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State of Florida
Department of Natural Resources
Tom Gardner, Executive Director

Division of Resource Management
Jeremy Craft, Director

Florida Geological Survey
Walt Schmidt, State Geologist and Chief

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Geology of Union County, Florida

by

Frank R. Rupert

Florida Geological Survey
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UNION COUNTY

GEOMORPHOLOGY

Union County is situated within the Northern Highlands geomorphic province of White (1970). This province spans north Florida from eastern Bradford County westward into Alabama. The topographically high clayey sand hills comprising this zone are thought to be dissected remnants of a much more extensive highland plain, possibly an ancient delta, which covered much of the Gulf Coastal Plain (White, 1970). Within Union County, land surface elevations vary from approximately 50 feet above mean sea level (MSL) in stream valleys at the southern edge of the county, to about 165 feet MSL in the flat plains of the central and northern areas. Large sandy swamps, bays and shallow swampy lakes cover much of north-central Union County; the numerous drainage streams in this area are generally sluggish, flowing in poorly-defined channels. Along the western and southern edges of the county, adjacent to the larger streams such as Olustee Creek, Swift Creek, and the Santa Fe River, the small dendritic drainage creeks are more deeply incised in channels in the surrounding terrain. This results in a series of steeply-sloped ravines cut in the otherwise flat topography along the western and southern edges of Union County. Fifty-foot bluffs border the wide flood plain of the Santa Fe River near Worthington Springs and along Olustee Creek, between Union and Columbia Counties.

The major lakes in Union County are Lake Butler, Palestine Lake, and Swift Creek Pond. These lakes are generally shallow, with low swampy shorelines and sand or mud bottoms; all have outflow channels which are tributaries to Olustee Creek or the Santa Fe River (Clark, et al, 1964).

STRATIGRAPHY

Union County is underlain by hundreds of feet of alluvial and marine sands, clays, limestones and dolomites (Clark et al, 1964). The oldest rock penetrated by water wells is limestone of the Middle Eocene Epoch (42 to 49 million years before present) Avon Park Formation. Undifferentiated surficial sands and clays of Pliocene to Holocene Age (5 million years old and younger) are the youngest sediments present. The Avon Park Formation and the younger overlying limestone units are important freshwater aquifers, and the discussion of the geology of Union County will be confined to these Eocene age and younger sediments. Figure 1 shows the geologic cross section locations, and figures 2 and 3 illustrate the underlying stratigraphy of Union County.

EOCENE SERIES

AVON PARK FORMATION

The Avon Park Formation (Miller, 1986) as it occurs under Union County is typically a dense, tan to dark brown, porous dolomite, frequently interbedded with tan, gray, or cream-colored limestones and dolomitic limestones of varying hardness (Clark, et al, 1964). Foraminifera are the dominant fossils present, although dolomitization has destroyed or altered many of the contained fossils. The Avon Park Formation is a component of the Floridan aquifer system and underlies Union County at depths ranging from 400 to 600 feet below land surface (Florida Geological Survey in-house well data).

OCALA GROUP

Marine limestones of the Ocala Group (Puri, 1957) unconformably overlie the Avon Park Formation under all of Union County (Clark, et al,

