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

In the Penns Grove and Wilmington South quadrangles, surficial deposits include artificial fill and river, wetland, windblown, and estuarine sediments. Surficial deposits are unconsolidated sediments that overlie Coastal Plain formations and that are the parent material for agronomic soils. They are as much as 130 feet thick beneath and adjacent to the Delaware River and as much as 120 feet thick in the Pennsville paleovalley, which extends southward from the Carneys Point area, but are generally less than 40 feet thick elsewhere. The deposits occupy a landscape shaped by four main episodes of valley incision. The deposits are described below. The age of the deposits and the episodes of valley erosion are shown on the correlation chart. The underlying bedrock and Coastal Plain formations are mapped by Stanford and Sugarman (2006).

DESCRIPTION OF MAP UNITS

▨ ARTIFICIAL FILL--Sand, silt, gravel, clay; gray to brown; demolition debris (concrete, brick, wood, metal, etc.), cinders, ash, slag, glass, trash. Massive to weakly stratified. As much as 40 feet thick, generally less than 15 feet thick. In highway and railroad embankments, filled wetlands and flood plains, and solid-waste landfills. Many small areas of fill, particularly along streams in urban areas, are not mapped. Extent of natural deposits beneath fill and dredge spoils is based in part on the position of shorelines and salt marshes shown on topographic map sheets 74 and 81 (N. J. Geological Survey, c. 1880, scale 1:21,120).

afd DREDGE SPOILS--Fine sand, silt, clay, minor medium-to-coarse sand and gravel; gray to brown. Contain variable amounts of organic matter and mica, and minor amounts of man-made materials. Massive to weakly stratified. As much as 40 feet thick.

Qal ALLUVIUM--Sand, silt, peat, minor clay; brown, yellowish-brown, gray; and pebble gravel. Contains variable amounts of organic matter. Peat and organic silt and clay typically overlie sand and pebble gravel. Sand and silt are massive to weakly stratified. Gravel occurs in massive to weakly stratified beds generally less than 2 feet thick. Sand is chiefly quartz with some glauconite and mica. Gravel is chiefly white, gray, and yellow quartz and quartzite, and a trace of gray chert. Beneath the Delaware River (section BB'), the lowermost alluvium includes late Pleistocene glaciofluvial sand and pebble-to-cobble gravel that may be the downstream extension of the glaciofluvial gravel that crops out in the Delaware River Valley north of the Burlington, New Jersey, area. This gravel was termed the "Trenton Gravel" by Cook (1880) and Lewis (1880). The same deposit was later named the "Van Sciver Lake" and "Spring Lake" beds by Owens and Minard (1979), although they considered it to be of interglacial age. This glaciofluvial deposit was laid down between about 20,000 and 15,000 years ago, during the late Wisconsinan glacial maximum. The glaciofluvial gravel includes much gray sandstone and mudstone, and some red sandstone and mudstone, gray gneiss, black chert, and purple-red conglomerate, in addition to white and gray quartz and quartzite. Alluvium is as much as 30 feet thick beneath the Delaware River, and as much as 15 feet thick elsewhere (estimated). Deposited in modern flood plains and stream channels, and in former flood plains and channels beneath estuarine deposits before Holocene sea-level rise.

Qm SALT-MARSH AND ESTUARINE DEPOSITS--Silt, fine sand, peat, clay; brown, dark-brown, gray, black; and minor medium sand and pebble gravel. Contain abundant organic matter and some mica. As much as 100 feet thick beneath and adjacent to the Delaware River; 40 feet thick elsewhere. Deposited in tidal wetlands, salt marshes, tidal flats, and tidal channels during Holocene sea-level rise, chiefly within the past 10,000 years.

Qs SWAMP DEPOSITS--Peat and organic silt and fine sand, minor organic clay; brown to black. As much as 20 feet thick (estimated). Deposited in non-tidal wetlands.

Qe EOLIAN SAND--Fine-to-medium sand, minor silt, very pale brown. As much as 15 feet thick. Forms a dune ridge near the junction of U. S. Route 40 and New Jersey Route 48. Also present as patchy veneers less than 3 feet thick on surface of units Qcm1, Qcm2, and Qcm3. These thin, patchy deposits are not sufficiently distinct lithically or morphologically to map.

