### DEPARTMENT OF ENVIRONMENTAL PROTECTION WATER RESOURCE MANAGEMENT **NEW JERSEY GEOLOGICAL SURVEY**

## INTRODUCTION

The Brookville quadrangle is in the Pine Barrens region of the New Jersey Coastal Plain, in the southeastern part of the state. Geologic materials in the Brookville quadrangle include surficial deposits of late Miocene to Holocene age that overlie the Cohansey Formation, a marginal marine deposit of middle Miocene age. The surficial deposits include river, wetland, hillslope, and windblown sediments. The Cohansey Formation was deposited in coastal settings between about 13 and 10 million years ago (Ma), when sea level was more than 200 feet higher than at present in this region. As sea level lowered after 10 Ma, rivers flowing on the emerging Coastal Plain deposited the Beacon Hill Gravel, forming a broad regional river plain. As sea level continued to lower, the regional river system shifted to the west of the Pine Barrens region, and local streams began to erode into the Beacon Hill plain. During the latest Miocene, Pliocene, and Pleistocene Epochs (about 8 Ma to 20,000 years ago), stream and hillslope sediments were deposited in several stages as valleys were progressively deepened by stream incision, and widened by seepage erosion, in step with lowering sea level.

A brief summary of depositional settings of the Cohansey Formation, and of the geomorphic history of the quadrangle, as recorded by surficial deposits and landforms, is provided in the two following sections. The age of the deposits and episodes of valley erosion are shown on the correlation chart. Lithologic logs for three test borings drilled for this study (numbers E200905910, E200905911, and E200905912) are provided in table 1.

This map shows materials to a depth of 250-300 feet, which includes the Cohansey Formation and, in the western part of the quadrangle, the uppermost part of the Kirkwood Formation. Three test holes in the quadrangle (wells 32-49, 32-8457, and 33-43) penetrated below the Kirkwood, to total depths of 1741, 3340, and 1759 feet, respectively. A lithologic log for test hole 32-49 (Transcontinental Gas Pipeline Corporation well 17) is in Johnson (1961), formation assignments for test hole 33-43 (Transcontinental Gas Pipeline Corporation well 18) are in Kasabach and Scudder (1961), and an electric log for well 33-43 (U. S. Geological Survey well number 29-372) is in Zapecza (1989). Formations below the Kirkwood are shown on sections and described in Owens and others (1998). They are not shown or discussed on this map.

## COHANSEY FORMATION

The Cohansey Formation has been interpreted as either 1) a deltaic deposit with

inner-shelf sand at its base, passing upward into interbedded delta-front sand and clay, in turn overlain by fluvial sand and gravel and alluvial clay (Markiewicz, 1969; Rhodehamel, 1973; Newell and others, 2000), or 2) two or three stacked sequences composed of beach and shoreface sand overlain by tidal-flat sand and clay (Carter, 1972, 1978). Newell and others (2000) mapped inner-shelf and overlying delta-front facies in the Brookville quadrangle, implying a single transgression of sea level. Carter (1972) indicated two or three stacked transgressive sequences in the map area. Pollen and dinoflagellates recovered from peat beds in the Cohansey at Legler, about 20 miles north of Brookville, indicate a coastal swamp-tidal marsh environment (Rachele, 1976). The Legler pollen (Greller and Rachele, 1983), pollen recovered from a corehole near Mays Landing, New Jersey (Owens and others, 1988), and dinocysts recovered from coreholes in Cape May County, New Jersey (de Verteuil, 1997; Miller and others, 2001) indicate a late middle to early late Miocene age for the Cohansey.

