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FLORIDA GEOLOGICAL SURVEY
Guy H. Means, *State Geologist and Director*

OPEN-FILE REPORT 111

Text to accompany geologic map of the USGS West Palm Beach 30 x 60 minute quadrangle, south Florida

By

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ABSTRACT

The accompanying 1:100,000 scale geologic map (Open-File Map Series 114, Plate 1) depicts the areal distribution of surficial geologic units for the U.S. Geological Survey (USGS) West Palm Beach 30 x 60 minute quadrangle. The map was constructed using a combination of field mapping (at 1:24,000 scale), compilation of data from existing maps (various scales), borehole core and cuttings analyses and descriptions, and analyses of various Geographic Information System (GIS) data sources. The resulting data were compiled in ESRI® ArcGIS® Pro™ 2.9.5 software for publication as part of the Florida Geological Survey Open-File Map Series. Mapped geologic units range in age from Pliocene to Holocene. Important resources in the mapped area include potable groundwater, sand, fossil shell, and limestone.

The geologic map and accompanying plates produced for this area not only provide a greater understanding of the interaction between the geologic units, associated karst, and ecosystems, but have utility as a land management tool for economic development, mineral and energy production, and environmental protection for Florida. Examples include designing new construction projects, siting new water supply wells, wastewater treatment plants, energy production facilities, waste management and storage facilities, locating sources of mineable resources, and protecting surface and groundwater quality.

Keywords: Florida, geologic map, Hawthorn Group, Arcadia Formation, Peace River Formation, Tertiary/Quaternary undifferentiated shelly sediments, Anastasia Formation, geomorphology, hydrogeology, Glades County, Hendry County, Martin County, Okeechobee County, Palm Beach County, West Palm Beach

INTRODUCTION

Florida Geological Survey (FGS) Open-File Report (OFR) 111 accompanies Open-File Map Series (OFMS) 114, which is comprised of two plates. Plate 1 depicts the near-surface geology of the USGS West Palm Beach 30 x 60 minute quadrangle. Plate 2 depicts six geologic cross-sections, a stratigraphic correlation chart, and an index geologic map with cross-section lines for the study area.

The study area is in southeastern Florida (Figure 1) and covers portions of Glades, Hendry, Martin, Okeechobee, and Palm Beach counties. It includes the communities of Bell Glade, Boynton Beach, Clewiston, Jupiter, Juno Beach, Lantana, North Palm Beach, Pahokee, Palm Beach, Riviera Beach, South Bay, Wellington, and West Palm Beach. The quadrangle is bounded to the north by the USGS Fort Pierce 30 x 60 minute quadrangle (Green, et al., 2022a; Green, et al., 2022b), to the northwest by the USGS Arcadia 30 x 60 minute quadrangle, (Green et al., 1998; Green et al., 1999), both previously mapped under the STATEMAP program, and to the west by the USGS Fort Myers 30 x 60 minute quadrangle (in progress). It is bounded to the south by the USGS Fort Lauderdale 30 x 60 minute quadrangle, and to the southwest by the USGS Naples 30 x 60 minute quadrangle (to be mapped 2023-2025).

One objective of this report is to provide basic geologic information for the accompanying OFMS 114. Information provided in this report and on the plates from OFMS 114 is intended for a diverse audience of professionals in geology, hydrology, engineering, environmental and urban planning, academia, and laypersons, all of whom have varying levels of geologic knowledge. The maps can help users identify and interpret geologic features which impact activities related to groundwater quality and quantity, as well as aid in locating mineral resources, land-use planning, and construction project design. Applied uses of the maps and data in this report include: 1) identifying potential new mineral resources, 2) characterizing zones of geologic hazards, 3) characterizing potential aquifer recharge, discharge, and confinement, 4) surface water, groundwater, and fate and transport modeling, 5) aiding water-management decisions on groundwater usage, 6) providing information on aquifer vulnerability to potential pollution, 7) characterizing ecosystems, and 8) recreational activities.

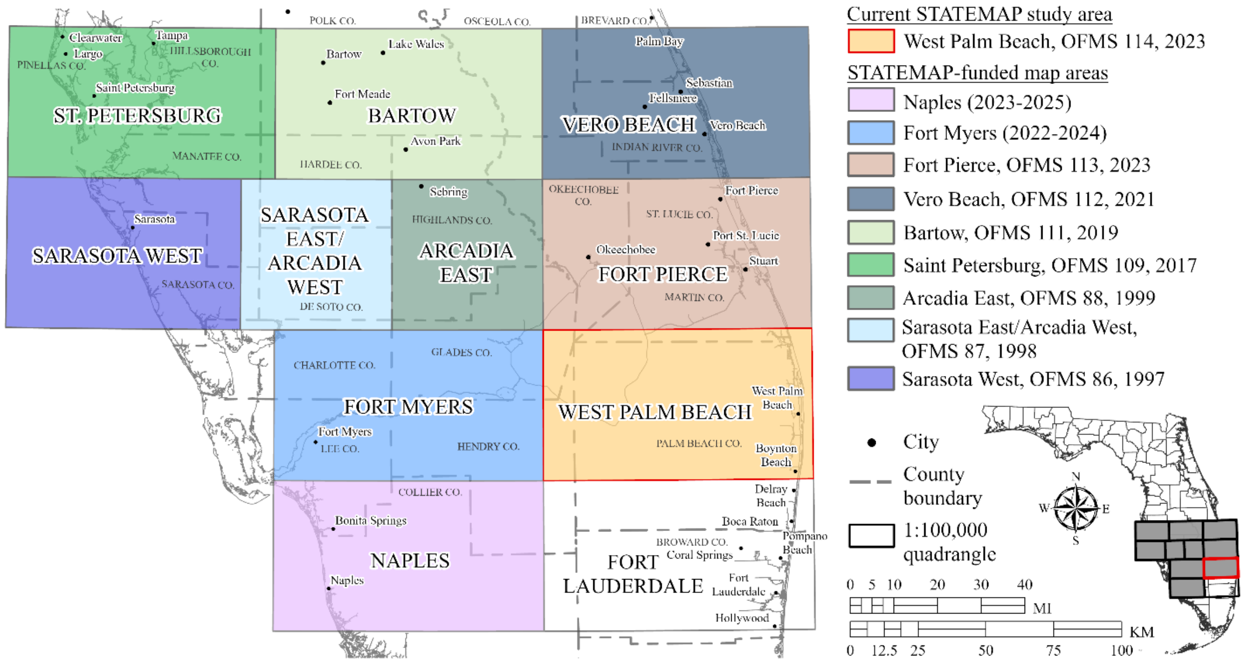

Figure 1. Nearby areas mapped under the FGS STATEMAP Program.

Methods

Mapping efforts consisted of: 1) reviewing and compiling existing geologic literature and data, 2) mapping geologic units in the field at 1:24,000 scale using standard techniques, 3) analyzing existing borehole core and cuttings samples from the FGS Sample Collections Facility, 4) drilling new cores, 5) collecting and describing outcrop samples, and 6) preparing a geologic map and geological cross-sections of the area. Fieldwork, performed during the fall of 2021 through the spring of 2023, consisted of sampling and describing outcrops, as well as collecting samples from beach and pit exposures.

Four new geologic samples were added to the FGS surface-sample collection (M-Series) and eight cores (205 feet [62.5 meters] total) were drilled. Numerous outcrops were also examined during this project. In addition to the new M-Series samples collected, 141 historical M-Series samples were examined. All data, including formation picks from over 250 boreholes within the study area and a five-mile (8.0 kilometer) buffer from surrounding quadrangles, were compiled and analyzed. Figure 2 shows the locations of FGS cores, cuttings, outcrops, and M-Series samples within the study area. Appendix A lists borehole samples utilized within the quadrangle. The map and accompanying plates were developed in ESRI® ArcGIS® Pro™ 2.9.5 software for publication as part of OFMS 114.

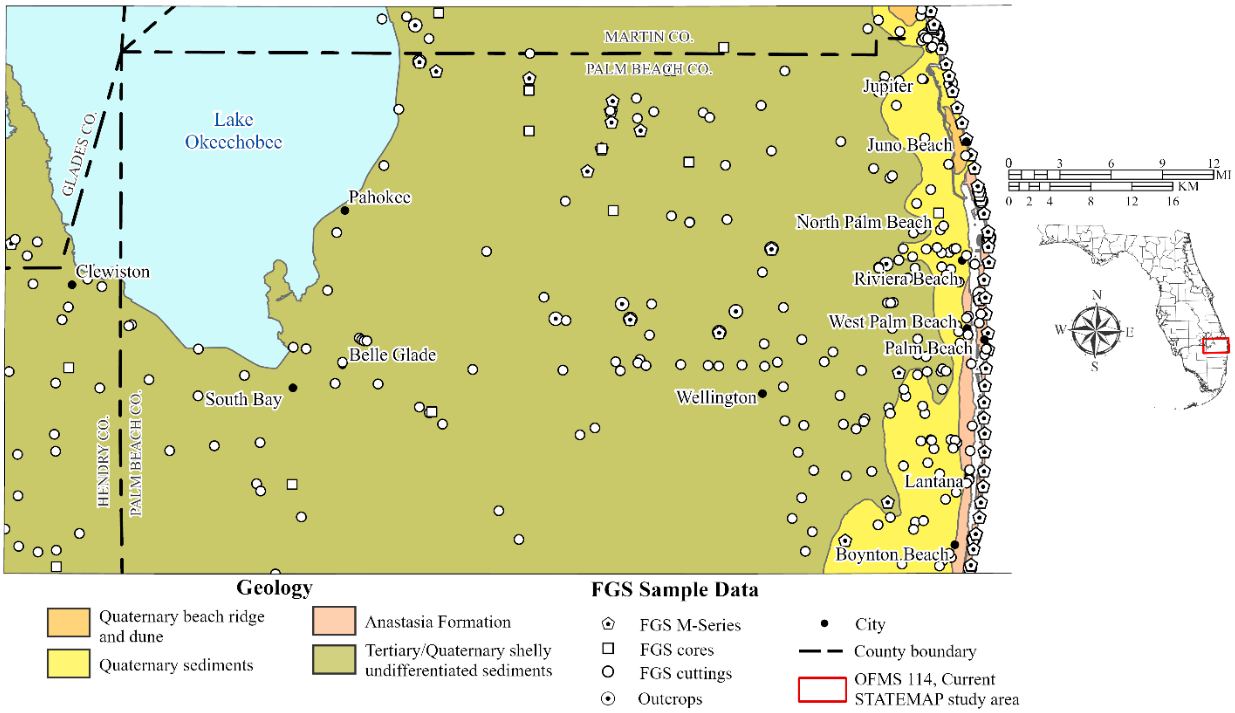

Figure 2. FGS cores, cuttings, outcrops, and M-series samples used for models.

