DEPARTMENT OF ENVIRONMENTAL PROTECTION
LAND USE MANAGEMENT
NEW JERSEY GEOLOGICAL SURVEY

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

SURFICIAL GEOLOGY OF THE CAMDEN AND PHILADELPHIA QUADRANGLES
CAMDEN, GLOUCESTER, AND BURLINGTON COUNTIES, NEW JERSEY
OPEN-FILE MAP OFM 60

INTRODUCTION

Surficial sediments in the New Jersey part of the Camden and Philadelphia quadrangles include artificial fill and fluvial, estuarine, and salt-marsh deposits. They are as much as 100 feet thick beneath and adjacent to the Delaware River but are generally less than 20 feet thick elsewhere. The deposits lie upon 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 formations are mapped by Stanford and others (2004).

DESCRIPTION OF MAP UNITS

ARTIFICIAL FILL--Sand, silt, gravel, clay; gray to brown; demolition debris (concrete, brick, wood, metal, etc.), cinders, ash, slag, glass. Massive to weakly stratified; dredge spoils are well-stratified in places. As much as 30 feet thick. In highway and railroad embankments, filled marshes and floodplains, and dredge-spoil disposal areas along the Delaware River in West Deptford, Pennsauken, and Palmyra. Many small areas of fill, particularly along streams in urban areas, are not mapped. Extent of fill is based in part on the position of shorelines and salt marshes shown on topographic manuscript map sheets 63 and 69 (N. J. Geological Survey, 1906, scale 1:21,120).

afl TRASH FILL--Trash mixed and covered with silt, clay, sand, and minor gravel. As much as 60 feet thick. In solid-waste landfills. Small areas of trash fill may be included within artificial fill.

Qal ALLUVIUM--Sand, silt, minor clay; brown, yellowish-brown, gray; and pebble gravel. Contains variable amounts of wood and fine organic matter. Sand and silt is 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 and minor ironstone. Gravel is chiefly white, gray, and yellow-stained quartz and quartzite, minor reddish-brown ironstone, and a trace of gray chert. Sand and gravel beds may be locally cemented with iron. Alluvium is as much as 70 feet thick beneath the Delaware River, and as much as 15 feet thick elsewhere. Deposited in modern floodplains and stream channels, and in former floodplains and channels beneath estuarine deposits before Holocene sea-level rise. Beneath the Delaware River (sections AA', BB'), alluvium includes late Pleistocene glaciofluvial sand and pebble-to-cobble gravel. The glaciofluvial deposits were laid down about 20,000 years ago, during the late Wisconsinan glacial maximum. They were later incised and reworked by the postglacial Delaware River before the rising sea entered the Delaware Valley about 10,000 years ago. The glaciofluvial gravel, which is exposed in dredge spoils along the river in Red Bank and Pennsauken, is chiefly white and gray quartz and quartzite, with much gray sandstone and mudstone, and some red sandstone and mudstone, gray gneiss, black chert, and purple-red conglomerate.

Qm SALT-MARSH AND ESTUARINE DEPOSITS--Silt, sand, peat, clay; brown, dark-brown, gray, black; and minor pebble gravel. Contain abundant organic matter. As much as 50 feet thick. Deposited in salt marshes, tidal flats, and tidal channels during Holocene sea-level rise, chiefly within the past 10,000 years.

Qtl LOWER TERRACE DEPOSITS--Fine-to-coarse sand, minor silt; yellow, yellowish-brown; 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 mica, and minor feldspar. Gravel is chiefly white, gray, and yellow-stained quartz and quartzite, minor reddish-brown ironstone, and a trace of gray chert. As much as 40 feet thick along the Delaware River, 15 feet thick elsewhere (estimated). Form terraces with surfaces 5 to 15 feet above modern floodplains and estuaries.

Qtu UPPER TERRACE DEPOSITS--Fine-to-coarse sand, minor silt; yellow, reddish-yellow, brownish-yellow, light-gray, locally olive-yellow; pebble gravel, minor fine cobble 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. Gravel is chiefly white, gray, and yellow-stained quartz and quartzite, minor reddish-brown ironstone, and a trace of gray chert. As much as 25 feet thick. Form terraces with surfaces 15 to 40 feet above modern flood plains. Grades downvalley to, or is onlapped by, the Cape May Formation, unit 2 (unit Qcm2), and so is contemporaneous with, or slightly older than, the Cape May 2. Sand in the upper terrace deposits contains less feldspar and rock fragments, and the gravel contains less chert and sandstone, than in the Pensauken Formation (unit Tp). These materials are generally deeply weathered to clay in the Pensauken and did not survive reworking during fluvial incision and erosion of that formation.