In the Brookville quadrangle, clays in the Cohansey are in thin beds or laminas generally less than six inches thick, and are always interbedded with sand. Most are oxidized and multicolored but brown organic clay and peat was penetrated in several hand-auger holes in the Oyster Creek headwaters and in boring E200905911 at depths of 57-59 feet and 80-83 feet (table 1). Clayey strata are generally less than 25 feet thick, and some are continuous for more than 8 to 10 miles both downdip (northwest to southeast) and along strike (northeast to southwest). The laminated bedding and thin but areally extensive geometry indicate bay or estuarine intertidal settings. Alluvial clays generally are thicker and more restricted areally because they are deposited in flood plains and abandoned river channels. Clayey strata occur throughout the entire thickness of the Cohansey in the Brookville quadrangle, and there is no upsection transition to coarser fluvial sediments. The contact of the Cohansey and the Beacon Hill Gravel is not exposed but clayey strata in the Cohansey are within 25 stratigraphic feet of the base of the Beacon Hill (section AA'), so the transition from intertidal deposition in the Cohansey to fluvial deposition in the Beacon Hill is abrupt and possibly unconformable. Similar relationships are observed in the adjacent Woodmansie quadrangle (Stanford, 2010). These observations favor the stacked beach-tidal flat model of Carter (1972) for the Cohansey in this area, and imply that the Cohansey was deposited during several rises and falls of sea

# SURFICIAL DEPOSITS AND GEOMORPHIC HISTORY

Sea level in the New Jersey region began a long-term decline following deposition of the Cohansey Formation. As sea level lowered, the inner continental shelf emerged as a coastal plain. River drainage was established on this plain. The Beacon Hill Gravel, which caps the highest elevations in the quadrangle, on the Cedar Creek-Oswego River divide (fig. 1), is the earliest record of this drainage. It is a deeply weathered quartz-chert gravel preserved in erosional remnants of a large river plain that formerly covered much of the New Jersey Coastal Plain. Flow direction inferred from cross-beds, slope of the deposit, and gravel provenance, indicates that the Beacon Hill was laid down by rivers draining southward from the Valley and Ridge province in northwestern New Jersey and southern New York (Stanford, 2009). In the Beacon Hill, and in upland gravels reworked from the Beacon Hill, rare chert pebbles containing coral, brachiopod, and pelecypod fossils of Devonian age indicate that some of these rivers flowed from north of what is now Kittatinny and Shawangunk Mountains, where chert-bearing Devonian rocks crop out.

Continued decline of sea level during the late Miocene and early Pliocene (approximately 8 to 3 Ma) caused the regional river system to erode into the Beacon Hill plain. As it did, it shifted to the west of the Brookville quadrangle. The area of the Brookville quadrangle became an upland from which local streams drained eastward to the Atlantic and westward into the regional trunk river. These local streams eroded shallow valleys into the Beacon Hill Gravel. Groundwater seepage, slope erosion, and channel erosion reworked the gravel and deposited it in floodplains, channels, and pediments, 20 to 50 feet below the level of the former Beacon Hill plain. These deposits are mapped as Upland Gravel, High Phase (unit Tg). Today, owing to topographic inversion, they cap interfluves and hilltops. Red arrows on figure 1 show drainage routes of streams at this time, as inferred from the location and elevation of the interfluve deposits.

Another period of lowering sea level in the early Pleistocene (approximately 2 Ma to 800 ka) led to another period of valley deepening. Groundwater seepage, channel incision, and slope erosion reworked both the Beacon Hill and Upland gravels. The reworked sediment was deposited as the Upland Gravel, Lower Phase (unit TQg) in shallow valleys 20 to 50 feet below the Upland Gravel, High Phase. These deposits today cap low interfluves and form more extensive mantles in head-of-valley areas and upper slopes. Stream drainage at this time, inferred from interfluve deposits, is shown by purple arrows on figure 1.

Continuing downcutting in the middle and late Pleistocene (about 800 to 20 ka) formed the modern valley network. Sediments laid down in modern valleys include Upper and Lower Terrace Deposits (units Qtu and Qtl), inactive deposits in dry valleys (unit Qald), and active floodplain (Qal) and wetland (Qals) deposits in valley bottoms. Like the upland gravels, the terrace and floodplain deposits indicate erosion, transport, and redeposition of sand and gravel reworked from older surficial deposits and the Cohansey Formation by streams, groundwater seepage, and slope processes. Wetland deposits formed by accumulation of organic matter in swamps and bogs.

