DEPARTMENT OF ENVIRONMENTAL PROTECTION
LAND USE MANAGEMENT
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U. S. GEOLOGICAL SURVEY
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SURFICIAL GEOLOGY OF THE BRIDGEPORT AND MARCUS HOOK QUADRANGLES
GLOUCESTER AND SALEM COUNTIES, NEW JERSEY
GEOLOGIC MAP SERIES GMS 06-2

INTRODUCTION

In the Bridgeport and Marcus Hook quadrangles, surficial deposits include artificial fill and river, hillslope, wetland, and estuarine sediment. Surficial deposits are unconsolidated sediments that overlie bedrock and 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 but are generally less than 20 feet thick elsewhere. The deposits occupy a landscape shaped by five main episodes of valley erosion. 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. Massive to weakly stratified. As much as 20 feet thick. In highway and railroad embankments and filled wetlands and flood plains. 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 68 and 74 (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. Contains variable amounts of organic matter and mica, and minor amounts of man-made materials. Massive to weakly stratified. As much as 30 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 AA'), the lowermost alluvium includes late Pleistocene glaciofluvial sand and pebble-to-cobble gravel that is the downstream extension of the glaciofluvial gravel that crops out in the Delaware Valley north of the Burlington, New Jersey, area. This gravel was informally 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 and schist, 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 pebble gravel. Contain abundant organic matter and some mica. In swamps away from the Delaware River and major creeks, the deposits are chiefly woody freshwater peat, including cedar wood and logs from former cedar swamps. 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 6 feet thick (estimated). Mapped only where generally greater than 2 feet thick. Deposited in nontidal wetlands.

Qtl LOWER TERRACE DEPOSITS--Fine-to-medium sand, minor coarse sand and silt; yellow, reddish-yellow, olive-yellow, brown, gray; 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 25 feet thick. In tributary valleys, form stream terraces with surfaces 2 to 5 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 -20 to -40 feet in elevation. Both the tributary-valley terraces and the terrace deposits in the main Delaware Valley were laid down in valleys cut into the Cape May Formation, unit 2, and into a younger unit of the Cape May Formation (unit 3), which does not extend into the map area but is present just to the south. After deposition of the lower terrace sediments, 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 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) on wood within the lower terrace deposits at depths of 30 and 28 feet below land surface, respectively, in borings B-96-1, and MW-209D (plotted on map) in Marcus Hook, Pennsylvania, confirm this age range (Jengo, 2006).

Qcl LOWER COLLUVIUM--Fine-to-medium sand and silt, yellow to brownish-yellow, few to some pebbles. Massive to weakly stratified. As much as 6 feet thick. Forms foot-slope aprons that grade to the modern flood plain. Deposited by mass movement and unchanneled washing of material on hillslopes. Hillslope deposits that are on grade with upper terrace deposits (known as "Upper Colluvium") occur in this region but not at mappable scale in the map area.

Qtu UPPER TERRACE DEPOSITS--Fine-to-coarse sand, minor silt; yellow, reddish-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. Sand in the upper terrace deposits contains significantly less feldspar and chert, and the gravel contains significantly less chert and sandstone, than in units Tp, Tg1, and Tg2, because these deeply weathered materials did not survive reworking from the older deposits.