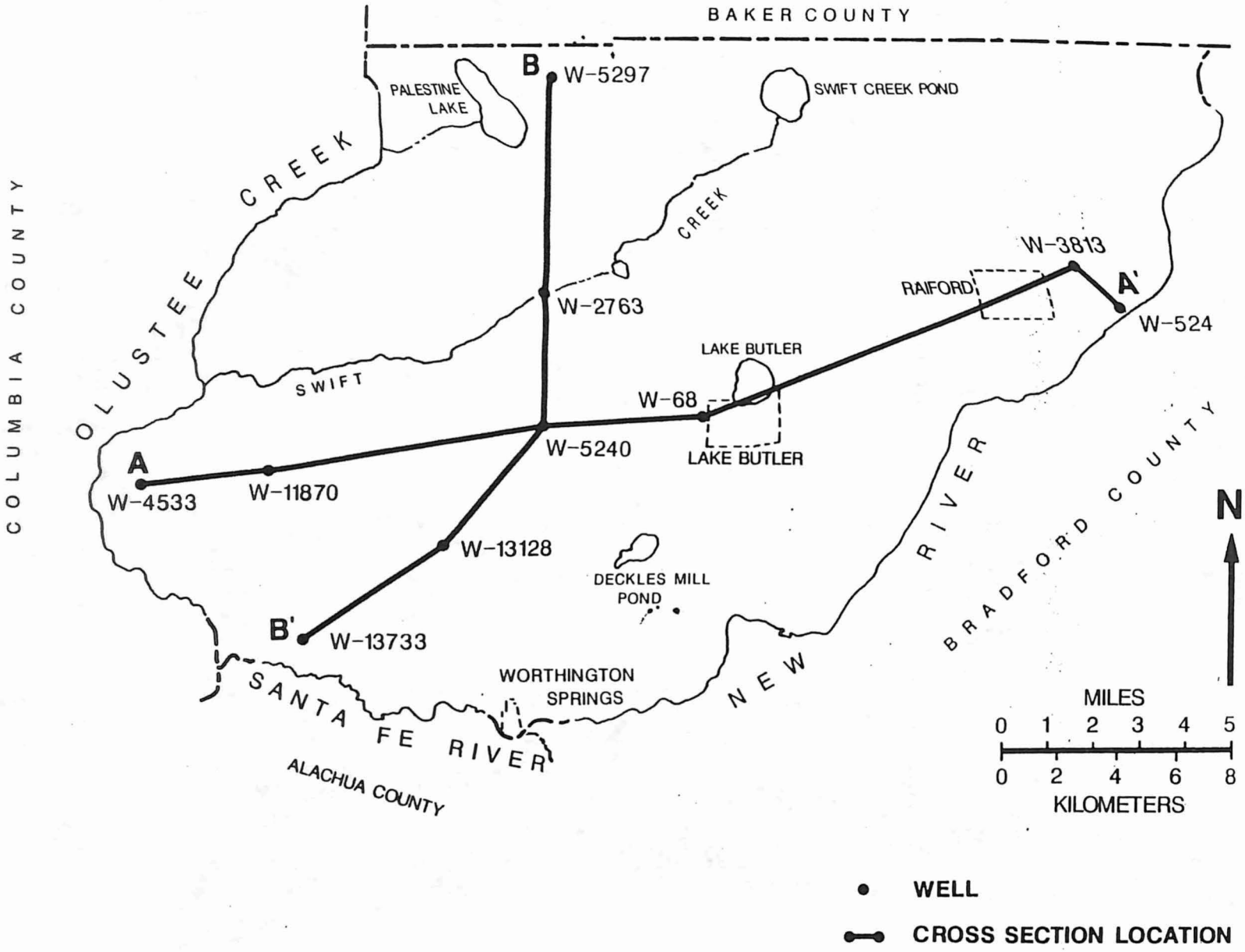

FIGURE 1: UNION COUNTY GEOLOGICAL CROSS SECTION LOCATIONS

