Prepared in cooperation with the
CITY OF JACKSONVILLE, ONSLOW WATER AND SEWER AUTHORITY, AND U.S. MARINE CORPS, CAMP LEJEUNE

Scientific Investigations Map 3055
Hydrogeologic Framework of Onslow County, North Carolina, 2008—Sheet 1 of 1
Fine, J.M., 2008, Hydrogeologic Framework of Onslow County, North Carolina, 2008

Abstract

The unconsolidated sediments that underlie the Onslow County area are composed of interlayered permeable and impermeable beds, which overlie the crystalline basement rocks. The aquifers, composed mostly of sand and limestone, are separated by confining units composed mostly of clay and silt. The aquifers from top to bottom are the surficial, Castle Hayne, Beaufort, Peedee, Black Creek, and Upper and Lower Cape Fear aquifers. For this study, the Castle Hayne aquifer is informally divided into the upper and lower Castle Hayne aquifers.

The eight aquifers and seven confining units of the Tertiary and Cretaceous strata beneath Onslow County are presented in seven hydrogeologic sections. The hydrogeologic framework was refined from existing interpretations by using geophysical logs, driller's logs, and other available data from 123 wells and boreholes.

Introduction

For the past three decades, ground-water levels in the central Coastal Plain of North Carolina have declined as much as 200 feet from overpumping and depleting storage in the Cretaceous Black Creek and Upper Cape Fear aquifers (North Carolina Division of Water Resources, 2001). Because of these declines, the resulting increased potential for lateral salt-water migration along the coast and upward leakage of brackish water from deeper aquifers prompted the North Carolina Division of Water Resources (DWR) to institute the Central Coastal Plain Capacity Use Area (CCPCUA) rules for 15 counties, effective August 1, 2002 (North Carolina Division of Water Resources, 2001). Under the CCPCUA rules, a ground-water withdrawal of more than 100,000 gallons per day from the Cretaceous aquifers is subject to a water-use reduction of as much as 75 percent over a 16-year period.

The Black Creek aquifer is a major source of water for Onslow County. In order to meet the required reduction in withdrawals from the Cretaceous aquifers and continue to meet demand, water suppliers in Onslow and the surrounding counties have shifted withdrawals from the Black Creek aquifer to the Castle Hayne aquifer.

The effects of increased development of the Castle Hayne aquifer and decreased use of the Black Creek aquifer in Onslow County are unknown. In 2007, the U.S. Geological Survey (USGS), in cooperation with the City of Jacksonville, Onslow Water and Sewer Authority, and the Marine Corps Base, Camp Lejeune, began an investigation to delineate and describe the ground-water flow system in the Onslow County area. As part of the initial phase of this study, a hydrogeologic framework has been delineated for all aquifers and confining units that underlie Onslow and parts of Duplin, Jones, and Pender Counties and is presented in this report. This hydrogeologic framework will form the basis of a digital ground-water flow model, which can be used to simulate and manage the ground-water flow system of Onslow County.

Study Area

Onslow County is located in the south-eastern part of the Coastal Plain physiographic province of North Carolina (fig. 1). The Coastal Plain's hydrogeology consists of an eastward dipping wedge of interbedded sand, clay, and limestone layers in the Quaternary to Cretaceous strata (table 1). The aquifers underlying Onslow County, in descending order, are the surficial, upper and lower Castle Hayne, Beaufort, Peedee, Black Creek, and Upper and Lower Cape Fear aquifers.

Table 1. Correlation chart of North Carolina Coastal Plain geologic and hydrogeologic units (modified from Lyke and Winner, 1990).

System[1]	Geologic units	Hydrogeologic units
Quaternary	Quaternary deposits	Surficial aquifer
Tertiary	Yorktown Formation[2]	Yorktown confining unit[2] Yorktown aquifer[2]
	Eastover Formation[2]	Pungo River confining unit[2] Pungo River aquifer[2]
	Pungo River Formation[2]	
	Belgrade Formation	Upper Castle Hayne confining unit Upper Castle Hayne aquifer Lower Castle Hayne confining unit Lower Castle Hayne aquifer
	River Bend Formation	
	Castle Hayne Limestone	
	Beaufort Formation	Beaufort confining unit Beaufort aquifer
Cretaceous	Peedee Formation	Peedee confining unit Peedee aquifer
	Black Creek Formation	Black Creek confining unit Black Creek aquifer
	Middendorf Formation[2]	
	Cape Fear Formation	Upper Cape Fear confining unit Upper Cape Fear aquifer Lower Cape Fear confining unit Lower Cape Fear aquifer
	Unnamed units[2]	Lower Cretaceous confining unit[2] Lower Cretaceous aquifer[2]

[1]System identification of a given hydrogeologic unit is only approximate and reflects the age or ages of the principal geologic unit or units composing each hydrogeologic unit.
[2]Unit not present in the study area.