Qtl LOWER TERRACE DEPOSITS--Fine-to-medium sand, minor silt; yellow, brown, olive-yellow; pebble gravel. Sand is massive to well-stratified. Gravel occurs in thin beds (generally less than 6 inches thick) within and at the base of the deposit. Sand is chiefly quartz and glauconite. Gravel is chiefly white, gray, and yellow quartz and quartzite, and a trace of gray chert. In deposits beneath the Delaware River and its fringing marshes, gravel also includes gray and red sandstone and mudstone, gray gneiss and schist, and purple-red conglomerate. As much as 50 feet thick beneath the Delaware River, 15 feet thick (estimated) elsewhere. In tributary valleys, form stream terraces with surfaces 2 to 10 feet above modern estuaries and flood plains. Beneath the Delaware River and its fringing marshes, form eroded stream-terrace remnants, now covered by estuarine deposits, with top surfaces rising to about -20 feet in elevation. Both the tributary-valley terraces and the terrace deposits in the main Delaware River Valley were laid down in valleys cut into the Cape May Formation, units 2 and 3 (units Qcm2, Qcm3). After the lower terrace sediments were deposited, the Delaware River eroded as much as 80 feet into and through the lower terrace before depositing glaciofluvial gravel, and then postglacial alluvium and estuarine sediment. These relationships indicate that the lower terrace deposits beneath the river were laid down during the period of lower-than-present sea level (known as the early and middle Wisconsinan in North American stage terminology) between the interglacial highstand of sea level about 125,000 years ago (the Sangamon interglacial) and the last glacial maximum about 20,000 years ago (the late Wisconsinan glacial), when sea level was at its lowest late Pleistocene level of about 350 feet below that at present. Radiocarbon dates of 31,380+4530-2880 (GX 22966) and 29,330+/-600 (Beta 190911) radiocarbon years before present on wood within the lower terrace deposits in Marcus Hook, Pennsylvania, about 6 miles northeast of Penns Grove, confirm this age range (Jengo, 2006).

Qtu UPPER TERRACE DEPOSITS--Fine-to-medium sand, minor silt; yellow, olive-yellow, brownish-yellow; pebble gravel. Sand is massive to well-stratified. Gravel occurs in thin beds (generally less than 6 inches thick) within and at the base of the deposit. Sand is chiefly quartz with some glauconite and a trace of feldspar, mica, and chert. Gravel is chiefly white, gray, and yellow quartz and quartzite, and a trace of gray chert. As much as 25 feet thick. Form stream terraces with surfaces 15 to 40 feet above modern estuaries and flood plains. Grade to, or are onlapped by, the Cape May Formation, unit 2 (unit Qcm2), and so are contemporaneous with, or slightly older than, the Cape May 2.

CAPE MAY FORMATION (Salisbury and Knapp, 1917)--Estuarine and fluvial-estuarine deposits of middle and late Pleistocene age. Divided into three units (Qcm1, Qcm2, Qcm3) based on surface elevation and age (Newell and others, 1995). Fossils, pollen, and amino-acid racemization ratios in shells from unit Qcm2 elsewhere in the Delaware estuary and Delaware Bay area indicate that it is of Sangamon age (about 125,000 years ago), when sea level was approximately 20 to 30 feet higher than at present in this region (Newell and others, 1995; Lacovara, 1997; Wehmiller, 1997). Within the map area, radiocarbon dates on wood within unit Qcm2 from a depth of 11-13 feet in boring PG-12 and on wood from a depth of 26-28 feet in boring PG-10 both yielded an age of >40,000 radiocarbon years before present (laboratory numbers I-16,603 and I-16,602, respectively), indicating a pre-late Wisconsinan age. Unit Qcm1 is an older estuarine deposit laid down during a pre-Sangamon interglacial sea-level highstand and is of early or middle Pleistocene age (Lacovara, 1997; O'Neal and McGeary, 2002). Unit Qcm3 was deposited during sea-level fall from the highstand represented by the Qcm2 deposits and is of Sangamon or early Wisconsinan age. Salisbury and Knapp (1917) included fluvial terrace deposits within the Cape May Formation; here they are mapped separately as units Qtl and Qtu because they differ in age and origin from the Cape May. Unit Qcm2 is equivalent to the Lynch Heights Formation in Delaware and unit Qcm3 is equivalent to the Scotts Corners Formation in Delaware (Ramsey, 2005).