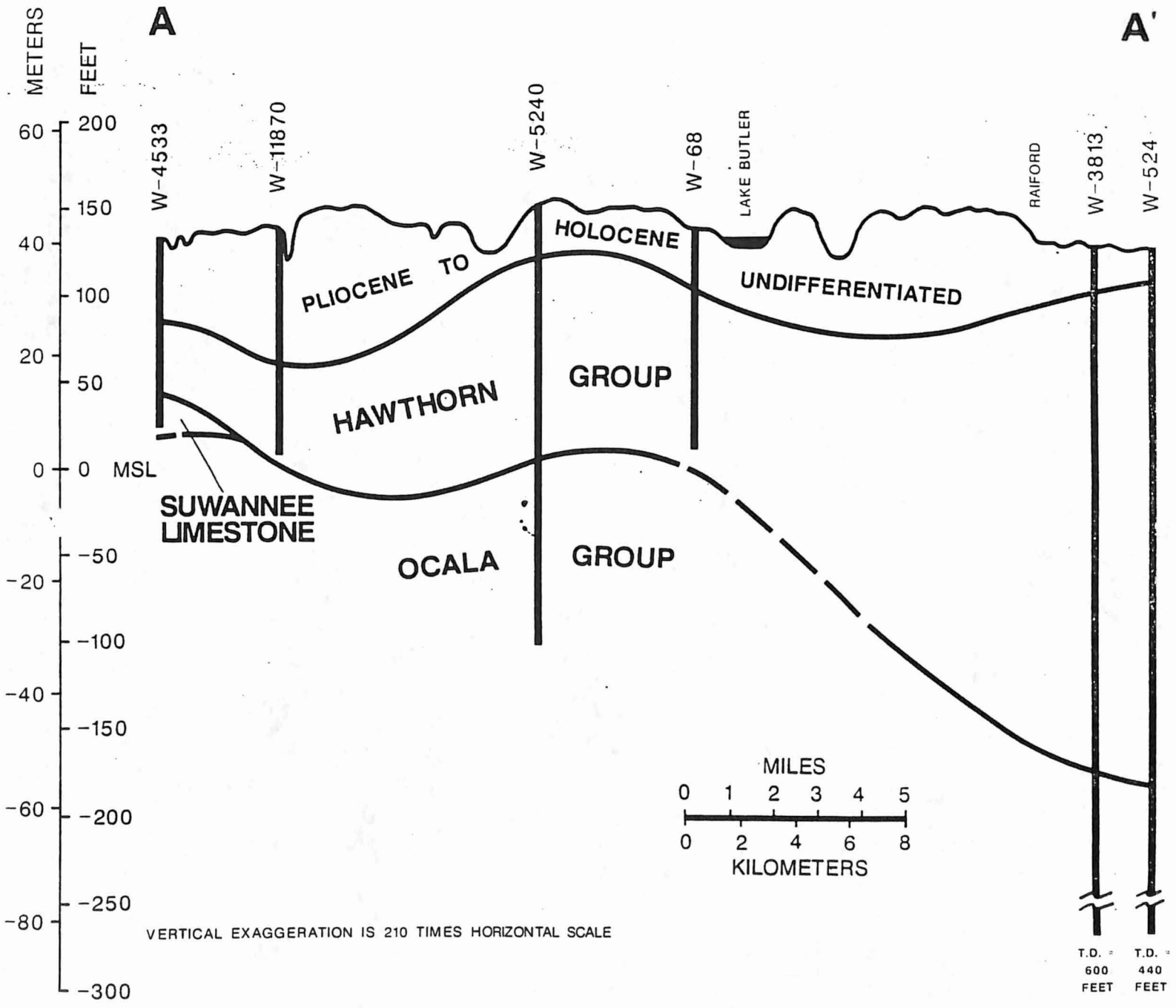

FIGURE 2: GEOLOGICAL CROSS SECTION A – A'