Methods

The hydrogeologic sections presented in this report were interpreted from geophysical logs, driller's logs, water-level data, and water-quality data collected in 123 wells and boreholes. These interpretations came from this study, the DWR's hydrogeologic framework database (J.C. Lautier, unpub. data, North Carolina Division of Water Resources, 2006), and previous USGS studies that were conducted in the area by Lyke and Winner (1990) and Winner and Coble (1996).

Hydrogeologic interpretations were tabulated and displayed as point data using geographical information system (GIS) software. The GIS software then interpolated the point data into triangulated irregular networks (TIN), which fill in the gaps between the point data and create planes representing the tops and bottoms of each aquifer and confining unit. The hydrogeologic cross sections were constructed from the created TINs (figs. 2–8)

Surficial Aquifer

The surficial aquifer is an important part of the ground-water flow system. This unconfined aquifer, composed mostly of sand, silt, and clay of Quaternary strata (table 1), is the primary source of recharge for the deeper aquifers and is the source of base flow for the area's streams and rivers. With the exception of irrigation and private supply wells, the surficial aquifer generally is unused in the study area.

Upper and Lower Castle Hayne Aquifers

Tertiary marine sediments of the Belgrade, River Bend, and Castle Hayne Formations compose the Castle Hayne aquifer (Lyke and Winner, 1990). It is a highly productive aquifer composed of limestone and sand, with minor amounts of clay. The Castle Hayne aquifer is overlain by the Castle Hayne confining unit throughout most of the Onslow County area with the exception of the north and northeastern parts of the county, where it is unconfined and in direct contact with the surficial aquifer. For this study, the Castle Hayne aquifer has been informally subdivided into two aquifers, the upper and lower Castle Hayne, to better represent head differences that exist in the aquifer. The Castle Hayne aquifer is used predominantly for water supply in Onslow County and will be a main source for future development.

Beaufort Aquifer

The Beaufort aquifer is composed of Tertiary marine sediments and rocks of the Beaufort Formation, described by Lyke and Winner (1990) as fine to medium glauconitic sand, clayey sand, shell and limestone, and interbedded clay. Most of the study area is underlain by the Beaufort aquifer, with the exception of the western edge of Onslow County where the aquifer pinches out. The Beaufort confining unit separates the Castle Hayne aquifer from the Beaufort aquifer. The Beaufort aquifer is a relatively unused aquifer in Onslow County.

Peedee Aquifer

The Peedee aquifer consists of sediments of the Peedee Formation, which is the youngest Cretaceous formation in the study area. The Peedee Formation is composed primarily of sand with interbedded clay and silt layers, but limestone and partially consolidated calcareous sandstone are layered within the sands of the aquifer in some areas (Lyke and Winner, 1990). The Peedee confining unit separates the Beaufort aquifer or the Castle Hayne aquifer (where the Beaufort aquifer is not present) from the Peedee aquifer. Because of high levels of iron and the presence of saltwater, the Peedee aquifer is only used for water supply in the northern part of Onslow County.

Black Creek Aquifer

The Black Creek aquifer is composed of the Cretaceous Black Creek and Middendorf Formations (Winner and Coble, 1996). However, the Middendorf Formation is not present in the study area. The Black Creek Formation is composed of interbedded sand and clay layers, which contain shells, glauconite, and large amounts of organic matter (Lyke and Winner, 1990). The Black Creek confining unit separates the Peedee aquifer from the Black Creek aquifer. The Black Creek aquifer is a source of high quality drinking water in the study area, but the presence of saltwater prevents the aquifer from being used for water supply in the southern half of Onslow County.

Upper and Lower Cape Fear Aquifers

The deepest Cretaceous aquifers in the study area are the Upper and Lower Cape Fear aquifers. These aquifers are composed of sand with minor amounts of clay, gravel, and limestone of the Cape Fear Formation. The Upper Cape Fear confining unit separates the Upper Cape Fear aquifer from the Black Creek aquifer, and the Lower Cape Fear confining unit separates the Upper Cape Fear aquifer from the Lower Cape Fear aquifer. The Lower Cape Fear aquifer is underlain by crystalline bedrock. The Upper and Lower Cape Fear aquifers are not used in the study area because of their depth and the presence of saltwater.