Qcm2 CAPE MAY FORMATION (Salisbury and Knapp, 1917)--Fine-to-coarse sand, minor silt and clay; yellow, brownish-yellow, reddish-yellow, very pale brown, light-gray; minor pebble gravel. Massive to well stratified. Sand is quartz with a little glauconite and a trace of mica and feldspar. Gravel composition as in unit Qtu. As much as 40 feet thick. Unit Qcm2 (Newell and others, 1995) forms a terrace with a maximum surface elevation of about 35 feet. Fossils, pollen, and amino-acid racemization ratios in shells from this unit elsewhere in the Delaware estuary and Delaware Bay area indicate that it is an estuarine or fluvial-estuarine deposit of Sangamon age (about 125,000 years ago), when sea level was approximately 30 feet higher than at present in this region (Woolman, 1897; Newell and others, 1995; Lacovara, 1997; Wehmiller, 1997). Unit Qcm1 is an older estuarine or fluvial-estuarine deposit of uncertain age that forms a terrace with a maximum elevation of about 50 feet. A bed of black clay within Qcm1 (the "Fish House Clay" of Woolman, 1897), formerly exposed in the pit just south of Delair Junction, contained freshwater mussels, horse bones and teeth, pine and birch bark, and maple, oak, and basswood leaves (Woolman, 1897; Bogan and others, 1989). These fossils indicate that the Cape May 1 unit was deposited in a temperate, interglacial climate. Because it is at higher elevation than Sangamon-age deposits, it was probably 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). Salisbury and Knapp (1917) included fluvial terrace deposits within the Cape May Formation; here they are mapped separately as units Qtl and Qtu.

Tp PENSAUKEN FORMATION (Salisbury and Knapp, 1917)--Fine-to-coarse 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 (Bowman and Lodding, 1969; Owens and Minard, 1979). The feldspar generally is 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 reddish-brown ironstone; 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 40 feet thick. Occurs as erosional remnants capping uplands. The base of the deposit descends from an elevation of 80-100 feet in the southeastern corner of the map area to at or slightly below modern sea level adjacent to the Delaware River in the Cramer Hill area of Camden, reflecting thickening of the deposit towards the main Delaware Valley. Over most of the map area, the base of the Pensauken is between 50 and 70 feet in elevation. The variation in basal elevation reflects fluvial channeling into the underlying substrate of Cretaceous formations. 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 Camden quadrangle is in the central and southeastern 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. 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). 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 age. Soil zone generally includes some lag pebbles from eroded surficial deposits. May include thin, patchy colluvial or alluvial sediments less than 3 feet thick.

MAP SYMBOLS

Contact--Solid where well-defined by landforms; dashed where approximate, feathered, or gradational; short-dashed where exposed in former sand and clay pits.

31-1447 6 fill 16 Qm 47 Qtl **Thickness 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 or engineer's log. Where multiple surficial units were identified, 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 base of unit was not reached at depth shown. Identifiers of the form 31-xxxx are well permits issued by the N. J. Department of Environmental Protection, Bureau of Water Allocation. Identifiers prefixed by W, E, B, P, G, or GB are bridge borings provided by the Delaware River Port Authority. Identifiers prefixed by PR are bridge borings from Woolman (1897). Identifiers prefixed by HR are from Richards (1943). Identifiers prefixed by CNW, 104, and GH are from Jengo (1999). Identifiers of the form 31-xx-xxx are N. J. Atlas Sheet coordinates of records of wells in the Bureau of Water Allocation files that do not have permit numbers.

31-20047 47 **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

20 **Thickness of surficial material in former exposure**--In feet. From permanent note collection of the N. J. Geological Survey.

Excavation perimeter--Marks edges of former sand and clay 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 2001.

Shallow topographic basin--Line at rim, pattern within basin. Depth generally less than 5 feet. Basins were likely formed by thawing of permafrost between 15,000 and 18,000 years ago. Drawn from air photos taken in 1979.

Paleocurrent--Arrow shows direction of former river flow. Measured from tabular, planar cross beds at red dot.

