SURFICIAL GEOLOGIC MAP OF NEW JERSEY

DESCRIPTION OF MAP UNITS

HOLOCENE

- floodplain alluvium
- beach sand
- freshwater wetland deposit
- estuary and salt marsh deposit
- postglacial stream terrace

PLEISTOCENE GLACIAL

- Kittatinny Mountain Till
- Netcong Till
- Rahway Till
- Flanders Till
- Port Murray Till
- moraine
- sand and gravel
- lake clay

PLEISTOCENE NONGLACIAL

- windblown sand and silt
- colluvium
- Lower Stream Terrace
- Upper Stream Terrace
- Cape May 3 Marine Terrace
- Cape May 2 Marine Terrace
- Cape May 1 Marine Terrace

PLIOCENE

- Pensauken Formation

LATE MIOCENE

- Bridgeton Formation
- Upland Gravel
- Beacon Hill Gravel
- surficial deposits thin or absent

DESCRIPTION OF MAP SYMBOLS

- limit of late Wisconsinan glaciation
- limit of Illinoian glaciation
- limit of pre-Illinoian glaciation

Department of Environmental Protection

NEW JERSEY GEOLOGICAL AND WATER SURVEY

2016

SUSSEX
Franklin
Newton
Andover
Delaware Water Gap
PASSAIC
Mahwah
WARREN
Belvidere
Boonton
BERGEN
Paterson
Hackensack
MORRIS
Morristown
ESSEX
Newark
HUDSON
Jersey City
Gladstone
Phillipsburg
UNION
Elizabeth
Somerville
Carteret
Milford
HUNTERDON
Flemington
SOMERSET
New Brunswick
MIDDLESEX
MERCER
Trenton
Freehold
MONMOUTH
Asbury Park
Mount Holly
Toms River
Camden
OCEAN
BURLINGTON
Woodbury
CAMDEN
GLOUCESTER
SALEM
Salem
ATLANTIC
Mays Landing
Bridgeton
CUMBERLAND
Atlantic City
CAPE MAY
Cape May Court House

75°00′ 74°30′ 74°00′ 41°00′ 40°30′ 40°00′ 39°30′ 39°00′ 76°00′ 75°30′

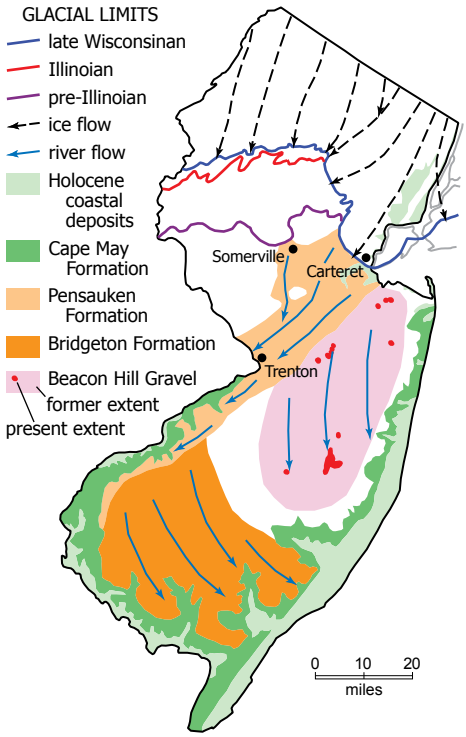
0 5 10 15 20 mi
0 10 20 30 km

Scale 1:1,000,000

SURFICIAL GEOLOGY OF NEW JERSEY

Surficial deposits are sediments laid down by rivers, glaciers, ocean currents and waves, wind, and movement of soil and rocks on hillslopes. They overlie bedrock and unconsolidated Coastal Plain formations, and are the parent material for agronomic soils. In New Jersey they are as much as 400 feet thick, but are less than 25 feet thick over most of the state. New Jersey is a coastal state at the southern limit of continental glaciation and so has a variety of surficial deposits formed during its rich history of glaciation, changing sea level, and evolving river systems.

The oldest surficial deposit in New Jersey is the *Beacon Hill Gravel* (italicized names are the deposits shown on the maps), a weathered river gravel composed mostly of quartz and chert pebbles that caps the highest hills in the Coastal Plain, which is the part of the state south of a line between Trenton and Carteret. Most of the gravel has been eroded away. Remnants of the gravel, shown in red on the maps, are sufficient to show that it was laid down by a river system that flowed southward across central New Jersey. This river system deposited a gravel plain on coastal deposits exposed when sea level lowered in the middle and late Miocene, between 15 to 10 Ma (millions of years ago). Southward flow is indicated by the decline in the elevation of the plain from 350 to 200 feet from north to south, and by cross bedding in sandy parts of the deposit, which record current direction.



Continued lowering of sea level caused the river system to cut down into the Beacon Hill plain. The river also shifted to the west in central New Jersey and swung southeasterly across southern New Jersey. It laid down the *Bridgeton Formation* in a plain across southern New Jersey. This deposit consists mostly of quartz and chert gravel eroded from the Beacon Hill, but it includes traces of schist, gneiss, and sandstone from northern New Jersey and eastern Pennsylvania. Southeastward flow is documented by cross bedding, and the decline in the elevation of the plain from 180 to 60 feet from northwest to southeast.