Four USGS tiles from the 3D Elevation Program (3DEP;U.S. Geological Survey, 2022) were mosaicked together in ESRI® ArcGIS® Pro™ 2.9.5 to create the digital elevation model for this study area. Depending on the data available, these tiles can be a combination of light detection and ranging (LiDAR) and topographic-derived DEM. All elevation values are in meters and are referenced to the North American Vertical Datum of 1988 (NAVD 88). This data has a horizontal resolution of 1/3 arc-second (approximately 10 meters), and a vertical resolution of 1 meter.

Top-of-unit rasters were created for several geologic units within the study area using the borehole descriptions completed during this study. In order to produce interpolated top-of-unit rasters, the borehole depth for the top of each unit was first converted from depths below land surface(BLS) into elevations referenced to mean sea-level (MSL). This conversion was performed by taking the elevation value of the borehole location from the hybrid digital elevation model raster and subtracting the depth below land surface value, resulting in the MSL elevation for the top-of-unit for each borehole location.

The MSL elevation data for each geologic top-of-unit was used to create a Natural Neighbor (NN) interpolation of the top-of-unit surface. The NN method of interpolation is a simple and exact interpolation method that relies on Voronoi tessellation (a partitioning of a plane into regions based on distances to points) to select a local subset of points and determine a weighted influence at every raster grid cell. This method produces a surface that passes through every data point in the input data set and thus does not attempt to account for errors or outliers. The NN method is particularly useful for visualizing the 'raw' data for problematic areas and extreme outliers prior to building and optimizing the final model.

After examining the initial models created for geologic units, it was evident that some of the predictive errors in the first model were directly attributable to either low data density, local outliers in the borehole data, or both. Outliers are a common occurrence in Florida geologic data for a variety of reasons, both human and natural, including: 1) Hawthorn Group units can be difficult to distinguish even for a trained professional geologist, and therefore some degree of uncertainty may exist in locating contacts, 2) many of the borehole samples are based on cuttings taken at intervals of 10 feet (3.1 meters), which introduces uncertainty in the elevation of the contacts even when the contact is clearly evident and 3) dissolution in carbonate units can produce significantly different unit elevations in boreholes that are a short distance apart.

In cases where the accuracy metrics of the modeled surfaces indicated large amounts of error due to outliers, an iterative modeling process was used to reduce the average standard error of the interpolated surface and the least-accurate boreholes were removed from the dataset via cross-validation to improve predictive accuracy. After the removal of outlier data points (generally fewer than ten boreholes per unit), a new interpolated raster was generated.

Figure 3 is a boxplot used to illustrate the distribution and range of elevation values, relative to MSL, for each geologic unit investigated within the study area. The crossbar within the box represents the median elevation value for each geologic unit. The upper and lower borders of each box correspond to the 25th and 75th percentiles, or the first and third quartiles, respectively; this area is also called the interquartile range and represents the middle 50% of the values in each group. The whiskers that extend from each boxplot reach no further than 150% of the interquartile range. Data that fall beyond the whiskers are considered outlier points and are represented by a dot.

Once the top-of-unit models were completed, they were subtracted from the digital elevation model to produce a raster showing overburden depth between each unit and land surface. The overburden rasters were then used to assist in drawing the final surficial geologic map for the study area.

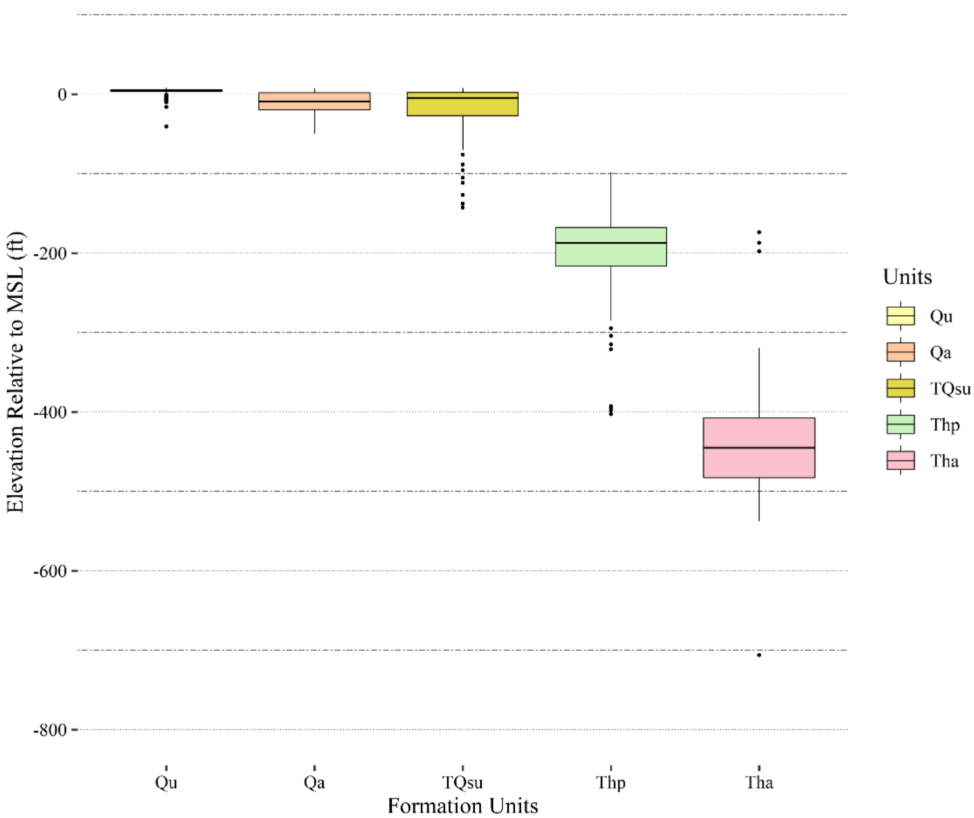

Figure 3. Boxplot of top of lithostratigraphic unit elevation ranges.

Much of the study area is blanketed by a veneer of Quaternary undifferentiated sediments. For this reason, and in keeping with geologic mapping practices developed by Scott et al. (2001), the authors have adopted the procedure of mapping the first named geologic unit within 20 feet (6.1 meters) of the surface. If Quaternary undifferentiated sediments (Qu) have a thickness greater than 20 feet (6.1 meters), they appear as the mapped unit. If these undifferentiated sediments are less than 20 feet (6.1 meters) thick, the underlying lithostratigraphic unit appears on the map. The geologic map (OFMS 114, Plate 1) and the geologic cross-sections (OFMS 114, Plate 2) may appear to disagree slightly when depicting the upper unit due to this convention. This is because geologic cross-section contacts are based on straight-line projection between boreholes, which may lead to apparent unit thicknesses between boreholes not supported by field evidence or other nearby boreholes.

Public access in portions of the mapped area was hindered by the presence of numerous wetlands, mines, farms, ranches, and privately-owned land. Fieldwork access was typically limited to public roads, State-owned lands, and County-owned lands. As such, large sections of the mapped area were inaccessible. In these areas, the authors had to rely on existing core, cuttings, outcrop, and M-Series sample data.

Previous Work

The current study builds on previous geologic investigations in and around the present map area. Preliminary county geologic maps for Glades (Campbell, 1993), Hendry (Scott, 1993a), Martin (Duncan and Scott, 1993), Palm Beach (Scott, 1993b) counties were previously published at a 1:126,720 scale by the FGS. However, each of these geologic maps was constructed in an average timeframe of two weeks utilizing selected in-house geologic data with little-to-no field work. A statewide geologic map (Scott et al., 2001), published by the FGS, provided a framework for the current, more detailed mapping. Although these maps provided a starting point for the detailed geologic mapping undertaken for this project, significant refinement of prior geologic maps was possible because of this additional field work and data.

Scott (1988) published detailed descriptions, structure contour maps, and isopach maps for units of the Hawthorn Group. This study also benefited from the work performed during geologic mapping of the USGS Fort Pierce (Green et al., 2022a; Green et al., 2022b), Bartow (Green et al., 2019a; Green et al., 2019b), Sarasota and Arcadia (Green et al., 1997; Green et al., 1998; Green et al., 1999), and Vero Beach (Green et al., 2021a; Green et al., 2021b) 30 x 60 minute quadrangles. Some of the field relationships and stratigraphic problems were worked out during those projects.

GEOLOGIC SUMMARY

The near-surface geology of the USGS 30 x 60 minute West Palm Beach quadrangle is composed of a complex mixture of Tertiary to Quaternary carbonate and siliciclastic sediments. A combination of factors, including fluvio-deltaic deposition, marine deposition and erosion of sediments as a result of eustatic changes in sea level, dissolution of underlying carbonates (karstification), and structural features have influenced the geology of the study area.

