DEPARTMENT OF ENVIRONMENTAL PROTECTION
LAND USE MANAGEMENT
NEW JERSEY GEOLOGICAL SURVEY

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

INTRODUCTION

Bedrock of the Penns Grove and Wilmington South quadrangles includes unconsolidated Coastal Plain formations that overlie metamorphic and igneous basement rocks. The Coastal Plain formations include sand, clay, and glauconite clay laid down in coastal, nearshore marine, and continental-shelf settings between 110 and 20 million years ago (Ma). The underlying metamorphic rocks are much older and were originally laid down as sediments, or intruded as magma, between 700 and 420 million years ago, and compressed and deformed several times. 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*. Four cross sections show the subsurface geometry of the formations along the line of section. Further details on the regional stratigraphy of the Coastal Plain formations are provided by Owens and others (1998). Surficial deposits of Pliocene and Quaternary age overlie the bedrock formations in most of the map area. The surficial deposits are mapped by Stanford (2006).

DESCRIPTION OF MAP UNITS

Tkw KIRKWOOD FORMATION--Silty clay to silty, very fine sand. Yellow, reddish-yellow, white, light gray. As much as 30 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 this area (Isphording and Lodding, 1969). The lower member is of early Miocene age (22-21 Ma) based on strontium stable-isotope ratios (Sugarman and others, 1993). Unconformably overlies the Vincentown, Hornerstown, and Navesink formations.

Tvt VINCENTOWN FORMATION--Glauconitic clayey quartz sand, medium grained. Locally calcareous and fossiliferous, with foraminifera and bryozoan detritus. Glauconite occurs primarily in soft grains of medium sand size. Yellowish-brown, olive, light gray. As much as 40 feet thick. Late Paleocene in age, based on foraminifera (Olsson and Wise, 1997). Unconformably overlies the Hornerstown Formation.

Tht HORNERSTOWN FORMATION--Glauconite clay. Olive, green, black where unweathered, olive brown with brown to reddish-brown mottles where weathered. Glauconite occurs primarily in soft grains of fine-to-medium sand size, with botryoidal and accordion shapes. Quartz, mica, feldspar, and phosphatic material also occur as minor constituents. Between 20 and 25 feet thick. Early Paleocene in age based on foraminifera (Olsson and Wise, 1997). Unconformably overlies the Navesink Formation.

Kns NAVESINK FORMATION--Glauconite clay to sandy clay. Locally fossiliferous, with calcareous shell beds. Olive, green, black where unweathered; olive brown to olive yellow where weathered. As much as 15 feet thick. Glauconite occurs primarily in soft grains of medium-to-coarse sand size, with botryoidal form. Quartz sand, medium grained, is the principal accessory. Pyrite, mica, and phosphatic material are minor constituents. The basal few feet of the Navesink contain a glauconitic quartz sand with granules and black phosphate pebbles. Late Cretaceous (Maastrichtian) in age based on foraminifera (Olsson, 1964). Strontium stable-isotope age estimates for the Navesink range between 69-67 Ma (Sugarman and others, 1995). Unconformably overlies the Mount Laurel Formation.

Kml MOUNT LAUREL FORMATION--Quartz sand, slightly glauconitic, medium grained. Yellowish-brown to reddish-yellow where weathered, gray where unweathered. As much as 70 feet thick in map area. Contains traces of feldspar, mica, and phosphate pebbles. The upper several feet are a coarse sand with granules and pebbles; this interval also contains glauconite from the overlying Navesink Formation concentrated in burrows. Late Cretaceous (late Campanian) in age based on nannoplankton (Sugarman and others, 1995). Grades downward into the Wenonah Formation.

Kw 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. As much as 40 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.

Kmt MARSHALLTOWN FORMATION--Glauconitic clayey quartz sand, fine- to medium-grained. Olive to dark gray where unweathered, brown to olive brown where weathered. As much as 20 feet thick. Late Cretaceous (middle Campanian) in age, based on nannoplankton (Sugarman and others, 1995). Unconformably overlies the Englishtown Formation.

Ket ENGLISHTOWN 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. As much as 40 feet thick. Sand contains some lignite and mica and minor amounts of glauconite; silt and clay contain some mica and lignite. Late Cretaceous (early Campanian) in age, based on pollen (Wolfe, 1976). Grades downward into the Woodbury Formation.

Kwb WOODBURY FORMATION--Clay with minor thin beds of very fine quartz sand. Dark gray and black where unweathered, yellowish brown to brown where weathered. As much as 50 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. Minard (1965) includes this clay in the Merchantville or Englishtown Formations in the adjacent Woodstown quadrangle. It is mapped separately here because the general absence of sand beds distinguishes it from the overlying Englishtown Formation and the absence of glauconite distinguishes it from the underlying Merchantville Formation.