Summary

The hydrogeologic framework of the Onslow County area is described as a series of eight generally eastward dipping and thickening wedge-shaped aquifers that are separated by seven confining units. The aquifers and confining units are composed mostly of sand, silt, clay, and limestone of Tertiary and Cretaceous strata. The aquifers from top to bottom are the surficial aquifer, upper and lower Castle Hayne aquifers, Beaufort aquifer, Peedee aquifer, Black Creek aquifer, Upper Cape Fear aquifer, and Lower Cape Fear aquifer. The Castle Hayne, Peedee, and Black Creek aquifers are the primary sources for water supply in the Onslow County area.

To better understand the hydrogeology of the study area, seven hydrogeologic sections were constructed from interpretations of data from 123 wells and boreholes. These interpretations were derived from geophysical logs, driller's logs, water-level data, and water-quality data. This hydrogeologic framework can be used in the construction of a digital ground-water flow model to better understand the ground-water flow system of the Onslow County area.

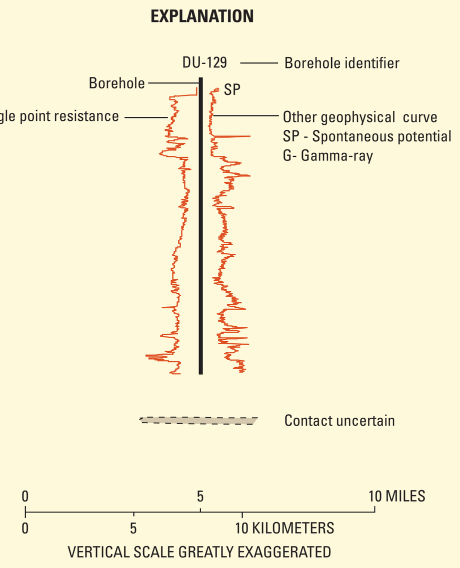
References

Lyke, W.L., and Winner, M.D., Jr., 1990, Hydrogeology of aquifers in Cretaceous and younger rocks in the vicinity of Onslow and southern Jones Counties, North Carolina: U.S. Geological Survey Water-Resources Investigations Report 89–4128, 49 p.

North Carolina Division of Water Resources, 2001, Central Coastal Plain Capacity Use Area Rules, accessed September 9, 2008, at http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Central_Coastal_Plain/CCPrulefinal5-10-2001.pdf.

Winner, M.D., Jr., and Coble, R.W., 1996, Hydrogeologic framework of the North Carolina Coastal Plain, Regional Aquifer-System Analysis—Northern Atlantic Coastal Plain: U.S. Geological Survey Professional Paper 1404–I, 106 p. + 14 pls.

Figure 1. Locations of hydrogeologic cross sections in Duplin, Jones, and Pender Counties, North Carolina.