The oldest unit to crop out in the West Palm Beach quadrangle is the Tertiary/Quaternary undifferentiated shelly sediments. The unit can be seen in numerous pits and quarries throughout the map area (OFMS 114, Plate 1). The Tertiary/Quaternary undifferentiated shelly sediments overlie the Peace River Formation throughout the mapped area (OFMS 114, Plate 2). The oldest unit investigated for geologic cross-sections is the Oligocene-Miocene Arcadia Formation (Hawthorn Group; OFMS 114, Plate 2). Detailed descriptions of the lithology of all units found in the study area begin on page 12 of this publication.

The West Palm Beach quadrangle encompasses portions of the Florida Southeast Coast basin, Lake Okeechobee basin, and a very small portion of the Caloosahatchee basin (Figure 4). There are no documented springs within the study area.

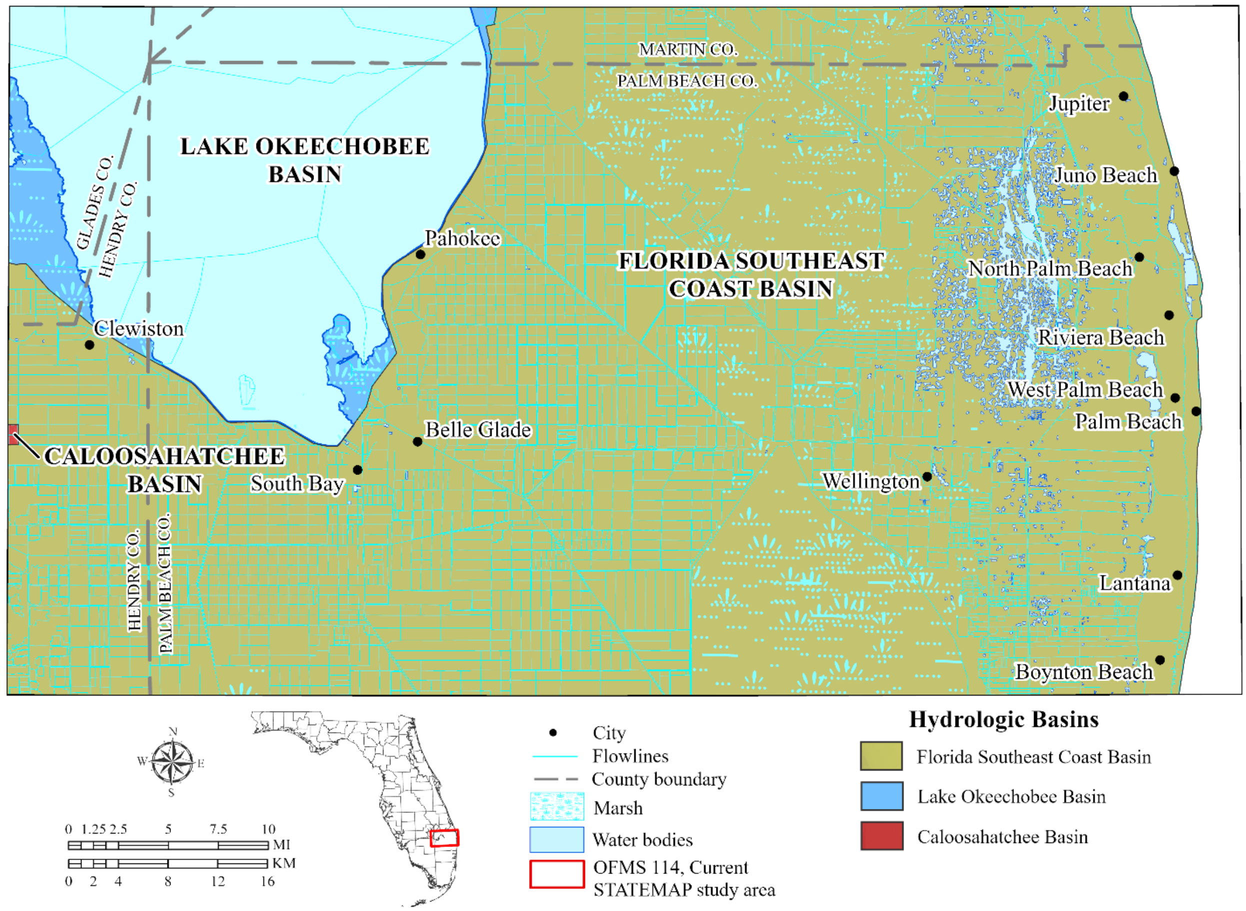

Figure 4. Location of selected river basins and other water bodies (modified from Hydrologic Unit Codes: Basins, 1993).

Structure

The South Florida Basin (Applin and Applin, 1965; Winston, 1971) is a stratigraphic basin which contributed to the thickening and deepening towards the south of Mesozoic and early Cenozoic lithostratigraphic units in the southern Florida peninsula. The basin encompasses most of the southern Florida Peninsula in which the stratigraphic units generally dip gently to the south and southeast. The Okeechobee Basin (Riggs, 1979), which includes most of southern Florida (Figure 5), is an area where mid-Cenozoic and younger stratigraphic units gently dip south and southeast. As can be seen in the geologic cross sections (OFMS 114, Plate 2), the South Florida and Okeechobee basins have had minimal influence on the late Cenozoic units.

Figure 5. Principal subsurface structures of the Florida peninsula (modified from Scott, 1988).

Geomorphology

The Florida Geological Survey recently published the Florida Geomorphology Atlas (Williams et al., 2022). The atlas synthesized over a century of geomorphic writings and maps about Florida, along with the addition of new data and interpretations of the geomorphology. These include specific regional discussions of landforms and relationships to the underlying geology and the coastal, fluvial, and karst processes that have affected the evolution of landforms. *The Geomorphology of the Florida Peninsula* (White, 1970), in addition to work by former FGS colleague, Thomas M. Scott, was central to the new statewide map. Recent data and technology, such as LiDAR coverages and new possibilities for digital geomorphological mapping that employ spatiotemporal and geocomputational approaches to data analysis, allowed the FGS to revise nomenclature and refine geomorphic district and province boundaries. In the following section, all geomorphic unit names and most discussions are from Williams et al., 2022.

The new atlas shows the geomorphology by regional units (districts; Figure 6) and sub-regional to local units (provinces; Figure 7). Districts are defined by regional groupings to form map polygons that have landforms which are distinct from adjacent districts. Defining the more localized provinces and their landforms is important for the characterization of the regions within districts. A brief discussion of districts and provinces within the West Palm Beach quadrangle is listed below. For more information and detail, the reader can refer to Williams et al., 2022.

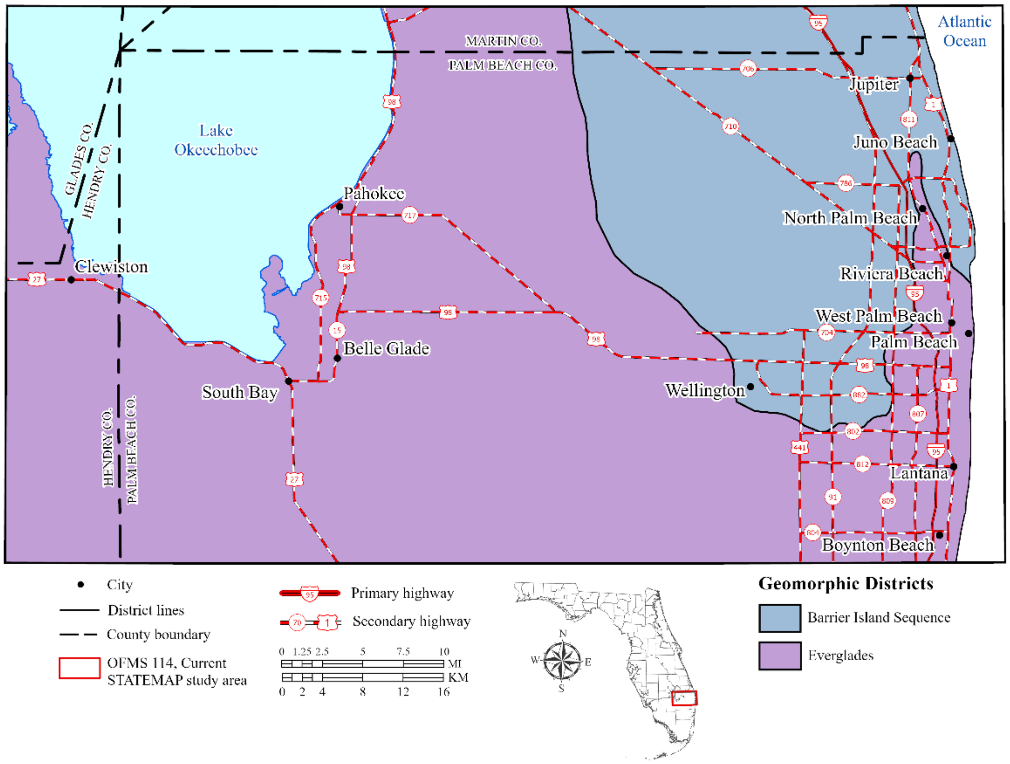

Figure 6. Geomorphic districts within the West Palm Beach quadrangle.

