

Based on U. S. Geological Survey Salts (1948, reprinted 1988) and Delaware City (1953) quadrangles. Corner ticks for Salts are to North American Datum of 1927 corner ticks for Delaware City are on North American Datum of 1983. A gap of base information occurs along the boundary of the quadrangles.

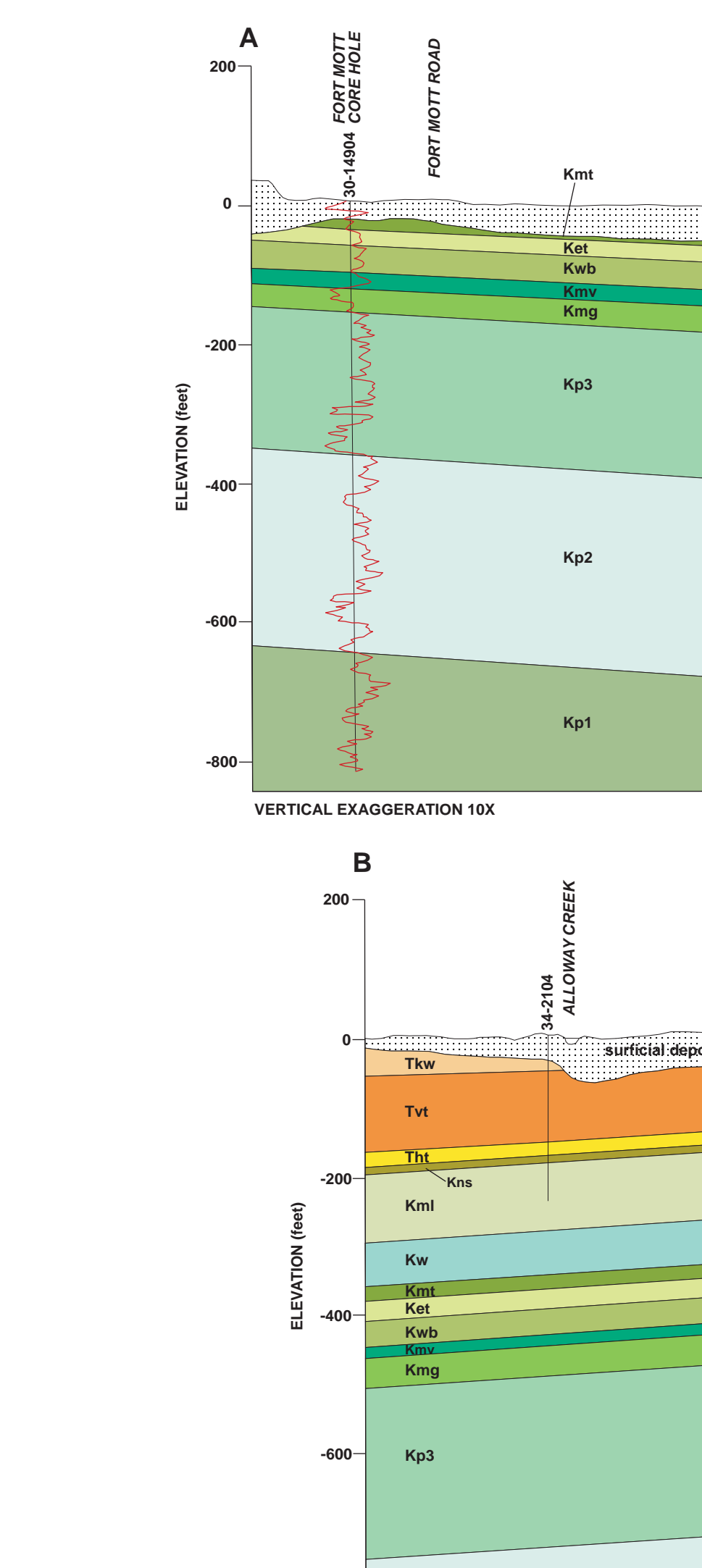
Research supported by the U. S. Geological Survey National Cooperative Geologic Mapping Program, under USGS award number 66HQ020047. The views and conclusions contained in this map are those of the author and do not necessarily represent those of the U. S. Government.