Qcm3 CAPE MAY FORMATION, UNIT 3--Fine-to-medium sand, minor coarse sand, silt, clay, and peat; yellow, brownish-yellow, very pale brown, light-gray; and pebble gravel, minor cobble gravel. Massive to laminated. Sand is quartz with a little glauconite and a trace of mica, feldspar, and chert. Gravel is chiefly white, gray, and yellow quartz and quartzite, with minor gray chert, gray to red sandstone and mudstone, and white-to-gray clay rip-up clasts. As much as 40 feet thick. Forms a terrace with a maximum surface elevation of about 15 feet.

Qcm2 **Qcm2l** CAPE MAY FORMATION, UNIT 2--Fine-to-medium sand, minor coarse sand, silt, clay, and peat; yellow, brownish-yellow, very pale brown, light-gray; and pebble gravel, minor cobble gravel. Massive to laminated. Sand is quartz with a little glauconite and a trace of mica, feldspar, and chert. Gravel is chiefly white, gray, and yellow quartz and quartzite, with minor gray chert. As much as 50 feet thick. In the subsurface in the Pennsville paleovalley, logs of wells and borings record gray to dark gray silt, clayey silt, and sandy silt, with some peat and wood; as much as 40 feet thick. These fine-grained sediments are mapped separately as unit Qmc2l on section BB'. Qcm2 forms a terrace with a maximum surface elevation of about 35 feet.

Qcm1 **Qcm1/Tp** CAPE MAY FORMATION, UNIT 1--Fine-to-medium sand, minor silt; very pale brown, yellow; and pebble gravel. Massive to weakly stratified. Sand is quartz with a little glauconite. Gravel is chiefly white and yellow quartz with minor gray chert. As much as 15 feet thick. In eroded remnants of a terrace with a maximum surface elevation of 65 feet. Qcm1/Tp indicates areas where the Cape May Formation, unit 1, is generally less than 6 feet thick over Pensauken Formation.

Tp PENSAUKEN FORMATION (Salisbury and Knapp, 1917)--Fine-to-coarse sand, clayey sand, minor silt and very coarse sand; reddish-yellow to yellow; pebble gravel. Massive to well-stratified, commonly with tabular, planar cross-beds in sand. Pebble gravel occurs as thin layers (generally less than 3 inches thick) within the sand and as thicker, massive beds in places at the base of the formation, where it may include some cobble gravel. Sand is chiefly quartz with some feldspar, rock fragments (chert and shale), mica, and glauconite. The feldspar and chert are generally partially weathered to a white clay. Gravel is chiefly yellow, reddish-yellow (from iron-staining), white, or gray quartz and quartzite; a little brown-to-gray chert; and a trace of brown, reddish-brown, and gray sandstone and shale, and white-to-gray gneiss. The chert, sandstone, shale, and gneiss are generally partially weathered or fully decomposed. As much as 20 feet thick (estimated). Occurs on the low upland east of the Cape May 2 terrace, with a maximum surface elevation of 75-80 feet. The base of the deposit descends from an elevation of about 75 feet in the southwest corner of the map area to about -20 feet on the east edge of the Pennsville paleovalley, where it is covered by the Cape May Formation but is penetrated by borings. This pattern records thickening of the deposit towards the main Delaware River valley and indicates that the Pensauken was deposited as an aggraded valley fill. This geometry, regional paleoflow data (Owens and Minard, 1979; Martino, 1981), and the provenance of the sand and gravel in the formation, indicate that the Pensauken was deposited by a large river flowing southwesterly from the New York City area to the Delmarva Peninsula. The map area is in the southeastern and central parts of the former river valley. The age of the Pensauken is not firmly established. Berry and Hawkins (1935) describe plant fossils from the Pensauken near New Brunswick, New Jersey that they consider to be of early Pleistocene age. Owens and Minard (1979) assign a late Miocene age based on correlation to units in the Delmarva Peninsula. In Delaware, the Columbia Formation, which is a fluvial sand of similar lithology and topographic position as the Pensauken, contains pollen indicating a Pleistocene age (Groot and Jordan, 1999). Pollen from a black clay bed within the Pensauken near Princeton, New Jersey, includes cool-temperate species and a few pre-Pleistocene taxa. This assemblage suggests a Pliocene age (Stanford and others, 2002). The pre-Pleistocene taxa *Momipites, Gordonia?,* and *Plicapollis* were recovered from peaty silty clay at a depth of 56-58 feet in boring PG-10 (Newell and others, 1995) in the map area. If this clay is within the Pensauken Formation and if the pollen are not redeposited from older formations, this assemblage also indicates a Pliocene or older age. A Pliocene age is also consistent with the geomorphic and stratigraphic relation of the Pensauken to late Pliocene or early Pleistocene till and to middle and late Miocene marine and fluvial deposits in central New Jersey (Stanford, 1993).