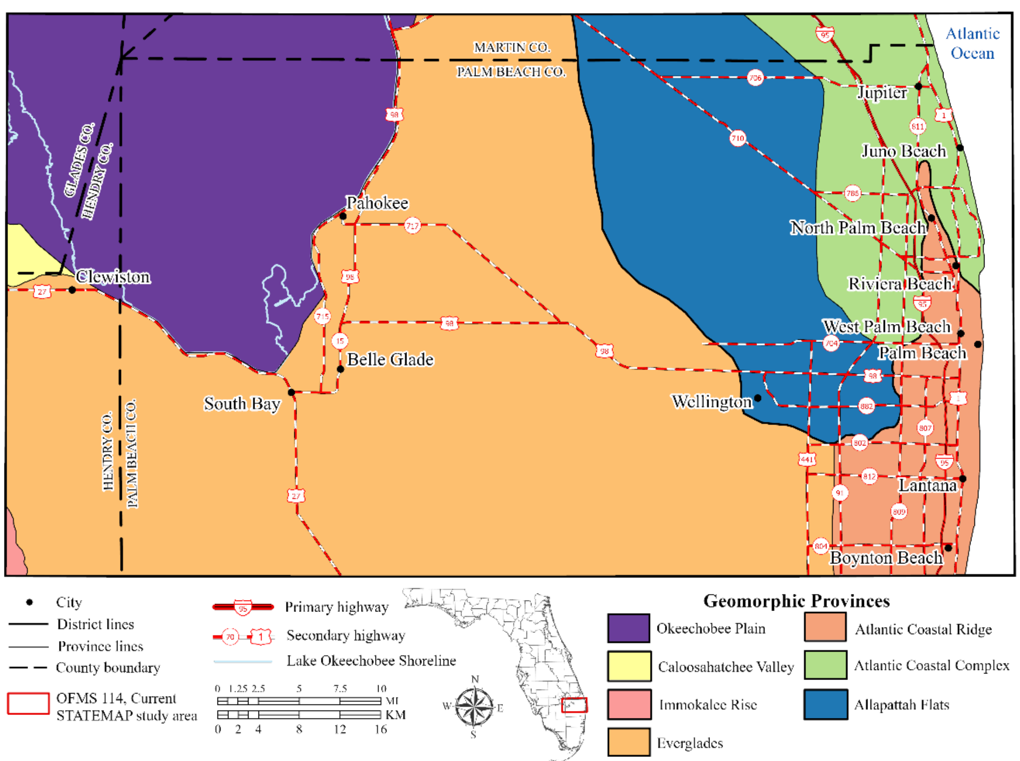

Figure 7. Geomorphic provinces within the West Palm Beach quadrangle.

Barrier Island Sequence District

The Barrier Island Sequence District occurs along the Atlantic Coast. It extends from Georgia (Clark and Zisa, 1976) into Florida, and south to the vicinity of Lake Okeechobee (Williams et al., 2022). Quaternary coastal processes formed extensive barrier islands, beaches, lagoons, embayments, and shallow-water marine terraces in the district. Other landforms include strand plains and shore-parallel dunes and swales (Williams et al., 2022). Within the mapped area, the Barrier Island Sequence District is subdivided into two provinces: Allapattah Flats and the Atlantic Coastal Complex (Figure 7). Within the study area, elevations in the district range from sea level along the Atlantic Coast, to approximately 55 feet (16.8 meters) above MSL in the Atlantic Coastal Complex province.

Atlantic Coastal Complex

The Atlantic Coastal Complex extends along the Atlantic coast from the St. Johns River in Duval County to central Palm Beach County (Williams et al, 2022). Most of the Atlantic Coastal Complex is a Pleistocene strand plain. The province consists of Quaternary barrier islands and related features on, and inland from, the Atlantic Coast. Many of the beach ridges and dunes in the province are subparallel to the coast. Water bodies and wetlands landward of the barrier islands include lagoons and small embayments. Within the study area, tidal estuarine coastlines are dominated by mangrove swamps, and coastal dunes, some modified by aeolian processes, may be observed at Jonathan Dickinson State Park, Jupiter Ridge Natural Area, and Juno Dunes Natural Area. Elevations of the province in the study area (Figure 7) range from sea level along the Atlantic Coast to about 55 feet (16.8 meters) above MSL on dunes.

Allapattah Flats Province

Allapattah Flats extends from southern St. Lucie County to northeastern Palm Beach County (Williams et al., 2022). The province includes the indistinct, low-elevation, drainage divide between the headwater wetlands of the St. Johns River and the northeastern Everglades. It is characterized by very little change in elevation, highly variable directions of surface water flow, and numerous shallow circular wetlands in undeveloped areas of the landscape. These wetlands trend north-northwest to south-southeast, parallel to the ancient coastal landforms (Williams et al., 2022). Elevations in the southern part of Allapattah Flats in the study area (Figure 7) range from 15 feet (4.6 meters) to 30 feet (9.1 meters) MSL, with most elevations below 20 feet (6.1 meters) MSL.

Everglades District

The Everglades District includes the southern part of peninsular Florida. All the provinces within the Everglades District are related to a vast and complex drainage system that begins with the Kissimmee River and its tributaries in the Barrier Island Sequence District to the north of the mapped area (Williams et al., 2022). Many areas are characterized by wetlands, but others include Quaternary carbonate islands and coastal ridges. The dominant flow of water through the central and eastern Everglades District has historically been north to south. Drainage in much of the district is by way of sloughs, sheet flow in wetlands, and poorly defined stream systems. All the provinces within the district have relatively flat landscapes, and elevation changes of inches or a few feet often mark the differences between provinces. With few exceptions, pre-development drainage was as sheet flow and through sloughs (wetlands). The Everglades District is subdivided within the mapped area into five provinces: Okeechobee Plain, Caloosahatchee Valley, Immokalee Rise, the Everglades Province, and the Atlantic Coastal Ridge (Figure 6). The Everglades District has little topographic relief. Elevations within the district gradually decrease from north to south. Elevations of the district within the mapped area range from approximately sea level to 45 feet (0.0 to 13.7 meters) MSL.

Okeechobee Plain Province

The Okeechobee Plain is the northernmost province of the Everglades District and encompasses parts of Highlands, Okeechobee, Glades, and Martin counties and small areas of St. Lucie and Hendry counties. This province includes Lake Okeechobee and the low-elevation plains and wetlands surrounding the northern half of the lake (Williams et al., 2022). The Okeechobee Plain is a broad, relatively flat marine terrace that has been modified by fluvial processes and wetland development. The boundary with the Everglades Province is along the southern shore of Lake Okeechobee, the former location of a low sill that controlled flow to the Everglades. The sill has been replaced by the Herbert Hoover Dike. The land surface of the Okeechobee Plain has low relief, with elevations ranging from 15 feet (4.6 meters) to 20 feet (6.1 meters) MSL within the study area (Figure 7).

Caloosahatchee Valley Province

The Caloosahatchee Valley is located in central Lee, northern Hendry, and southern Glades counties. The province consists of the pre-development Caloosahatchee River valley, and the low valley between Lake Okeechobee and the Caloosahatchee River (Williams et al., 2022). Historically, excess water entering the northern Everglades from the Kissimmee River, Fisheating Creek, other smaller drainages, and Lake Okeechobee overflowed westward into the low valley of wetlands and lakes, including Lake Hicpochee and Lake Flirt. Most of these lakes were drained by 20th Century construction of the Caloosahatchee Canal which permanently connected Lake Okeechobee to the Caloosahatchee River for flood control and navigation. Where development has not occurred, there are many swampy regions along streams. The significant number of drainage canals associated with development suggest that much of the land surface was historically poorly drained. The Caloosahatchee Valley occurs in a very small region along the western boundary of the study area (Figure 7). Elevations of the province within the study area range from approximately ten feet (3.05 meters) to 20 feet (6.1 meters) MSL.

Immokalee Rise Province

Immokalee Rise is located within much of Hendry, north-central Collier, and eastern Lee counties. The province is a region of slightly higher elevation compared to its neighboring provinces. It is relatively flat but has abundant closed topographic depressions. It has swampy drainage with more-or-less linear marshes and cypress sloughs that discharge to adjacent provinces (Williams et al., 2022). Immokalee Rise occurs in the southwestern corner of the study area (Figure 7). Elevations of the province within the study area range from 15 feet (4.6 meters) to 25 feet (7.6 meters) MSL.

Everglades Province

The Everglades Province extends from the southern shore of Lake Okeechobee through Palm Beach, Broward, and Miami-Dade counties and parts of Glades, Martin, Hendry, Monroe, and Collier counties. The province constitutes the largest subtropical wetland in the United States. The Everglades Province is a broad plain, sloping gently from north to south in southern peninsular Florida. For the most part, the province was covered by sawgrass marsh with scattered tree islands that transition to mangroves to the south and pine flatwoods to the east and west (Williams et al., 2022). Today, parts of this drainage system have been interrupted by canals, agricultural areas, and other land uses, including the Everglades

Agricultural Area in the north. Within the study area (Figure 7), elevations in the Everglades Province range from about 10 feet (3.05 meters) to approximately 25 feet (7.6 meters) MSL.

Atlantic Coastal Ridge Province

The Atlantic Coastal Ridge occurs in coastal regions of Palm Beach, Broward, and Miami-Dade counties. The province is an important topographic feature in southeastern Florida. It parallels and, over much of its extent, is adjacent to the Atlantic Ocean. Prior to 20th Century development, it limited the eastern extent of the southern Everglades drainage system. The Atlantic Coastal Ridge includes a larger Pleistocene coastal ridge and associated smaller ridges from northern Palm Beach County to near Homestead in Miami-Dade County. The province is narrow, averaging about seven miles across from east to west. The ridge feature is continuous throughout Palm Beach County. The Atlantic Coastal Ridge is dominantly composed of shelly quartz sand, coquina, and limestone (Williams et al., 2022). The Atlantic Coastal Ridge is adjacent to the Atlantic Coast in the eastern part of the quadrangle (Figure 7). Elevations vary from sea level to 45 feet (13.7 meters) MSL within the study area.