INTRODUCTION

Bedrock of the Salem and Delaware City quadrangles includes unconsolidated Coastal Plain formations that consist of sand, clay, and glauconitic clay laid down in coastal, nearshore-marine, and continental-shelf settings between 120 and 10 million years ago (Ma). The lithology and age of the formations are provided in the Description of Map Units. Age relations are also summarized in the Correlation of Map Units. Cross sections AA' and BB' show the subsurface geometry of the formations along the line of section. Further detail on the regional stratigraphy of the Coastal Plain formations is provided by Owens and others (1998). Surficial deposits of late Miocene, Pliocene, and Quaternary age overlie the bedrock formations in most of the map area. The surficial deposits were mapped by Stanford (2009).

DESCRIPTION OF MAP UNITS

- Tch** COHANSEY FORMATION—Fine-to-coarse sand, some very coarse sand and very fine to fine pebbles. White, very pale brown, yellow, brownish-yellow, reddish-yellow, light gray. Massive to cross-bedded. Sand consists of quartz with a trace of weathered chert. Pebbles consist of subangular to subrounded quartz and minor weathered chert. As much as 70 feet thick. Middle Miocene in age, based on pollen (Owens and others, 1998). Unconformably overlies the Kirkwood Formation.
- Tkw** KIRKWOOD FORMATION—Silty clay, clay, minor silt very fine sand. Yellow, brownish-yellow, white, gray, very pale brown, reddish-yellow. As much as 90 feet thick. The Kirkwood sediments in the map area are within the informal lower member of the Kirkwood Formation (Owens and others, 1998), also known as the Alloway Clay in outcrop in the Salem region (Hypshoring and Lodding, 1969). The lower member is of early Miocene age (22-21 Ma) based on strontium stable-isotope ratios (Sugarmann and others, 1993). Unconformably overlies the Manassas, Vincentown, and Hornestown Formations.
- Twt** MANASSAS FORMATION—Glauconitic clay to sandy clay. Olive, green, olive-brown. As much as 60 feet thick in map area (estimated). In subsurface only, covered by Kirkwood Formation. Inferred from well logs. Described by dillers as brown, gray, or green clay, or mud. Early Eocene in age, based on calcareous nanofossils (Owens and others, 1998). Unconformably overlies the Vincentown Formation.
- Tvt** VINCENTOWN FORMATION—Glauconitic clay quartz sand, medium-grained. Locally calcareous and fossiliferous, with shells and bryozoan detritus. Glauconitic occurs primarily in soft grains of medium sand size. Yellowish-brown, olive, light gray. As much as 100 feet thick. Described by dillers as coral sand, limonite, lime rock, cement sand, and black and white sand. Late Paleocene in age, based on foraminifera (Olson and Wise, 1987). Unconformably overlies the Hornestown Formation.
- Th** HORNESTOWN FORMATION—Glauconitic clay. Olive, green, black where unweathered, olive-brown to reddish-brown mottles where weathered. Glauconitic occurs primarily in soft grains of fine-to-medium sand size, with bryozoid and acornion shapes. Quartz, mica, feldspar, and phosphatic material also occur in minor concentrations. Between 20 and 25 feet thick. Described by dillers as black mud, green mud, or green clay. Early Paleocene in age based on foraminifera (Olson and Wise, 1987). Unconformably overlies the Navasink Formation.
- Kw** NAVASINK FORMATION—Glauconitic clay to sandy clay. Locally fossiliferous, with calcareous shell beds. Olive, green, black where unweathered, olive-brown to olive-yellow where weathered. Between 15 and 20 feet thick. Described by dillers as shell mud at black mud and shells. Glauconitic occurs primarily in soft grains of medium-to-coarse sand size. Quartz sand, medium-grained, is the principal accessory. Pyrite, mica, and phosphatic material are minor constituents. The basal few feet of the Navasink contain a glauconitic quartz sand with granules and black phosphate pebbles. Late Cretaceous (Maestrichtian) in age based on foraminifera (Olson, 1966). Strontium stable-isotope age estimates range from 60 to 67 Ma (Sugarmann and others, 1995). Unconformably overlies the Mount Laurel Formation. The unconformity is marked by a sharp positive gamma ray response on geophysical logs.
