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GEOLOGY OF THE MILLVILLE QUADRANGLE
CUMBERLAND AND SALEM COUNTIES, NEW JERSEY
OPEN-FILE MAP SERIES OFM 105
pamphlet containing table 1 accompanies map

INTRODUCTION

The Millville quadrangle is in the New Jersey Coastal Plain, in the southern part of the state. Outcropping sediments in the quadrangle include surficial deposits of late Miocene to Holocene age that overlie the Cohansey Formation, a marginal marine deposit of middle to late Miocene age. The surficial deposits include river, wetland, estuarine, and windblown sediments. The Cohansey Formation includes beach, nearshore, bay, and marsh sediments deposited when sea level was, at times, more than 100 feet higher than at present in this region. As sea level lowered after the Cohansey was laid down, rivers flowing on the emerging Coastal Plain deposited the Bridgeton Formation, forming a broad regional river plain. Later, the regional river system shifted to the west of the quadrangle as sea level continued to lower, and local streams began to erode into the Bridgeton plain. Through the latest Miocene, Pliocene, and Quaternary, stream and estuarine sediments were deposited in several stages as valleys were progressively deepened and widened by stream erosion.

A summary of the stratigraphy of the Kirkwood and Cohansey formations in the quadrangle, and of the geomorphic history of the quadrangle as recorded by surficial deposits and landforms, is provided below. The age of the deposits and episodes of valley erosion are shown on the correlation chart. Table 1 lists the formations penetrated in selected wells and test borings, as interpreted from drillers' descriptions and geophysical logs.

Cross sections AA' and BB' show deposits to a depth of 600 feet (elevation -500 feet), which includes the Cohansey Formation, the Kirkwood Formation, and the uppermost part of the Shark River Formation, which was penetrated in four water wells (wells 33, 51, 139, and 173 in table 1). A research test hole, the Millville corehole (well 149, section BB') (Sugarman and others, 2005) also penetrated the Shark River, and was drilled to a total depth of 1500 feet, terminating in Lower Cretaceous sediments. Formations below the uppermost Shark River are shown on sections and described in Owens and others (1998) and Sugarman and others (2005). They are not shown or discussed on this map.

All the water wells in the quadrangle, which include domestic wells, agricultural irrigation wells, a few industrial wells, and 16 public-supply wells (wells 1, 10, 46, 54, 58, 60, 62, 107, 108, well at 149, 171-175, and 186 in table 1) draw water from sand of the Cohansey Formation (unit Tchs) and sand in the uppermost Kirkwood Formation (Tkw) from depths of 50 to 200 feet. Most wells draw water from the Cohansey and are screened near the base of the formation. One public-supply well (174) draws water from sand wholly in the Kirkwood Formation, from a depth of between 250 and 290 feet.

KIRKWOOD FORMATION

The Kirkwood Formation in the Millville quadrangle ranges from 120 to 300 feet in thickness and consists of an upper sand with silt-clay interbeds and a lower silt-clay, as recorded in gamma-ray logs of wells 139, 149, and 173, and lithologic logs of wells 33, 51, 173, and 184, which penetrated the lower clay. In the Millville corehole, the upper sand is interpreted as estuarine, bay, and nearshore (delta front) deposits. The upper part of the sand is correlated with the Kirkwood 2a sequence of Sugarman and others (1993), which is equivalent to the Wildwood Member of Owens and others (1998). The lower part of the sand is correlated with the Kirkwood 1b sequence of Sugarman and others (1993), which is equivalent to the Shiloh Member of Owens and others (1998). The Kirkwood 2 sequence is of early to middle Miocene age and the Kirkwood 1 sequence is of early Miocene age. The lower clay is interpreted as an inner-shelf (prodelta) deposit, and correlated with the Kirkwood 1a sequence, which is equivalent to the Brigantine Member (or the "lower member" of Owens and others, 1998). Strontium stable-isotope ratio ages from shells in the clay in the Millville corehole yield early Miocene ages of 19 to 21 Ma (million years ago).

The gamma ray logs of the Kirkwood in the Millville corehole and well 139 (section BB'), two miles northwest of the corehole, are very similar (see tie lines on section BB'). The logs show that the upper sand thins to the northwest, and that beds in the Kirkwood, and the Kirkwood-Shark River contact, dip at 25 feet per mile to the southeast. This dip contrasts with the nearly flat-lying clay beds in the Cohansey and the Cohansey-Kirkwood contact. This contrast may be due in part to warping of the Kirkwood before deposition of the Cohansey, or to facies transition of the upper, inner-shelf sands of the Kirkwood 2 sequence to the beach and bay sediments of the Cohansey. Facies transition may also account for the slight irregularities of the Kirkwood-Cohansey contact, which shows about 50 feet of gentle relief through the quadrangle.

COHANSEY FORMATION

The Cohansey Formation consists of stacked successions composed of beach and nearshore sand (Sand facies, Tchs) overlain by interbedded sand and clay (Clay-Sand facies, Tchc) deposited in tidal flats, bays, and coastal wetlands (Carter, 1972, 1978). Pollen and dinoflagellates recovered from peat beds in the Cohansey at Legler, in Ocean County, indicate a coastal swamp-tidal marsh environment (Rachele, 1976). The Legler pollen (Greller and Rachele, 1983), pollen recovered from a corehole near Mays Landing, New Jersey (Owens and others, 1988), and dinocysts obtained from coreholes in Cape May County, New Jersey (deVerteuil, 1997; Miller and others, 2001) indicate a middle to early late Miocene age for the Cohansey. The Cohansey generally lacks datable marine fossils, particularly in updip areas where it has been weathered. As indicated by the possible facies relations described above, lower parts of the Cohansey in updip locations like the Millville quadrangle may be age-equivalent to the upper Kirkwood downdip (for example, Kirkwood sequence 2, about 17-15 Ma, and sequence 3, 12-14 Ma, Sugarman and others, 1993) and may represent the coastal facies of the Kirkwood shallow-shelf deposits.

In the Millville quadrangle, clays in the Cohansey occur in thin beds or laminas generally less than 6 inches thick, and are interbedded with sand. Most are oxidized to white, yellow, and reddish colors. Brown to black organic clay and lignite was exposed in the former Clayville clay pit 1.5 miles northeast of Millville. Drillers' logs also record organic clay in several wells (intervals noted as "Tchco" in table 1). Clayey strata are less than 25 feet thick, and generally less than 15 feet thick. Some strata may be laterally continuous for more than 7 miles, as traced from gamma-ray logs (section BB') and lithologic well logs (fig. 1, sections AA', BB'). These correlations must be considered as provisional, given the varied accuracy of drillers' lithologic logs and the scarcity of gamma ray logs. The laminated bedding and thin but areally extensive geometry of the clay beds indicate bay or estuarine intertidal settings. Alluvial clays generally are thicker and more areally restricted because they are deposited in floodplains and abandoned river channels. The repetitive stacking of bay clays and beach sand (chiefly tidal delta and nearshore deposits) indicates that the Cohansey was deposited during several episodes of rising and falling sea level during a period of overall rising sea level.

SURFICIAL DEPOSITS AND GEOMORPHIC HISTORY

Sea level in the New Jersey region began a long-term decline following deposition of the Cohansey Formation. As sea level lowered, the inner continental shelf emerged as a coastal plain. River drainage was established on this plain. The Bridgeton Formation (Tb) (Salisbury and Knapp, 1917) consists of fluvial sand and gravel that is the earliest record of this drainage in the Millville quadrangle. The Bridgeton river system deposited a broad braidplain across southern New Jersey, south of the present-day Mullica River. This plain covered the entire Millville quadrangle. Regionally, paleoflow indicators, slope of the plain, and gravel provenance, indicate that the Bridgeton was deposited by a river system draining southeastward from what is now the Delaware River valley (Owens and Minard, 1979; Martino, 1981; Stanford, 2009). Cross beds in sand exposed at five locations in the Bridgeton in the quadrangle (shown on map) likewise record southeastward paleoflow. The topography of the base of the Bridgeton, based on outcrop and well data (red contours on fig. 2), shows that it aggraded in shallow south- to southeast-draining valleys cut into the underlying Cohansey Formation. This trend is slightly more southerly than the paleoflow indicators, suggesting that flow on the aggrading plain was slightly more easterly than earlier flow during channeling into the Cohansey. Gravel in the Bridgeton consists primarily of quartz, quartzite, and chert, and trace amounts (<0.1 %) of red and gray sandstone and siltstone, gneiss, and schist. These lithologies also indicate flow from the Delaware basin.

The Bridgeton lacks datable material. It overlies the middle-to-upper Miocene Cohansey Formation and is older than the Pensauken Formation, a fluvial deposit of Pliocene age that occupies a valley inset as deep as 200 feet below the Bridgeton plain. These relationships indicate a late Miocene age for the Bridgeton. Significant age is also indicated by its deep and intense weathering. Feldspar minerals in the sand have weathered to clay, and iron-bearing silicate minerals have weathered to oxides and hydroxides (Owens and others, 1983). This weathering gives the deposit a clayey sand texture and a distinctive orange to reddish color. Chert, gneiss, siltstone, and schist pebbles are deeply weathered or decomposed throughout the entire deposit.