LITHOSTRATIGRAPHIC UNITS

Tertiary System

Oligocene-Pliocene Series

Hawthorn Group

The lower Oligocene to lower Pliocene Hawthorn Group (Th) within the mapped area is composed of sediments from the Arcadia and Peace River formations. The Peace River Formation unconformably overlies the Arcadia Formation and is unconformably overlain by the Tertiary/Quaternary undifferentiated shelly sediments, throughout the mapped area (OFMS 114, Plate 2). The top of the Hawthorn Group ranges from approximately 90 feet (27.4 meters) below MSL in W-14296 (Appendix A) to 390 feet (118.9 meters) below MSL in W-13090 (Appendix A). The thickness of the Hawthorn Group ranges from approximately 510 feet (155.5 meters) in W-13090 (Appendix A) to 920 feet (280.4 meters) in thickness in W-13834 (Appendix A). The Hawthorn Group forms part of the intermediate aquifer system/intermediate confining unit (IAS/ICU) in the study area (Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986).

Arcadia Formation

The lower Oligocene to middle Miocene (Covington, 1993; Brewster-Wingard et al., 1997) Arcadia Formation (Tha) is a poorly to moderately indurated, yellowish-gray to white carbonate with variable amounts of quartz sand and phosphate, interbedded with siliciclastic-dominant sediments. Phosphate content can be highly variable, ranging up to 25 percent, but is more commonly in the 10 percent range (Scott, 1988). Although limestone is present, dolostone is most common, ranging in grain size from microcrystalline to medium, with the coarser material often having a sucrosic texture. Minor clay and chert beds (some composed of silicified clay) also occur (Scott, 1988). Porosity types include intergranular and moldic. The Arcadia Formation was identified in wells within the study area based on the presence of sandy, phosphatic carbonate beds, with occasional presence of bored phosphatic hardgrounds.

The Arcadia Formation ranges from approximately 160 feet (48.8 meters) below MSL (Appendix A; W-18256) to approximately 860 feet (262.1 meters) below MSL (Appendix A; W-13090). The unit ranges from 360 feet (109.7 meters) thick in W-9968 (Appendix A) to approximately 500 feet (152.4 meters) thick in W-16052 (Appendix A). The Arcadia Formation forms part of the intermediate aquifer system/intermediate confining unit (IAS/ICU) in the study area (Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986).

Peace River Formation

The middle Miocene to lower Pliocene (Scott, 1988; Covington, 1993) Peace River Formation (Thp) is comprised of unconsolidated to poorly indurated yellowish-gray to olive-gray, interbedded quartz sands, clays, and carbonates. Siliciclastics are the predominant component of the unit (Scott, 1988). Phosphatic sand and gravel are most common in the uppermost beds, although they are generally interspersed throughout the unit. The Peace River Formation contains a diverse fossil assemblage of marine and terrestrial fauna. Porosity types in the formation are generally intergranular.

In areas where the carbonate component of the Peace River Formation is high, or the siliciclastic component of the Arcadia Formation is high, identifying the contact between these formations can be difficult. In such cases, the contact of the Peace River Formation with the Arcadia Formation is best estimated based on the occurrence of sedimentary structures, and where the overall lithologic sequence becomes more carbonate-dominant (Scott, 1988). In most of the study area, the contact is readily recognized at the first occurrence of a light-colored, phosphatic and quartz-sandy dolosilt.

The Peace River Formation ranges from approximately 90 feet (27.4 meters) below MSL in W-14296, to 390 feet (118.9 meters) below MSL in W-13090. Thicknesses range from approximately 150 feet (45.7 meters) in W-10135, to 570 feet (173.7 meters) in W-13834 (Appendix A).

The Peace River Formation sediments comprise a low-permeability confining- to semi-confining facies within the IAS/ICU within the study area (Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986).

Tertiary/Quaternary Systems

Pliocene/Pleistocene Series

Tertiary/Quaternary undifferentiated shelly sediments

Tertiary/Quaternary undifferentiated shelly sediments typically consist of fine-to-medium quartz sand and marine mollusk shell beds with variable amounts of micrite, silt, clay, and calcite cement. The unit occasionally contains lenses and thin beds of fresh-water mollusks. Colors range from light gray to light-olive gray. Fossil mollusk shells, which may vary from whole to fragments, are often highly weathered and abraded and regularly become the dominant lithology. Porosity is generally intergranular. Other accessory minerals may include calcite, aragonite, mica, heavy minerals, pyrite, and minor phosphate sand and gravel. A basal phosphate lag is occasionally present. In the study area, these Tertiary/Quaternary undifferentiated shelly sediments occur in the form of both unconsolidated sand with varying percentages of shell fragments and calcite-cemented sand and shell fragments, with occasional lithified carbonate beds.

The Tertiary/Quaternary undifferentiated shelly sediments present in the study area are generally less than 30 feet (9.1 meters) above MSL, with most of the unit being less than ten feet (3.0 meters) above MSL (OFMS 114, Plate 2, cross-sections). The elevation of the Tertiary/Quaternary undifferentiated shelly sediments is highest in the western portion of the mapped area and lowest along the Atlantic Coast (OFMS 113, Plate 2). It is postulated that these occurrences of higher elevation Tertiary/Quaternary undifferentiated shelly sediments are indicative of paleo-shorelines that have been “stranded” due to sea-level fluctuation. Additional studies, with much better core control than available in this study, are needed to determine the exact nature and relationships of the unit in the region.

The Tertiary/Quaternary undifferentiated shelly sediments are overlain by undifferentiated Quaternary sediments in parts the mapped area (OFMS 114, Plate 2). In the eastern portion of the mapped area, along the Atlantic Coast, the unit is sometimes overlain by the Anastasia Formation. The Tertiary/Quaternary undifferentiated shelly sediments are exposed in several quarries within the study area.

Tertiary/Quaternary undifferentiated shelly sediments disconformably overlie the Peace River Formation throughout the West Palm Beach quadrangle.

The top of the Tertiary/Quaternary undifferentiated shelly sediments ranges from approximately 25 feet (7.6 meters) above MSL in W-15748), to 140 feet (42.7 meters) below MSL in W-12429. The thickness of the Tertiary/Quaternary undifferentiated shelly sediments in the mapped area varies from approximately 10 feet (3.1 meters) in W-15378 to 380 feet (115.8 meters) in W-15937 (Appendix A).

Permeable strata within the Tertiary/Quaternary undifferentiated shelly sediments form part of the surficial aquifer system (SAS; Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986).

Pleistocene/Holocene Series

Anastasia Formation

The late Pleistocene Anastasia Formation (Qa) is present within a narrow band along parts of the eastern edge of the study area. The formation, named by Sellards (1912), is composed of interbedded coquinoid limestone and quartz sand. It typically occurs as an orangish-brown, poorly- to well-indurated coquinoid limestone consisting of whole and broken mollusk shells in a quartz sand matrix. The coquina is commonly cemented by sparry calcite. The sand occurs in beds that are light-gray-to-tan and orangish-brown, unconsolidated to moderately indurated, and variably fossiliferous. Porosity is intergranular to intercrystalline but may be vuggy and even karstic in more cemented zones. In the study area, the Anastasia Formation occurs predominantly as a light-gray-to-tan and orangish-brown, unconsolidated to moderately indurated quartz sand and shells, with coquinoid limestone being less common. Exposures of the Anastasia Formation can be seen in numerous places along the Atlantic Coast, with particularly good examples near the Palm Beach Golf Club on the north end of Palm Beach Island.

The Anastasia Formation, which lies on top of the Tertiary/Quaternary undifferentiated shelly sediments in the eastern edge of the mapped area, can be difficult to distinguish from the Tertiary/Quaternary undifferentiated shelly sediments in some areas due to similarity in lithologic components. Typically, the Anastasia Formation is distinguished based on its fairly uniform fossil content, tendency to contain rounded sand and shell fragments (typical of beach material), orangish-brown color, and lack of clay and silt matrix. In localities where the Anastasia Formation-Tertiary/Quaternary undifferentiated shelly sediments cannot be easily distinguished, Tertiary/Quaternary undifferentiated shelly sediments were picked where the shell fragments become more leached and weathered, and contain a more diverse taxonomy and texture.

The top of the Anastasia Formation ranges from approximately 15 feet (4.6 meters) above MSL in W-12222, to 40 feet (12.2 meters) below MSL in W-4912. The thickness of the Anastasia Formation varies from approximately five feet (1.5 meters) in W-12424, to 80 feet (24.4 meters) in W-15937 (Appendix A). This formation is considered part of the SAS (Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986).

Quaternary undifferentiated sediments

Quaternary undifferentiated sediments (Qu) include siliciclastic sediments, organics, and freshwater carbonates. While not a formally recognized lithostratigraphic unit, following the convention of Scott et al. (2001), the Quaternary undifferentiated sediments are mapped as a discrete unit where these sediments exceed a thickness of 20 feet above formally recognized lithostratigraphic units. The Quaternary undifferentiated sediments in the mapped area may be highly variable in thickness. Quaternary undifferentiated sediments in the study area lie unconformably on Anastasia Formation or Tertiary/Quaternary undifferentiated shelly sediments (OFMS 114, Plate 2).

Quaternary undifferentiated sediments generally consist of white-to-gray to orange-to-brown, fine- to coarse-grained, clean-to-clayey (usually) unfossiliferous quartz sand, sandy clays and clays, with variable admixtures of organics. Minor shell fragments are sometimes present in Quaternary undifferentiated sediments near the coast. This makes distinction between Quaternary undifferentiated sediments and Anastasia Formation difficult at times. The Quaternary undifferentiated sediments form part of the SAS (Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986).