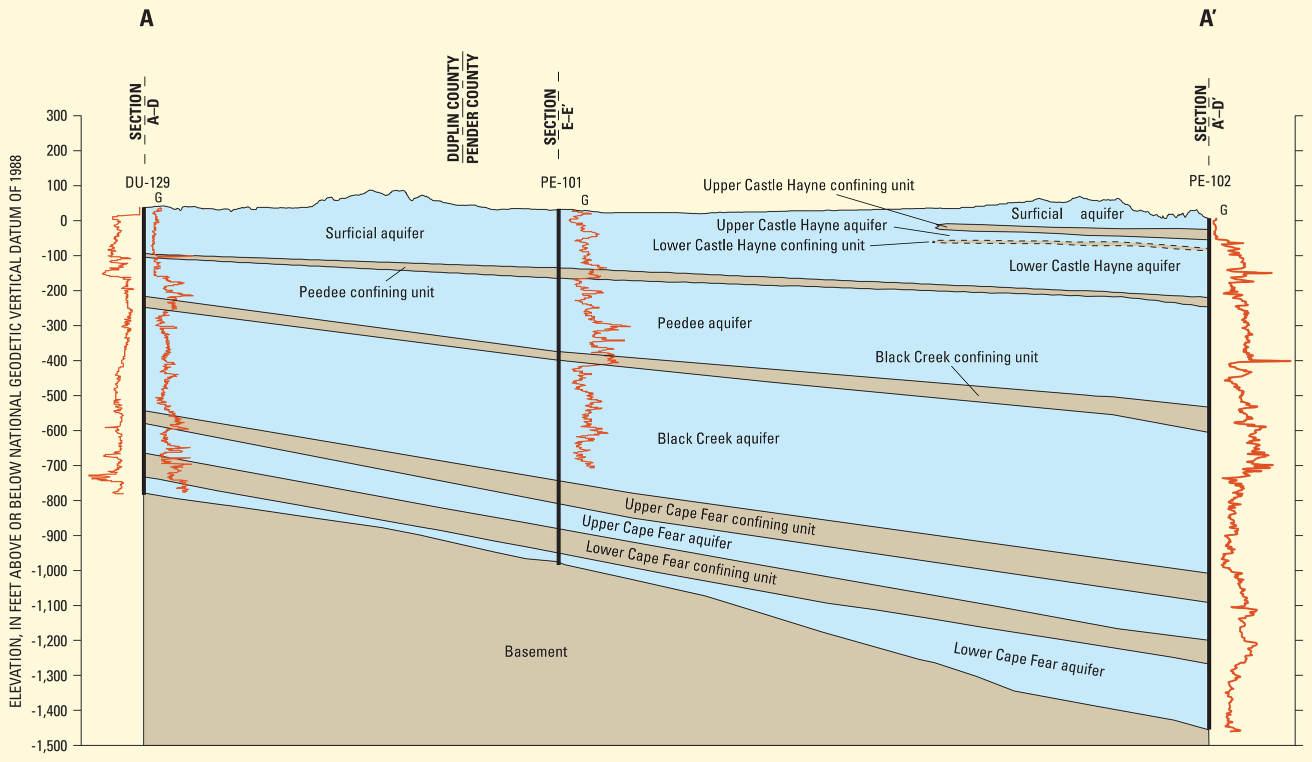


Figure 2. Hydrogeologic cross section A–A′ in Duplin and Pender Counties, North Carolina.

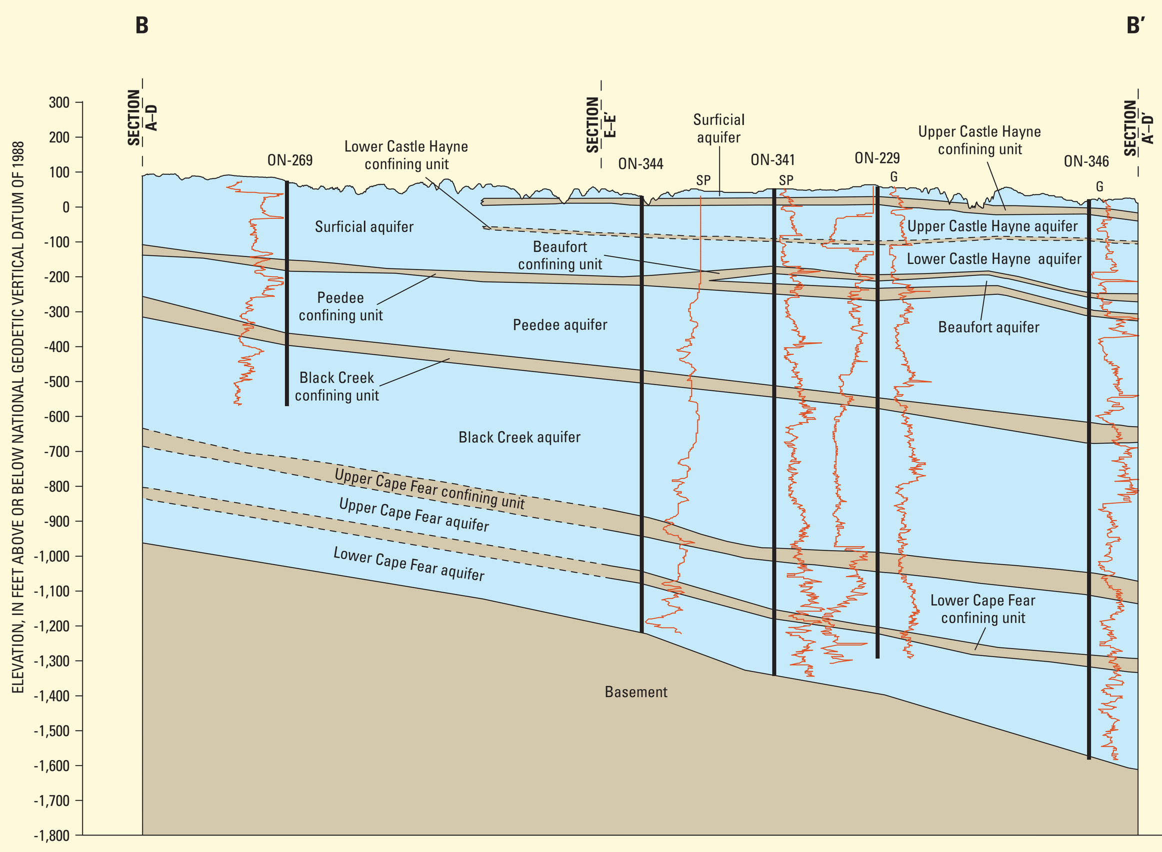


Figure 3. Hydrogeologic cross section B–B′ in Onslow County, North Carolina.