Continued lowering of sea level in the late Miocene and early Pliocene caused the Bridgeton river system to downcut and shift to the west of the Millville quadrangle, to what is now the lower Delaware valley and the Delmarva Peninsula. The Bridgeton plain was abandoned and a new local drainage was established, including the Maurice River and its tributaries. In the Pliocene and early Pleistocene the Maurice and its tributaries cut broad shallow valleys into the former Bridgeton plain, to a maximum depth of about 150 feet in the quadrangle. These valleys had been eroded to nearly their present depth by the middle Pleistocene, or possibly the early Pleistocene, when a period of high sea level flooded the valleys to an elevation of 60 to 70 feet. The Cape May Formation, unit 1 (Qcm1) (Salisbury and Knapp, 1917; Newell and others, 1995) consists of estuarine sand and gravel deposited during this highstand. The age of this highstand is uncertain but it may have been the particularly long interglacial period around 400 ka (thousand years ago), when sea level at similar elevation is recorded in the Bahamas and Bermuda (Olson and Hearty, 2009). The Cape May 1 is preserved as benches along the valley sides, 10 to 30 feet higher than the surface of the upper fluvial terrace in the valley. Its upland edge is thin and onlaps the Bridgeton or Cohansey formations.

As sea level lowered following the Cape May 1 highstand, the Maurice and its tributaries again incised, removing most of the Cape May deposits and deepening valleys perhaps 10 to 20 feet below their bottom before the highstand. Another sea level highstand at 125 ka, known as the Sangamonian interglacial stage, rose to an elevation of about 30 feet in the New Jersey area, flooding the Maurice valley south of Millville. Upstream from the limit of submergence, the river and its tributaries deposited sand and gravel, forming the upper stream terrace (Qtu). Some of this deposit may have been laid down during a period of cold climate, peaking at 150 ka and known as the Illinoian glacial stage, before the Sangamonian highstand. During such cold periods in the middle and late Pleistocene in the New Jersey Coastal Plain, tundra replaced forest and soil drainage was impeded by permafrost (French and others, 2007). More sediment was washed from hillslopes, causing aggradation of fluvial deposits in valleys. Closely-spaced, shallow gullies scribed into valley-side slopes (fig. 3) are evidence of slope erosion during periods of permafrost, as they are dry and inactive in the present-day temperate climate. They are common on the slopes bordering the upland edge of upper terraces. Sea level lowered again after 80 ka, following the Sangamonian interglacial, as another period of cold climate, known as the Wisconsinan glacial stage, once again brought periods of tundra and permafrost. The upper terraces were incised and eroded to depths of as much as 40 feet along the Maurice River. During cold periods within the Wisconsinan, sediment aggraded in the eroded valleys to form lower terrace deposits (Qtl). Braided channels on the lower terrace, and on parts of the upper terrace (fig. 3) record this influx of sand. As sand clogs streams, channels become shallow and divide easily, forming a braided pattern.

The bare sandy river plains also provided a source of mobile sediment for wind erosion. Winds blowing from the west eroded sand from the terraces in the Maurice valley and deposited it in dune fields on the east side of the valley (Qe) (figs. 2 and 3). The dunes form extensive deposits on the upper terrace and Cape May 1 bench. Between Parvin Branch and Union Lake, the dunes also lap up onto the Bridgeton upland. Most individual dunes within the fields are elongate in a north-south or northeast-southwest direction; a few are crescentic, and the axis of the crescent trends northwest-southeast. These forms indicate that the dunes are transverse and were deposited by winds blowing from the northwest. The position of the dune fields on the upper terrace, and on older surfaces, and their absence from younger surfaces, indicates that they are chiefly of Wisconsinan age. Some may be of Illinoian age.

Climate again warmed and sea level rose near the end of the Wisconsinan, beginning around 15 ka. The Maurice and its tributaries incised the lower terrace to a maximum depth of 20 feet, and widened the incision by lateral erosion, forming the modern floodplain. Modern streams, with little sediment influx once forest regrew, developed meandering rather than braided channels (fig. 3). Sand and gravel channel deposits and backswamp peat (Qals) were laid down in the floodplains. Floodplain sediment accumulated chiefly in the Holocene (beginning about 11 ka), as recorded by radiocarbon dates of basal peat in other alluvial wetlands in southern New Jersey (Buell, 1970; Florer, 1972; Stanford, 2000). In the Millville quadrangle, dates of 7590±30 radiocarbon years BP (8420-8370 calibrated years) (Beta 384711) and 7330±30 radiocarbon years BP (8190-8040 calibrated years) (Beta 385825) were obtained on plant material beneath 3.5 and 4.5 feet, respectively, of pebbly sand at two sites on low-lying parts of the lower terrace (fig. 2, also plotted on map). These sites are on parts of the lower terrace that lack braided channels and that, like the modern floodplain, are separated from the upper terrace by scarps with a meander-channel form, indicating that they formed after the period of braided-channel development. The dates and associated landforms show that deposition of the lower terrace continued until sometime after about 7300 radiocarbon years ago in places, followed by final incision to the modern floodplain. As sea level rose to near its present position within the last 3 ka, salt marsh and estuarine deposits (Qm) were laid down atop the floodplain sediments along the Maurice River south of Millville.

DESCRIPTION OF MAP UNITS

ARTIFICIAL FILL—Sand, pebble gravel, minor clay and organic matter; gray, brown, very pale brown, white. In places includes minor amounts of man-made materials such as concrete, asphalt, brick, cinders, and glass. Unstratified to poorly stratified. As much as 20 feet thick. In road and railroad embankments, dams, filled wetlands and low ground, and infilled sand and clay pits. Small areas of fill in urban areas are not mapped

aft — TRASH FILL—Trash mixed and covered with clay, silt, sand, and minor gravel. As much as 60 feet thick.

Qals — WETLAND AND ALLUVIAL DEPOSITS—Fine-to-medium sand and pebble gravel, minor coarse sand; light gray, yellowish-brown, brown, dark brown; overlain by brown to black peat and gyttja (gel-like organic mud). Peat is as much as 10 feet, but generally less than 4 feet, thick. Sand and gravel consist chiefly of quartz and a trace (<1%) of chert and are generally less than 3 feet thick. Sand and gravel are stream-channel deposits; peat and gyttja form from the vertical accumulation and decomposition of plant debris in swamps and marshes. In floodplains and alluvial wetlands on modern valley bottoms.

Qm — SALT-MARSH AND ESTUARINE DEPOSITS—Peat, clay, silt, fine sand; brown, dark brown, gray, black; minor medium-to-coarse sand and pebble gravel. Contain abundant organic matter and shells. As much as 10 feet thick (estimated). Deposited in salt marshes, tidal flats, and tidal channels during Holocene sea-level rise.

Qe — EOLIAN DEPOSITS—Fine-to-medium quartz sand; very pale brown, yellow. As much as 20 feet thick. Form fields consisting of linear, transverse and, less commonly, crescentic, dune ridges as much as 15 feet high and areas of small, low dunes of indistinct form. Sand is from wind erosion of the upper terrace deposits, and, less commonly, lower terrace deposits.

Qtl — LOWER TERRACE DEPOSITS—Fine-to-medium sand, pebble gravel, minor coarse sand; light gray, brown, dark brown; very pale brown, yellowish-brown where well-drained. As much as 20 feet thick. Sand and gravel consist of quartz and a trace (<1%) of grains and pebbles of white to gray chert. Form terraces and pediments in valley bottoms with surfaces 2 to 10 feet above modern floodplains. In areas of poor drainage, deposits include peaty sand and sand with gyttja and may be overlain by peat less than 2 feet thick. The gyttja and peat are younger than the sand and gravel and accumulate due to poor drainage. Gravel is more abundant in lower terrace deposits than in upper terrace deposits due to removal of sand from the upper terrace deposits by stream and seepage erosion.

Qtu — UPPER TERRACE DEPOSITS—Fine-to-medium sand, pebble gravel, minor coarse sand; very pale brown, brownish-yellow, yellow. As much as 40 feet thick. Sand and gravel consist of quartz and, in places, a few (<5%) grains and pebbles of unweathered and partly weathered white to gray chert, and rare (<0.01%) weathered gneiss and sandstone granules and pebbles. Form terraces and pediments with surfaces 5 to 25 feet above modern floodplains. Also form valley-bottom fills in small tributary valleys on uplands, grading to the main-valley terraces. Include stratified stream-channel deposits and poorly stratified to unstratified deposits laid down on pediments by slopewash and groundwater seepage.