Qwcp OUTCROP OF COASTAL PLAIN FORMATIONS--Exposed formations of Cretaceous and Tertiary age, oxidized and weathered to variable depths. Soil zone generally includes some lag pebbles from eroded surficial deposits. May include thin, patchy colluvial or alluvial sediments less than 3 feet thick. Not shown on sections owing to variable depth of weathering.

MAP SYMBOLS

Contact--Solid where well-defined by landforms; dashed where approximately located; short-dashed where featheredged or gradational; dotted where covered by water or where artificially exposed within excavated areas.

30-8511 ● 66
DRPC 1 ● 2 water >52 Qm
Thickness and stratigraphy of surficial material in well or boring--Location accurate to within 200 feet. Upper number is identifier; lower number is thickness in feet of surficial material, inferred from driller's log. Where multiple surficial units were penetrated, the depth (in feet below land or water surface) of the base of the unit is indicated next to the unit symbol. A ">" indicates that the base of the unit was not reached at depth shown. Identifiers of the form 30-xxxx are well permits issued by the N. J. Department of Environmental Protection, Bureau of Water Allocation. Identifiers of the form PG-x are auger borings drilled by J. P. Owens and D. S. Powars of the U. S. Geological Survey. Other alphanumeric identifiers are test borings or wells with logs on file at the N. J. Geological Survey.

30-6729 ⊙ 38
Thickness of surficial material in well or boring--Location accurate to within 500 feet. Identifiers and thickness values as above.

● **Material observed in hand-auger hole, exposure, or excavation**

Excavation perimeter--Marks edges of sand pits. Topography within these areas may differ from that on the base map. Contacts within excavated areas show the approximate distribution of surficial materials in 2002.