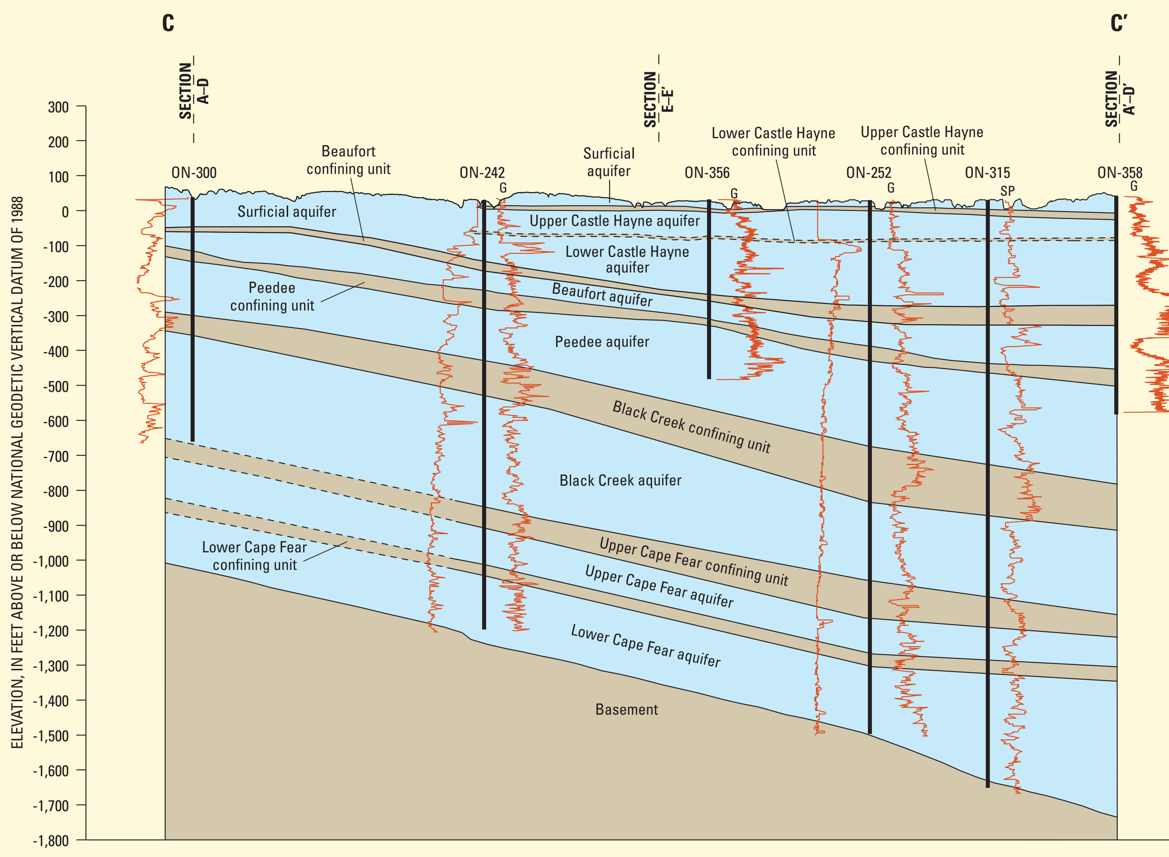


Figure 4. Hydrogeologic cross section C–C′ in Onslow County, North Carolina.

