DEPARTMENT OF ENVIRONMENTAL PROTECTION
LAND USE MANAGEMENT
NEW JERSEY GEOLOGICAL SURVEY

Prepared in cooperation with the
U.S. GEOLOGICAL SURVEY
NATIONAL GEOLOGIC MAPPING PROGRAM

BEDROCK GEOLOGY OF THE LONG BRANCH QUADRANGLE
MONMOUTH COUNTY, NEW JERSEY
OPEN-FILE MAP OFM 78

INTRODUCTION

Bedrock of the Long Branch quadrangle consists of unconsolidated sand, silt, clay, and glauconite clay laid down in coastal, nearshore-marine, and continental-shelf settings between 95 and 10 million years ago. The sediments are classed in 19 formations and members. Lithology and age of the formations are provided in the *Description of Map Units*. Age of the formations and their bounding unconformities are summarized in the *Correlation of Map Units*. Cross sections AA', BB', and CC' show the subsurface geometry of the formations along the line of section. Surficial sand and gravel, silty sand, and organic silt and clay, of late Miocene, Pliocene, and Quaternary age, overlie the bedrock in most of the quadrangle. The surficial deposits include fluvial, estuarine, and nearshore-marine sediments and were mapped by Stanford (2000). They are shown by overprint pattern on the map where they are more than 5 feet thick.

DESCRIPTION OF MAP UNITS

Tch COHANSEY FORMATION—Fine-to-coarse quartz sand, with thin beds of very coarse sand to very fine pebbles; very pale brown, white, yellow, light gray. Weakly horizontally bedded to cross-bedded. Sand and very fine pebbles consist of quartz with minor (<5%) quartzite and chert. Coarse-sand beds are locally iron-cemented. As much as 30 feet thick in the Long Branch quadrangle. In hilltop erosional remnants above 140-160 feet in elevation in the southwest corner of the quadrangle. Latest middle Miocene in age, based on pollen (Owens and others, 1988, 1998). Unconformably overlies the Kirkwood Formation.

Tkw KIRKWOOD FORMATION—Very-fine-to-fine quartz sand, minor medium-to-coarse sand and very fine pebbles, with thin beds of silt and clay; very pale brown, white, yellow, light gray. Sand is unstratified to horizontally bedded. Silt and clay are interlaminated or thinly interbedded with very fine-to-fine sand. Sand consists of quartz with minor mica and a trace (<1%) of glauconite in places in the lowermost several feet of the formation. As much as 75 feet thick. Early Miocene in age based on diatoms (Woolman, 1895; Sugarman and Owens, 1994), foraminifera (Miller and others, 2006), and strontium-isotope ratios (Sugarman and others, 1993). Unconformably overlies the Manasquan and Vincentown Formations.

Tmq MANASQUAN FORMATION—Glauconitic (15-30%) clayey-silty very-fine-to-fine sand to fine-sandy clayey silt; olive and olive-gray where unweathered, olive-brown to brown where weathered; unstratified. As much as 80 feet thick. Early Eocene in age based on calcareous nanofossils (Sugarman and others, 1995; Owens and others, 1998; Miller and others, 2006) and foraminifera (Miller and others, 2006). Described by drillers as "green sand" or "green clay". Unconformably overlies the Vincentown Formation.

Tvt VINCENTOWN FORMATION—Glauconitic (5-20%) silty medium-to-coarse quartz sand, some fine-to-medium sand, some very coarse sand to very fine pebbles; yellow, reddish-yellow, olive-yellow, olive-brown; unstratified to weakly horizontally stratified. Coarse sands are locally iron-cemented into beds and masses as much as 10 feet thick. Lowermost 10-20 feet of the formation is silty fine-to-medium sand, with more glauconite than upsection. Total thickness of formation is 180 feet. Late Paleocene in age, based on foraminifera (Olsson and Wise, 1987; Miller and others, 2006) and calcareous nannofossils (Sugarman and others, 1991). Unconformably overlies the Hornerstown Formation.