Qcm1 — CAPE MAY FORMATION, UNIT 1— Fine-to-medium sand, pebble gravel, minor coarse sand; yellowish-brown, yellow, very pale brown (fig. 4). Sand and gravel consist of quartz and, in places, a few grains and pebbles of weathered to decomposed white and yellow chert. As much as 30 feet thick. In erosional remnants of an estuarine valley fill with surfaces as much as 75 feet in elevation in the Maurice River and White Marsh Branch valleys.

Tb — BRIDGETON FORMATION—Medium-to-coarse sand, fine-to-medium sand, clayey to very clayey in places, pebble gravel, trace to few cobbles; reddish-yellow, yellow, brownish-yellow, red, very pale brown (fig. 5). Coarse sand and gravel beds are iron-cemented in places. Clay-size material forms grain coatings and interstitial fill in sand; this clay is from weathering of chert and feldspar. Beds of light gray to pale red detrital silty clay, 6 to 12 inches thick, occur within the sand in the old pits west of the Maurice River and south of Silver Lake in Millville, but were not observed elsewhere. Sand and gravel consist of quartz and as much as 20 percent chert. Gravel also includes some gray and brown quartzite, traces of red, brown, and gray sandstone and siltstone and white granite and gneiss; gray schist occurs as a rarity. Sand includes some weathered feldspar. Most chert is weathered to white and yellow clay-size material; unweathered chert is gray to brown. Sandstone, siltstone, granite, gneiss, and schist pebbles are deeply weathered or decomposed. As much as 50 feet thick. Upper part of formation is generally unstratified, or poorly stratified, owing to weathering, cryoturbation, and bioturbation. Below a depth of 5 to 10 feet, tabular- planar to low-angle cross bedding, and horizontal plane-bedding, are locally preserved (fig. 4). Caps uplands throughout the entire quadrangle, above an elevation of 40 to 90 feet (fig. 2).

COHANSEY FORMATION—The Cohansey Formation is a fine-to-medium quartz sand, with some strata of medium-to-very coarse sand and fine gravel, very fine sand, and interbedded clay and sand, deposited in estuarine, bay, beach, and inner shelf settings. The Cohansey is here divided into two map units: a sand facies and a clay-sand facies, based on lithologic and gamma-ray well logs, and surface mapping using 5-foot hand-auger holes, exposures, and excavations (fig. 1). Total thickness of the Cohansey in the quadrangle is as much as 200 feet.

Tchs — Sand Facies—Fine-to-medium sand, some medium-to-coarse sand, minor very fine sand, minor very coarse sand to very fine pebbles, trace fine-to-medium pebbles; very pale brown, brownish-yellow, white, reddish-yellow, rarely red and reddish-brown (fig. 5). Well-stratified to unstratified; stratification ranges from thin, planar, subhorizontal beds to large-scale trough and planar cross-bedding. Sand consists of quartz; coarse-to-very coarse sand may include as much as 5% weathered chert and a trace of weathered feldspar. Coarse-to-very coarse sands commonly are slightly clayey; the clays occur as grain coatings or as interstitial infill. This clay-size material is from weathering of chert and feldspar rather than from primary deposition. Pebbles are chiefly quartz with minor gray chert and rare gray quartzite. Some chert pebbles are light gray, partially weathered, pitted, and partially decomposed; some are fully weathered to white clay. In a few places, typically above clayey strata, and where iron-bearing heavy minerals are abundant, sand may be hardened or cemented by iron oxide, forming reddish-brown hard sands or ironstone masses. Locally, sand facies includes isolated lenses of interbedded clay and sand like those within the clay-sand facies described below. The sand facies is as much as 100 feet thick.

Tchc — Clay-Sand Facies—Clay interbedded with clayey fine sand, very fine-to-fine sand, fine-to-medium sand, less commonly with medium-to-coarse sand and pebble lags. Clay beds are commonly 0.5 to 3 inches thick, rarely as much as 3 feet thick, sand beds are commonly 1 to 6 inches thick but are as much as 2 feet thick. Clays are white, yellow, very pale brown, reddish-yellow, and light gray; a few clay beds are brown to dark brown and contain lignitic organic matter (fig. 6). Sands are yellow, brownish-yellow, very pale brown, reddish-yellow. As much as 25 feet thick.

Tkw — KIRKWOOD FORMATION—Fine sand, fine-to-medium sand, sandy clay, and clay, minor coarse sand and pebbles; gray, dark gray, brown. Sand consists of quartz and some mica and lignite. Contains mollusk shells in places. In subsurface only. As much as 300 feet thick in central and southern part of quadrangle, thins to 120-150 feet in northern part of quadrangle. In the map area, the upper half of the formation is sand with interbedded silt-clay; the lower half is predominantly silt-clay (see "Kirkwood Formation" section above).

Tsr — SHARK RIVER FORMATION—Clayey glauconitic quartz sand, gray to dark green. In subsurface only. Approximately 320 feet thick in the Millville corehole. The Shark River is of middle to late Eocene age based on foraminifers and calcareous nannofossils sampled in the Millville corehole (Sugarman and others, 2005)

MAP SYMBOLS

Contact—Solid where well-defined by landforms as visible on 1:12,000 stereo airphotos and LiDAR imagery, long-dashed where approximately located, short-dashed where feathered or gradational, dotted where excavated. In excavations, contacts are drawn to the base map topography, compiled in 1953.

Contact of Cohansey facies—Approximately located. Dotted where concealed by surficial deposits.

(Tchc) Concealed Cohansey Formation, clay-sand facies

Qtu4/Tchs — Material penetrated by hand-auger hole, or observed in exposure or excavation.Where more than one unit was penetrated, the thickness (in feet) of the upper unit is indicated next to its symbol and the lower unit is indicated following the slash.

Material formerly observed—Recorded in N. J. Geological and Water Survey files. Abbreviations as above.

47 — Well or test boring—Location accurate to within 200 feet. Log of formations penetrated shown in table 1.

74 — Well or test boring—Location accurate to within 500 feet. Log of formations penetrated shown in table 1.

7330+/-30 Beta 385825 — Radiocarbon date—Age in radiocarbon years, with error and lab number.

figure 6 — Photograph location

Gamma-ray log—On sections. Radiation intensity increases to right.

Paleocurrent direction—Arrow indicates direction of stream flow, as inferred from dip of planar, tabular cross-beds observed at point marked by x.

Abandoned channel—Line in channel axis.

Fluvial scarp—Line at top, ticks on slope.

Shallow topographic basin—Line at rim, pattern in basin. Includes thermokarst basins formed from melting of permafrost, and a few seepage basins formed by groundwater erosion.

Excavation perimeter—Line encloses excavated area.

Sand or clay pit—Inactive in 2014. Clay pit indicated by "c".

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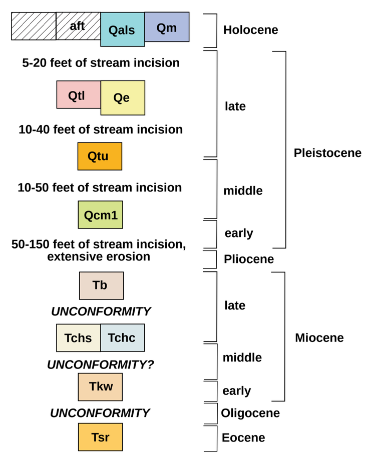
CORRELATION OF MAP UNITS



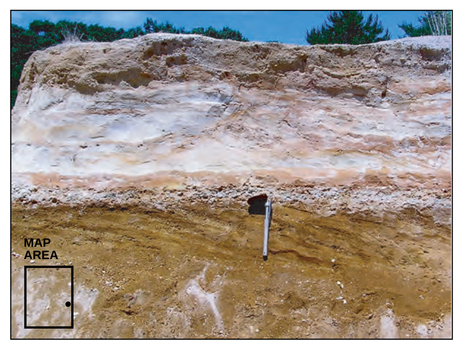


Figure 4. Cape May Formation, unit 1 (above shovel head) over Bridgeton Formation. Cross beds in the Bridgeton indicate paleoflow to east (right). Location shown on inset.

Figure 5. Bridgeton Formation (above line) over Cohansey Formation, sand facies. Orange color in Cohansey sand is from iron deposition. Location shown on inset.

Figure 6. Organic clay of the Cohansey Formation, clay-sand facies (dark bed) over Cohansey Formation, sand facies (below line). White beds above and below the organic clay are oxidized clay and very fine sand. Bridgeton Formation (orange bed) overlies Cohansey clay in the background. Location shown on inset.