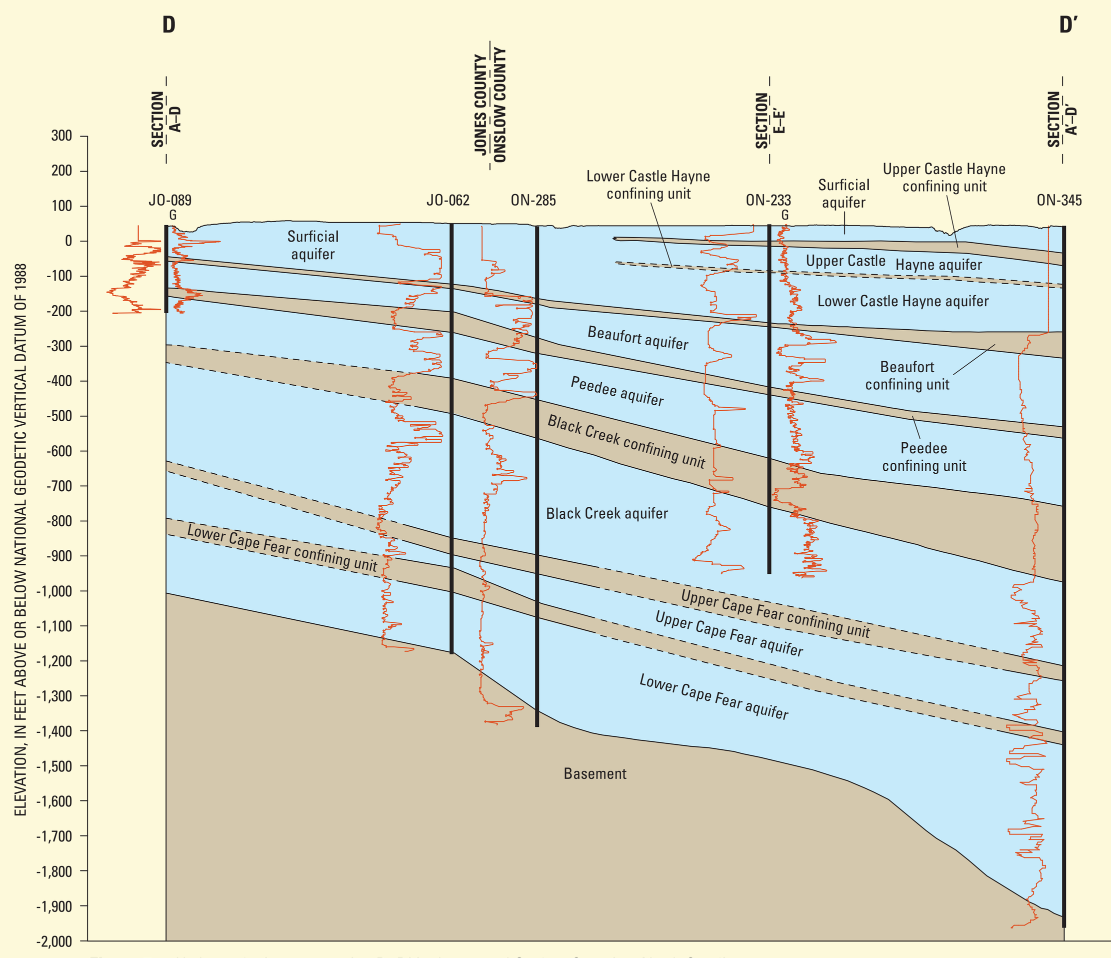


Figure 5. Hydrogeologic cross section D–D′ in Jones, and Onslow Counties, North Carolina.

