DEPARTMENT OF ENVIRONMENTAL PROTECTION
NEW JERSEY GEOLOGICAL SURVEY

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

SURFICIAL GEOLOGY OF THE RUNNEMEDE QUADRANGLE CAMDEN AND GLOUCESTER COUNTIES, NEW JERSEY OPEN FILE MAP OFM 52

INTRODUCTION

Surficial sediments in the Runnemede quadrangle include artificial fill and fluvial, estuarine, salt-marsh, and hillslope deposits. They are as much as 50 feet thick but are generally less than 20 feet thick, and are absent over much of the quadrangle. The deposits lie upon a landscape shaped by three main episodes of valley incision. The deposits are described below. The temporal relationships of the deposits and the episodes of valley erosion are shown on the correlation chart.

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. As much as 30 feet thick. In highway and railroad embankments and filled marshes and floodplains. Many small areas of fill, particularly along streams in urban areas, are not mapped.

afl TRASH FILL--Trash mixed and covered with silt, clay, sand, and minor gravel. As much as 80 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 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 ironstone. Gravel is chiefly white, gray, and yellow 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 15 feet thick (estimated). Deposited in modern flood plains and stream channels.

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 30 feet thick (estimated). Deposited in modern salt marshes and tidal channels during the Holocene sea-level rise, chiefly within the past 6000 years.

Qtl LOWER TERRACE DEPOSITS--Fine-to-coarse sand, minor silt; yellow, reddish-yellow, olive-yellow; pebble gravel, minor 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 and glauconite. Gravel is chiefly white, gray, and yellow quartz and quartzite, minor reddish-brown ironstone, and a trace of gray chert. As much as 15 feet thick (estimated). Glauconite is more abundant than in older surficial deposits because streams had incised into the glauconite-rich Navesink and Hornerstown formations during deposition of this unit. Form terraces with surfaces 5 to 15 feet above modern flood plains.

Qcl LOWER COLLUVIUM--Fine-to-coarse sand, few to some pebbles, minor silt; yellow to brownish-yellow. Massive to weakly stratified. Sand is quartz with minor glauconite. Gravel composition as in unit Qtl. As much as 10 feet thick (estimated). Forms footslope aprons that grade to the lower terraces or to the modern flood plains.

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 a little glauconite and a trace of feldspar. Gravel is chiefly white, gray, and yellow 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. Grade downvalley to, or are onlapped by, the Cape May Formation, unit 2 (Qcm2), and so are contemporaneous with, or slightly older than, the Cape May 2. Sand in the upper terrace deposits contains significantly fewer feldspar and rock fragments, and the gravel contains significantly fewer chert and sandstone clasts, than in units Tp, Tg, and Tb because these deeply weathered materials did not survive reworking from the older deposits.

Qcu UPPER COLLUVIUM--Fine-to-coarse sand; yellow, brownish-yellow, light-gray, very pale brown; and pebble gravel. Massive to weakly stratified. Sand is quartz with minor glauconite. Gravel composition as in unit Qtu. As much as 15 feet thick (estimated). Rests on slopes that grade to the upper terraces.

Qcm2 CAPE MAY FORMATION, UNIT 2 (Salisbury and Knapp, 1917; Newell and others, 2000)--Fine-to-coarse sand, minor silt; 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 feldspar. Gravel composition as in unit Qtu. As much as 40 feet thick (estimated). Forms a terrace with a surface elevation of about 30 feet. Fossils, pollen, and amino-acid racemization ratios in shells from this unit elsewhere in the Delaware estuary 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; Lacovara, 1990; Newell and others, 1995). 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-medium sand, minor coarse sand and silt; 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), and glauconite (Bowman and Lodding, 1969; Owens and Minard, 1979). The feldspar is 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 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 50 feet thick (estimated). Occurs as erosional remnants capping uplands in the northwestern and northern parts of the quadrangle. Base of the deposit descends from an elevation of about 110 feet in the Lawnside area to about 25 feet in the northwest corner of the quadrangle, reflecting thickening of the deposit towards the main Delaware Valley. This geometry, and 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 Runnemede quadrangle is on the southeastern edge 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).