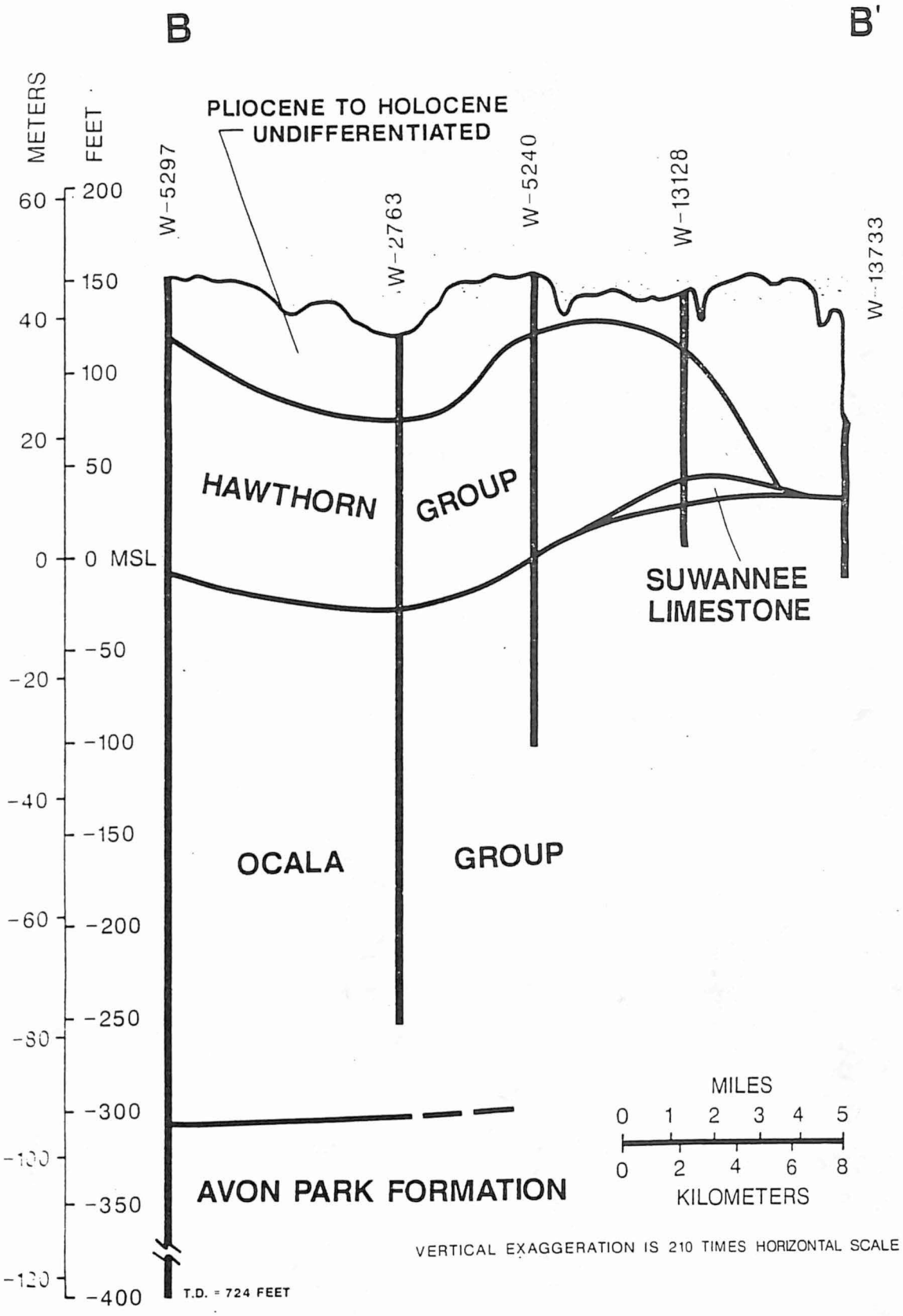

FIGURE 3: GEOLOGICAL CROSS SECTION B - B'

1964). The Ocala Group is comprised of three formations; in ascending order, these are the Inglis Formation, the Williston Formation, and the Crystal River Formation. These formations are differentiated on the basis of lithology and fossil content. Typically, the lithology of the Ocala Group grades upward from alternating soft and hard, white to tan fossiliferous limestone and dolomitic limestone of the Inglis and lower Williston formations into white to pale orange, abundantly fossiliferous, chalky limestones of the upper Williston and Crystal River formations. Foraminifera, molluscs, bryozoans, and echinoids are the most abundant fossil types occurring in the Ocala Group sediments. Thickness of the Ocala Group sediments under Union County averages about 250 feet. Depths to the top of the Ocala Group range from about 40 feet just west of Worthington Springs, to nearly 300 feet near Raiford. The porous and cavernous nature of the Ocala Group limestones make them important freshwater-bearing units of the Floridan aquifer system. Many drinking water wells in Union County withdraw water from the Crystal River Formation.

OLIGOCENE SERIES

SUWANNEE LIMESTONE

The Oligocene age (24 to 37 million years B. P.) Suwannee Limestone (Cooke and Mansfield, 1936) overlies the Ocala Group sediments under most of Union County west of Lake Butler (Clark et al, 1964). In general, the Suwannee Limestone consists of tan, white, or cream-colored marine limestone, frequently dolomitic and coquinoid in portions and varying considerably in hardness. In some wells, the Suwannee Limestone is lithologically similar to the Ocala Group limestones, and is identified primarily on the last occurrence of the foraminifera Dictyoconus cookei. The

thickness of the Suwannee Limestone ranges between 20 and 40 feet, and the beds may be discontinuous in the subsurface; this unit is not known in wells east of Lake Butler (Clark, et al, 1964). In north Florida, the Suwannee Limestone is a freshwater-bearing unit of the Floridan aquifer system.