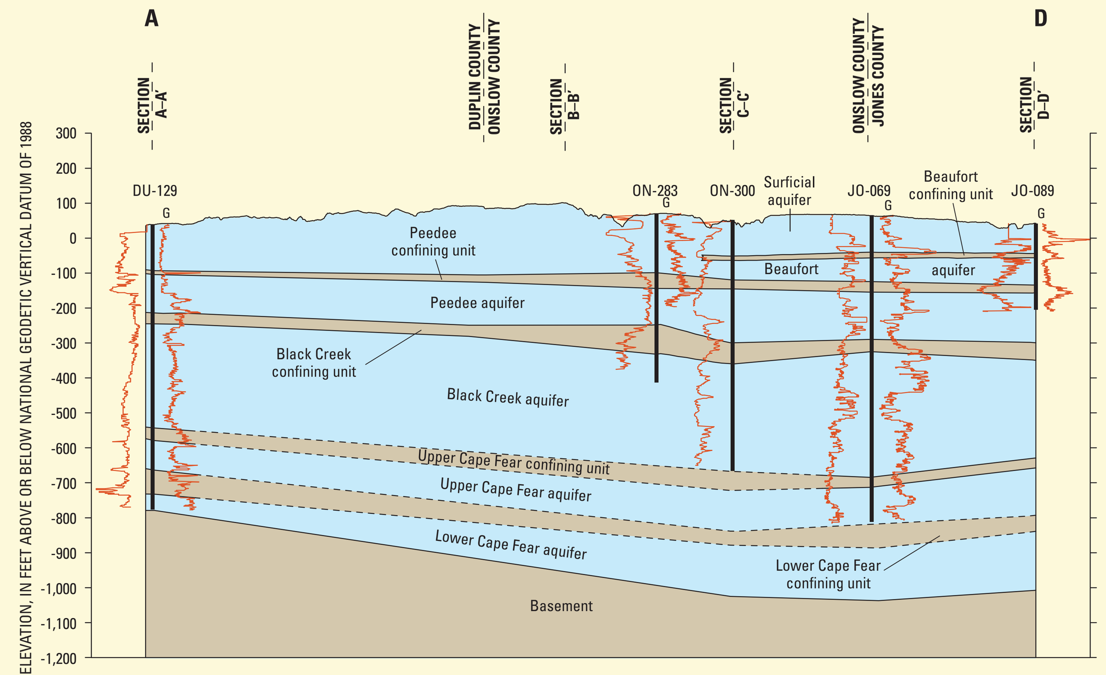


Figure 6. Hydrogeologic cross section A–D in Duplin, Onslow, and Jones Counties, North Carolina.

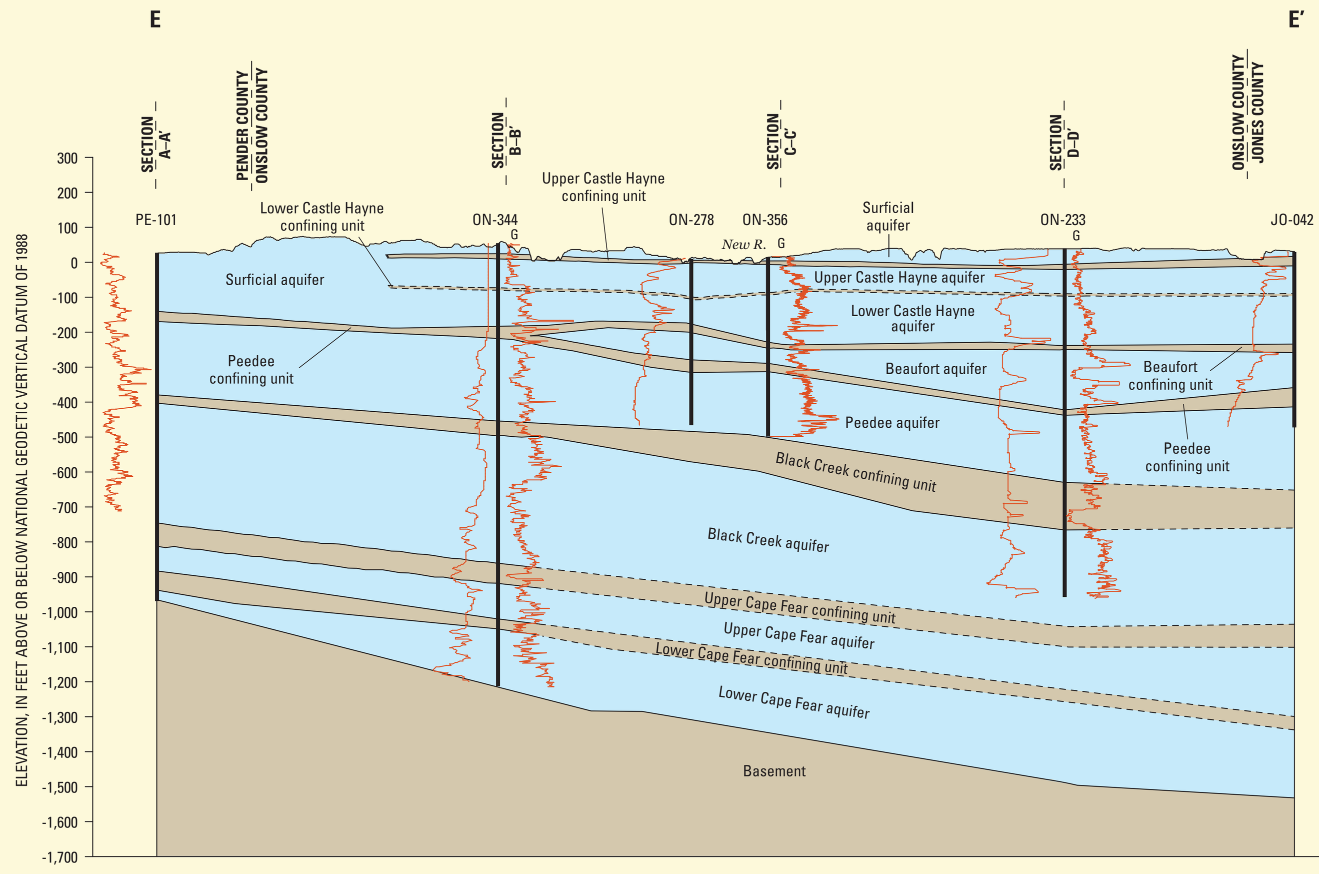


Figure 7. Hydrogeologic cross section E–E′ in Pender, Onslow, and Jones Counties, North Carolina.