Quaternary beach ridge and dune sediments

Following the convention of Scott et al. (2001), Quaternary beach ridge and dune sediments are mapped as a subdivision of undifferentiated Quaternary sediments. They consist of sediments which have been deposited and have surficial expressions as beach ridge and dune landforms up to 30 feet (9.1 meters) above MSL. Subdivisions of the undifferentiated Quaternary sediments are not lithostratigraphic units but are utilized in order to facilitate a better understanding of Florida's geology.

SPOIL

The areas marked as spoil on the map are disturbed islands created by dredging in the Indian River Lagoon, Lake Worth, along navigation channels, and fill areas for roads and bridges. These are typically a mixture of sand and shells from either the Tertiary/Quaternary undifferentiated shelly sediments, the Anastasia Formation, or Holocene sediments. There are some areas denoted as spoil on the cross-sections (OFMS 114, Plate 2, cross-sections B-B' and E-E') that correspond with the Herbert Hoover Dike (around Lake Okeechobee) and mine spoil. These areas are too narrow or small to display on the geologic map. In the case of the mine spoil, the unit being mined is TQsu.

HYDROGEOLOGY

Hydrostratigraphic units within the map area, in ascending order, consist of the FAS, the IAS/ICU, and the SAS (Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition, 1986). A correlation chart of the hydrostratigraphic units, and their relationship to lithostratigraphic units, can be seen on OFMS 114, Plate 2, Figure 2. The sands, silts, clays, and carbonates of the Hawthorn Group comprise the IAS/ICU. The SAS is comprised of Quaternary undifferentiated sediments, Anastasia Formation, and Tertiary/Quaternary undifferentiated shelly sediments.

DERIVATIVE PRODUCTS

Several derivative products were developed in the process of completing this project. During the mapping efforts, data from 248 boreholes with samples were analyzed and used (Appendix A). Formation picks made on these cores and cutting samples will allow creation of structure contour and isopach maps for the top of several units in the area, as well as future 3-D models. Additional derivative products anticipated to come from this mapping effort include aquifer vulnerability assessment maps, karst susceptibility and risk maps, and aquifer and confining unit maps. Data derived from prior STATEMAP products have often been used to augment other Florida Geological Survey and Florida Aquifer Vulnerability Assessment (FAVA) projects in the state (Arthur et al., 2007; Baker et al., 2007; Kromhout et al., 2017). These geologic maps will also be compiled and published as part of the Statewide Surficial Geologic Map in the next decade.

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APPENDIX A: FLORIDA GEOLOGICAL SURVEY BOREHOLES UTILIZED FOR STUDY

This table lists FGS boreholes within the boundaries of the USGS West Palm Beach 30 x 60 minute quadrangle utilized for the project. Due to graphical constraints, not all boreholes will appear on Plate 1 of OFMS 114. The first 30 boreholes in the table were utilized for geologic cross-sections and appear on Plates 1 and 2 of OFMS 114.

Map ID	Well Label	Data Source	Sample Type	Latitude	Longitude	24K QUAD	Elevation (ft.)	Total Depth (ft.)
1	W-9104	FGS	Cuttings	26.56701	-80.21644	GREENACRES CITY	16	984
2	W-9108	FGS	Cuttings	26.52000	-80.21306	GREENACRES CITY	14	1083
3	W-9112	FGS	Cuttings	26.55611	-80.51389	SHAWANO	9	1200
4	W-9113	FGS	Cuttings	26.67972	-80.45083	LOXAHATCHEE NW	6	1004
5	W-9115	FGS	Cuttings	26.68639	-80.24000	PALM BEACH FARMS	17	1030
6	W-10079	FGS	Cuttings	26.61590	-80.74839	OKEELANTA	8	1150
7	W-10102	FGS	Cuttings	26.50036	-80.73311	OKEELANTA	9	935
8	W-10144	FGS	Cuttings	26.52417	-80.98528	LAKE HARBOR SW	20	850
9	W-12427	FGS	Cuttings	26.90922	-80.61228	PORT MAYACA	17	236
10	W-12442	FGS	Cuttings	26.94283	-80.34755	WEST OF ROOD	22	205
11	W-12446	FGS	Cuttings	26.95828	-80.48311	BIG MOUND NORTH	24	193
12	W-12447	FGS	Cuttings	26.94256	-80.23199	ROOD	22	236
13	W-12591	FGS	Cuttings	26.68034	-80.53950	SIXMILE BEND	10	240
14	W-12593	FGS	Cuttings	26.85972	-80.62694	PAHOKEE	16	240
15	W-12597	FGS	Cuttings	26.69812	-80.80923	LAKE HARBOR	12	580
16	W-13090	FGS	Cuttings	26.96774	-80.08450	JUPITER	7	1165
17	W-15811	FGS	Cuttings	26.79411	-80.98972	CLEWISTON NORTH	8	13424
18	W-15937	FGS	Cuttings	26.92375	-80.13979	ROOD	17	3505
19	W-16052	FGS	Cuttings	26.63483	-80.23284	PALM BEACH FARMS	18	3502
20	W-16058	FGS	Cuttings	26.53564	-80.92561	LAKE HARBOR SW	15	502
21	W-16078	FGS	Cuttings	26.54556	-80.10500	LAKE WORTH	16	390
22	W-16182	FGS	Cuttings	26.73453	-80.23389	PALM BEACH FARMS	16	3300
23	W-16387	FGS	Continuous Core	26.68139	-80.93667	CLEWISTON SOUTH	13	562
24	W-17052	FGS	Cuttings	26.80078	-80.67331	PAHOKEE	10	3510
25	W-17093	FGS	Cuttings	26.60784	-80.94928	LAKE HARBOR SW	16	2235
26	W-17542	FGS	Cuttings	26.69982	-80.71595	BELLE GLADE	18	2504
27	W-18256	FGS	Cuttings	26.99068	-80.60462	PORT MAYACA	21	2049
28	W-18775	FGS	Cuttings	26.72361	-80.94333	CLEWISTON SOUTH	19	3500
29	W-18857	FGS	Cuttings	26.68896	-80.37515	LOXAHATCHEE NW	25	3252
30	W-18901	FGS	Cuttings	26.74991	-80.68223	BELLE GLADE	11	1647
31	W-15	FGS	Cuttings	26.71806	-80.06361	PALM BEACH	22	90
32	W-20	FGS	Cuttings	26.66757	-80.63255	BELLE GLADE	11	1332
33	W-227	FGS	Cuttings	26.73472	-80.93722	CLEWISTON SOUTH	18	135
34	W-231	FGS	Cuttings	26.60867	-80.83730	LAKE HARBOR SE	18	41
35	W-317	FGS	Cuttings	26.77201	-80.04559	RIVIERA BEACH	10	1004
36	W-778	FGS	Cuttings	26.55056	-80.70778	OKEELANTA	8	50
37	W-779	FGS	Cuttings	26.67500	-80.76389	LAKE HARBOR	11	51
38	W-782	FGS	Cuttings	26.62278	-80.43417	LOXAHATCHEE SW	11	54
39	W-783	FGS	Cuttings	26.67917	-80.39444	LOXAHATCHEE NW	5	50
40	W-845	FGS	Cuttings	26.67778	-80.07917	PALM BEACH	20	153

Map ID	Well Label	Data Source	Sample Type	Latitude	Longitude	24K QUAD	Elevation (ft.)	Total Depth (ft.)
41	W-2047	FGS	Cuttings	26.68611	-80.37722	LOXAHATCHEE NW	10	26
42	W-2048	FGS	Cuttings	26.62889	-80.41944	LOXAHATCHEE NW	12	26
43	W-2050	FGS	Cuttings	26.71047	-80.36567	LOXAHATCHEE	21	30
44	W-2051	FGS	Cuttings	26.82833	-80.44833	BIG MOUND SOUTH	16	30
45	W-2052	FGS	Cuttings	26.97131	-80.58260	PORT MAYACA	22	30
46	W-2053	FGS	Cuttings	26.69847	-80.70331	BELLE GLADE	8	28
47	W-2054	FGS	Cuttings	26.64722	-80.59194	SIXMILE BEND	8	25
48	W-2055	FGS	Cuttings	26.63229	-80.56922	SIXMILE BEND	8	26
49	W-2056	FGS	Cuttings	26.53083	-80.49417	LOXAHATCHEE SW	7	41
50	W-2370	FGS	Cuttings	26.72825	-80.03981	PALM BEACH	4	53
51	W-2782	FGS	Cuttings	26.61506	-80.06377	LAKE WORTH	19	9
52	W-3094	FGS	Cuttings	26.71006	-80.05254	PALM BEACH	12	167
53	W-3430	FGS	Cuttings	26.61778	-80.06972	LAKE WORTH	13	255
54	W-3595	FGS	Cuttings	26.77889	-80.10667	RIVIERA BEACH	13	107
55	W-3614	FGS	Cuttings	26.65694	-80.17861	PALM BEACH FARMS	13	70
56	W-3619	FGS	Cuttings	26.66208	-80.07802	PALM BEACH	16	197
57	W-4087	FGS	Cuttings	26.90694	-80.36111	WEST OF ROOD	23	87
58	W-4098	FGS	Cuttings	26.90111	-80.37722	BIG MOUND NORTH	24	53
59	W-4101	FGS	Cuttings	26.63167	-80.17528	PALM BEACH FARMS	20	77
60	W-4133	FGS	Cuttings	26.90611	-80.31250	WEST OF ROOD	23	50
61	W-4720	FGS	Cuttings	26.78250	-80.07056	RIVIERA BEACH	28	75
62	W-4901	FGS	Cuttings	26.91883	-80.37822	BIG MOUND NORTH	26	50
63	W-4908	FGS	Cuttings	26.91883	-80.37822	BIG MOUND NORTH	26	50
64	W-4910	FGS	Cuttings	26.75642	-80.06094	RIVIERA BEACH	22	196
65	W-4911	FGS	Cuttings	26.61775	-80.08942	LAKE WORTH	13	210
66	W-4912	FGS	Cuttings	26.57150	-80.06475	LAKE WORTH	16	135
67	W-5435	FGS	Cuttings	26.79206	-80.96797	CLEWISTON NORTH	11	1025
68	W-5469	FGS	Cuttings	26.86756	-80.05421	RIVIERA BEACH	25	75
69	W-5721	FGS	Cuttings	26.69248	-80.03624	PALM BEACH	5	85
70	W-5748	FGS	Cuttings	26.78214	-80.07819	RIVIERA BEACH	13	87
71	W-5781	FGS	Cuttings	26.69729	-80.03449	PALM BEACH	11	140
72	W-6141	FGS	Cuttings	26.93519	-80.09661	JUPITER	5	160
73	W-6271	FGS	Cuttings	26.62750	-80.16278	PALM BEACH FARMS	17	154
74	W-6550	FGS	Cuttings	26.64600	-80.13079	PALM BEACH FARMS	18	147
75	W-6566	FGS	Cuttings	26.78681	-80.08261	RIVIERA BEACH	11	180
76	W-6567	FGS	Cuttings	26.82567	-80.10256	RIVIERA BEACH	13	197
77	W-6580	FGS	Cuttings	26.61717	-80.06553	LAKE WORTH	17	208
78	W-7500	FGS	Cuttings	26.70792	-80.65106	BELLE GLADE	12	2242
79	W-7857	FGS	Cuttings	26.79976	-80.10577	RIVIERA BEACH	16	145
80	W-7862	FGS	Cuttings	26.76765	-80.06906	RIVIERA BEACH	14	242
81	W-8077	FGS	Cuttings	26.70638	-80.64868	BELLE GLADE	14	2077
82	W-8303	FGS	Cuttings	26.71581	-80.12697	PALM BEACH FARMS	19	200
83	W-8322	FGS	Cuttings	26.72342	-80.44777	LOXAHATCHEE NW	8	10905
84	W-8324	FGS	Cuttings	26.75284	-80.90423	CLEWISTON NORTH	20	44
85	W-8368	FGS	Cuttings	26.70644	-80.10197	PALM BEACH	16	165
86	W-8704	FGS	Cuttings	26.61667	-80.09917	LAKE WORTH	14	100
87	W-8740	FGS	Cuttings	26.75506	-80.97200	CLEWISTON NORTH	16	70

