in the underlying Oligocene and Eocene carbonates. The topographic lowlands immediately adjacent to the river, generally characterized by thin Pleistocene-Holocene sands and clayey sands lying on limestone, comprise the Suwannee River Valley Lowlands. River valley floor elevations range from about 100 feet above msl in northeastern Suwannee County to about 35 feet above msl at the southern tip of the county. For most of its course, the valley is less than one mile wide.

The Santa Fe River arises in the swampy hammocks to the east in Bradford County, and flows westward in a narrow, incised valley generally lying about 35 feet or less above msl. It forms the southern county boundary between Suwannee and Gilchrist Counties. The Santa Fe flows in a channel cut in Eocene carbonates, which commonly crop out along the lower portion of the river. Pleistocene and Holocene siliciclastics form a sediment veneer over the carbonates in the river bed and along the banks.

The Ichetucknee River comprises the southeastern-most boundary of Suwannee County. The stream arises in a series of fresh water springs within Ichetucknee Springs State Park and flows about five miles southwestward to a confluence with the Santa Fe River. The Ichetucknee is a clear, pristine stream flowing in a sand-bottom channel carved in the underlying Eocene carbonate bedrock. A narrow river valley lowlands zone, about one-half mile wide, borders the stream along its upper reaches. The valley coalesces with the wider lowlands of the Santa Fe River near the confluence of the two rivers.

STRATIGRAPHY

The oldest rock commonly penetrated by water wells in Suwannee County is marine limestone of the Middle Eocene Avon Park Formation. Undifferentiated Pleistocene and Holocene surficial sands, clayey sands, and alluvium are the youngest sediments present. Figures 2 and 3 illustrate the shallow stratigraphy of the county. The Avon Park Formation and the younger overlying carbonates are important freshwater aquifers, and the following discussion of the geology of Suwannee County is confined to these Eocene and younger sediments.

Eocene Series
Avon Park Formation

The Avon Park Formation (Applin and Applin, 1944; Miller, 1986) is a lithologically variable Middle Eocene (about 47 to 43.5 million years ago [mya]) carbonate unit underlying all of Suwannee County. It is typically a yellowish-gray to grayish-orange to dark yellowish brown dolostone, interbedded with grayish-white to yellowish-gray limestones and dolomitic limestones. The unit commonly contains varying amounts of peat, lignite, and plant remains (Florida Geological Survey in-house well logs). Mollusks, echinoids, and foraminifera, where preserved, are the prin-

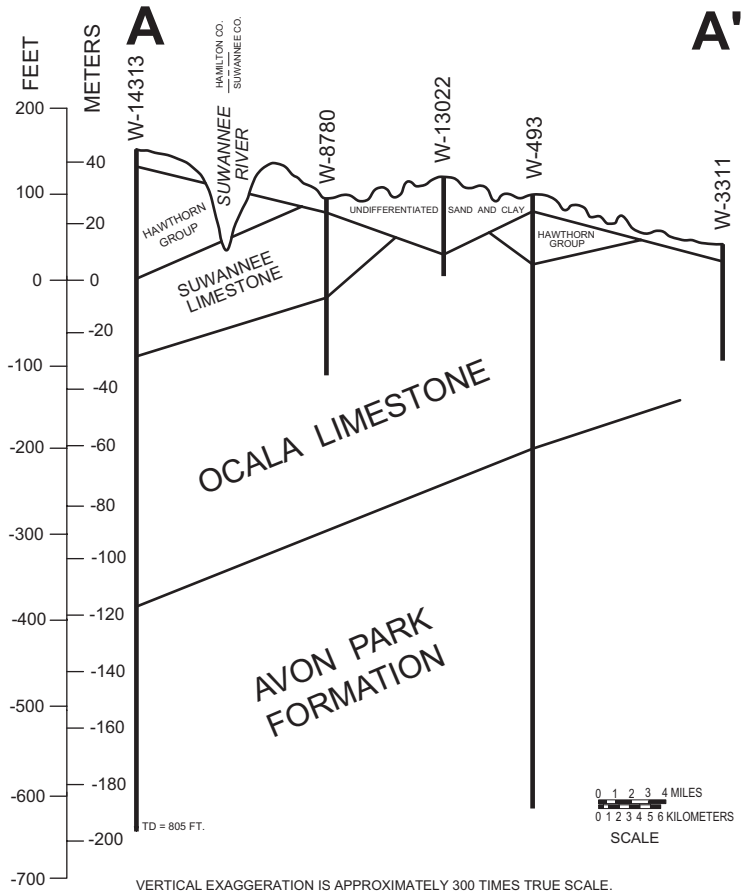

Figure 2. Geologic cross section A - A'.