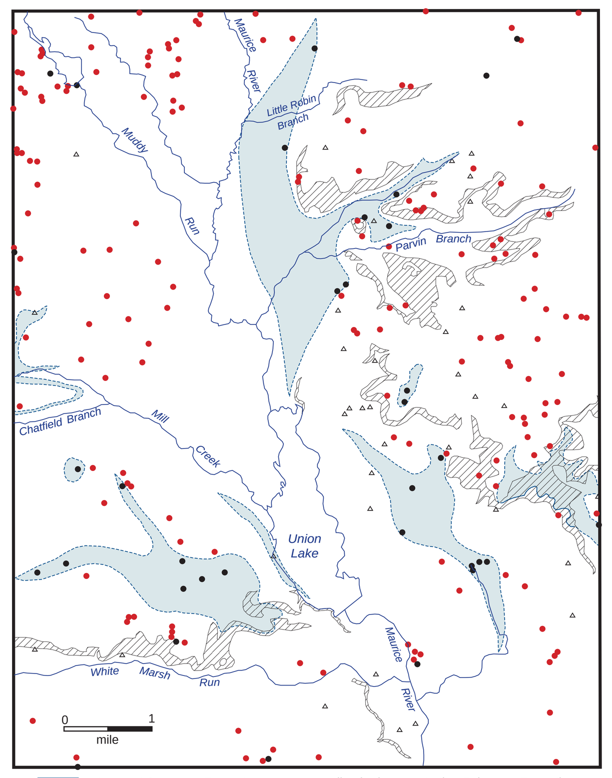


Figure 1.--Subcrop of Cohansey Formation, clay-sand facies (blue), in the Millville quadrangle. Surficial deposits cover the Cohansey over most of the quadangle; subcrop is inferred from records of wells and borings (red and black circles) and field observations (triangles).

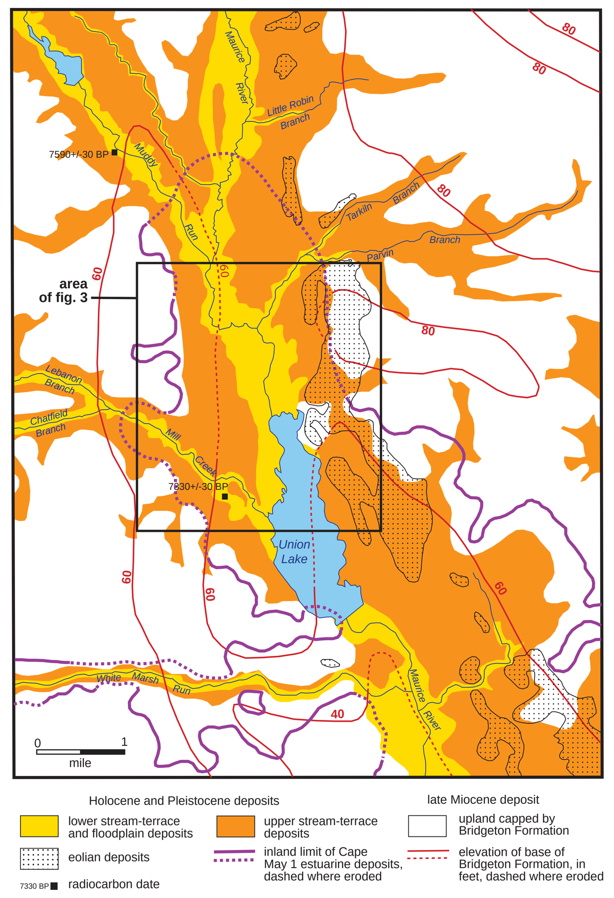


Figure 2.--Surficial deposits and geomorphic features of the Millville quadrangle. The upper stream-terrace deposits are in valleys cut into the Bridgeton fluvial plain during the early and middle Pleistocene. The lower stream-terrace deposits and modern floodplain are in inner valleys eroded into the upper terrace during the Wisconsinan glacial stage of the late Pleistocene. The Cape May 1 deposits were laid down during a sea-level highstand in the middle Pleistocene.

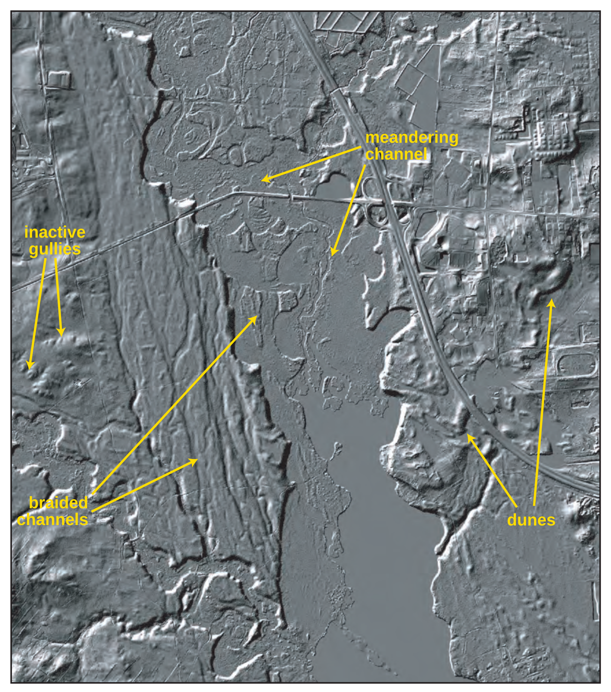
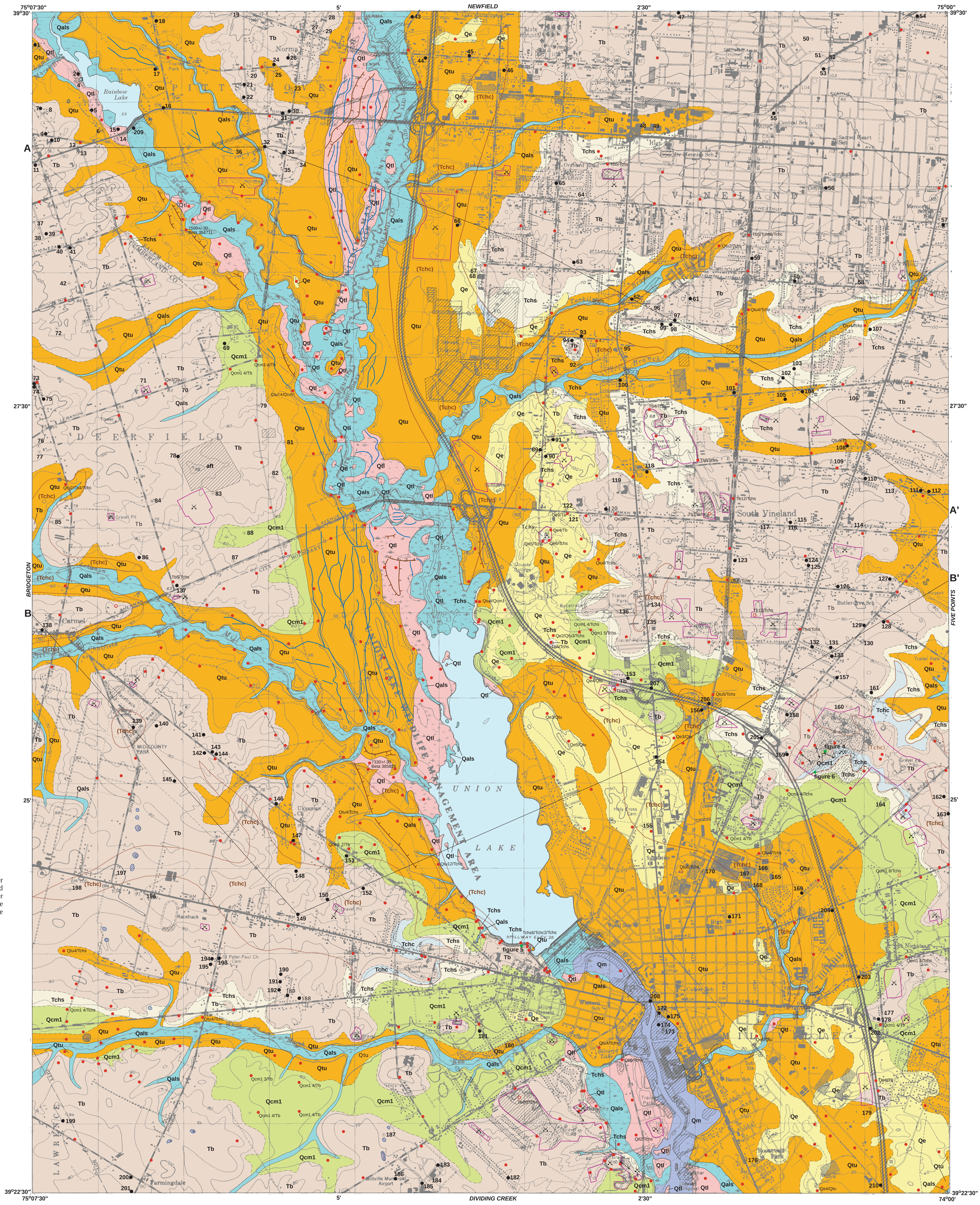


Figure 3.--LiDAR shaded relief image of part of the Maurice River valley showing relict braided channels on the upper terrace (west side of image) and, less prominently, on the lower terrace (on east side of upper terrace); inactive gullies on hillslopes (on west side of upper terrace); meandering channels in the modern floodplain; and relict dunes on the east side of valley. Area of image shown on figure 2.