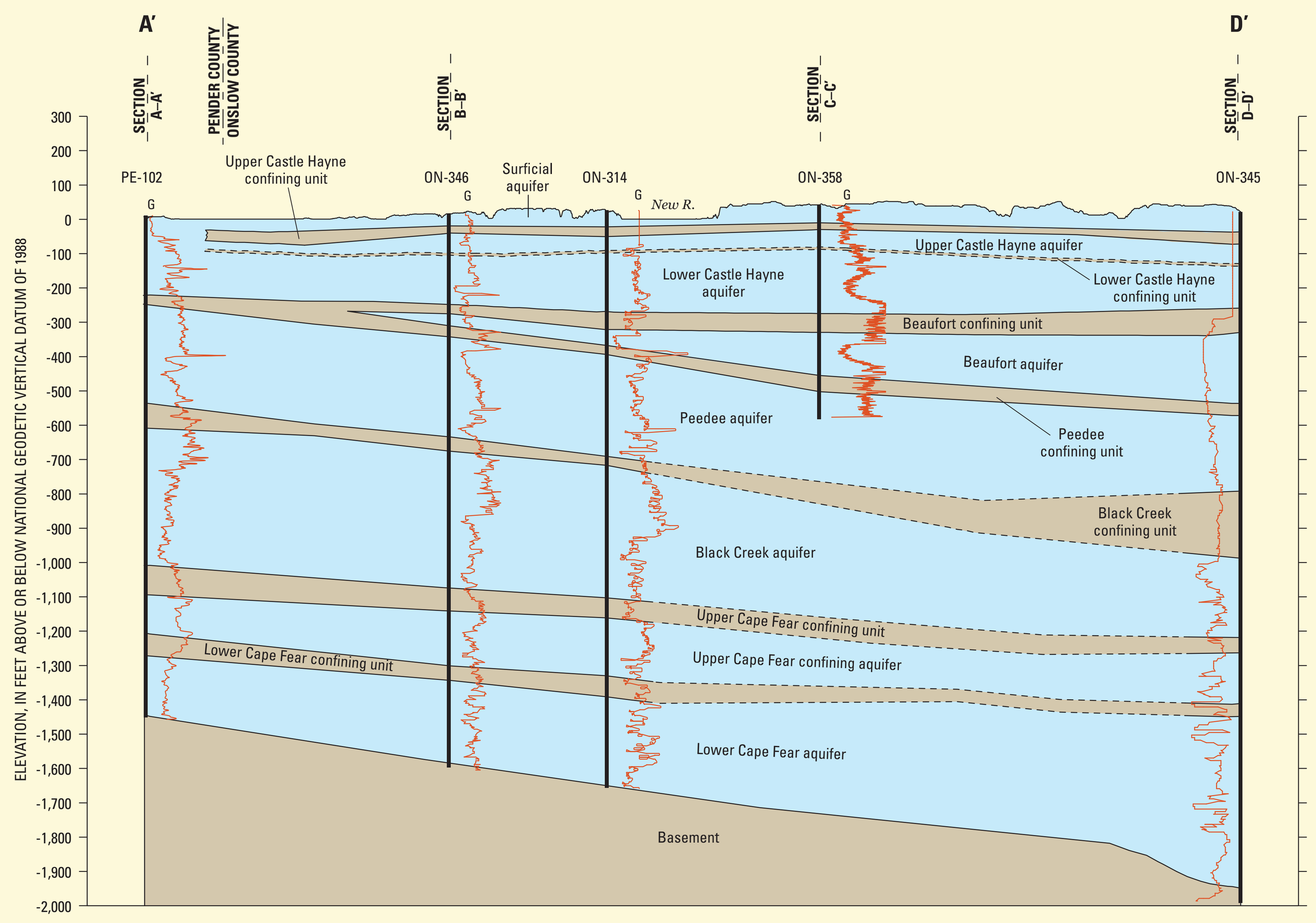


Figure 8. Hydrogeologic cross section A′–D′ in Pender, Onslow, and Jones Counties, North Carolina.

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