

TO: FDOT
FROM: HDR, Inc.
DATE: July 28, 2008
PROJECT: St Johns River Crossing
FPID No: 208225-3-21-01
Clay, Duval, and St. Johns Counties; Florida

Geology and soils are considered as part of the evaluation of the St Johns River Crossing Project. They are considered because they influence the type of foundation required for construction of bridges and walls. The composition and location relative to the water table, and density of soils that will be excavated, determine the suitability of these soils for reuse as fill on the project.

Geology and Hydrogeology

The following describes the geology and hydrogeology of the study area. Surficial deposits, underlying aquifer systems, and structural features, systems in eastern Clay County (the area from Middleburg east to the St. Johns River) and western St. Johns County (between I-95 and the St. Johns River) were evaluated. It should be noted that no significant structural geologic features are located within the study area. The following describes the surficial deposits and aquifer systems which will be encountered within the study area.

Two aquifer systems are present within the study area: the Floridan Aquifer and the surficial aquifer (*Figure 1*). Both of these serve as potable water resources, though the majority of the area's drinking water is provided by the Floridan Aquifer.

The surficial aquifer consists of Pleistocene and Holocene sand, silt, clay and limestone at the base. Groundwater from the surficial aquifer is used for irrigation and individual domestic supplies. According to Fairchild (1972), the surficial aquifer ranges from 50 feet (ft) to 200 ft thick. Generally, the basal 5 ft to 40 ft of the surficial aquifer is comprised of an Upper Miocene and Pliocene bioclastic, soft, friable, cavernous sandy limestone. The limestone unit (rock aquifer) is the principal water-producing zone. The unit is discontinuous in parts of the study area, and ranges from 3 ft to 40 ft thick, and grades into a sand and shell unit. According to Spechler (1994), the limestone, where present, occurs at an approximate depth of 65 ft below land surface (bls).

Figure 1: Typical Geologic Cross-section

Series	Stratigraphic unit	General lithology	Hydrogeologic unit		Hydrogeologic properties
Holocene to Upper Miocene	Undifferentiated surficial deposits	Discontinuous sand, clay, shell beds, and limestone	Surficial aquifer system		Sand, shell, limestone, and coquina deposits provide local water supplies
Miocene	Hawthorne Group	Interbedded, phosphatic sand, clay, limestone, and dolomite	Intermediate confining unit		Sand, shell, and carbonate deposits provide limited local water supplies. Low permeability clays serve as the principle continuing beds for the Floridan aquifer system below
Eocene	Ocala Limestone	Massive fossiliferous chalky to granular marine limestone	Floridan aquifer system	Upper Floridan aquifer	Principle source of ground water. High permeability overall. Water from some wells shows increasing salinity.
	Avon Park Formation	Alternating beds of massive granular and chalky limestone, and dense dolomite		Middle confining unit	Low permeability limestone and dolomite
				Upper Zone	Principle source of ground water. Water from some wells shows increasing salinity.
	Oldsmar Formation	Semiconfining Unit		Low permeability limestone and dolomite	
Paleocene	Cedar Keys Formation	Uppermost appearance of evaporates; dense limestones	Sub-Floridan confining unit	Fernandina permeable zone	High permeability; salinity increase with depth