Qcm2
Qcm1 CAPE MAY FORMATION (Salisbury and Knapp, 1917)--Fine-to-medium sand, minor coarse sand, silt, clay, and peat; yellow, brownish-yellow, very pale brown, gray, brown; and pebble gravel, minor cobble gravel. Massive to well-stratified. Sand is quartz with a little glauconite and a trace of mica, feldspar, and chert. Gravel composition as in unit Qtu. As much as 40 feet thick but generally less than 20 feet thick. Unit Qcm2 (Newell and others, 2000) 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 20-30 feet higher than at present in this region (Newell and others, 1995; Wehmiller, 1997; Lacovara, 1997). Unit Qcm2 is equivalent to the Lynch Heights Formation in Delaware (Ramsey, 1993). Unit Qcm1 is an older estuarine or fluvial-estuarine deposit of uncertain age that occurs up to a maximum elevation of about 60 feet. It was 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). Areas symboled as "Qcm1/Tp" indicate extent of Cape May Formation, unit 1, less than 5 feet thick over Pensauken Formation. 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. In Pennsylvania, deposits correlative to the Cape May Formation are mapped as "Trenton Gravel" (Berg and others, 1980). At its type location the Trenton Gravel is a glaciofluvial deposit, not an interglacial estuarine deposit (see description of unit Qal). South of the Burlington, New Jersey area (about 30 miles northeast of Bridgeport) the glaciofluvial deposit occurs only at the bottom of the valley channeled into the Cape May and lower terrace sediments during the late Wisconsinan glacial maximum, and it is now entirely buried by Holocene estuarine deposits.

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 and chert are generally partially weathered to 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 40 feet thick (estimated). Occurs on the low upland southeast of the Cape May 2 terrace, with a maximum surface elevation of 75-80 feet. A scarp southeast of Kings Highway defines the southeastern limit of the Pensauken. The base of the deposit descends from an elevation of about 80 feet at the foot of this scarp to less than 10 feet in the valleys of Pargay Brook and Grand Sprute Run, where it crops out beneath the Cape May Formation. This pattern records thickening of the deposit towards the main Delaware Valley. 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). 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). The Delaware River may have continued to deposit the Pensauken in the Delaware Valley and the Columbia Formation on the Delmarva Peninsula into the early and middle Pleistocene, after glacial diversion of the trunk Pensauken river in the New York City area (Stanford, 1993).

Tg2
Tg1 UPLAND GRAVEL--Fine-to-coarse sand, minor silt; yellow, reddish-yellow, very pale brown; and pebble gravel, minor fine cobble gravel. Sand is massive to weakly stratified to thinly layered horizontally in places, particularly in unit Tg2. 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, and a little weathered chert. Gravel is iron-cemented in places, particularly in unit Tg1. As much as 15 feet thick. Occurs as erosional remnants of stream and hillslope deposits capping uplands and ridgetops in the southeastern corner of the quadrangle. Unit Tg1 caps ridgetops above about 105 feet in elevation and is older than Tg2 and the Pensauken Formation. However, it is younger than the Bridgeton Formation, a fluvial deposit of late Miocene age with a base at elevations above 120 feet just to the east and south of the map area. Unit Tg2 has a basal elevation ranging from 65 to 95 feet and grades to the Pensauken Formation. The Tg2 deposits were laid down by slope wash and stream deposition in valleys that were tributaries to the Pensauken river. Post-Pensauken stream erosion resulted in a topographic inversion, with the former valley-bottom deposits now capping interfluves.

Qwcp OUTCROP OF COASTAL PLAIN FORMATIONS--Exposed formations of Cretaceous 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 section owing to variable depth of weathering.

MAP SYMBOLS

Contact--Solid where well-defined by landforms; dashed where approximate, featheredged, or gradational; short-dashed where exposed within excavated areas.

30-4747
47
B47
10 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 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 Bxxx and Axx are borings drilled for the Commodore Barry bridge (provided courtesy of the Delaware River Port Authority). Identifiers of the form "Sun x" and xxx+xx are borings with logs on file at the N. J. Geological Survey. Identifiers of the form MW-x, LPA-x, and xx-xx-x are from Jengo (2006).

30-1147
21

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

Qcm1/Tp **Unit to left of slash overlies unit to right--**Indicates extent of thin veneer of Cape May Formation, unit 1(Qcm1) over Pensauken Formation (Tp).

Excavation perimeter--Marks edges of former 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.

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 formed on the Cape May Formation, unit 2; 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 2. May contain thin peat or organic silt less than 2 feet thick; basins containing peat generally greater than 2 feet thick are mapped as unit Qs. Most basins were likely formed by melting of permafrost after the last glacial maximum about 20,000 years ago, some may have been formed by wind erosion or groundwater processes.