- Kt** MOUNT LAUREL FORMATION—Quartz sand, slightly glauconitic (5-10 percent by volume), medium-grained. Yellowish-brown to reddish-yellow where weathered, gray where unweathered. Between 30 and 90 feet thick. Contains traces of feldspar, mica, and phosphate pebbles. The upper several feet consists of coarse sand containing granules and pebbles; this interval also contains glauconite from the overlying Navasink Formation concentrated in burrows. Described by dillers as pepper sand, salt-and-pepper sand, and black-and-white sand. Late Cretaceous (late Campanian) in age based on nanofossiliferous (Sugarmann and others, 1995). Grades downward into the Wenonah Formation.
- Ku** WENONAH FORMATION—Quartz sand, micaceous, slightly glauconitic, fine-to very fine-grained. Yellow to very pale brown where weathered, gray to pale olive where unweathered. Between 60 and 70 feet thick. Late Cretaceous (late Campanian) in age based on pollen (Wolfe, 1976) and ammonite fossils (Kennedy and Cobban, 1994). Grades downward into the Marshalltown Formation.
- Km** MARSHALLTOWN FORMATION—Glauconitic clayey quartz sand, fine-to medium-grained. Olive to dark gray where unweathered, yellowish-brown to brown where weathered. Between 15 and 25 feet thick. Late Cretaceous (middle Campanian) in age, based on nanofossiliferous (Sugarmann and others, 1995). Unconformably overlies the Englishtown Formation.
- Kl** ENGLISH TOWN FORMATION—Quartz sand, fine-to medium-grained, with thin beds of clay and silt. Sand is white, yellow, and light gray where weathered, gray where unweathered. Silt and clay are light gray to brown where weathered, dark gray to black where unweathered. Between 20 and 30 feet thick. Sand contains some lignite and mica, and minor glauconitic silt and clay contains some mica and lignite. Late Cretaceous (early Campanian) in age, based on pollen (Wolfe, 1976). Grades downward into the Woodbury Formation.
- Kj** WOODBURY FORMATION—Clay with minor thin beds of very fine quartz sand. Dark gray and black where unweathered, yellowish-brown to brown where weathered. Between 30 and 40 feet thick. Clay is micaceous, with some pyrite and lignite, and traces of glauconite. Late Cretaceous (early Campanian) in age based on pollen (Wolfe, 1976). Grades downward into the Merchantville Formation.
- Ki** MERCHANTVILLE FORMATION—Glauconitic fine-sandy silt clay to clayey silt. Olive, dark gray, black where unweathered, olive-brown to yellowish-brown where weathered. Between 15 and 35 feet thick. Glauconitic occurs primarily as soft grains of fine-to-medium sand size. Sand fraction is chiefly quartz, feldspar, mica, and pyrite are minor constituents. Iron cementation is common. Late Cretaceous (early Campanian) in age based on ammonite fossils (Owens and others, 1977). Unconformably overlies the Magothy Formation.



MAP SYMBOLS

- Contact—Approximately located. Triangle indicates contact observed in outcrop.
- Subcrop contact—Contact of Manassas and Vincentown Formations beneath Kirkwood Formation. Approximately located.
- Formation observed in outcrop, excavation, or hand-auger hole.
- Well or boring, location accurate to within 200 feet—Number followed by map-unit symbol in depth, in feet below land surface, of base of unit (or total depth of well, if last number as inferred from diller's log or gamma-ray log (indicated by "G"). Depths may differ from those on map and sections owing to variations in diller's descriptions. Map units are not listed for wells shown on sections. Identifiers of the form 30-xxxx or 34-xxxx are New Jersey Department of Environmental Protection well permit numbers. Identifiers of the form SL-xx and DC-xx are auger borings drilled by D. S. Powner and J. P. Owens of the U. S. Geological Survey. Identifiers of the form DC-xx and DC-xx are from Talley (1965). Well 19 in Salem City is from Johnson (1961). Unit "OCZa" shown for this log indicates weathered schist of the Wissahickon Formation of late Proterozoic and early Paleozoic age.
- Well or boring, location accurate to within 500 feet—Identifiers and symbols as above.
- Gamma-ray log—On sections. Intensity increases to right.
- Surficial deposits—On sections.