Tht HORNERSTOWN FORMATION—Glauconite (>50%) clay and silty clay; olive, dark green, black where unweathered, olive-brown with brown to reddish-brown mottles where weathered; unstratified. Glauconite occurs primarily in soft grains of fine-to-medium sand size. Thickness is 25 to 30 feet. Early Paleocene in age, based on foraminifera (Olsson and others, 1997; Landman and others, 2004; Miller and others, 2006) and calcareous nannofossils (Sugarman and others, 1991; Miller and others, 2006). Unconformably overlies the Tinton Formation.

Kt TINTON FORMATION—Glauconitic (5-30%) silty medium-to-coarse and fine-to-medium quartz sand; reddish-brown, reddish-yellow, yellowish-brown where weathered, grayish-brown, brown, olive-brown where unweathered; unstratified to weakly horizontally stratified. Commonly iron-cemented into beds and masses as much as 15 feet thick. Uppermost 4-6 feet, just below contact with Hornerstown Formation, is a brown to olive-gray glauconitic clayey-silty fine sand to fine-sandy silt-clay ("New Egypt Formation" of Landman and others, 2004). Total thickness of Tinton is 30 to 40 feet. Late Cretaceous (late Maestrichtian) in age based on foraminifera, nannofossils, and ammonites (Landman and others, 2004) and strontium-isotope ratios (Sugarman and others, 1995). Overlies the Shrewsbury Member of the Red Bank Formation. Contact with Shrewsbury is not exposed in the Long Branch quadrangle. It is gradational over several feet in the Sandy Hook quadrangle, north of the Long Branch quadrangle (Minard, 1969), but may be unconformable in the Marlboro quadrangle, west of the Long Branch quadrangle (Sugarman and Owens, 1996).

Krs RED BANK FORMATION, SHREWSBURY MEMBER—Fine-to-medium quartz sand, minor medium-to-coarse sand, slightly silty, glauconitic (<5%), and micaceous; reddish-yellow, yellow where weathered, light gray and gray where unweathered; unstratified to weakly horizontally bedded; locally iron-cemented. As much as 100 feet thick. Late Cretaceous (late Maestrichtian) in age based on fossils in the underlying Sandy Hook Member; the Shrewsbury Member is unfossiliferous. Grades downward within 2-3 feet to the Red Bank Formation, Sandy Hook Member. On geophysical well logs, transition to Sandy Hook Member is marked by increased gamma-ray intensity and decreased resistance.

Krsh RED BANK FORMATION, SANDY HOOK MEMBER—Fine-sandy clayey silt, micaceous, slightly glauconitic (<5%); brown to yellowish-brown where weathered, dark gray, olive-gray where unweathered; unstratified. Calcareous brachiopod, pelecypod, and gastropod fossils are common. As much as 20 feet thick. Late Cretaceous (late Maestrichtian) in age based on calcareous nannofossils (Sugarman and Owens, 1996), foraminifera (Olsson, 1964; Olsson and Wise, 1987; Owens and others, 1977), and strontium-isotope ratios (Sugarman and others, 1995). Grades downward within 2-3 feet into the Navesink Formation. On geophysical well logs, transition to Navesink is marked by increased gamma-ray intensity and slightly decreased resistance.

Kns NAVESINK FORMATION—Glauconitic (20-50%) clayey-silty fine-to-medium quartz sand to fine-sandy clayey silt; dark gray, gray, grayish-brown, olive-gray where unweathered, brown to yellowish-brown where weathered; unstratified. Glauconite occurs chiefly in soft grains of fine-to-medium sand size. Calcareous brachiopod, pelecypod, and gastropod fossils are common. Late Cretaceous (late Maestrichtian) in age based on calcareous nannofossils and foraminifera (Olsson, 1964; Miller and others, 2006), macrofossils (Sohl, 1977), and strontium-isotope ratios (Sugarman and others, 1995). Unconformably overlies the Mount Laurel Formation. Contact with Mount Laurel is commonly marked by a sharp peak in gamma-ray intensity on geophysical well logs, with reduced intensity in the Mount Laurel.