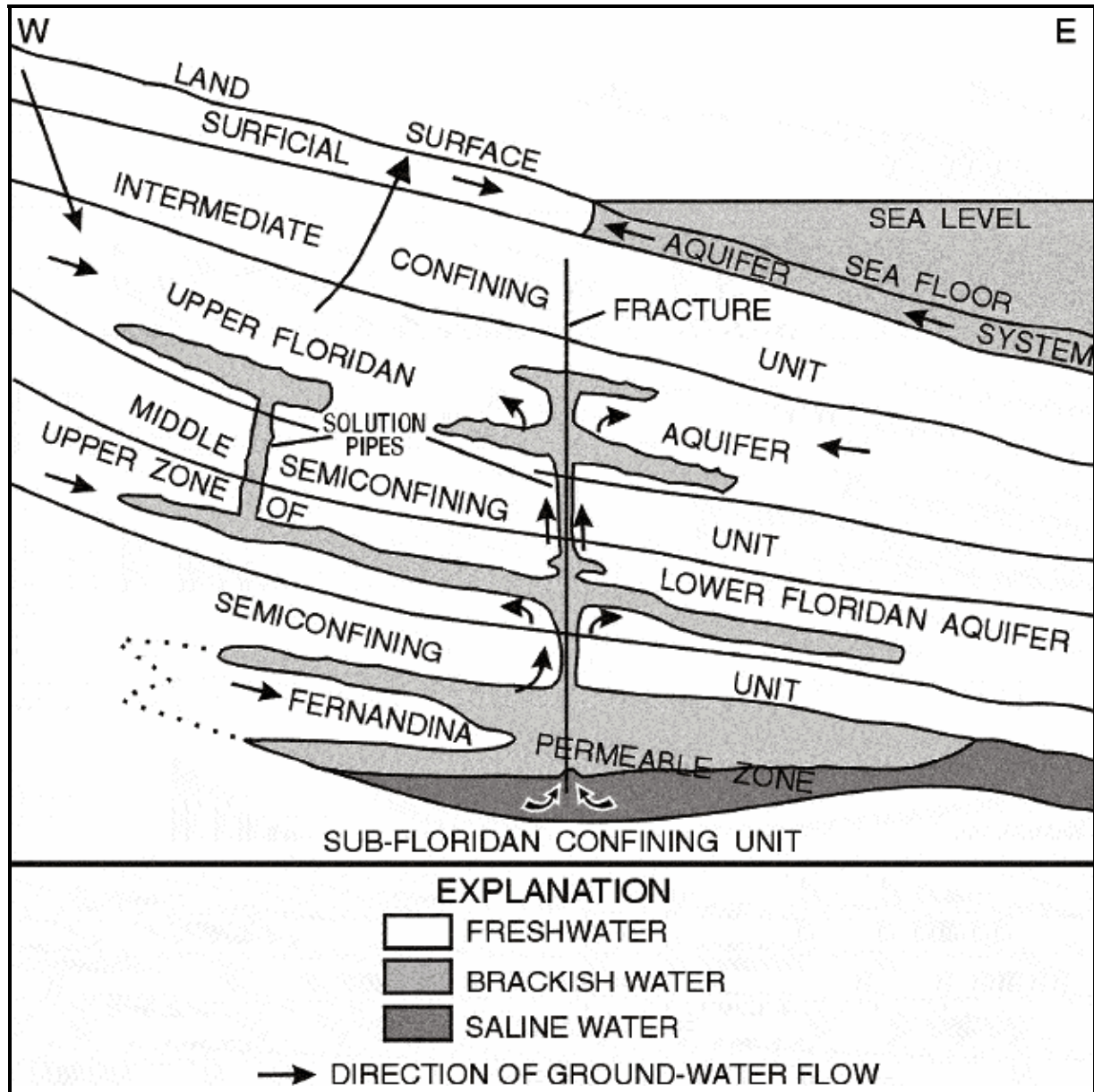
Source: Spechler 1994

Groundwater within the surficial aquifer generally flows from topographic highs to topographic lows (**Figure 2**). Recharge to the aquifer is through the infiltration of precipitation. Discharge is primarily from evapotranspiration, pumping from wells and through lateral migration to the St. Johns River and its tributaries. Within the study area (and throughout the region), the surficial aquifer is used primarily for irrigation purposes; however on some occasions, water wells serving private residences utilize it for drinking water. All ten of the proposed alternatives will limit recharge to the surficial aquifer in areas where the highway is constructed. The impacts will be minor and limited to the areas which are paved and designed to handle runoff during construction process.