Base from U. S. Geological Survey, 1997.
North American Datum of 1927.
Topography compiled 1953. Planimetry derived from imagery taken 1983. Photoinspected using imagery dated 1997.

APPROXIMATE MEAN DECLINATION, 1998

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

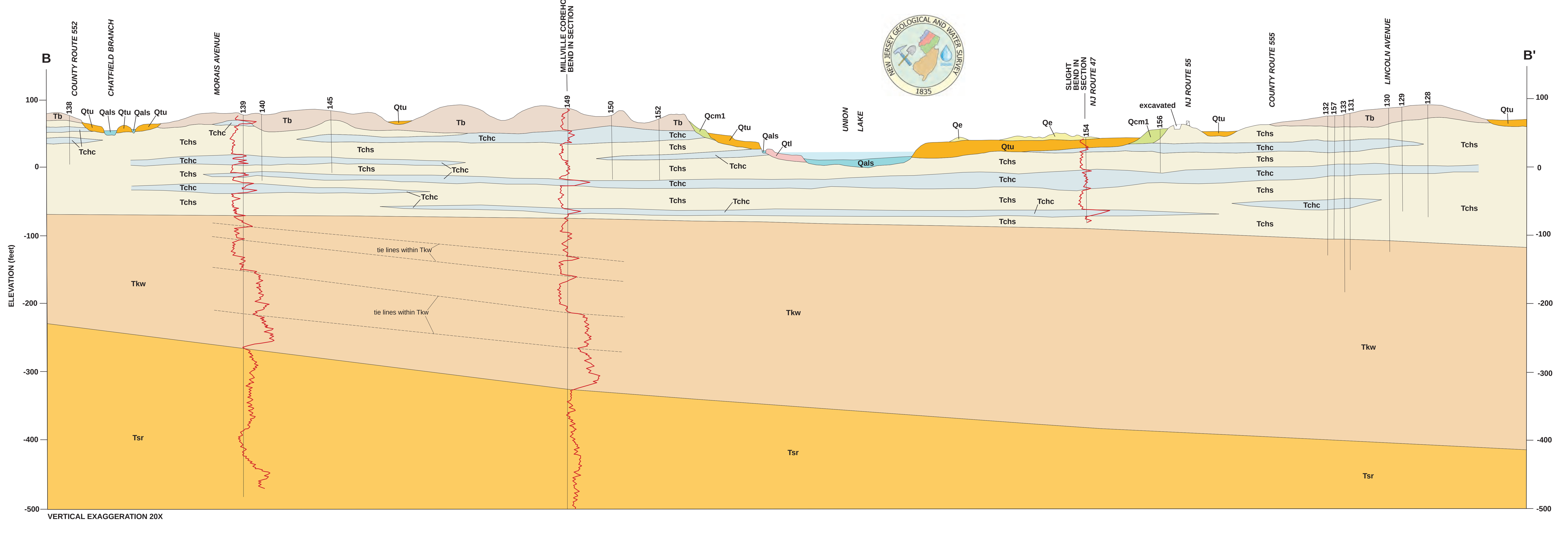
LOCATION IN NEW JERSEY

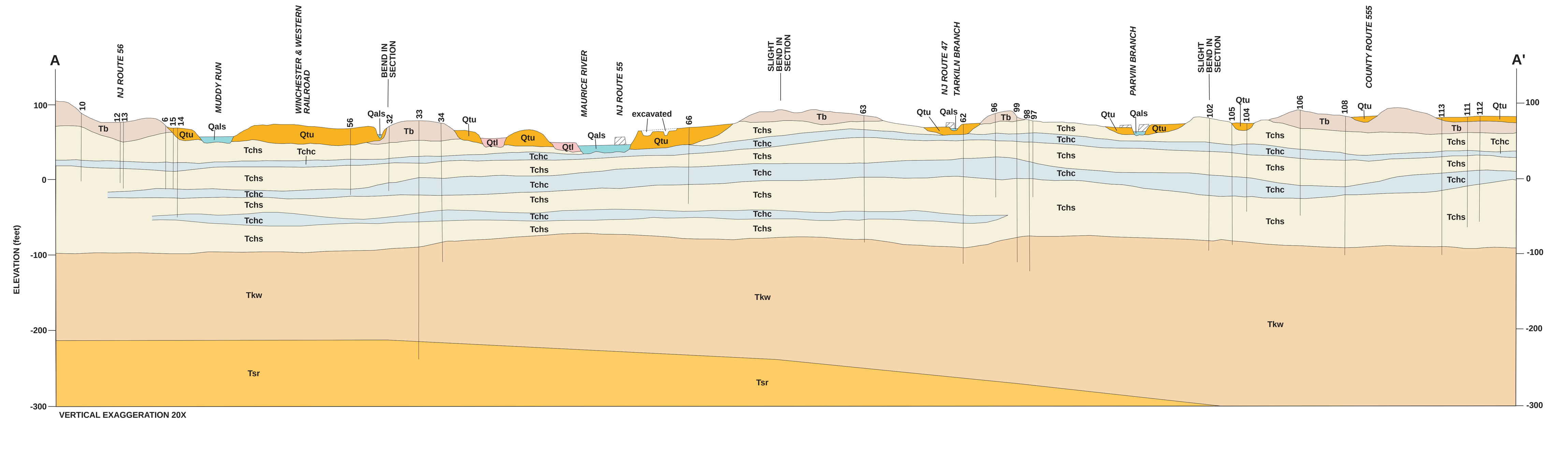
Geology mapped 2014
Cartography by S. Stanford

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program under Statemap award number G13AC00182.
The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U. S. Government.

GEOLOGY OF THE MILLVILLE QUADRANGLE, CUMBERLAND AND SALEM COUNTIES, NEW JERSEY

by
Scott D. Stanford
2015





Geology of the Millville Quadrangle
Cumberland and Salem Counties, New Jersey

New Jersey Geological and Water Survey
Open File Map OFM 105
2015

pamphlet with table 1 to accompany map

Table 1. Selected well and boring records.

Well Number	Identifier[1]	Formations Penetrated[2]
1	35-10914	15 Q 30 Tchs+Tchc 60 Tchs 75 Tchco 95 Tchs+Tchc 105 Tchco 120 Tchs
2	35-11224	15 Q 50 Tchs 65 Tchs+Tchc 78 Tchs
3	35-222	11 Q 42 Tchs 46 Tchc
4	35-2911	5 Q 14 Tchs+Tchc 38 Tchs 51 Tchc 60 Tchs+Tchc 70 Tchs 75 Tchs+Tchc
5	35-10818	15 Q 40 Tchc 60 Tchs 75 Tchs+Tchc 85 Tchc 105 Tchs
6	35-7840	8 Q 52 Tchs 60 Tchc 75 Tchs 82 Tchs+Tchc
7	35-9332	15 Tb 25 Tchs 40 Tchs+Tchc 50 Tchco 85 Tchs 90 Tchs+Tchco
8	35-9034	15 Tb 60 Tchs 70 Tchc 84 Tchs
9	35-3335	30 Tb 45 Tchs 60 Tchs+Tchc 72 Tchs
10	35-8203	15 Tb 45 Tchs 55 Tchs+Tchc 90 Tchs
11	35-6825	11 Tb 32 Tchs 56 Tchs+Tchc 82 Tchs 86 Tchc 105 Tchs
12	35-6644	30 Tb 50 Tchs 60 Tchco 80 Tchs
13	35-4757	45 Tb 75 Tchs+Tchc 88 Tchs
14	35-4914	46 Q+Tchs 84 Tchs 92 Tchs+Tchc 115 Tchs 120 Tchs+Tchc
15	35-8486	15 Tchs+Tchc 50 Tchs 60 Tchco 65 Tchs+Tchc 80 Tchs
16	35-11300	36 Q 51 Tchs
17	35-1004	20 Q 30 Tchs+Tchc 53 Tchc 75 Tchs
18	35-9040	8 Q 23 Tchs 60 Tchs+Tchc 87 Tchs
19	35-8902	27 Tb 28 Tchc 60 Tchs
20	35-4359	12 Tb 53 Tchs+Tchc 75 Tchs 78 Tchs+Tchc 103 Tchs 124 Tchs+Tchc 130 Tchco
21	35-10819	11 Tb 29 Tchs 43 Tchs+Tchc 48 Tchc 114 Tchs 119 Tchs+Tchc
22	35-686	17 Tb 29 Tchs 43 Tchc 62 Tchs
23	35-504	17 Tb 27 Tchs 40 Tchc 50 Tchs
24	35-9965	20 Tb 120 Tchs
25	35-1231	20 Tb 70 Tchs
26	35-9166	27 Tb 40 Tchs 44 Tchc 80 Tchs 89 Tchc 147 Tchs
27	35-3210	30 Tb 40 Tchs 50 Tchs+Tchc 90 Tchs 100 Tchs+Tchc 171 Tchs 180 Tkw
28	35-2827	30 Tb 40 Tchs 50 Tchs+Tchc 90 Tchs 100 Tchs+Tchc 171 Tchs 180 Tkw
29	35-6473	30 Tb 50 Tchs+Tchc 83 Tchs 85 Tchc 111 Tchs+Tchc 150 Tchs 170 Tkw
30	35-3440	20 Tb 90 Tchs 100 Tchs+Tchc 150 Tchs 182 Tkw
31	35-7467	15 Tb 30 Tchs+Tchc 50 Tchs 65 Tchc 135 Tchs 165 Tchs+Tchc 189 Tkw
32	35-8358	29 Tb 70 Tchs+Tchc 80 Tchs 85 Tchs+Tchc
33	35-1114	27 Tb 60 Tchs+Tchc 75 Tchs 84 Tchc+Tchs 154 Tchs+Tchc 170 Tchs 290 Tkw 317 Tsr
34	35-11047	23 Tb 43 Tchs 47 Tchc 64 Tchs+Tchc 75 Tchs 100 Tchs+Tchc 105 Tchs 124 Tchs+Tchc 182 Tkw
35	35-791	21 Tb 30 Tchs 38 Tchc 50 Tchs
36	35-978	32 Q 90 Tchs
37	35-6661	30 Tb 100 Tchs
38	35-6663	30 Tb 100 Tchs
39	35-7498	23 Tb 67 Tchs 89 Tchs+Tchc 105 Tchs 110 Tchs+Tchc