Tg UPLAND GRAVEL--Fine-to-coarse sand, minor silt; yellow, reddish-yellow, very pale brown; and pebble gravel. Sand is massive to weakly stratified. Gravel occurs as thin beds (generally less than 1 foot thick) within the sand, and at the base of the deposit. Sand is chiefly quartz, with some glauconite, and a trace of weathered feldspar and chert. Gravel is chiefly yellow, reddish-yellow (from iron-staining), white, and gray quartz and quartzite, with a little ironstone and a trace of weathered chert. As much as 15 feet thick. The chert content of the upland gravel is significantly lower than in unit Tb because the weathered material did not survive reworking from the older deposit. Occurs as erosional remnants capping uplands or interfluves in the eastern and southern parts of the quadrangle. The base of the deposits descends from an elevation of about 130 feet in the southeast to about 60 feet in the west and central parts of the quadrangle, where the deposits grade into the Pensauken Formation. This relationship, and the northwest-southeast trend of many of the deposits, suggest that the upland gravels were laid down by northwesterly flowing local streams that were tributaries to the Pensauken river. Post-Pensauken stream erosion resulted in a topographic inversion, with the former valley-bottom deposits now forming interfluves.

Tb BRIDGETON FORMATION (Salisbury and Knapp, 1917)--Medium-to-coarse sand, minor fine sand, clay, and silt; reddish-yellow, red, yellow, white, very pale brown; pebble gravel, and minor cobble gravel. Massive in upper 5-10 feet, where bioturbation, cryoturbation, and soil processes have destroyed the stratification. Generally well-stratified below the soil zone, 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 (as much as 2 feet thick) in places at the base of the deposit, where it may include some cobble gravel. The gravel and coarse sand beds may be locally iron-cemented. Sand is chiefly quartz with some feldspar and rock fragments (chiefly chert and shale). The feldspar and chert are generally weathered to white clay, which has been translocated by ground water to form coatings on the quartz grains and to fill voids in the coarser sand beds. Glauconite is rare to absent because glauconitic Coastal Plain formations were not exposed during deposition of the Bridgeton. Gravel is chiefly yellow, reddish-yellow, and reddish-brown (from iron-staining) to white and gray quartz and quartzite with some gray and brown chert, and a trace of weathered reddish-brown to gray sandstone and shale and weathered white-to-gray gneiss. Many of the chert pebbles are weathered to white and yellow clay. As much as 30 feet thick. Occurs as erosional remnants on the highest uplands. Base of deposit descends from an elevation of about 190 feet near Pine Hill to about 105 feet in the southwestern corner of the quadrangle. Paleoflow measured at 4 exposures in the quadrangle (plotted on map), and at numerous locations regionally (Owens and Minard, 1979; Martino, 1981), is southeasterly. The Bridgeton was deposited by a river that flowed southeasterly to easterly across the southern New Jersey Coastal Plain. Stratigraphic position and petrologic correlations to marine deposits in the Delmarva Peninsula suggest a late Miocene age (Owens and Minard, 1979; Pazzaglia, 1993).

Qwcp WEATHERED COASTAL PLAIN FORMATIONS--Exposed formations of Cretaceous through Miocene 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, featheredged, or gradational; dotted within excavated areas where topography differs from the base map.

31-5513 / 12 **Thickness of surficial material in well or boring--**Upper number is the well permit number, issued by the N. J. Department of Environmental Protection, Bureau of Water Allocation; lower number is thickness in feet of surficial material inferred from driller's log.

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

Material formerly observed--From files of the N. J. Geological Survey, based on field observations between 1900 and 1945 by H. B. Kummel, G. N. Knapp, and M. E. Johnson.

Paleocurrent measurement--Observation at **x**, arrow indicates paleoflow direction. Measured on planar, tabular cross-beds in the Bridgeton Formation.

Excavation scarp--Line at top, ticks on slope. 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 1999.

Sand and gravel pit--Inactive in 1999.

Sand and gravel pit--Active in 1999.

9 **Glauconite pit--**Inactive in 1999. Excavated in the Navesink or Hornerstown Formations of Cretaceous and Paleocene age.

Dune field--Low, small wind-shaped dunes. Sand in dunes derived from underlying map unit.

Shallow topographic basin--Line at rim, pattern in basin. Depth generally less than 5 feet. Of probable periglacial origin. Drawn from air photos taken in 1979.

REFERENCES

Berry, E. W., and Hawkins, A. C., 1935, Flora of the Pensauken Formation in New Jersey: Geological Society of America Bulletin, v. 46, p. 245-252.

Bowman, J. F., and Lodding, William, 1969, The Pensauken Formation--a Pleistocene fluvial deposit in New Jersey, *in* Subitzky, Seymour, ed., Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions: New Brunswick, N. J., Rutgers University Press, p. 3-6.