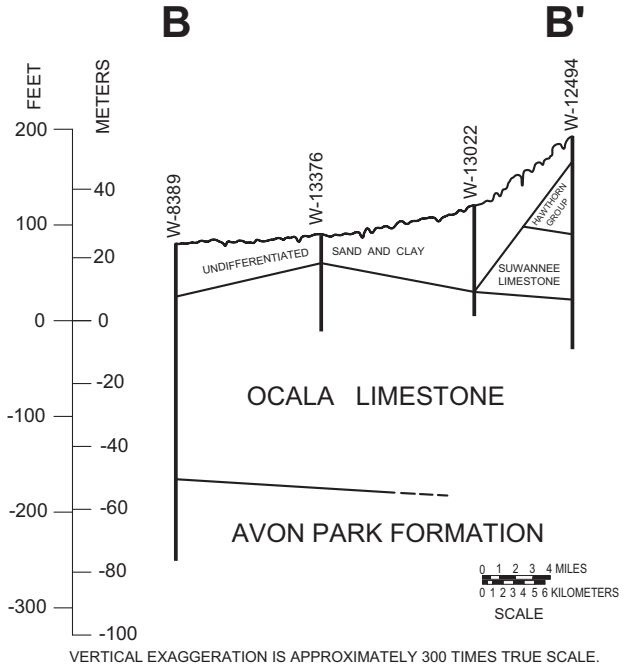

Figure 3. Geologic cross section B - B'.

cipal fossils present. The top of the Avon Park Formation varies in depth from approximately 300 feet below land surface (bls) in northwestern Suwannee County to about 100 feet bls in the southernmost part of the county. Deep oil test well data indicate that the Avon Park Formation ranges from approximately 650 to 800 feet thick under Suwannee County (FGS in-house well logs).

Ocala Limestone

Marine limestones of the Upper Eocene (39.5 - 38 mya) Ocala Limestone (Puri, 1957; Scott, 1991) unconformibly overlie the Avon Park Formation under all of Suwannee County. It is divided into upper and lower units based on lithology. The lithology of the Ocala Limestone grades upward from alternating hard and soft, white to tan to gray fossiliferous limestone and dolomitic limestone of the lower unit into white to very light gray to light yellowish-orange, abundantly fossiliferous, chalky limestones of the upper unit (FGS in-house well files). Foraminifera, mollusks, bryozoans, and echinoids are the most abundant fossils occurring in this unit. Thickness of the Ocala Limestone under Suwannee County ranges between about 80 and 220 feet thick. It generally thins against the structurally high Avon Park Formation toward the crest of the Ocala Platform in the western portion of the county. The Ocala Platform is a structurally positive feature centered under the Big Bend area of the western peninsula. This feature brings Eocene carbonates close to the surface over its crest, and younger units lap onto the flanks of the feature. Suwannee County lies just east of the axis of the platform Depth to the irregular and highly-karstic top of the Ocala Limestone ranges from exposure at land surface in eastern and southern Suwannee County to about 270 feet below land surface in the eastern part of the county. The Ocala Limestone commonly crops out along the banks of the major rivers bordering central and southern Suwannee County.

The highly permeable and cavernous natures of the Ocala Limestone make it an important freshwater bearing unit of the Floridan aquifer system. Many drinking water wells in Suwannee County withdraw water from this limestone.

Oligocene Series
Suwannee Limestone

The Suwannee Limestone (Cooke and Mansfield, 1936) is an Oligocene (37.5 - 28 mya) marine limestone and dolostone underlying the northern half of Suwannee County. It pinches out against the underlying Ocala Limestone just north of an approximate west-east line connecting the towns of Dowling Park and Wellborn. It is typically a white to yellowish-gray to grayish-brown, skeletal to micritic, fossiliferous limestone, altered in some areas to variably recrystallized dolostone. Mollusks, foraminifera, echinoids, bryozoans, and ostacods, in various degrees of preservation, comprise the dominant fossil assemblage present in this unit. The Suwannee Limestone forms the near-surface carbonate bedrock in northern Suwannee County. Its top typically ranges in depth from as much as 150 feet below land surface to surface exposures in sinks, streambeds, and along the Suwannee River north of Dowling Park. Although variable, its thickness ranges between about 45-180 feet.