Kml MOUNT LAUREL FORMATION—Glauconitic (3-15%) fine-to-medium quartz sand, minor medium-to-coarse sand, with thin interbeds of clay and silt; yellowish-brown where weathered, olive-gray to olive-brown where unweathered. Sand is unstratified to horizontally bedded to cross-bedded. As much as 50 feet thick in the southern part of the quadrangle; thins to 20 feet to the north. In subsurface only, covered by surficial deposits in the Navesink River estuary and by overlying Coastal Plain formations elsewhere. Late Cretaceous (late Campanian) in age, based on calcareous nannofossils and strontium-isotope ratios (Sugarman and others, 1991; Miller and others, 2006). Grades downward into the Wenonah Formation. On geophysical well logs, transition to Wenonah is generally marked by slightly decreased resistance and increased gamma-ray intensity.

Kw WENONAH FORMATION—Silty fine-to-very-fine quartz sand to fine-sandy clayey silt, micaceous, slightly glauconitic (<5%); yellow, very pale brown where weathered, gray to pale-olive where unweathered; unstratified. As much as 40 feet thick. In subsurface only, covered by surficial deposits in the Navesink River estuary and by overlying Coastal Plain formations elsewhere. Late Cretaceous (late Campanian) in age based on pollen (Wolfe, 1976) and ammonites (Kennedy and Cobban, 1994). Grades downward into the Marshalltown Formation. On geophysical well logs, transition to Marshalltown is marked by increased gamma-ray intensity.

Kmt MARSHALLTOWN FORMATION—Glauconitic (20-50%), slightly micaceous, silty-clayey fine-to-medium quartz sand, to fine-sandy clayey silt; olive-gray to olive-brown; unstratified. Thickness is 15 to 20 feet. In subsurface only. Late Cretaceous (middle Campanian) in age based on calcareous nannofossils, foraminifera, mollusks, and strontium-isotope ratios (Sugarman and others, 1995). Unconformably overlies the Englishtown Formation. On geophysical well logs, contact with Englishtown is marked by decreased gamma-ray intensity and slightly increased resistance.

Ket ENGLISHTOWN FORMATION—Fine-to-medium quartz sand, minor medium-to-coarse sand, with thin interbeds of clay and silt; micaceous and lignitic, with a trace (<1%) of glauconite; white and light gray where weathered, dark gray where unweathered. Sand is unstratified to horizontally bedded to cross-bedded. In subsurface only. As much as 140 feet thick in the eastern part of the quadrangle, thins to 110 feet thick in the west. In the Asbury Park quadrangle to the south of the Long Branch quadrangle, and farther southwest in northern Ocean County, the Englishtown is divided into an upper and lower member based on the presence of a clay-silt facies in the middle of the formation that is distinctive on gamma-ray logs (Nichols, 1977; Sugarman and Owens, 1994; Miller and others, 2006). This facies is not well marked on gamma-ray logs in the Long Branch quadrangle (wells 29-9335, 29-7941, 29-9465, 29-6173, 29-23948, and 29-48307) and so the members are not mapped here. Late Cretaceous (middle to late Campanian) in age, based on pollen (Wolfe, 1976), ostracodes (Gohn, 1992), calcareous nannofossils, and strontium-isotope ratios (Miller and others, 2006). Grades downward into the Woodbury Formation. On geophysical well logs, transition to Woodbury is marked by increased gamma-ray intensity and decreased resistance.

Kwb WOODBURY FORMATION—Clay, silty clay, with minor thin beds of very fine quartz sand, slightly micaceous and lignitic; dark gray and black where unweathered, yellowish-brown to brown where weathered; unstratified. In subsurface only. As much as 240 feet thick in the eastern part of the quadrangle, thins to 160 feet thick in the central and western parts of the quadrangle. Late Cretaceous (early to middle Campanian) based on pollen (Wolfe, 1976), ostracodes (Gohn, 1992), and calcareous nannofossils (Miller and others, 2006). Grades downward into the Merchantville Formation. On geophysical well logs, transition to the Merchantville is marked by slightly increased gamma-ray intensity.