Map ID	Well Label	Data Source	Sample Type	Latitude	Longitude	24K QUAD	Elevation (ft.)	Total Depth (ft.)
88	W-9106	FGS	Cuttings	26.63083	-80.21417	PALM BEACH FARMS	16	938
89	W-9107	FGS	Cuttings	26.65608	-80.11389	PALM BEACH	19	1004
90	W-9109	FGS	Cuttings	26.54958	-80.12947	GREENACRES CITY	20	978
91	W-9110	FGS	Cuttings	26.64222	-80.58222	SIXMILE BEND	9	1095
92	W-9111	FGS	Cuttings	26.59492	-80.11642	LAKE WORTH	18	930
93	W-9114	FGS	Cuttings	26.68368	-80.30811	LOXAHATCHEE	19	1028
94	W-9968	FGS	Cuttings	26.66361	-80.90611	CLEWISTON SOUTH	11	850
95	W-9969	FGS	Cuttings	26.66786	-80.94950	CLEWISTON SOUTH	22	910
96	W-9971	FGS	Cuttings	26.65694	-80.80944	LAKE HARBOR	8	820
97	W-9973	FGS	Cuttings	26.67778	-80.99528	CLEWISTON SOUTH	17	1040
98	W-9979	FGS	Cuttings	26.67111	-80.85778	LAKE HARBOR	8	903
99	W-10078	FGS	Cuttings	26.66806	-80.67472	BELLE GLADE	14	1050
100	W-10080	FGS	Cuttings	26.61306	-80.79333	LAKE HARBOR SE	8	1120
101	W-10135	FGS	Cuttings	26.60500	-80.98667	LAKE HARBOR SW	18	860
102	W-10145	FGS	Cuttings	26.56861	-80.98611	LAKE HARBOR SW	19	890
103	W-10213	FGS	Cuttings	26.71944	-80.87500	LAKE HARBOR	8	840
104	W-10235	FGS	Cuttings	26.71833	-80.87778	CLEWISTON SOUTH	12	200
105	W-10397	FGS	Cuttings	26.54658	-80.09689	LAKE WORTH	15	180
106	W-10432	FGS	Cuttings	26.53894	-80.10678	LAKE WORTH	16	118
107	W-10437	FGS	Cuttings	26.64086	-80.09517	PALM BEACH	14	200
108	W-10607	FGS	Cuttings	26.54656	-80.09694	LAKE WORTH	15	205
109	W-10699	FGS	Cuttings	26.96333	-80.08639	JUPITER	23	86
110	W-10700	FGS	Cuttings	26.96248	-80.08800	JUPITER	16	85
111	W-10978	FGS	Cuttings	26.53932	-80.99874	LAKE HARBOR SW	20	50
112	W-11176	FGS	Cuttings	26.57333	-80.74778	OKEELANTA	8	53
113	W-11462	FGS	Cuttings	26.96333	-80.08639	JUPITER	23	89
114	W-11799	FGS	Cuttings	26.80225	-80.07919	RIVIERA BEACH	22	100
115	W-11800	FGS	Cuttings	26.78566	-80.06599	RIVIERA BEACH	13	310
116	W-11917	FGS	Cuttings	26.63643	-80.15416	PALM BEACH FARMS	17	110
117	W-11920	FGS	Cuttings	26.66479	-80.23421	PALM BEACH FARMS	17	45
118	W-11951	FGS	Cuttings	26.64111	-80.12917	PALM BEACH FARMS	12	97
119	W-12221	FGS	Cuttings	26.97691	-80.11839	JUPITER	9	120
120	W-12222	FGS	Cuttings	26.51412	-80.06968	LAKE WORTH	25	115
121	W-12418	FGS	Cuttings	26.68312	-80.29755	LOXAHATCHEE	20	189
122	W-12419	FGS	Cuttings	26.68451	-80.33505	LOXAHATCHEE	18	190
123	W-12420	FGS	Cuttings	26.59118	-80.20449	GREENACRES CITY	19	234
124	W-12421	FGS	Cuttings	26.68701	-80.39894	LOXAHATCHEE NW	6	175
125	W-12424	FGS	Cuttings	26.59007	-80.14754	GREENACRES CITY	19	119
126	W-12425	FGS	Cuttings	26.58785	-80.08088	LAKE WORTH	13	345
127	W-12426	FGS	Cuttings	26.60979	-80.08643	LAKE WORTH	6	358
128	W-12428	FGS	Cuttings	26.81089	-80.15532	DELTA	15	267
129	W-12429	FGS	Cuttings	26.62979	-80.04865	PALM BEACH	5	249
130	W-12432	FGS	Cuttings	26.59118	-80.05143	LAKE WORTH	7	275
131	W-12434	FGS	Cuttings	26.60784	-80.05087	LAKE WORTH	7	249
132	W-12438	FGS	Cuttings	26.78590	-80.06393	RIVIERA BEACH	12	314
133	W-12439	FGS	Cuttings	26.81201	-80.28922	WEST OF DELTA	19	174
134	W-12441	FGS	Cuttings	26.93367	-80.11948	JUPITER	8	210