The Suwannee Limestone locally comprises the uppermost unit of the Floridan aquifer system. Some shallow rural domestic and agricultural wells draw water from this unit.

Oligocene to Pliocene Series
Hawthorn Group Undifferentiated

Sediments of the Hawthorn Group (Scott, 1988) unconformably overlie the Ocala and Suwannee Limestones in north-

central and eastern Suwannee County. Statewide, the age of Hawthorn Group sediments range from about 25.5 - 4.8 mya.

The Hawthorn Group is a heterogeneous mixture of siliclastic and carbonate sediments. Tan, brown, gray, and white sandy, phosphatic dolostone commonly occurs in the lower part of the Hawthorn Group in Suwannee County. The upper portion is typically comprised of olive-green, blue and or brown, phosphatic clay, quartz sand and dolosilt, with carbonate interbeds. Fossils include mollusks and foraminifera. The predominant unifying character of both upper and lower portions of the Hawthorn Group is the presence of black, brown, or amber, very fine sand to pebble sized phosphate grains. Phosphate content ranges from trace amounts to in excess of 20 percent.

The Hawthorn Group ranges in depth from surface exposure down to about 75 feet below land surface. It reaches a maximum thickness of about 70 feet in northeastern Suwannee County.

Pliocene, Pleistocene and Holocene Series

Undifferentiated Pliocene - Holocene marine and alluvial, fine to coarse quartz sands and clayey sands form a thin veneer over most of Suwannee County. They are generally less than about 50 feet thick county-wide, but some buried sinkholes may contain up to 270 feet of undifferentiated sediments. They directly overlie the karstic limestones of the Suwannee and Ocala Limestones. Many of the larger and higher sand bodies west of the Cody Scarp in southern Suwannee County are relict dunes, bars, and barrier islands associated with various Pleistocene sea level high stands.

GROUNDWATER

Groundwater is water that fills the pore spaces in subsurface rocks and sediments. This water is derived principally from precipitation within Suwannee and adjoining counties. The bulk of Suwannee County's potable water is withdrawn from groundwater aquifers. Three aquifer systems are present under Suwannee County, the surficial aquifer system, the intermediate aquifer system and confining unit, and the Floridan aquifer system.

Surficial aquifer system

The surficial aquifer system is the uppermost freshwater aquifer in Suwannee County. This non-artesian aquifer is present only within the thicker portions of the Pliocene-Holocene undifferentiated sands and clays. It is thin or absent in much of Suwannee County, but may occur sporadically in the northeastern portion of the county, east of Live Oak, and in the central portion of the county (Barineau et al, in preparation). The surficial aquifer system, where present, is unconfined and its upper surface is the water table. In general, the water table elevation fluctuates with precipitation and conforms to the topography of the land surface. Recharge to the surficial aquifer system is largely through rainfall percolating downward through the unconsolidated surficial sediments, and to a lesser extent, by upward seepage from the underlying Floridan aquifer system. Water naturally discharges from the aquifer by evaporation, evapotranspiration, spring seeps and downward seepage into the Floridan aquifer system. The surficial aquifer system is not used as a source of consumptive water in Suwannee County.

Intermediate aquifer system and confining unit

A discontinuous intermediate aquifer system and confining unit is present within the Hawthorn Group sediments in Suwannee County. Clay and clayey sand beds in the Hawthorn Group, perforated by sinks, provide a region of semi-confinement to the underlying Floridan aquifer system in the eastern and northeastern portions of the county (Scott et al., 1991). Laterally discontinuous carbonate beds in the Hawthorn Group may also function as an intermediate aquifer system. Wells in the vicinity of Wellborn, in northeastern Suwannee County, penetrate this aquifer system (Ron Ceryak, SRWMD, personal communication). The intermediate aquifer system is not used extensively as a source of water within the county.