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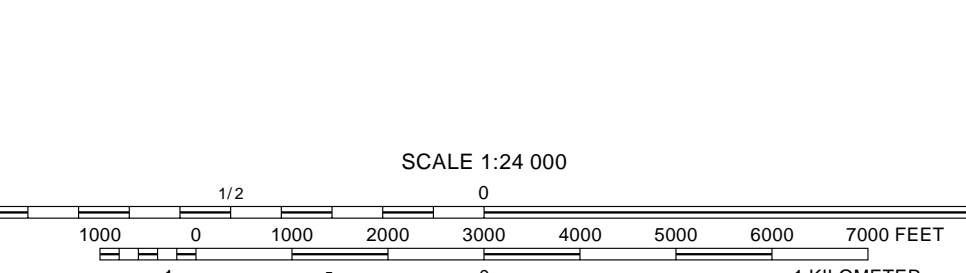
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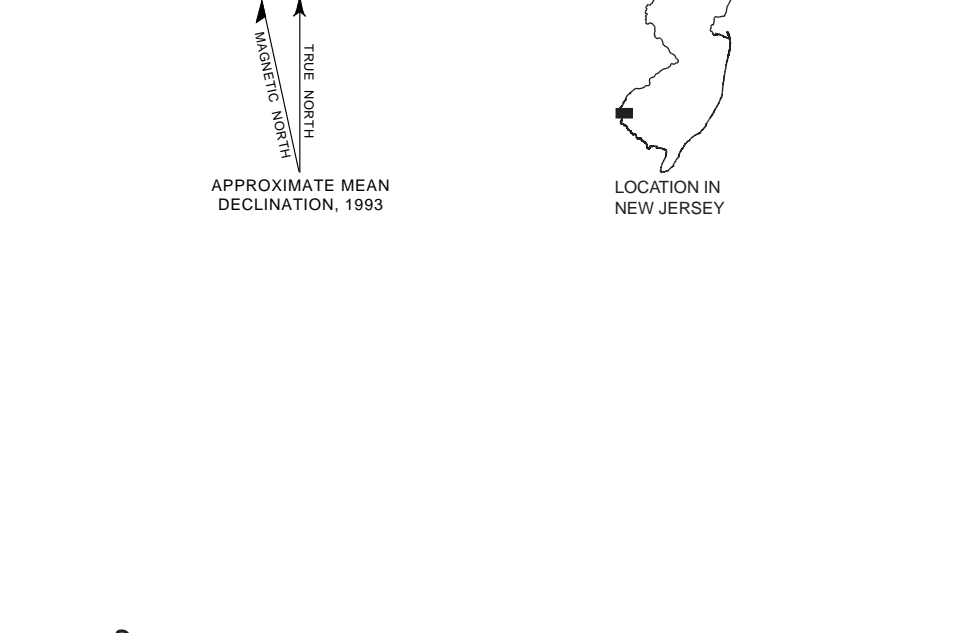
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BEDROCK GEOLOGY OF THE SALEM AND DELAWARE CITY QUADRANGLES SALEM COUNTY, NEW JERSEY

by Scott D. Stanford and Peter J. Sugarmann 2009



SCALE 1:24,000
CONTOUR INTERVAL 10 FEET (SALEM QUADRANGLE)
5 FEET (DELAWARE CITY QUADRANGLE)
NATIONAL GEOLOGIC VERTICAL DATUM OF 1929



Geology mapped 2008-2007. Cartography by S. Stanford and M. Giarra.