Map ID	Well Label	Data Source	Sample Type	Latitude	Longitude	24K QUAD	Elevation (ft.)	Total Depth (ft.)
135	W-12443	FGS	Cuttings	26.77979	-80.05365	RIVIERA BEACH	8	272
136	W-12448	FGS	Cuttings	26.78590	-80.11588	RIVIERA BEACH	16	282
137	W-12589	FGS	Cuttings	26.93750	-80.13361	ROOD	10	153
138	W-12590	FGS	Cuttings	26.88312	-80.09421	JUPITER	10	520
139	W-12592	FGS	Cuttings	26.78423	-80.52589	BRYANT	16	200
140	W-12598	FGS	Cuttings	26.58229	-80.05199	LAKE WORTH	7	200
141	W-12599	FGS	Cuttings	26.68451	-80.04948	PALM BEACH	3	120
142	W-12605	FGS	Cuttings	26.68667	-80.66750	BELLE GLADE	16	220
143	W-12638	FGS	Cuttings	26.75729	-80.06365	RIVIERA BEACH	29	220
144	W-12656	FGS	Cuttings	26.68006	-80.07782	PALM BEACH	15	397
145	W-12671	FGS	Cuttings	26.67812	-80.07421	PALM BEACH	13	322
146	W-12673	FGS	Cuttings	26.67896	-80.15726	PALM BEACH FARMS	24	357
147	W-12675	FGS	Cuttings	26.69534	-80.18533	PALM BEACH FARMS	16	260
148	W-12686	FGS	Cuttings	26.51776	-80.07190	LAKE WORTH	22	130
149	W-12688	FGS	Cuttings	26.98709	-80.13953	ROOD	8	65
150	W-12729	FGS	Cuttings	26.96874	-80.09711	JUPITER	9	70
151	W-12730	FGS	Cuttings	26.97403	-80.09530	JUPITER	10	60
152	W-12732	FGS	Cuttings	26.97136	-80.09400	JUPITER	14	62
153	W-12733	FGS	Cuttings	26.97076	-80.09100	JUPITER	18	60
154	W-12860	FGS	Cuttings	26.69090	-80.09393	PALM BEACH	13	180
155	W-12865	FGS	Cuttings	26.67769	-80.09280	PALM BEACH	14	200
156	W-12976	FGS	Cuttings	26.54310	-80.14156	GREENACRES CITY	18	150
157	W-13000	FGS	Cuttings	26.73861	-80.12584	PALM BEACH FARMS	17	3575
158	W-13092	FGS	Cuttings	26.99060	-80.09787	JUPITER	11	80
159	W-13093	FGS	Cuttings	26.99625	-80.09678	JUPITER	26	80
160	W-13505	FGS	Cuttings	26.98861	-80.62889	PORT MAYACA OE W	0	31
161	W-13588	FGS	Cuttings	26.64742	-80.09737	PALM BEACH	13	200
162	W-13741	FGS	Cuttings	26.78542	-80.09325	RIVIERA BEACH	12	222
163	W-13754	FGS	Cuttings	26.57975	-80.75177	LAKE HARBOR SE	10	60
164	W-13834	FGS	Cuttings	26.70552	-80.64637	BELLE GLADE	13	3200
165	W-13839	FGS	Cuttings	26.70552	-80.64355	BELLE GLADE	11	1408
166	W-13932	FGS	Cuttings	26.84815	-80.12884	DELTA	16	130
167	W-13936	FGS	Cuttings	26.85005	-80.12626	DELTA	17	130
168	W-14150	FGS	Cuttings	26.97950	-80.15005	ROOD	8	58
169	W-14186	FGS	Cuttings	26.92679	-80.13209	ROOD	12	201
170	W-14216	FGS	Cuttings	26.50846	-80.11821	LAKE WORTH	18	102
171	W-14228	FGS	Cuttings	26.72639	-80.05194	PALM BEACH	12	187
172	W-14296	FGS	Cuttings	26.74389	-80.46941	LOXAHATCHEE NW	8	10880
173	W-14384	FGS	Cuttings	26.56535	-80.07518	LAKE WORTH	22	210
174	W-14460	FGS	Cuttings	26.73838	-80.13168	PALM BEACH FARMS	18	3800
175	W-14473	FGS	Cuttings	26.72028	-80.04139	PALM BEACH	13	100
176	W-14563	FGS	Cuttings	26.72472	-80.05389	PALM BEACH	12	65
177	W-14621	FGS	Cuttings	26.69278	-80.10234	PALM BEACH	13	180
178	W-14627	FGS	Cuttings	26.57333	-80.74778	OKEELANTA	8	60
179	W-14756	FGS	Cuttings	26.60707	-80.21990	GREENACRES CITY	18	90
180	W-14852	FGS	Cuttings	26.68667	-80.19389	PALM BEACH FARMS	17	108
181	W-14930	FGS	Cuttings	26.76880	-80.10435	RIVIERA BEACH	15	200

Map ID	Well Label	Data Source	Sample Type	Latitude	Longitude	24K QUAD	Elevation (ft.)	Total Depth (ft.)
182	W-14957	FGS	Cuttings	26.53720	-80.20611	GREENACRES CITY	17	85
183	W-15032	FGS	Cuttings	26.76988	-80.07806	RIVIERA BEACH	15	200
184	W-15076	FGS	Cuttings	26.66216	-80.11572	PALM BEACH	18	168
185	W-15098	FGS	Cuttings	26.91197	-80.12209	JUPITER	12	175
186	W-15164	FGS	Cuttings	26.70628	-80.21583	PALM BEACH FARMS	17	64
187	W-15229	FGS	Cuttings	26.71278	-80.06167	PALM BEACH	20	200
188	W-15306	FGS	Cuttings	26.63402	-80.15527	PALM BEACH FARMS	18	120
189	W-15370	FGS	Cuttings	26.51131	-80.07814	LAKE WORTH	15	250
190	W-15377	FGS	Cuttings	26.76282	-80.07362	RIVIERA BEACH	16	187
191	W-15424	FGS	Cuttings	26.59750	-80.09250	LAKE WORTH	13	128
192	W-15459	FGS	Cuttings	26.57944	-80.05444	LAKE WORTH	15	102
193	W-15496	FGS	Cuttings	26.51919	-80.96631	LAKE HARBOR SW	18	110
194	W-15538	FGS	Cuttings	26.57944	-80.05444	LAKE WORTH	15	90
195	W-15738	FGS	Cuttings	26.77583	-80.12028	RIVIERA BEACH	15	45
196	W-15748	FGS	Cuttings	26.90179	-80.30610	WEST OF ROOD	26	3310
197	W-15842	FGS	Cuttings	26.76003	-80.11139	RIVIERA BEACH	16	160
198	W-16041	FGS	Cuttings	26.70262	-80.25297	LOXAHATCHEE	19	190
199	W-16044	FGS	Cuttings	26.54894	-80.22584	GREENACRES CITY	14	190
200	W-16047	FGS	Cuttings	26.85978	-80.29061	WEST OF DELTA	20	180
201	W-16060	FGS	Cuttings	26.91228	-80.25533	WEST OF ROOD	20	170
202	W-16061	FGS	Cuttings	26.76562	-80.25449	WEST OF DELTA	19	220
203	W-16065	FGS	Cuttings	26.80306	-80.09806	RIVIERA BEACH	10	360
204	W-16072	FGS	Cuttings	26.67495	-80.10227	PALM BEACH	13	340
205	W-16076	FGS	Cuttings	26.58618	-80.17255	GREENACRES CITY	22	260
206	W-16079	FGS	Cuttings	26.81194	-80.21389	DELTA	22	190
207	W-16185	FGS	Cuttings	26.83778	-80.08861	RIVIERA BEACH	13	50
208	W-16187	FGS	Cuttings	26.70278	-80.06028	PALM BEACH	15	100
209	W-16188	FGS	Cuttings	26.80978	-80.32588	WEST OF DELTA	20	200
210	W-16191	FGS	Cuttings	26.76979	-80.14004	DELTA	17	100
211	W-16192	FGS	Cuttings	26.76895	-80.14004	DELTA	19	100
212	W-16193	FGS	Cuttings	26.81528	-80.34389	WEST OF DELTA	19	250
213	W-16234	FGS	Cuttings	26.85654	-80.14477	DELTA	20	3320
214	W-16391	FGS	Cuttings	26.93040	-80.13527	ROOD	11	1350
215	W-16585	FGS	Cuttings	26.77972	-80.97778	CLEWISTON NORTH	9	32
216	W-16626	FGS	Cuttings	26.75944	-80.91833	CLEWISTON NORTH	15	38
217	W-16628	FGS	Cuttings	26.62278	-80.95056	LAKE HARBOR SW	22	33
218	W-16629	FGS	Cuttings	26.52083	-80.94833	LAKE HARBOR SW	12	38
219	W-17036	FGS	Cuttings	26.90784	-80.40394	BIG MOUND NORTH	24	162
220	W-17037	FGS	Cuttings	26.94283	-80.34144	WEST OF ROOD	23	155
221	W-17039	FGS	Cuttings	26.68368	-80.36921	LOXAHATCHEE	16	100
222	W-17432	FGS	Cuttings	26.50667	-80.08139	LAKE WORTH	13	250
223	W-17449	FGS	Continuous Core	26.99394	-80.57311	PORT MAYACA	23	73
224	W-17451	FGS	Continuous Core	26.81714	-80.08094	RIVIERA BEACH	7	84
225	W-17524	FGS	Continuous Core	26.64306	-80.57972	SIXMILE BEND	17	52
226	W-17528	FGS	Continuous Core	26.57917	-80.71694	OKEELANTA	9	62

Map ID	Well Label	Data Source	Sample Type	Latitude	Longitude	24K QUAD	Elevation (ft.)	Total Depth (ft.)
227	W-17580	FGS	Cuttings	26.68395	-80.27477	LOXAHATCHEE	19	190
228	W-17606	FGS	Cuttings	26.80944	-80.32611	WEST OF DELTA	20	200
229	W-17607	FGS	Cuttings	26.85978	-80.29061	WEST OF DELTA	20	180
230	W-17613	FGS	Cuttings	26.68285	-80.25255	LOXAHATCHEE	18	190
231	W-17641	FGS	Cuttings	26.88034	-80.17699	ROOD	18	220
232	W-17644	FGS	Cuttings	26.76562	-80.25449	WEST OF DELTA	19	222
233	W-17656	FGS	Cuttings	26.91222	-80.25528	WEST OF ROOD	20	170
234	W-17657	FGS	Cuttings	26.61722	-80.08861	LAKE WORTH	12	270
235	W-17868	FGS	Continuous Core	26.50631	-80.94825	LAKE HARBOR SW	19	201
236	W-17885	FGS	Cuttings	26.86000	-80.07083	RIVIERA BEACH	6	245
237	W-17891	FGS	Cuttings	26.80583	-80.07611	RIVIERA BEACH	13	40
238	W-18728	FGS	Cuttings	26.73780	-80.36352	LOXAHATCHEE	22	2300
239	W-18999	FGS	Cuttings	26.73828	-80.12847	PALM BEACH FARMS	18	2330
240	W-19260	FGS	Cuttings	26.61047	-80.06755	LAKE WORTH	24	3300
241	W-19262	FGS	Cuttings	26.61028	-80.06744	LAKE WORTH	24	2200
242	W-19870	FGS	Cuttings	26.87231	-80.24531	DELTA	16	150
243	W-19938	FGS	Continuous Core	26.92581	-80.48400	BIG MOUND NORTH	26	20
244	W-19939	FGS	Continuous Core	26.89012	-80.48391	BIG MOUND NORTH	26	21
245	W-19940	FGS	Continuous Core	26.87448	-80.41220	BIG MOUND SOUTH	23	52
246	W-19941	FGS	Continuous Core	26.86263	-80.32658	WEST OF DELTA	23	45
247	W-19944	FGS	Continuous Core	26.82006	-80.40117	BIG MOUND SOUTH	21	22
248	W-19945	FGS	Continuous Core	26.96338	-80.29204	WEST OF ROOD	25	32