Kmv MERCHANTVILLE FORMATION--Glauconitic fine-sandy silty clay to clayey silt. Olive, dark gray, black where unweathered, olive brown to yellowish brown where weathered. As much as 30 feet thick. Glauconite occurs primarily as soft grains of fine-to-medium sand size. Sand fraction is chiefly quartz; feldspar, mica, and pyritic 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.

Kmg MAGOTHY FORMATION--Quartz sand, fine- to very coarse-grained, and clay and silt, thin-bedded. Sand is white, yellow, light gray where weathered, gray where unweathered. Clay and silt are white, yellow, brown, rarely reddish-yellow where weathered, gray to black where unweathered. Gray colors are dominant. Sand includes some lignite, pyrite, and minor feldspar and mica. Silt and clay beds include abundant mica and lignite. Late Cretaceous (Turonian-Coniacian) in age based on pollen (Christopher, 1979, 1982; Miller and others, 2004). Unconformably overlies the Potomac Formation. Contact with Potomac Formation placed at change from predominantly gray clay and silt in Magothy Formation to red clay in the Potomac, as reported in well or boring logs, or at increased gamma-ray intensity, decreased electrical resistance, and increased spontaneous potential on geophysical logs, recording the thicker clays in the Potomac. Thickness ranges from 40 to 50 feet over most of the map area, to 150 feet in the northeast corner of the Penns Grove quadrangle. This thickening is due, in part, to erosion of the Potomac Formation before the Magothy was deposited. Regionally, the Magothy thickens, and the Potomac correspondingly thins and pinches out, northeastward along strike in New Jersey (Owens and others, 1998). The upper 10 to 15 feet of the Magothy Formation as mapped here may include the Cheesequake Formation, which has been identified biostratigraphically in coreholes in this region (Miller and others, 2004; Sugarman and others, 2004) but, as a largely non-glauconitic silt, cannot be lithically distinguished from the Magothy based on outcrop and well data in the map area.

Kp3 POTOMAC FORMATION--Quartz sand, fine- to very coarse-grained, and clay and silt, thin- to thick-bedded; minor pebble-to-cobble gravel. Sand is white, yellow, light gray where weathered, gray where unweathered. Clay and silt are white, yellow, brown, reddish-yellow, red where weathered, gray where unweathered. Clay beds are as much as 10 feet thick, sand beds are as much as 50 feet thick. Clay beds are more abundant than sand beds. Total thickness of formation as much as 650 feet in map area. The Potomac Formation in the map area is divided into two informal subunits (Kp3, Kp2) based on pollen zonations (Doyle and Robbins, 1977), although it is not known if the

Kp2

boundary between the units is an unconformity. Unit 3 (Kp3) is of Late Cretaceous (early Cenomanian) age. Unit 2 (Kp2) is present in the subsurface only, and is mapped based on a regionally traceable 30-to-50-foot thick sand at the base of unit 3, as identified in geophysical and lithologic well logs (McKenna and others, 2004; Sugarman and others, 2004). Unit 2 is of Early Cretaceous (Albian) age (Doyle and Robbins, 1977; Owens and others, 1998). The Potomac Formation unconformably overlies Late Proterozoic and early Paleozoic bedrock.

OCZu LATE PROTEROZOIC AND EARLY PALEOZOIC METAMORPHIC AND IGNEOUS ROCKS--Gray schist and gneiss. Upper 5 to 50 feet is commonly weathered to a brown, red, gray, or greenish gray micaceous sandy clayey saprolite. Of Late Proterozoic and early Paleozoic age. Includes the Wissahickon Formation and related rocks of the Potomac-Philadelphia-Hartland terrane of Late Proterozoic, Cambrian, and Ordovician age (Volkert and others, 1996; Schenck and others, 2000). In subsurface only.

MAP SYMBOLS

Contact--Approximately located.

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

30-9247 ● 78 Ket 102 Kwb — Well or boring, location accurate to within 200 feet--Number followed by map-unit symbol is depth, in feet below land surface, of base of unit (or total depth of well, if within unit OCZu) as inferred from driller's log or geophysical log (for wells not shown on sections). Map-unit symbol without a depth indicates uppermost formation as inferred from driller's log, for these wells, underlying formations cannot be positively identified. Identifiers of the form 33-xxx are U. S. Geological Survey Ground Water Site Inventory numbers. Identifiers of the form 30-xxxx are N. J. Department of Environmental Protection well permit numbers. Identifiers of the form PG-xx are auger borings drilled by D. S. Powars and J. P. Owens of the U. S. Geological Survey. Well 45B (section BB') is from Leggette, Brashears, and Graham, Inc. (1979). Penns Grove well 2 (section BB') is from Woolman (1902, p. 92).

30-4748 ○ 73 Ket 107 Kwb — Well or boring, location accurate to within 500 feet--Identifiers and symbols as above.