Kmv MERCHANTVILLE FORMATION—Glauconitic (20-50%) clayey silt to sandy clayey silt, slightly micaceous; olive, dark gray, black where unweathered, olive-brown to yellowish-brown where weathered; unstratified. Thickness is 40 to 60 feet. In subsurface only. Late Cretaceous (early Campanian to Santonian) in age based on ammonites (Owens and others, 1977) and calcareous nannofossils (Miller and others, 2006). The Cheesequake Formation, a glauconitic clayey silt underlying the Merchantville, is mapped in outcrop in northern Monmouth and eastern Middlesex counties (Sugarman and Owens, 1996; Sugarman and others, 2005; Stanford and Sugarman, 2008) and in the subsurface both west and south of the Long Branch quadrangle (Sugarman and Owens, 1994, 1996). Because it is lithically similar to the Merchantville and cannot be easily distinguished from it on geophysical logs, it is not mapped separately here. If present, it is included here within the Merchantville, or uppermost Magothy Formation.

Kmg MAGOTHY FORMATION—Fine-to-medium quartz sand, some very-fine-to-fine sand and minor medium-to-coarse sand, micaceous, lignitic, and pyrite-bearing in places, with thin interbeds of silt and clay; white to yellow where weathered, light gray to gray where unweathered. Sand is cross-bedded to laminated. As much as 220 feet thick. In subsurface only. Late Cretaceous (Turonian-Santonian) in age, based on pollen (Christopher, 1979, 1982; Miller and others, 2006). Unconformably overlies the Raritan Formation, Woodbridge Clay member. On geophysical well logs, contact with the Woodbridge is marked by increased gamma-ray intensity.

In its outcrop area in eastern Middlesex County the Magothy is divided into 5 members. From bottom to top they include: South Amboy Fire Clay, Old Bridge Sand, Amboy Stoneware Clay, Morgan beds, and Cliffwood beds (Sugarman and others, 2005). The Old Bridge is a thick sand, the other members are interbedded clay-silt and fine sand. These members may extend downdip in the subsurface (Miller and others, 2006). Geophysical well logs in the Long Branch quadrangle (wells 29-21612, 29-23948, 29-21510, 29-9335, 29-7941, 29-9465, and 29-6173) show generally higher gamma-ray intensity and lower resistivity in the uppermost 50 feet of the formation, and again in the lowermost 30-40 feet, than in the middle 100-120 feet. The upper fine-grained beds may correspond to the Amboy Stoneware Clay and Morgan and Cliffwood beds, and the lower fine-grained beds may correspond to the South Amboy Fire Clay. The middle sand may correspond to the Old Bridge Sand.

Krw RARITAN FORMATION, WOODBRIDGE CLAY MEMBER—Clay and silt, micaceous, lignitic, and pyrite-bearing; gray and black where unweathered, white to brown where weathered; with minor thin interbeds and laminas of white, yellow, and light gray very-fine-to-fine quartz sand. As much as 110 feet thick. In subsurface only, penetrated by wells 29-9465 and 29-1921. The driller's log for well 29-2366 in Eatontown reports "weathered bedrock", with no further information, beneath the Magothy Formation, at a depth of 875-891 feet. This depth is anomalously shallow for the basement surface, suggesting that the material may be weathered clay of either the Woodbridge or South Amboy Fire Clay member of the Magothy. The Woodbridge is Late Cretaceous (late Cenomanian) in age based on pollen (Christopher, 1979) and ammonites (Cobban and Kennedy, 1990). Grades downward into the Raritan Formation, Farrington Sand member. Transition to the Farrington is marked by decreased gamma-ray intensity on geophysical well logs.

Krf RARITAN FORMATION, FARRINGTON SAND MEMBER—Fine-to-coarse quartz sand, some coarse-to-very-coarse sand, minor beds of clay and silt; white and yellow where weathered, gray where unweathered. Sands are horizontally bedded to cross-bedded. As much as 60 feet thick. In subsurface only, penetrated in well 29-9465. Late Cretaceous (Cenomanian) in age based on pollen (Christopher, 1979). Unconformably overlies the Potomac Formation. Contact with Potomac is marked by increased gamma-ray intensity on geophysical well logs.

Kp POTOMAC FORMATION—Fine-to-medium quartz sand, some coarse-to-very-coarse sand, with beds of clay and silt; white, red, yellow where weathered, gray where unweathered. Sands are horizontally bedded to cross-bedded, clays are in beds as much as 8 feet thick. More than 90 feet thick, full thickness not penetrated in the Long Branch quadrangle. In subsurface only, partially penetrated in well 29-9465. Late Cretaceous (Albian-Cenomanian) based on pollen (Sugarman and Owens, 1996; Miller and others, 2006), which indicates that the Potomac in this area corresponds to the Potomac Formation, unit 3, of Doyle and Robbins (1977).