Well Number	Identifier[1]	Formations Penetrated[2]
40	35-8776	30 Tb 55 Tchs 110 Tchs+Tchc
41	35-8037	34 Tb 60 Tchs 65 Tchc+Tchs 100 Tchs
42	35-6712	25 Tb 60 Tchs+Tchc 95 Tchs 100 Tchs+Tchc
43	35-8723	15 Q 30 Tchs+Tchc 40 Tchco 55 Tchs+Tchc 65 Tchs 75 Tchs+Tchc 85 Tchs
44	35-8730	10 Q 80 Tchs 83 Tchc 100 Tchs
45	35-4899	15 Q 39 Tchs 43 Tchs+Tchc 53 Tchc 80 Tchs+Tchc 110 Tchs 122 Tchc 140 Tchs
46	35-861	10 Q 44 Tchc+Tchs 76 Tchs 100 Tchc 153 Tchs
47	35-434	18 Tb 32 Tchs 67 Tchc 69 Tchs+Tchc 84 Tchs
48	35-28	15 Q 25 Tchs 35 Tchs+Tchc 90 Tchs 95 Tchc 100 Tchs 105 Tchco 115 Tchs+Tchc 135 Tchs 136 Tchc
49	35-45	10 Q 28 Tchs 29 Tchc 35 Tchs 37 Tchs+Tchc 134 Tchs 136 Tchs+Tchc 140 Tchs
50	35-1358	36 Tb 53 Tchs+Tchc 66 Tchc+Tchs 82 Tchs+Tchc 84 Tchc 112 Tchs+Tchc 115 Tchc 118 Tchco
51	35-46 well 1	25 Tb 30 Tchc 189 Tchs+Tchc 350 Tkw 552 Tsr
52	35-46 well 2	30 Tb 50 Tchs 75 Tchs+Tchc 110 Tchs 137 Tchs+Tchc 144 Tchc
53	35-5184	30 Tb 40 Tchs 70 Tchs+Tchc 85 Tchs
54	35-632 35-667	12 Tb 18 Tchc or Tb 73 Tchs+Tchc 80 Tchc 114 Tchs 122 Tchc 143 Tchs 145 Tchc 220 Tchs+Tchc 227 Tkw
55	35-93	27 Tb 30 Tchc 34 Tchs 45 Tchc 49 Tchs 58 Tchc+Tchs 72 Tchs 81 Tchc 108 Tchs 110 Tchc 125 Tchs 128 Tchc
56	35-17	10 Tb 30 Tchs 50 Tchc+Tchs 65 Tchs 68 Tchc 96 Tchs+Tchc 190 Tchs
57	35-250	10 Tb 58 Tchs 59 Tchc
58	35-414	10 Tb 65 Tchs 98 Tchs+Tchc 109 Tchs
59	35-8541	20 Tb 60 Tchs 80 Tchs+Tchc 110 Tchs
60	35-668	15 Tchs 28 Tchc+Tchs 67 Tchs+Tchc 76 Tchs 82 Tchc 118 Tchs+Tchc 165 Tchs
61	35-7495	39 Tchs 43 Tchc 99 Tchs 121 Tchco 160 Tchs 170 Tchs+Tchc 190 Tchs 195 Tkw
62	35-962	18 Q 24 Tchc+Tchs 70 Tchs+Tchc 120 Tchs 145 Tchc+Tchs 164 Tchs 183 Tkw
63	35-1188	6 Tb 30 Tchs+Tchc 65 Tchs 80 Tchc+Tchs 128 Tchs 137 Tchs+Tchc 165 Tchs 168 Tkw
64	35-295	17 Tb 47 Tchs 59 Tchc+Tchs 80 Tchs+Tchc 100 Tchs
65	35-170	36 Tb 51 Tchs 58 Tchc 70 Tchs 71 Tchc
66	35-6482	20 Q 30 Tchs+Tchc 50 Tchs 75 Tchc 80 Tchs+Tchc 100 Tchs
67	35-1193	40 Tchs 90 Tchs+Tchc 183 Tchs 201 Tkw
68	35-1167	21 Q 90 Tchs 106 Tchc+Tchs 191 Tchs 196 Tkw
69	35-6330	2 Q 16 Tb 45 Tchs 74 Tchs+Tchc 110 Tchs 115 Tchs+Tchc
70	35-219	13 Tb 16 Tchs 17 Tchc 58 Tchs 60 Tchc
71	35-5972	13 Tb 85 Tchs 88 Tchs+Tchc 143 Tchs 160 Tchs+Tchc
72	35-7745	15 Tb 30 Tchs 42 Tchs+Tchc
73	35-7235	30 Tb 50 Tchs 80 Tchs+Tchc 110 Tchs
74	35-6147	15 Tb 45 Tchc+Tchs 60 Tchs+Tchc 100 Tchs 105 Tchc+Tchs 115 Tchs
75	35-8115	30 Tb 40 Tchs+Tchc 47 Tchco 85 Tchs
76	35-4882	16 Tb 33 Tchs 48 Tchc+Tchs 63 Tchs
77	35-4883	16 Tb 28 Tchs 29 Tchc 60 Tchs
78	35-4034	27 Tb 56 Tchs+Tchc
79	25-7373	25 Tchs 35 Tchs+Tchc 78 Tchs 85 Tchs+Tchc 115 Tchs
80	35-7375	5 Tb 15 Tchs 25 Tchs+Tchc 33 Tchs 50 Tchs+Tchc 107 Tchs
81	35-7374	10 Tchs+Tchc 35 Tchs 50 Tchs+Tchc 75 Tchs 107 Tchs+Tchc 125 Tchc+Tchs
82	35-7288	15 Tb 45 Tchs+Tchc 60 Tchs
83	35-6291, G	15 Tb 60 Tchs 65 Tchc 97 Tchs 104 Tchc 116 Tchs 124 Tchc 132 Tchs 138 Tchs 160 Tchs
84	35-1729	20 Tb 90 Tchs
85	35-7656	7 Tb 21 Tchs 30 Tchc 38 Tchs 43 Tchc 123 Tchs 130 Tchs+Tchc
86	35-3838	20 Tb 45 Tchs 60 Tchc+Tchs 71 Tchs
87	35-7377	5 Tb 35 Tchs 40 Tchs+Tchc 84 Tchs 89 Tchs+Tchc 95 Tchs 100 Tchs+Tchc 115 Tchs
88	35-7376	12 Tchs 25 Tchs+Tchc 30 Tchs 35 Tchs+Tchc 90 Tchs 115 Tchs+Tchc
89	35-1263	10 Tb 17 Tchc+Tchs 73 Tchs+Tchc
90	35-224	10 Tb 29 Tchs 32 Tchc 45 Tchs 48 Tchc 71 Tchs 78 Tchs+Tchc 107 Tchs 109 Tchc+Tchs
91	35-11409	13 Tb 18 Tchc 51 Tchs 79 Tchs+Tchc 87 Tchs 103 Tchc 120 Tchs
92	35-5638	15 Q 45 Tchs 50 Tchc+Tchs 60 Tchco 75 Tchs+Tchc 86 Tchs
93	35-7379	10 Tchs+Tchc 15 Tchc 30 Tchs 40 Tchs+Tchc 75 Tchs 85 Tchs+Tchc 96 Tchs