E, G — Geophysical log--On sections. "G" indicates gamma-ray log, shown in red, intensity increasing to right. "E" indicates electric log, shown in blue, with spontaneous potential shown on left-hand curve (voltage increasing to right) and resistance shown on right-hand curve (resistance increasing to right).

Surficial deposits--On sections, shown where more than 10 feet thick.

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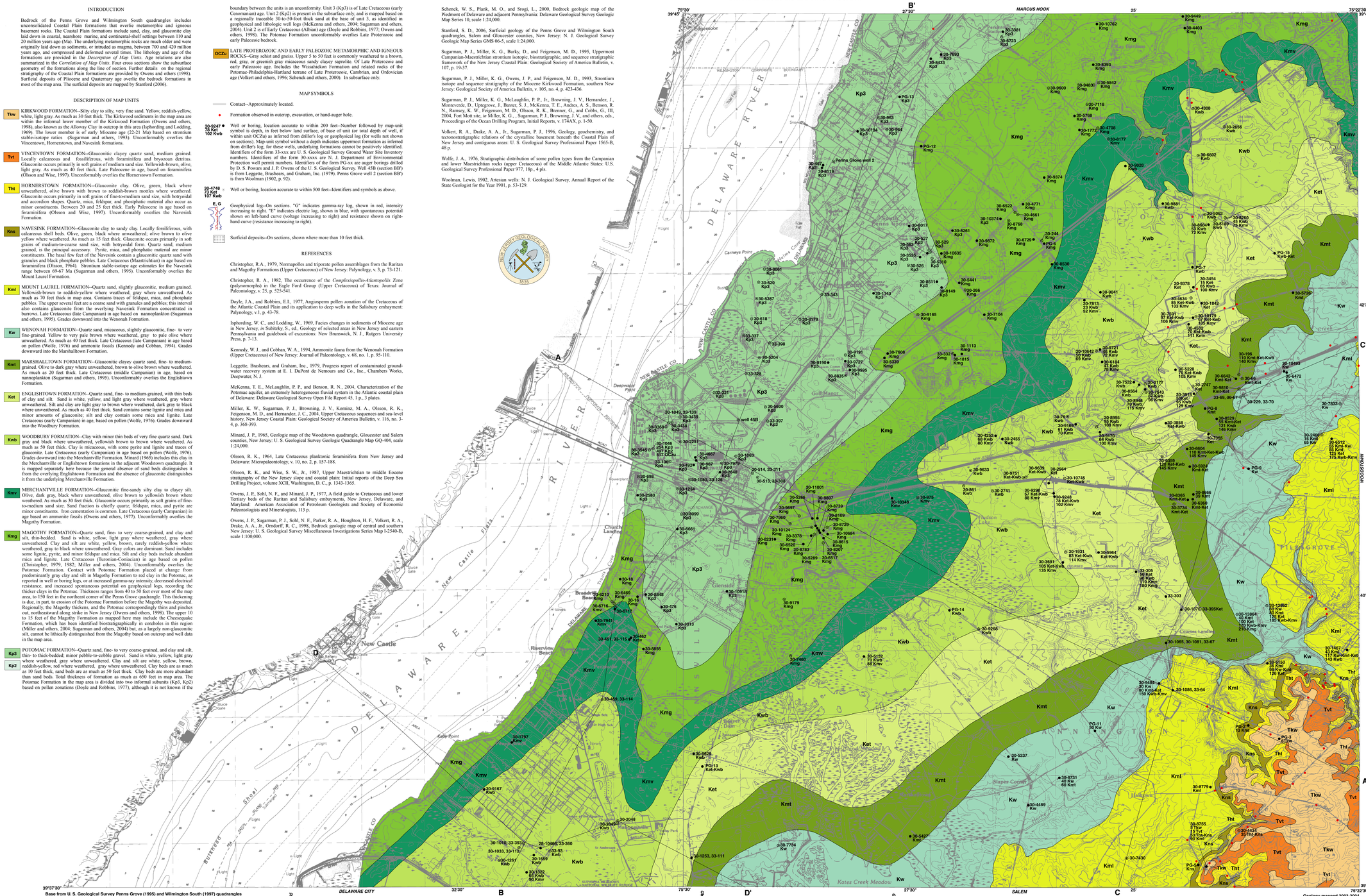

Base from U. S. Geological Survey Penns Grove (1995) and Wilmington South (1997) quadrangles

Geology mapped 2003-2004
Cartography by Scott Stanford and Michael Girard
Reviewed by John Jengo, Karl Muessig, Lloyd Mullikin, Kelvin Ramsey