Floridan aquifer system

In Suwannee County the Floridan aquifer system is comprised of hundreds of feet of Eocene and Oligocene marine limestones, including the Avon Park Formation, Ocala Limestone, and Suwannee Limestone. It is the principle source of drinking water in the county. The Floridan aquifer system exists as an unconfined, non-artesian aquifer in the Gulf Coastal Lowlands adjacent to the Suwannee, Santa Fe and Ichetucknee Rivers, where porous quartz sand directly overlies the limestone. In much of the rest of Suwannee County, the Floridan is semi-confined by clayey beds in the overlying Hawthorn Group. In the highlands near the town of Wellborn it is confined. Depth to the top of the Floridan aquifer system generally corresponds to the depth of limestone, and varies from surface exposure in the Suwannee, Santa Fe, and Ichetucknee River valley lowlands and the karst plain areas of western Suwannee County, to nearly 50 feet under the higher hills in the eastern part of the county.

Recharge to the Floridan aquifer system in Suwannee County is obtained from lateral inflow from the north and, to a lesser extent, from local rainfall percolating downward through the permeable surficial sands. The highest recharge by percolation occurs in the highly karstic limestone plain in western Suwannee County (Stewart, 1980).

Water leaves the Floridan aquifer system through well pumping and natural movement down-gradient and subsequent discharge through numerous springs and seeps. Numerous springs occur in and along the major streams bordering Suwannee County.

MINERAL RESOURCES

Suwannee County contains deposits of several economic mineral commodities. The most important of these is limestone. Other commodities of lesser potential include sand, clay, phosphate and peat. Information for this section is compiled from Hoenstine et al. (1993) and recent mining data from the Florida Geological Survey Mine Database. Mine status may change frequently.

Limestone

Two commercial grade carbonate rock units occur in Suwannee County. The Suwannee Limestone occurs near the surface under the northern half of Suwannee County, and the higher-purity Ocala Limestone is the shallow unit in the southern half of the county. The economic grade may vary considerably from one area to another. Several inactive mines are located in Suwannee County. These include Live Oak, five mines at locations both east and south of Dowling Park, three west of Pine Mount, two north and two east of Branford, and an old mine off county road 247 near the Suwannee-Columbia county line.

High purity, road base quality rock is currently mined in the Branford area in southern Suwannee County. The rock at this location is too soft and friable for aggregate use. Mining in the Branford area occurs to depths of 40 feet below water surface, and the total mineable thickness approaches 60 feet. Extraction is by dragline, and explosives may be used to fracture the rock for removal. The rock is typically dried and crushed before shipment to market by truck.

Aggregate and secondary road base grade limestones occur over much of the rest of the county. Large pits near Live Oak were worked up until 1975 and the material was utilized as fine and coarse aggregate as well as road base. Although overburden thickness may reach 50 feet in this area, and the rock is commonly soft with numerous clay seams, the Live Oak area still contains economic reserves.

The primary uses for limestone from Suwannee County are road base, agricultural soil conditioners, and asphalt screenings. The county has sufficient reserves of limestone to last many years, and the economics of future extraction will depend largely on market demand.

Sand

Impure quartz sand, commonly containing varying percentages of clay, heavy minerals and organics, is a principal component of surficial and shallow sediments throughout Suwannee County. Due to the impurities it has limited industrial potential. A number of shallow private pits in Suwannee County are worked for local fill sand. The potential for commercial mining is low at this time.

Clay

Clay sporadically occurs as a component of the undifferentiated surficial sediments covering Suwannee County, in alluvial deposits in the major stream valleys, and in Hawthorn Group sediments. Clay deposits in the county are typically stratified with quartz sands and clayey sands. Due to the impure nature of this clay, it is not an economic commodity in the county. Several local pits provide road and fill material, but there is currently little potential for commercial use.

Phosphate

Suwannee County lies at the northern extent of Florida's hard rock phosphate deposits. These deposits are typically formed at the top of the Ocala Limestone in isolated pockets, and are generally less than 5-feet thick. This commodity was mined in southeastern Suwannee County until 1966. The extensive pebble phosphate deposits of south-central Florida are more economical to mine, and their availability aided in the demise of the hard rock industry statewide. Due to the limited thickness and discontinuous nature of the hard rock phosphate deposits, it is unlikely that economic mining operations will resume in Suwannee County.

Peat

Peat forms in a wet, reducing environment when accumulation of organic materials exceeds the decomposition rate of that material. The U. S. Department of Agriculture, Soil Conservation Service, mapped about 90 acres of commercial grade peat in three isolated areas of northeastern Suwannee County (USDASCS, 1965). The peat varies in thickness from 30 to 60 inches and rests on sand. It is comprised largely of the remains of sweetbay, ash, cypress, pine, and other water tolerant plants. The lack of a local market keeps the potential for development of these resources low.

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