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

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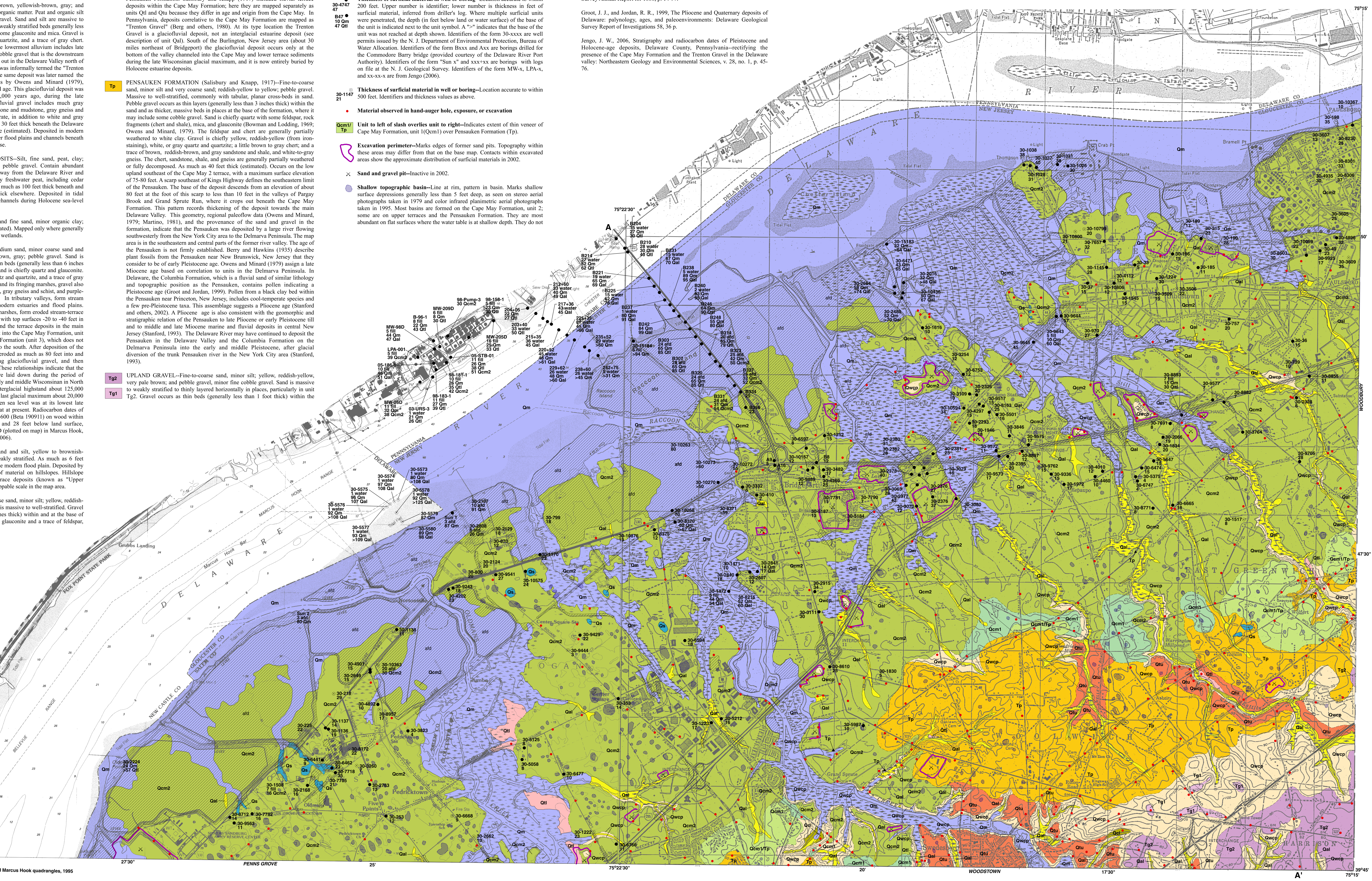
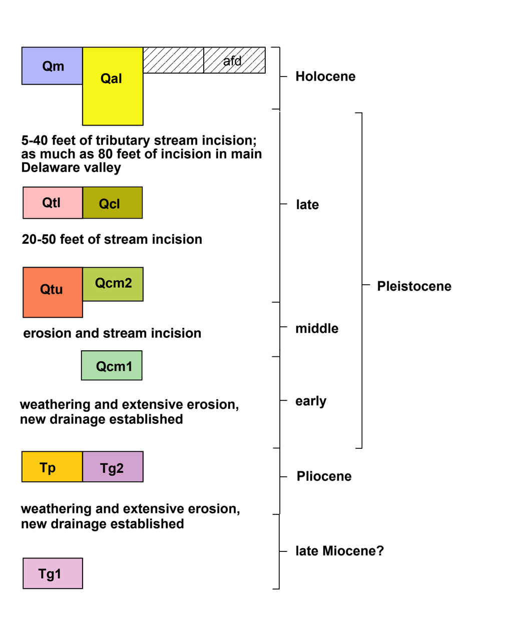
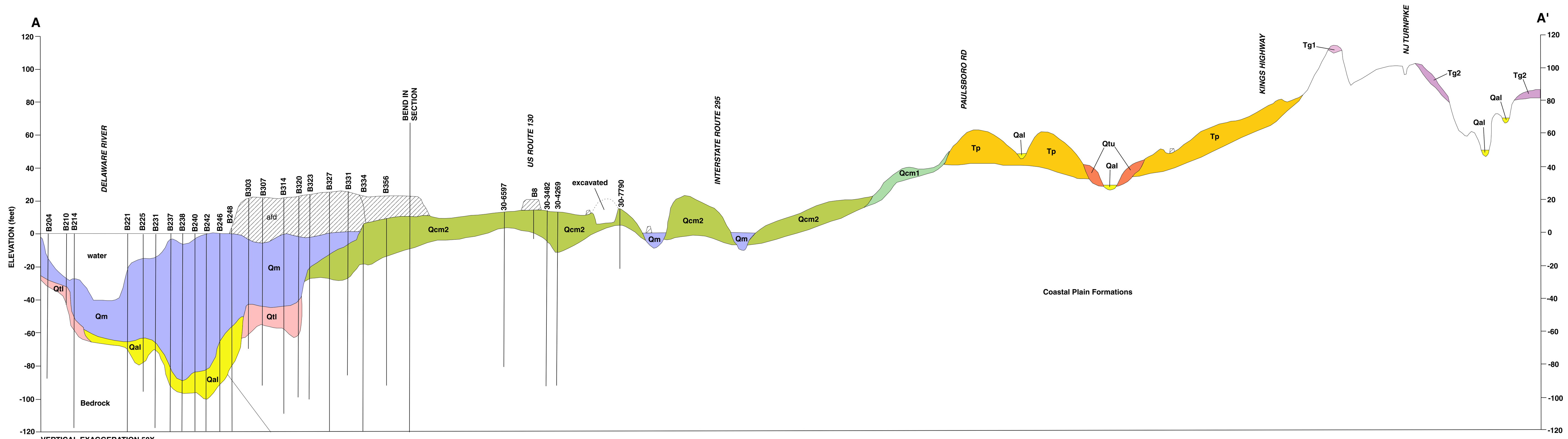


Base from U. S. Geological Survey Bridgeport and Marcus Hook quadrangles, 1995

Geology mapped 2001-2002
Cartography by S. Stanford and M. Girard
Reviewed by J. Jengo, S. Johnson, K. Muessig, K. Ramsey, and P. Sugarman

CORRELATION OF MAP UNITS





SURFICIAL GEOLOGY OF THE BRIDGEPORT AND MARCUS HOOK QUADRANGLES, GLOUCESTER AND SALEM COUNTIES, NEW JERSEY

by
Scott D. Stanford
2006

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

12°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 1999

LOCATION IN NEW JERSEY