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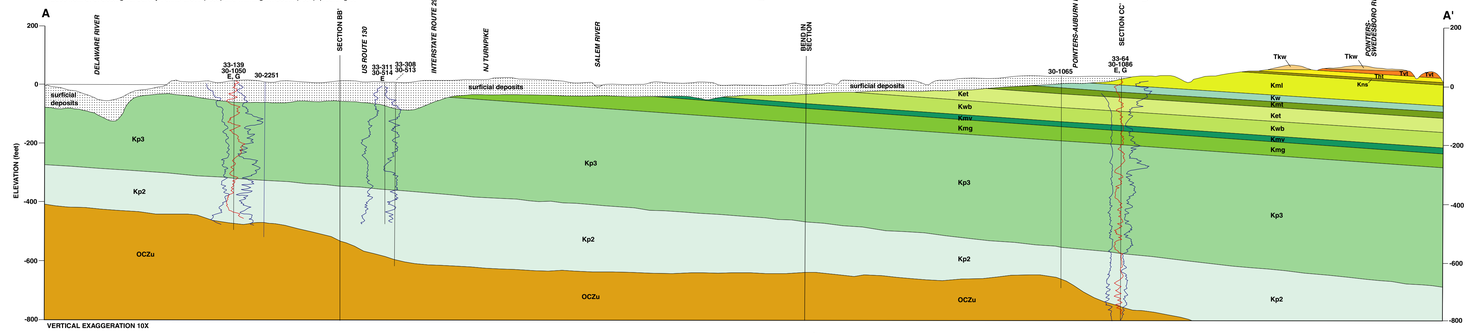
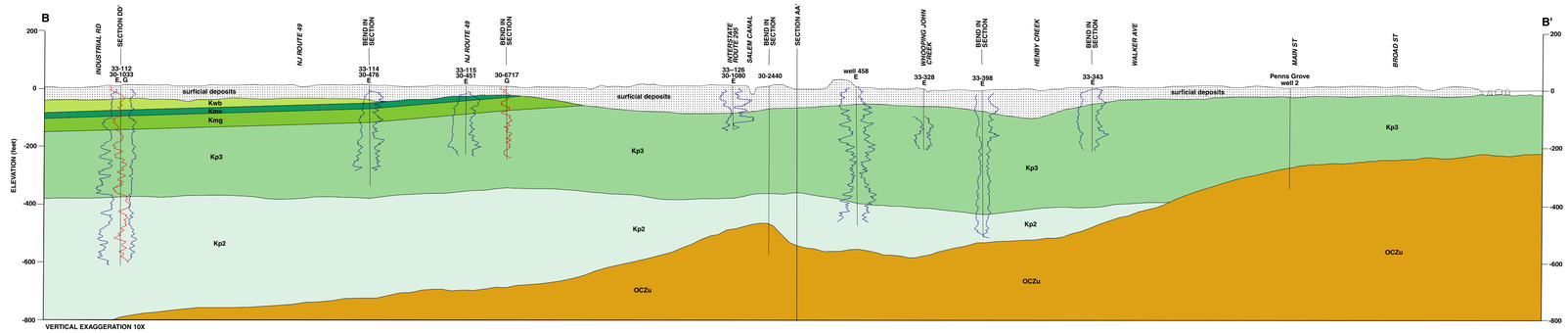
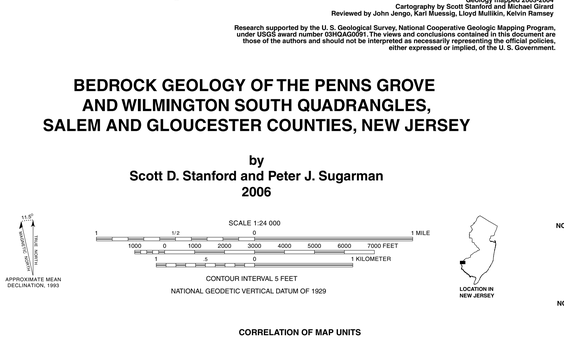




BEDROCK GEOLOGY OF THE PENNS GROVE AND WILMINGTON SOUTH QUADRANGLES, SALEM AND GLOUCESTER COUNTIES, NEW JERSEY

by
Scott D. Stanford and Peter J. Sugarman
2006



APPROXIMATE MEAN DECLINATION, 1993

SCALE 1:24 000

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

LOCATION IN NEW JERSEY

CORRELATION OF MAP UNITS

Tkw	Miocene	Tertiary
UNCONFORMITY		
Tvt	Paleocene	
UNCONFORMITY		
Tht		
UNCONFORMITY		
Kns	Maastrichtian	Late Cretaceous
UNCONFORMITY		
Kml, Kw, Kmt	Campanian	
UNCONFORMITY		
Ket, Kwb, Kmv		
UNCONFORMITY		
Kmg	Turonian-Coniacian	
UNCONFORMITY		
Kp3	Cenomanian	
UNCONFORMITY?		
Kp2	Albian	Early Cretaceous
UNCONFORMITY		
OCZu	Late Proterozoic-early Paleozoic	