MAP SYMBOLS

Contact—Approximately located. Solid triangle indicates contact observed in outcrop. Open triangle indicates contact formerly observed, as reported in permanent note collection of the N. J. Geological Survey.

Formation observed in outcrop or excavation, or penetrated in hand-auger hole.

Formation formerly observed in outcrop or excavation—Reported in permanent note collection of the N. J. Geological Survey.

Formation covered by surficial deposits—Surficial deposits of Quaternary, Pliocene, and late Miocene age continuous and generally more than 5 feet thick.

29-31486
14 surficial
37 Krs
39 Krsh

Well showing formations penetrated—Location accurate to within 200 feet. Identifiers of the form 29-xxxx are N. J. Department of Environmental Protection well permit numbers. Identifiers of the form 25-xxx are U. S. Geological Survey Ground Water Site Inventory identification numbers. Lithologic and geophysical logs for most of these wells are provided by Gronberg and others (1989). Identifiers of the form 29-xx-xxx are N. J. Atlas Sheet coordinates of records of wells in the permanent note collection of the N. J. Geological Survey. Identifiers of the form "Healy 3-23-63 B2" provide the date and identification number of test borings drilled by the A. J. Healy Company, with copies on file at the N. J. Geological Survey. Identifier "KP1" indicates a stratigraphic test hole drilled by the U. S. Geological Survey in cooperation with the N. J. Geological Survey and Rutgers University Earth and Planetary Sciences Department in 2008. Number preceding formation symbol is depth, in feet below land surface, of base of unit, as inferred from lithologic logs. Final number is total depth of well or boring rather than base of unit. "Surficial" indicates surficial deposits. Units joined with a "+" cannot be separately identified in the drillers' descriptions. For wells shown on sections the formations penetrated are not listed on the map label. Drillers' logs vary in detail and accuracy. They are used in combination with outcrop data and geophysical well logs to map contacts, so depths of some contacts inferred from the logs may not match those shown on the map and sections.

29-15004
70 Krs
120 Krsh
135 Kns

Well showing formations penetrated—Location accurate to within 500 feet. Identifiers and log information as above.

Geophysical log—On sections. Gamma-ray log is indicated by "G" after well identifier, and is shown by a red line. Intensity of gamma-ray radiation increases to right. Electric log is indicated by "E" after well identifier and is shown by paired blue lines, with spontaneous potential shown on left-hand curve (voltage increasing to right) and resistivity shown on right-hand curve (resistance increasing to right). Horizontal scale varies from well to well. Arrows indicate gamma responses that are due to well construction features rather than formation lithology (well 29-9335, section AA' only).