MIOCENE SERIES

HAWTHORN GROUP

Phosphatic sands, clays, limestones and dolomites of the Miocene age (5 to 24 million years B. P.) Hawthorn Group (Scott, in preparation) unconformably overlie the Suwannee Limestone in western Union County; east of Lake Butler, the Hawthorn Group sediments lie directly upon the Ocala Group limestones. The Hawthorn Group is predominantly a series of marine deposits, consisting of variable and interbedded lithologies, and characterized by phosphatic sands, granules and pebbles. Although not differentiated to date within Union County, three formations of the Hawthorn Group are distinguishable in surrounding counties; in order of decreasing age, these are: the Penney Farms Formation, interbedded phosphatic quartz sand, clay and carbonate; the Marks Head Formation, thinly and complexly interbedded phosphatic clays, sand, and carbonate; and the Coosawhatchie Formation, a green to tan phosphatic quartz sand with varying amounts of clay and dolomite. The Hawthorn Group sediments have a generally northeastward dip, and range in thickness from about 50 feet in parts of western Union County to at least 260 feet in the northeastern portion of the county near Raiford. The thick, relatively impermeable clays within the Hawthorn Group are the primary confining beds for the underlying Floridan aquifer system.

Pliocene to Holocene age undifferentiated sands form a thin veneer over the

Hawthorn Group sediments in most of Union County, although the larger river valleys in the southern and western parts of the county may cut down into Hawthorn section.

PLIOCENE TO HOLOCENE UNDIFFERENTIATED

Undifferentiated quartz sands and clays comprise the surficial sediments over most of Union County. These unfossiliferous deposits are virtually impossible to age-date, and include the unnamed reddish coarse clastics, the relict Pleistocene (2.8 million to 0.1 million years B. P.) marine terrace sands, and Holocene age (0.1 million years to present) aeolian, lacustrine and alluvial deposits.

GROUNDWATER

Groundwater is water that fills the pore spaces in subsurface rocks and sediments. This water is derived principally from precipitation within Union and nearby counties. The bulk of Union County's consumptive water is withdrawn from groundwater aquifers. Three main aquifer systems are present under Union County. In order of increasing depth, these are the surficial aquifer system, the intermediate aquifer system, and the Floridan aquifer system (Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986).

SURFICIAL AQUIFER SYSTEM

The surficial aquifer system is the uppermost freshwater aquifer in Union County. Sediments comprising this aquifer are primarily the sands and thin limestone layers in the uppermost part of the Hawthorn Group as well as the overlying Pliocene to Holocene Age sands. On average, the surficial aquifer system is about 40 feet thick over most of Union County

(Clark, et al, 1964). The surficial aquifer system is unconfined and its upper surface is the water table. In general, the water table elevation fluctuates with precipitation rate and conforms to the topography of the land surface. Within Union County, the water table is normally 10 feet or less below land surface. Recharge to the surficial aquifer system is largely through rainfall percolating downward through the surficial sediments, and to a lesser extent by upward leekage from the deeper aquifers. Water naturally discharges from the aquifer by evaporation, transpiration, springflow, and by downward seepage into the lower aquifers. The surficial aquifer system yields water of suitable quality for consumptive use and is normally tapped by shallow dug or sand point wells. Due to the relatively thin units comprising this aquifer, however, only limited amounts of water are available before local water table lowering occurs.

INTERMEDIATE AQUIFER SYSTEM

The intermediate aquifer system is comprised of water-bearing sand and limestone layers within the Hawthorn Group. Low permeability clays above the sand and carbonate layers generally confine the intermediate aquifer system under artesian conditions. Water yield from this aquifer varies locally with the quantity of sand and the porosity of the carbonate; in some areas, the Hawthorn Group carbonates are very dense, yielding little water. Recharge to the intermediate aquifer system consists chiefly of downward leakage from the surficial aquifer system and upward seepage from the Floridan aquifer system in areas where the piezometric surface of the Floridan aquifer system is higher than that of the intermediate system. Numerous rural and domestic wells draw water from the intermediate aquifer system, and as with the surficial aquifer system, the volume of water available depends largely on local thickness of the aquifer units.