The Miocene Hawthorn Group (Scott 1988) underlies the sediments of the surficial aquifer. The sediments of the Hawthorn Group are gray to blue-green and lime-green clay, sandy clay, and sandy, phosphatic limestone (Fairchild, 1972). The average thickness of the Hawthorn Group is over 300 ft in northeast Florida and it ranges from 250 ft to 500 ft thick in the study

area. This group, characterized by relatively low permeability, constitutes the confining unit between the surficial aquifer and the Floridan aquifer. The discrete water-bearing zones within the Hawthorn Group are referred to as the secondary artesian aquifer. These water bearing zones consist of limestone, typically patch reef deposits, and zones of more transmissive sands.

Figure 2: Typical Groundwater Flow



Source: Spechler, 1994

The Floridan aquifer, the principal source of groundwater in northeast Florida, is present beneath the Hawthorn Group. The Floridan aquifer is present at a depth of approximately 360 ft bls and averages approximately 1,500 ft thick in the study area. The base of the aquifer is defined by the first continuous evaporite sequence in the underlying Cedar Keys limestone.

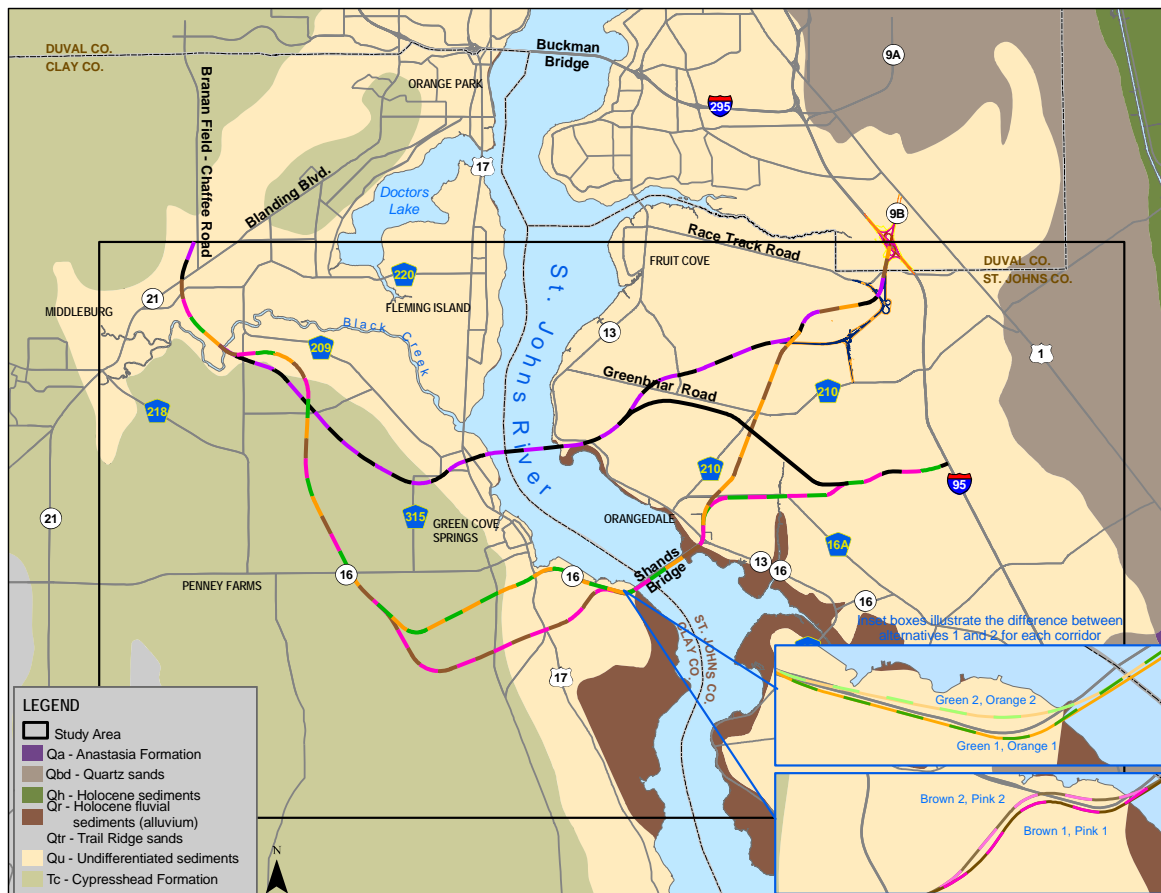
The Floridan aquifer consists of the Eocene Ocala Group, Avon Park (formerly the Lake City Limestone) and the Oldsmar Formation. The upper Avon Park contains beds of a low permeability dolomite, which restricts vertical migration between the upper and lower zones of the aquifer.