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SCALE 1:24 000

1 MILE 0 1/2 1

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 KILOMETER 0 .5 1

CONTOUR INTERVAL 20 FEET

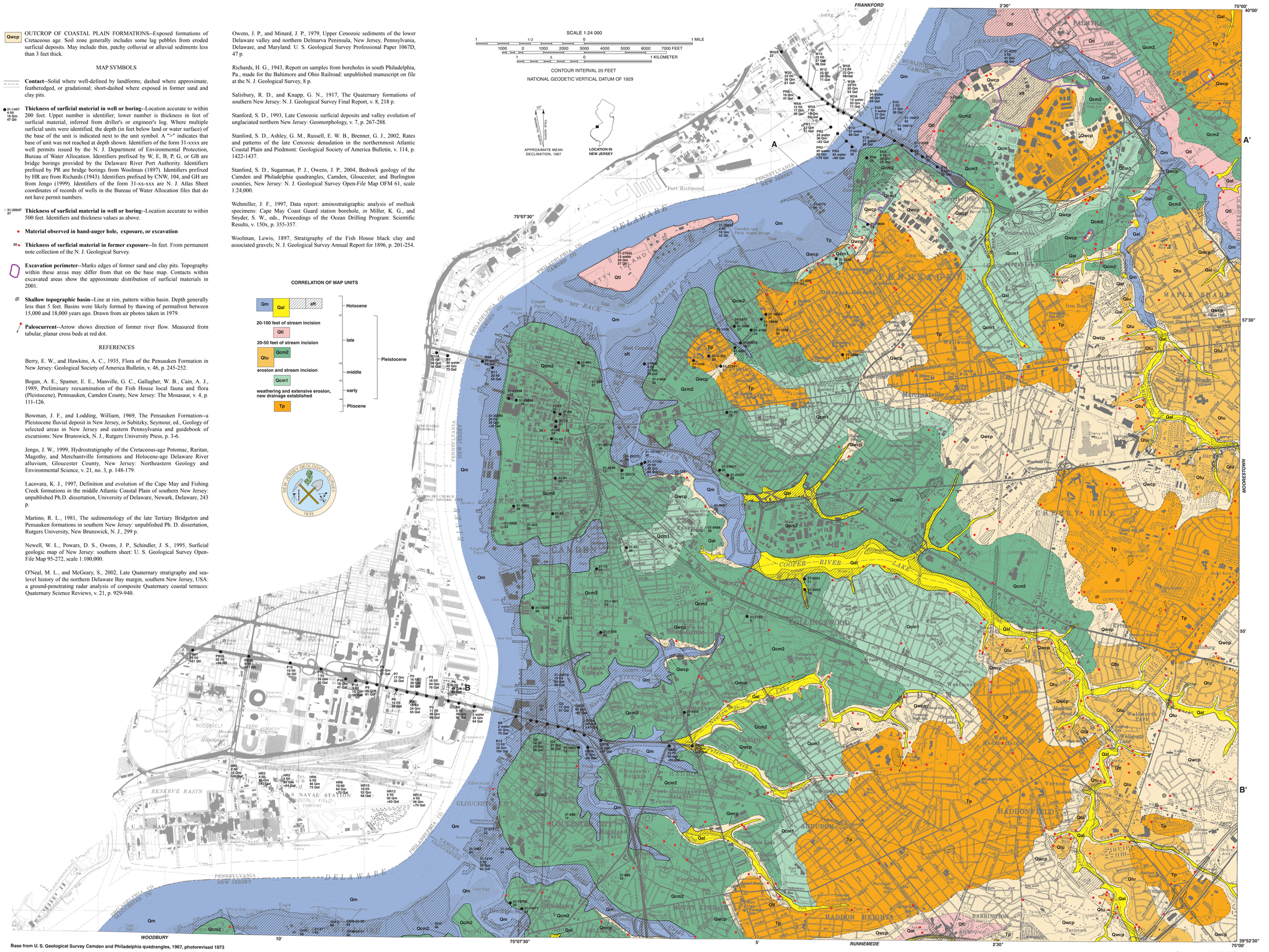
NATIONAL GEODETIC VERTICAL DATUM OF 1929

APPROXIMATE MEAN DECLINATION, 1967

LOCATION IN NEW JERSEY

CORRELATION OF MAP UNITS

Qm, Qal, afl		Holocene
20-100 feet of stream incision: Qtl	late	Pleistocene
20-50 feet of stream incision: Qtu, Qcm2	middle	Pleistocene
erosion and stream incision: Qcm1	early	Pleistocene
weathering and extensive erosion, new drainage established: Tp		Pliocene



Base from U. S. Geological Survey Camden and Philadelphia quadrangles, 1967, photorevised 1973

Geology mapped 2000-2001

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by
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