FLORIDAN AQUIFER SYSTEM

The Floridan aquifer system is comprised of several hundred feet of Eocene to Oligocene age porous marine limestones, including the Avon Park Formation, the Ocala Group, and Suwannee Limestone. It is by far the most productive aquifer in Union County. In extreme southwestern Union County, the upper part of the Floridan aquifer system is unconfined, and is under water table conditions; in the remainder of the county, the aquifer is confined by low permeabilty clays of the overlying Hawthorn Group, and is under artesian conditions. West of Lake Butler, the Suwannee Limestone comprises the upper unit of the Floridan aquifer system. East of Lake Butler, the Crystal River Formation of the Ocala Group is the uppermost unit. County-wide, depth to the Floridan varies between 75 and 325 feet (Florida Geological Survey in-house well data). The Floridan aquifer system is an important freshwater source throughout Florida, and many deep domestic wells and most municipal and industrial supply wells draw from this aquifer.

Recharge to the Floridan aquifer in Union County occurs primarily as downward leakage through the confining beds from the shallower aquifers (Clark, et al, 1964). In southwestern Union County, the Hawthorn Group is thin or absent, and direct recharge through downward percolation occurs. Water leaves the Floridan aquifer system through natural movement down gradient (westward) and subsequent discharge through springs, lakes, and along the Santa Fe River.

MINERAL RESOURCES

At present, no mineral commodities are being mined on a commercial basis in Union County. In general, the potential for commercial mineral

production in this county is low. The following discussion of the major mineral commodities is intended to provide an overview of the mining potential for each mineral.

SAND

A number of shallow private pits in Union County are worked for fill sand. These sand deposits are concentrated in the unconsolidated Pliocene to Holocene age surficial sediments covering most of the county. The unnamed variably-colored clayey coarse clastics, believed to be equivalent to the Miccosukee and Citronelle Formations to the west, characteristically contain fine to coarse grained quartz sand and localized gravel beds. These clayey sands are utilized as roadbase in counties to the south where the clay content is higher. Commercial sand production from these sediments in Union County would require extensive washing to remove the clay matrix; the economics of this procedure would probably preclude mining in Union County.

PHOSPHATE

Phosphatic sediments of the Hawthorn Group underlie most of Union County. The phosphate occurs as tan to black sand, granule, and pebble sized grains, and generally compriseing up to 25 percent by volume of the Hawthorn Group sediments. Most well lithologic logs reveal phosphate grain content to be highly variable, ranging on average between one and ten percent; the higher phosphate percentages occur at depths in excess of 60 feet in wells near Raiford (Florida Geological Survey in-house well data). The variable nature of these deposits, as well as the excessive depth to the higher phosphate concentrations make the phosphate mining potential low in Union County.

LIMESTONE AND DOLOMITE

Union County is underlain by extensive deposits of Eocene to Miocene age marine limestones. However, the excessive thickness of the overlying Hawthorn Group siliciclastics and the Pliocene to Holocene undifferentiated surficial sediments puts most limestone too deep for commercial mining. In the extreme southwestern corner of Union County, Ocala Group limestones are present wihtin 40 feet of the surface; however, this depth may still be beyond the range for economic mining, and the compositional quality of this rock for industrial use is untested.

PEAT

Peat is an organic deposit formed from rapid accumulation of decaying vegetation. To date, no commercial mining of peat occurs in Union County. Although unproven, the areas of highest peat potential are the shallow, swampy regions of the northern and central parts of the county.

CLAY

Clay and clayey sand deposits occur in the upper Hawthorn Group sediments as well as the undifferentiated Pliocene to Holocene surficial sediments over most of Union County. Except for private dirt fill pits, there has been no commercial exploitation of these deposits. The suitability of these clays for industrial and commercial use is, as yet, untested. To the east in Putnam County, and in counties to the south, the red clayey sands and sandy clays formerly referred to as unnamed coarse clastics are used extensively as road material.

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