Lacovara, K. J., 1990, Reference section for the Cape May Formation: lithology, palynology, and amino acid data: Geological Society of America Abstracts with Programs, v. 22, p. 29.

Martino, R. L., 1981, The sedimentology of the late Tertiary Bridgeton and Pensauken formations in southern New Jersey: unpublished Ph. D. dissertation, Rutgers University, New Brunswick, N. J., 299 p.

Newell, W. L., Powars, D. S., Owens, J. P., and Schindler, J. S., 1995, Surficial geologic map of New Jersey: southern sheet: U. S. Geological Survey Open File Map 95-272, scale 1:100,000.

Newell, W. L., Powars, D. S., Owens, J. P., Stanford, S. D., and Stone, B. D., 2000, Surficial geologic map of central and southern New Jersey: U. S. Geological Survey Miscellaneous Investigations Series Map I-2540-D, scale 1:100,000.

Owens, J. P., and Minard, J. P., 1979, Upper Cenozoic sediments of the lower Delaware valley and northern Delmarva Peninsula, New Jersey, Pennsylvania, Delaware, and Maryland: U. S. Geological Survey Professional Paper 1067D, 47 p.

Pazzaglia, F. J., 1993, Stratigraphy, petrography, and correlation of late Cenozoic middle Atlantic Coastal Plain deposits: implications for late-stage passive margin geologic evolution: Geological Society of America Bulletin, v. 105, p. 1617-1634.

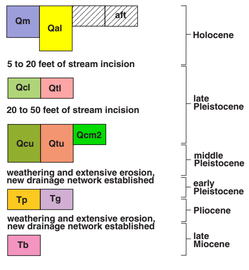
Salisbury, R. D., and Knapp, G. N., 1917, The Quaternary formations of southern New Jersey: N. J. Geological Survey Final Report, v. 8, 218 p.

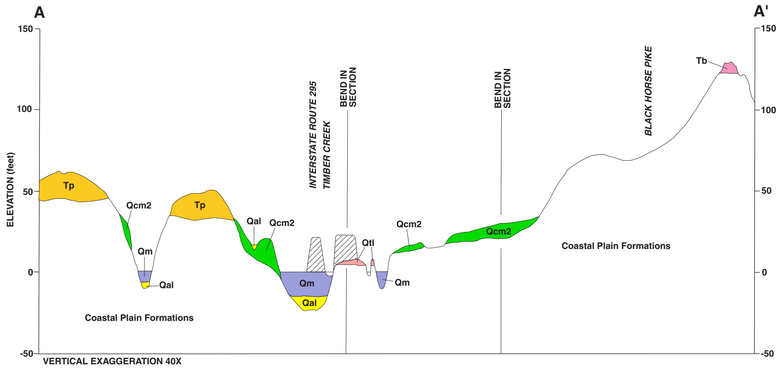
Stanford, S. D., 1993, Late Cenozoic surficial deposits and valley evolution of unglaciated northern New Jersey: Geomorphology, v. 7, p. 267-288.

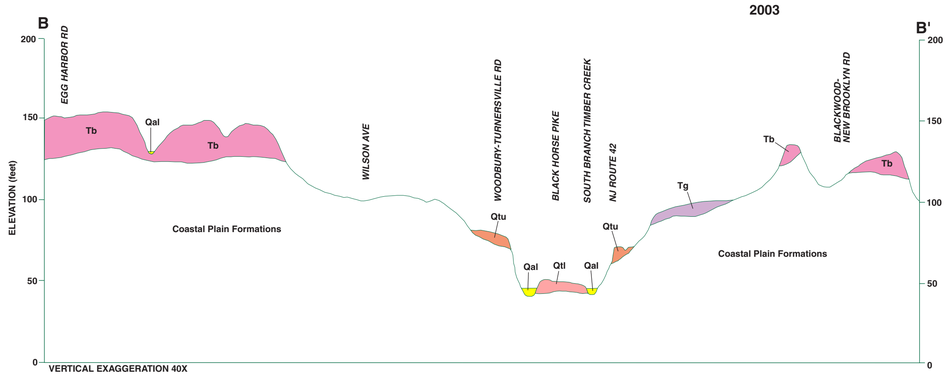
Stanford, S. D., Ashley, G. M., Russell, E. W. B., and Brenner, G. J., 2002, Rates and patterns of late Cenozoic denudation in the northernmost Atlantic Coastal Plain and Piedmont: Geological Society of America Bulletin, v. 114, p. 1422-1437.