The Floridan aquifer is the primary source of publicly and privately provided water within the study area. Over 90 percent of the water consumed is provided through municipally owned water plants pumping from the aquifer (Phelps and Spechler 1997). The recharge zone is located up-dip (to the west) in central Florida where the Ocala, Avon Park and Oldsmar formations outcrop. The ten proposed alternatives through the study area would not impact the recharge zone of the Floridan aquifer.

Study Area Specific Surficial Deposits

This section outlines the surficial geologic deposits which will be affected by the construction of any of the ten proposed routes. The geologic deposits described herein occur in Clay and St. Johns Counties and are comprised of unconsolidated sediments. *Figure 3* shows the proposed alternatives overlying the surficial geologic deposits observed within the study area.

Figure 3: Surficial Geology of the Study Area



Clay County

Cypresshead Formation

All ten proposed alternatives (Black, Purple, Pink 1, Pink 2, Orange 1, Orange 2, Brown 1, Brown 2, Green 1 and Green 2) are routed through the same geologic formation in Clay County, the late Pliocene Cypresshead Formation (Scott 1988). This formation is comprised of fine to very coarse grained, moderately to well sorted quartz sands with common occurrences of quartz pebbles. Clay is occasionally encountered and is typically kaolinitic. The Cypresshead Formation is the oldest surficial stratigraphic unit mapped in Clay County and unconformably overlies the Hawthorn Group. In this portion of the study area, the Cypresshead formation comprises the surficial aquifer.

Undifferentiated Quaternary Sediments

The Orange 1, Orange 2, Pink 1, Pink 2, Green 1, Green 2, Brown 1 and Brown 2 Alternatives cross the St. Johns River approximately 5 miles south of the Purple and Black Alternatives, near the existing Shands Bridge. These eight alternatives would be constructed through undifferentiated Quaternary sediments (Scott 1988). These sediments consist of sands, clayey sands and clays occasionally containing mollusks. Generally these sediments are not more than 20 ft thick. The undifferentiated sediments consist of reworked Cypress Formation sediments and unconformably overlie the Hawthorn Group. The surficial aquifer in the portion of the study area consists of these undifferentiated Quaternary sediments.

St. Johns County

Undifferentiated Quaternary Sediments

Located to the east of the St. Johns River are similar undifferentiated Quaternary Sediments to those found near the Shands Bridge in Clay County. All ten proposed alternatives encounter these sediments in the study area between the river sediments and the termination points of each alternative (Scott 1993). These sediments consist of sands, clayey sands and clays occasionally containing mollusks (Scott 1993). Generally, these sediments are not more than 20 ft thick. Like the undifferentiated sediments encountered in Clay County, these sediments consist of reworked Cypress Formation sediments and unconformably overlie the Hawthorn Group.

Clay and St. Johns County

St. Johns River Sediments

All ten alternatives cross the St. Johns River from Clay to St. Johns County. The St. Johns River is a northerly flowing river with headwaters located west of Melbourne, Florida, that discharges to the Atlantic Ocean in Mayport (Duval County), Florida. The lowlands along the St. Johns River (and its tributaries) are characterized as Holocene fluvial sediments. These fluvial sediments are comprised of fine sands, silts, clays and marls. Peat and other organic-

rich sediments are also often encountered within these sediments (Scott 1988). These sediments occur on both the west (Clay County) and East (St. Johns County) sides of the river.

References

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