As the Bridgeton was deposited, the northern Coastal Plain, north and east of the Bridgeton river system, became an upland from which local streams drained eastward to the Atlantic and westward to the Bridgeton valley. Gravel and sand eroded from the Beacon Hill and underlying Coastal Plain formations was deposited in these local stream valleys. Today, due to erosion of younger valleys into the intervening, more easily eroded sand uplands, these *Upland Gravels* cap hilltops and ridges.

By the early Pliocene (5 Ma), the river system had again shifted to the west, and cut down into the Bridgeton plain, forming a valley across central New Jersey and along the present Delaware River valley downstream of Trenton. This river, which included the Delaware, the Hudson, and possibly rivers from southern New England, laid down sand and gravel in this valley to form the *Pensauken Formation*. The Pensauken is mostly quartz and chert gravel eroded and redeposited from the Bridgeton and Beacon Hill but it also includes traces of sandstone and gneiss from northern New Jersey and the Hudson River valley. Cross bedding and the decline of the Pensauken plain from 160 to 80 feet in elevation from north to south show southwestward river flow.

In the early Pleistocene, sometime between 2.5 Ma and 800 ka (thousands of years ago), a glacier entered New Jersey and advanced as far south as the Somerville area. This advance, known as the pre-Illinoian glaciation, deposited till (mixed sediment laid down directly from glacial ice) and a few sand and gravel deposits laid down by glacial meltwater. The till, known as the *Port Murray Till*, is reddish-yellow, weathered, and clayey. It remains today only on flat uplands, where it was protected from erosion.

The pre-Illinoian glacier diverted the Pensauken River from its valley across New Jersey, rerouting it southward from the New York City area. A new local river network formed on the abandoned Pensauken plain north of Trenton. South of Trenton, the Delaware River followed the old Pensauken valley. Lowered sea level during and after the glaciation allowed these and other rivers in New Jersey to incise their valleys as much as 200 feet, forming the river network we see today. Periods of cold climate in the middle Pleistocene (800 to 125 ka) reduced forest cover, causing sediment to wash into valleys, forming what today are *Upper Terraces*, 20 to 50 feet above the modern floodplain. In areas of higher relief sediment moving downslope accumulated at the foot of hills in deposits known as *colluvium*.

A second glaciation advanced into New Jersey in the middle Pleistocene, most likely during the Illinoian stage at 150 ka. Deposits of this glaciation are exposed in a belt in Morris and Warren counties and lie buried beneath younger glacial deposits east and north of the outcrop belt. They include the *Flanders Till*, a brown sandy silt till that is much less weathered and eroded than the Port Murray Till, and some sand and gravel deposited in glacial lakes and river plains.

The most recent glacier advanced to its terminus at 25 ka, during the Wisconsinan stage of the late Pleistocene (125 to 11 ka). Its terminal position, and some retreat positions, are marked by *moraines* (ridges of till laid down along the glacier margin). Three tills were deposited by this glacier: *Kittatinny Mountain Till*, a gray-brown sandy silt till derived from sedimentary rocks in northwestern New Jersey, *Netcong Till*, a yellowish-brown sandy till derived from gneiss in north-central New Jersey, and *Rahway Till*, a reddish-brown sandy silt till derived from sedimentary rocks in northeastern New Jersey. In valleys, glacial meltwater laid down *sand and gravel* in glacial lakes and river plains, and *lake clay* on glacial-lake floors. South of the glacial limit, sediment was washed into valleys from uplands during cold periods in the Wisconsinan, forming what today are *Lower Terraces*, 5 to 20 feet above modern floodplains. During this and earlier cold periods, westerly wind blew fine sediment from terraces, glacial river plains and drained lake floors, and exposed Coastal Plain sands. These sediments were deposited as *windblown sand and silt* in sheets and dunefields to the east and south of the source areas.

Sea level dropped as glaciers grew, and rose as glaciers melted. Estuarine sand and silt, and beach sand and gravel, deposited during the highstands form the Cape May Formation, a series of terraces ringing the coast. The terraces document at least three highstands: one between 100 to 80 ka, when sea level was 10-15 feet higher than present (*Cape May 3*), one at 125 ka (*Cape May 2*), when sea level was 20 to 30 feet higher, and one at 400 ka or earlier (*Cape May 1*), when sea level was 60 to 70 feet higher.

After the Wisconsinan glacier retreated from New Jersey at 20 ka, climate warmed. Forest regrew by 15 ka. Peat, silt, and clay began to accumulate in shallow lakes and ponds left by the glacier to form *freshwater wetland deposits*. Rivers eroded into glacial sediments in their valleys, depositing *postglacial terraces* and then, in the Holocene (11 ka - present), modern *floodplain alluvium*. On floodplains in parts of the Coastal Plain where rivers carried little sediment, peat accumulated instead of alluvium. Through this time, rising sea level was flooding the lower reaches of coastal rivers to form estuaries and bays, in which *estuarine and salt-marsh deposits* of silt, sand, and peat were laid down. Ocean waves and currents were eroding sand from headlands and from the inner continental shelf, depositing *beach sand*. The coastal deposits were laid down mostly within the past 7 ka, after sea level had risen to near its present elevation. The alluvial, wetland, and coastal sediments continue to accumulate today, along with fill deposited by humans.