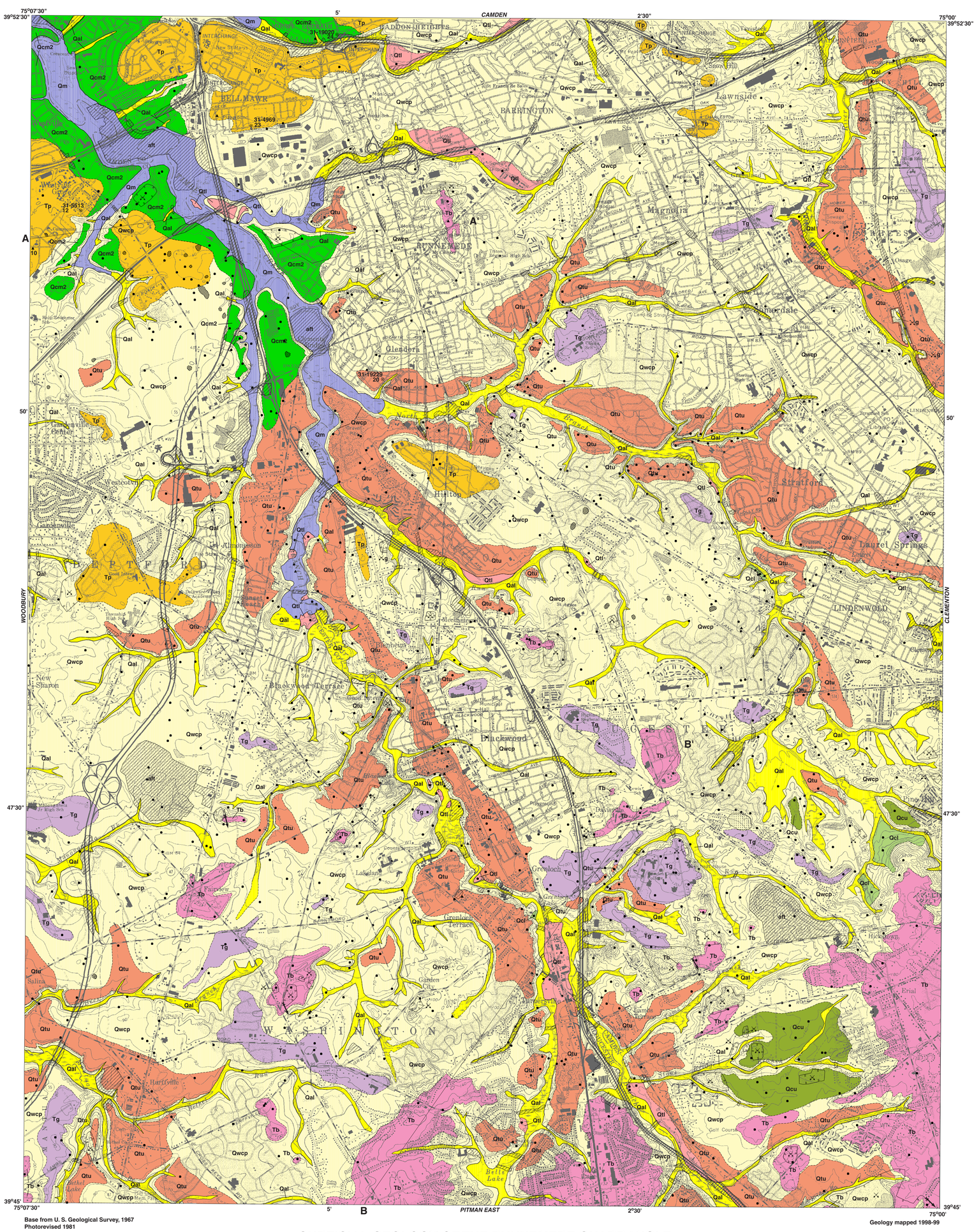
Woolman, Lewis, 1897, Stratigraphy of the Fish House black clay and associated gravels: N. J. Geological Survey Annual Report for 1896, p. 201-254.

CORRELATION OF MAP UNITS









SURFICIAL GEOLOGY OF THE RUNNEMEDE QUADRANGLE, CAMDEN AND GLOUCESTER COUNTIES, NEW JERSEY

by
Scott D. Stanford

2003

SCALE 1:24 000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

11° TRUE NORTH MAGNETIC NORTH

APPROXIMATE MEAN DECLINATION, 1981

NEW JERSEY GEOLOGICAL SURVEY 1835

LOCATION IN NEW JERSEY