Well Number	Identifier[1]	Formations Penetrated[2]
94	35-8123	40 Tb+Tchs 60 Tchs+Tchc 110 Tchs
95	35-636	30 Tchc 42 Tchs 45 Tchs+Tchc
96	35-185	11 Tb 14 Tchs 15 Tchc 25 Tchs 28 Tchc+Tchs 54 Tchs 61 Tchc 66 Tchs 69 Tchc 89 Tchs 91 Tchc 114 Tchs
97	35-7228	9 Tchs+Tchc 16 Tchc 55 Tchs+Tchc 61 Tchs 69 Tchc 78 Tchs+Tchc 94 Tchs 97 Tchc
98	35-7306	11 Tchs 20 Tchs+Tchc 39 Tchs 42 Tchc 150 Tchs 200 Tkw
99	35-7305	6 Tchs 35 Tchs+Tchc 70 Tchs 76 Tchc 87 Tchs 117 Tchs+Tchc 155 Tchs 190 Tkw
100	35-284	37 Q+Tchs 38 Tchc 55 Tchs 57 Tchs+Tchc
101	35-662	11 Q 16 Tchs+Tchc 50 Tchc 79 Tchs
102	35-7499	14 Tchs 22 Tchs+Tchc 30 Tchs 38 Tchc 43 Tchs 68 Tchs+Tchc 93 Tchc+Tchs 106 Tchc 163 Tchs 172 Tkw
103	35-3761	49 Tchs+Tchc 68 Tchs 71 Tchc 130 Tchs
104	35-9641	15 Q 25 Tchs 40 Tchs+Tchc 50 Tchc 75 Tchs 80 Tchco 95 Tchs+Tchco 128 Tchs
105	35-7516	12 Q 18 Tchs 30 Tchc+Tchs 32 Tchs 36 Tchc 100 Tchs 102 Tchc 158 Tchs 162 Tkw
106	35-8395	30 Tchs 74 Tchs+Tchc 110 Tchs 130 Tchs+Tchc 140 Tchs
107	35-7632	30 Tchs 41 Tchc 51 Tchc+Tchs 81 Tchs 83 Tchc 85 Tchs+Tchc 98 Tchs 101 Tchc 119 Tchs 121 Tchc 141 Tchs
108	35-1117	40 Tchs+Tchc 56 Tchs 59 Tchc 82 Tchs+Tchc 97 Tchs 102 Tchc+Tchs 174 Tchs 185 Tkw
109	35-11	12 Tb 40 Tchs 45 Tchc 123 Tchs
110	35-3762	30 Tb 58 Tchs+Tchc 63 Tchc 74 Tchs+Tchc 126 Tchs
111	35-11454	20 Q+Tb 47 Tchs+Tchc 73 Tchs 78 Tchc 103 Tchs+Tchc 149 Tchs
112	35-3402	20 Q+Tb 50 Tchs 60 Tchs+Tchc 70 Tchs 80 Tchs+Tchc 140 Tchs
113	35-901	23 Tb 103 Tchs+Tchc 154 Tchs 185 Tkw
114	35-4	28 Tb 32 Tchs 44 Tchs+Tchc 48 Tchc 60 Tchs 94 Tchs+Tchc 128 Tchs
115	35-882	126 Tchs 135 Tchc 146 Tchs 150 Tchc 172 Tchs
116	35-2892	10 Tb 20 Tchs 50 Tchs+Tchc 135 Tchs
117	35-144	11 Tb 50 Tchs
118	35-4065	10 Q 11 Tchs 13 Tchc 31 Tchs 36 Tchs+Tchc 90 Tchs 92 Tchc 97 Tchs 99 Tchc 104 Tchs 125 Tchc 155 Tchs 185 Tkw
119	35-949	22 Tb 66 Tchs+Tchc 109 Tchs 122 Tchc 159 Tchs 209 Tkw
120	35-954	15 Tb 34 Tchs 80 Tchc 105 Tchs 108 Tchc 142 Tchs+Tchc 169 Tchs 172 Tkw
121	35-319	51 Tchs 75 Tchc 87 Tchs 89 Tchc
122	35-204	18 Tchs 21 Tchc 68 Tchs 74 Tchc 90 Tchs
123	35-8346	30 Tb 60 Tchs 75 Tchc+Tchs 100 Tchs
124	35-3129	20 Tb 80 Tchs 90 Tchs+Tchc 120 Tchs
125	35-9407	13 Tb 54 Tchs+Tchc 82 Tchs 90 Tchs+Tchc 100 Tchs 105 Tchs+Tchc
126	35-234	10 Tb 21 Tchs 24 Tchc 87 Tchs
127	35-7933	15 Tb 30 Tchs 45 Tchs+Tchc 60 Tchc 75 Tchs+Tchc 98 Tchs
128	35-3638	15 Tb 82 Tchs 87 Tchs+Tchc 163 Tchs
129	35-11604	20 Tb 60 Tchs 70 Tchs+Tchc 90 Tchs 105 Tchs+Tchc 155 Tchs
130	35-8274	24 Tb 43 Tchs 52 Tchc 70 Tchs 94 Tchs+Tchc 194 Tchs 210 Tkw
131	35-6822	39 Tchs 52 Tchs+Tchc 124 Tchs 136 Tchc 190 Tchs 230 Tkw
132	35-6213	15 Tb 35 Tchc+Tchs 70 Tchs 85 Tchc+Tchs 150 Tchs+Tchc 165 Tchs 180 Tchs+Tchc 205 Tkw
133	35-5869	80 Tchs+Tchc 190 Tchs 200 Tchs+Tchc 215 Tchs 260 Tkw
134	35-839	16 Tb 25 Tchc 50 Tchs 80 Tchs+Tchc 93 Tchc 105 Tchc
135	35-362	13 Tb 15 Tchc 47 Tchs 60 Tchs+Tchc 89 Tchs 101 Tchs+Tchc 132 Tchs
136	35-956	6 Tb 31 Tchs 76 Tchs+Tchc 99 Tchc 145 Tchs
137	35-8337	125 Tchs 128 Tchco 180 Tchs
138	35-10490	9 Tb 22 Tchs 46 Tchs+Tchc 75 Tchs
139	35-1196, G	5 Tb 15 Tchc 55 Tchs 75 Tchc 85 Tchs 90 Tchc 100 Tchs 115 Tchc 155 Tchs+Tchc 340 Tkw 560 Tsr
140	35-4988	33 Tb 50 Tchs 80 Tchc+Tchs 84 Tchc 100 Tchs
141	35-10043	20 Tb 80 Tchs 110 Tchs+Tchc 140 Tchs
142	35-11000	15 Tb 30 Tchc+Tchs 40 Tchs 55 Tchc+Tchs 100 Tchs 105 Tchc 116 Tchs
143	35-8330	8 Tb 26 Tchs 44 Tchs+Tchc 63 Tchs 75 Tchs+Tchc 87 Tchs 90 Tchs+Tchc
144	35-8112	15 Tb 30 Tb+Tchs 50 Tchs+Tchc 60 Tchc 85 Tchs
145	35-8596	12 Tb 33 Tchs 47 Tchc 69 Tchs 76 Tchs+Tchc 92 Tchs