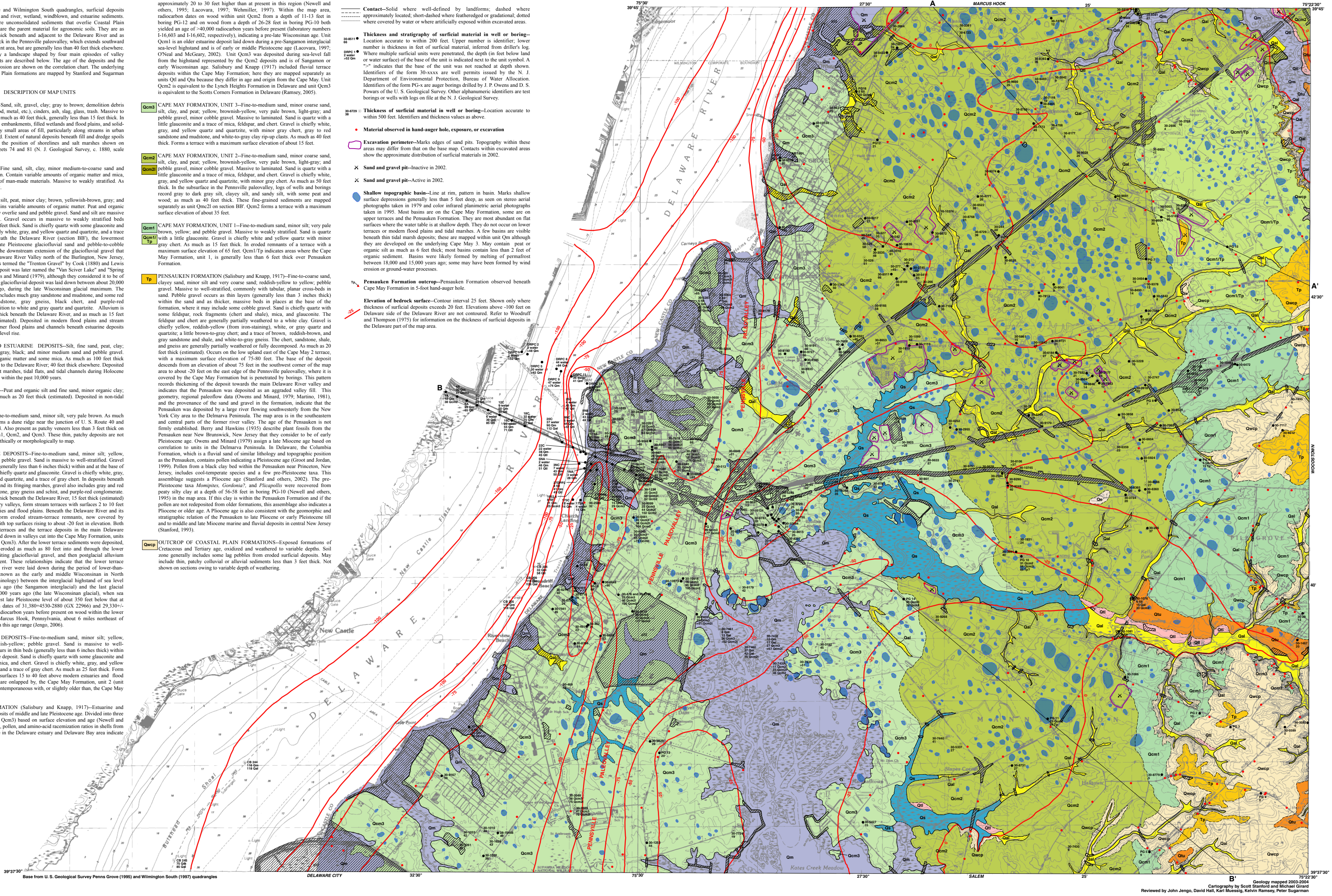
⨯ **Sand and gravel pit--**Inactive in 2002.

⨯ **Sand and gravel pit--**Active in 2002.

Shallow topographic basin--Line at rim, pattern in basin. Marks shallow surface depressions generally less than 5 feet deep, as seen on stereo aerial photographs taken in 1979 and color infrared planimetric aerial photographs taken in 1995. Most basins are on the Cape May Formation, some are on upper terraces and the Pensauken Formation. They are most abundant on flat surfaces where the water table is at shallow depth. They do not occur on lower terraces or modern flood plains and tidal marshes. A few basins are visible beneath thin tidal marsh deposits; these are mapped within unit Qm although they are developed on the underlying Cape May 3. May contain peat or organic silt as much as 6 feet thick; most basins contain less than 2 feet of organic sediment. Basins were likely formed by melting of permafrost between 18,000 and 15,000 years ago; some may have been formed by wind erosion or ground-water processes.

Tp **Pensauken Formation outcrop--**Pensauken Formation observed beneath Cape May Formation in 5-foot hand-auger hole.

-25 **Elevation of bedrock surface**--Contour interval 25 feet. Shown only where thickness of surficial deposits exceeds 20 feet. Elevations above -100 feet on Delaware side of the Delaware River are not contoured. Refer to Woodruff and Thompson (1975) for information on the thickness of surficial deposits in the Delaware part of the map area.