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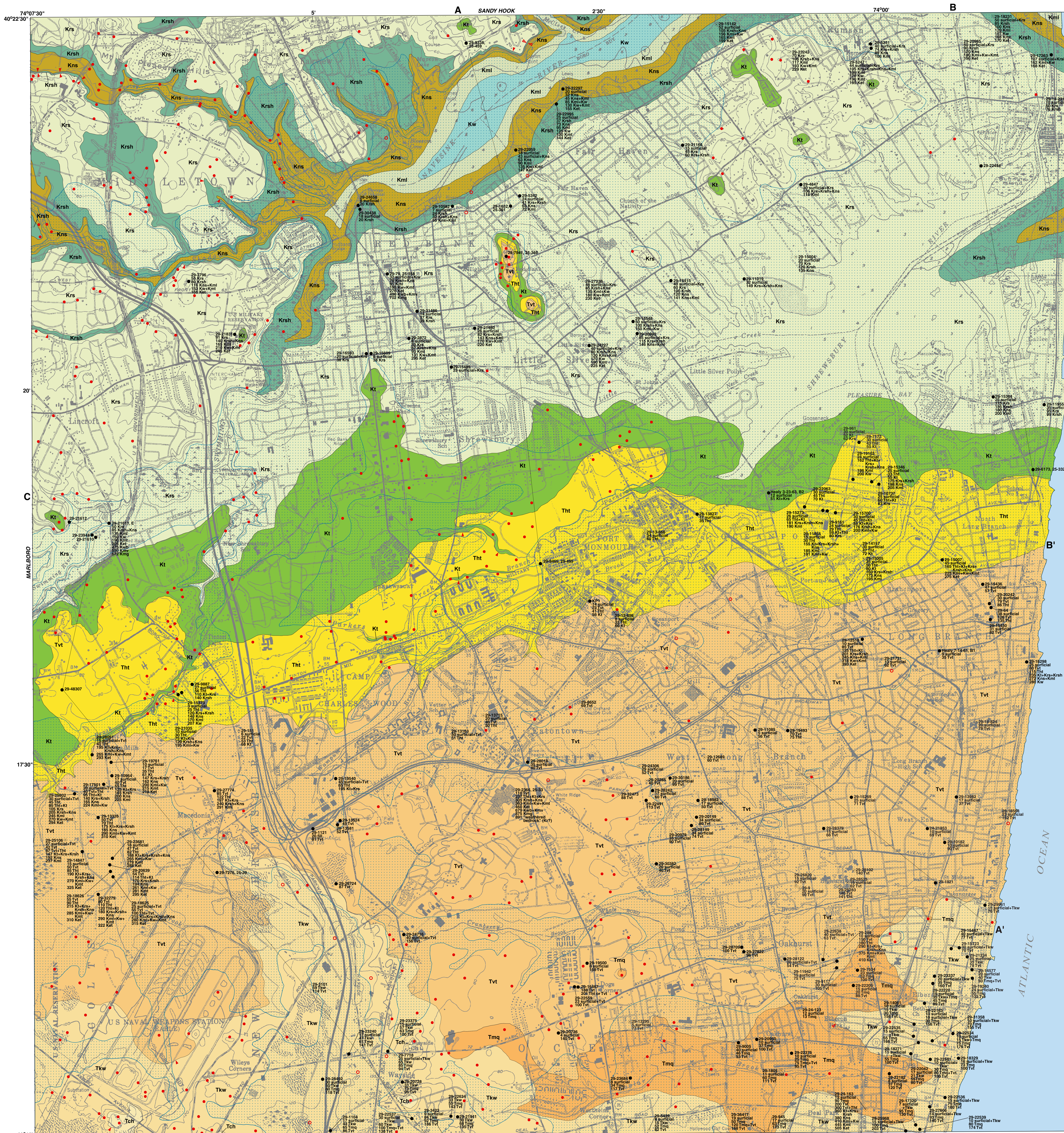

Base map from U. S. Geological Survey, 1954. Photorevised 1981.
1927 North American Datum.

Geology mapped 1994, 2009.
Cartography by S. Stanford.

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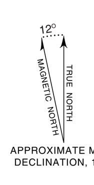
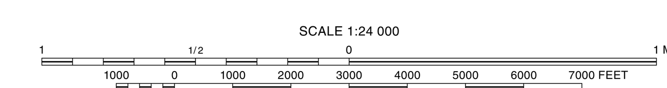
MONMOUTH COUNTY, NEW JERSEY

by
Scott D. Stanford and Peter J. Sugarman
2010





CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

CORRELATION OF MAP UNITS

Unit		Age		Epoch
Tch		middle		Miocene
	UNCONFORMITY			
Tkw		early		Miocene
	UNCONFORMITY			Oligocene
Tmq		early		Eocene
	UNCONFORMITY			
Tvt		late		Paleocene
	UNCONFORMITY			
Tht		early		Paleocene
	UNCONFORMITY			
Kt, Krs, Krsh, Kns		Maestrichtian		Late Cretaceous
	UNCONFORMITY			
Kml, Kw, Kmt		Campanian		Late Cretaceous
	UNCONFORMITY			
Ket, Kwb, Kmv		Campanian		Late Cretaceous
	UNCONFORMITY			
Kmg		Santonian-Coniacian-Turonian		Late Cretaceous
	UNCONFORMITY			
Krw, Krf		Cenomanian		Late Cretaceous
	UNCONFORMITY			
Kp		Albian		Late Cretaceous