Well Number	Identifier[1]	Formations Penetrated[2]
146	35-10703	10 Tb 30 Tchs 45 Tchs+Tchc 60 Tchs 90 Tchc 95 Tchs 105 Tchco 150 Tchs
147	35-9702	15 Tb 25 Tchs 40 Tchs+Tchc 50 Tchc 75 Tchs
148	35-9199	10 Tb 25 Tchs+Tchc 40 Tchs 50 Tchc 74 Tchs
149	35-22816, G Millville corehole; 35-12956, public-supply well adjacent	corehole: 37 Tb 55 Tchc 110 Tchs 117 Tchc 151 Tchs 155 Tchc 158 Tchs 410 Tkw 732 Tsr TD 1500 well: 41 Tb 51 Tchc 61 Tchc+Tchs 71 Tchs+Tchc 88 Tchs 111 Tchs+Tchc 115 Tchc 153 Tchs+Tchc
150	35-10920	15 Tb 45 Tchs+Tchc 55 Tchc 85 Tchs 95 Tchc+Tchs
151	35-8053	13 Tb 32 Tchs 60 Tchs+Tchc 72 Tchs 77 Tchs+Tchc
152	35-7145	15 Tb 40 Tchc 55 Tchs+Tchc 70 Tchc 78 Tchs+Tchc 88 Tchs
153	35-7660	10 Tb 29 Tchs 74 Tchs+Tchc 106 Tchs
154	35-5756, G	11 Q 17 Tchc 47 Tchs 50 Tchc 60 Tchs 62 Tchc 72 Tchs 75 Tchc 105 Tchs 112 Tchc 123 Tchs
155	35-1421	22 Q 27 Tchs+Tchc 74 Tchs 80 Tchs+Tchc
156	35-67	19 Q 24 Tchc 35 Tchs+Tchc 59 Tchs
157	35-4700	10 Tb 28 Tchs 60 Tchs+Tchc 65 Tchc 80 Tchs 95 Tchs+Tchc 97 Tchc 120 Tchs 132 Tchc 150 Tchs 155 Tchc 175 Tchs
158	35-200	12 Tb 40 Tchs
159	35-1280	19 Tb 40 Tchs 113 Tchs+Tchc 135 Tchs
160	35-5761	20 Tb 94 Tchs+Tchc 122 Tchs 127 Tchc 170 Tchs 173 Tchs+Tchc
161	35-4594	50 Tchs+Tchc 160 Tchs 200 Tchs+Tchc 215 Tchs 260 Tkw
162	35-7625	15 Tb 30 Tchs+Tchc 40 Tchc 80 Tchs 90 Tchco 120 Tchs 130 Tchc 153 Tchs 160 Tchco+Tchs
163	35-9043	10 Tb 20 Tchc 35 Tchs+Tchc 50 Tchs 65 Tchs+Tchc 90 Tchs 100 Tchs+Tchc 110 Tchc 127 Tchs
164	35-5472	14 Q 21 Tchs+Tchc 70 Tchs 71 Tchc 82 Tchs 103 Tchs+Tchc 106 Tchco 119 Tchs 128 Tchc 175 Tchs 190 Tkw
165	35-973	18 Q 37 Tchc 64 Tchs+Tchc 82 Tchs 100 Tchs+Tchc 114 Tchs 123 Tchs+Tchc 147 Tchs 158 Tchs+Tchc 170 Tchs 175 Tkw
166	35-986	15 Q 33 Tchc 62 Tchs+Tchc 90 Tchc 154 Tchs 158 Tchc
167	35-969	7 fill 12 Q 17 Tchc 36 Tchs+Tchc 62 Tchs 115 Tchs+Tchc 155 Tchs
168	35-977	11 Q 32 Tchc 87 Tchs+Tchc 149 Tchs 154 Tkw
169	35-7160	50 Tchs 52 Tchc 80 Tchs
170	35-1155	25 Q 43 Tchs 90 Tchs+Tchc 98 Tchc 107 Tchs+Tchc 115 Tchs 124 Tchs+Tchc 165 Tchs 175 Tkw
171	35-17509	23 Q 32 Tchs+Tchc 60 Tchs 95 Tchs+Tchc 97 Tchc 134 Tchs 146 Tkw
172	35-2522	12 fill 20 Q 82 Tchs+Tchc+Tchco 88 Tchc 100 Tchs 112 Tchs+Tchco 120 Tchs 122 Tchc
173	35-841, G to 280 feet	5 fill 36 Q 50 Tchc 115 Tchs 530 Tkw 720 Tsr 740 Tmq
174	35-12150	11 Q 30 Tchs+Tchc 61 Tchs 81 Tchs+Tchc 107 Tchs 111 Tchc 116 Tchs 297 Tkw
175	35-968	8 fill+Q 22 Tchs+Tchc 25 Tchc 102 Tchs+Tchc 108 Tchc 116 Tchs+Tchc 125 Tkw
176	35-314	21 Q 31 Tchs+Tchc 46 Tchs 60 Tchs+Tchc 75 Tchs
177	35-171	5 Tb 42 Tchs 47 Tchs+Tchc 67 Tchs
178	35-333	8 Tb 12 Tchs 16 Tchc 28 Tchs 36 Tchc 44 Tchs 55 Tchs+Tchc 57 Tchc 65 Tchs 66 Tchc
179	35-11181	30 Tchs 42 Tchs+Tchc
180	35-473	6 Q 14 Tchs 39 Tchc+Tchs 56 Tchs+Tchc 65 Tchs 69 Tchco
181	35-3519	20 Q 30 Tchs 40 Tchs+Tchc 70 Tchs 80 Tchs+Tchc 90 Tchs 100 Tchs+Tchc 130 Tchs 160 Tkw
182	35-5738	40 Tb 60 Tchs 90 Tchs+Tchc 95 Tchco 110 Tchs 111 Tchco
183	35-11007	22 Tb 40 Tchs 94 Tchs+Tchc 95 Tchc 98 Tchs
184	35-843	20 Tb 25 Tchc 59 Tchs 93 Tchc 115 Tchs 141 Tchs+Tchc 155 Tchc 185 Tchs+Tchc 380 Tkw
185	35-11003	10 Tb 70 Tchs+Tchc 94 Tchs 100 Tchc
186	35-862 35-12641	26 Tb 47 Tchs 112 Tchs+Tchc 142 Tchs 148 Tchc 185 Tchs 202 Tkw
187	35-9150	7 Tb 45 Tchs 105 Tchs+Tchc 142 Tchs
188	35-4133	80 Tchs+Tchc 90 Tchs 100 Tchc
189	35-8236	16 Tb 23 Tchc 46 Tchs 50 Tchc 58 Tchs 60 Tchs+Tchc
190	35-9047	9 Tb 47 Tchs+Tchc 80 Tchs 85 Ychs+Tchc
191	35-5660	12 Tb 33 Tchs 57 Tchs+Tchc 67 Tchs 72 Tchc
192	35-3907	8 Tb 70 Tchs 80 Tchs+Tchc 92 Tchs
193	35-470	26 Tchs 38 Tchc 86 Tchs 87 Tchc

Well Number	Identifier[1]	Formations Penetrated[2]
194	35-11185	15 Tb 45 Tchs+Tchc 60 Tchs 70 Tchc 95 Tchs
195	35-6824	15 Tb 40 Tchs+Tchc 55 Tchs 70 Tchs+Tchc 85 Tchs
196	35-7589	7 Tb 41 Tchs 54 Tchs+Tchc 70 Tchs
197	35-11525	15 Tb 30 Tchc 45 Tchs+Tchc 55 Tchs 65 Tchc 88 Tchs
198	35-6327	40 Tb 60 Tchc 125 Tchs 135 Tchs+Tchc
199	35-6845	15 Tb 30 Tchs 40 Tchc 85 Tchs 90 Tchs+Tchc
200	35-10226	10 Tb 25 Tchs 40 Tchc 50 Tchs 65 Tchs+Tchc 75 Tchc 86 Tchs
201	35-1406	8 Tb 15 Tchc 67 Tchs+Tchc 93 Tchs
202	64-863-H	14 Q 50 Tchs
203	64-866-1	9 Q 31 Tchs 42 Tchc 50 Tchs
204	64-865-7	25 Q or Tchs 35 Tchc 50 Tchs
205	64-868-4	50 Tchs
206	64-873-12	9 Q 50 Tchs
207	64-872-7	27 Tchs 32 Tchc 50 Tchs
208	231-W-6	30 Q 64 Tchs
209	202-W-8	12 Q 17 Tchc 22Tchs 33 Tchc 66 Tchs
210	64-860-26	4 Q 40 Tchs 50 Tchc

[1] Numbers of the form 35-xxxx are N. J. Department of Environmental Protection well-permit numbers. Numbers prefixed by "64-", "231-", or "202-" are N. J. Department of Transportation borings. A "G" following the identifier indicates that a gamma-ray log is available for the well. Where two well-permit numbers are reported without annotation, the first is for a production well and the second is for a test well at the same location. The geologic log is from the test well.

[2]Number is depth (in feet below land surface) of base of unit indicated by abbreviation following the number. Final number is total depth of well rather than base of unit. For example, "12 Tchs 34 Tchc 62 Tchs" indicates Tchs from 0 to 12 feet below land surface, Tchc from 12 to 34 feet, and Tchs from 34 to bottom of hole at 62 feet. Formation abbreviations and the corresponding drillers' descriptive terms used to infer the formation are: Q=yellow, white, and gray sand and gravel surficial deposits of Pleistocene and Holocene age (units Qtu, Qtl, Qals, Qcm1, Qe, Qm); Tb=orange, red, yellow, brown clayey sand and gravel to gravelly clay (Bridgeton Formation). Bedrock formations are: Tchs=white, yellow, gray, brown (minor red, orange) fine, medium, and coarse sand (and minor fine gravel) (Cohansey Formation); Tchc=yellow, white, gray (minor red and orange) clay, silty clay, and sandy clay (Cohansey Formation); Tchco=dark gray to black clay with wood or lignite (Cohansey Formation); Tkw=gray and brown clay, silt and sand (Kirkwood Formation); Tsr=gray to green glauconitic clayey silty sand with some mica and shells (Shark River Formation); Tmq=gray micaceous silt (Manasquan Formation, well 173 only). A "+" sign indicates that units are interbedded or that the depth of the contact between them cannot be determined. Units are inferred from drillers', geologists', or engineers' lithologic descriptions on well records filed with the N. J. Department of Environmental Protection, or on N. J. Department of Transportation boring logs, and from geophysical well logs. Units shown for wells may not match the map and sections due to variability in drillers' descriptions and the thin, discontinuous geometry of many clay beds. In some well logs, surficial deposits cannot be distinguished from Cohansey sands; thus, the uppermost Tchs unit in well logs may include overlying surficial deposits.