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, David Hall, Karl Muessig, Kelvin Ramsey, Peter Sugarman

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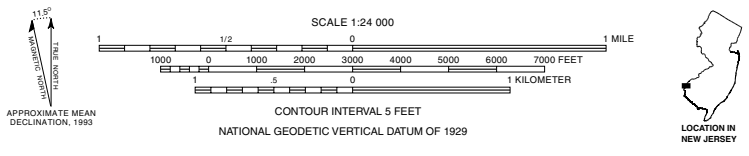
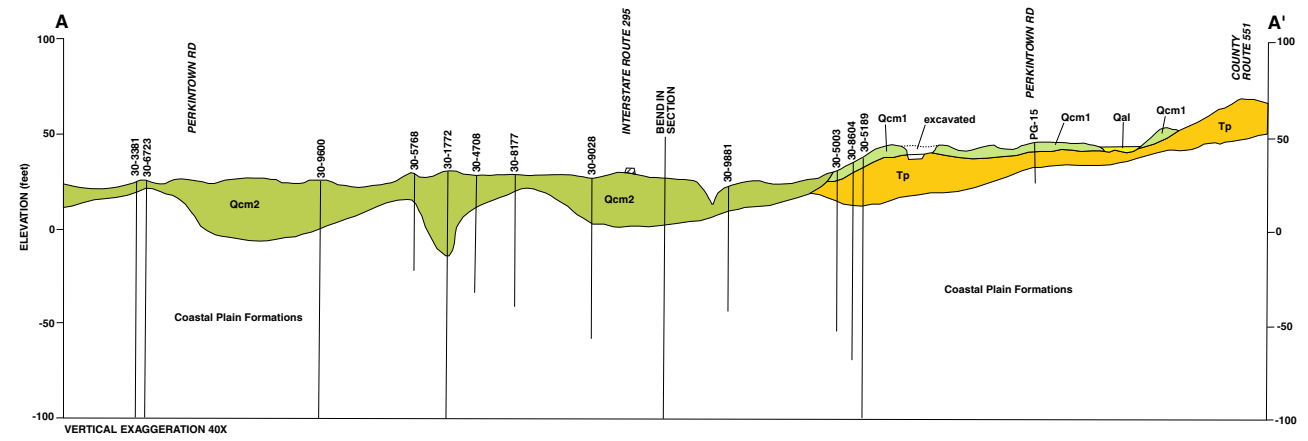
SURFICIAL GEOLOGY OF THE PENNS GROVE AND WILMINGTON SOUTH QUADRANGLES, SALEM AND GLOUCESTER COUNTIES, NEW JERSEY

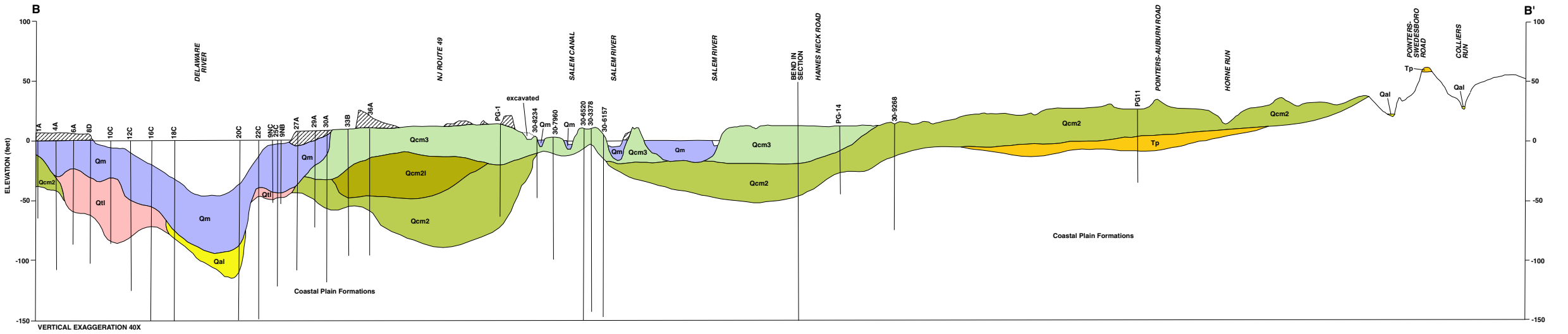
by
Scott D. Stanford
2006



CONTOUR INTERVAL 5 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929





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CORRELATION OF MAP UNITS