Upper Terrace Deposits form terraces and pediments 5 to 25 feet above modern wetlands and are the most widespread deposit in modern valleys. They may include sediments laid down during periods of cold climate, and also during periods of temperate climate when sea level was high, in the middle and late Pleistocene. During cold periods, permafrost impeded infiltration of rainfall and snowmelt and this, in turn, accelerated groundwater seepage and slope erosion, increasing the amount of sediment entering valleys. During periods of high sea level, the lower reaches of east-flowing streams in the quadrangle may have been close to sea level, facilitating deposition.

Sandy deposits forming terraces with a surface elevation of about 65 feet at two locations on the east edge of the quadrangle (mapped as Cape May Formation, unit 1, Qcm1) are the inland edge of a marine-terrace deposit. This terrace was laid down during a middle Pleistocene highstand when sea level was 60 to 70 feet higher than at present in this area. Global records show a period of sea level this high about 400 ka. The Cape May Formation, unit 1 deposits may have been laid down at this time.

Lower Terrace Deposits (unit Qtl) form low, generally wet, terraces less than 5 feet above modern valley bottoms. They are of much smaller extent than the upper terraces. They formed from stream and seepage erosion of the Upper Terrace Deposits, probably during or slightly after the last period of cold climate around 20 ka. Dry-valley alluvium (unit Qald) and windblown deposits (unit Qe)

wetland (unit Qals) deposits were laid down within the past 10 ka, based on basal radiocarbon dates on peat in other alluvial wetlands in the Pine Barrens (Buell, 1970; Florer, 1972; Stanford, 2000). Landforms and hydrologic observations indicate that groundwater seepage is an important geomorphic agent in the Brookville quadrangle, and in the Pine Barrens in general. Seepage occurs along the base of escarpments in the Cedar Creek, Forked River, and Oyster Creek basins (fig. 1). This seepage is from groundwater moving laterally atop a clay bed in the Cohansey Formation, which is continuous in the Cedar Creek and Forked River basins. In the Oyster Creek basin this clay thins and pinches out in places, and seepage is not as strongly developed as it is to the north, but a lower clay crops out near the valley floor (section CC'), creating a second seepage scarp (fig. 1). Groundwater intercepted by and moved eastward atop these clays, combined with the deeper incision of east-flowing streams owing to the much shorter distance they travel to the ocean, has led to groundwater diversion from the Oswego River basin into the east-draining basins, and westward migration of the surface divide (fig. 1). Oyster Creek and the South Branch of the Forked River are the most deeply incised, and collect seepage from two clay beds, and so divert groundwater southward from the North Branch Forked River basin and northward from the Fourmile Branch of Mill Creek basin, causing the

were likely also laid down at this time. Modern floodplain (unit Qal) and

These geomorphic observations are supported by base-flow measurements. Base flow, calculated from continuous and low-flow partial streamflow records collected for periods of 20 to 60 years and expressed as basin-wide recharge (in inches over the drainage area, fig. 2) is 48 inches in the Oyster Creek basin, 40 inches in the South Branch Forked River basin, 25 inches in the Mill Creek basin, 22 inches in the Cedar Creek basin, 17 inches in the Fourmile Branch basin, and 14 inches in the Oswego River basin (Gordon, 2004). These volumes indicate significant groundwater diversion from the Fourmile Branch and North Branch Forked River basins into the Oyster Creek and South Branch Forked River basins, and some diversion from the Oswego River basin into the Mill Creek and Cedar Creek basins, in agreement with observed seepage features and divide asymmetry. Further geomorphic evidence of divide migration is an abandoned valley on the Mill Creek-Dry Branch divide (shown by green arrow on fig. 1) marking the capture by Mill Creek of a former Oswego River tributary during the middle or late Pleistocene.

surface divide to migrate northward and southward, respectively.

Cold climate at glacial maximums in the middle and late Pleistocene produced permafrost in the Pine Barrens region (Wolfe, 1953; French and others, 2003). During thaws, permafrost at depth acted as an impermeable layer and supported the water table at a higher elevation than in temperate climate. Seepage features, including inactive scarps and amphitheater-shaped hollows, were developed at sites that are dry today. These are indicated by special symbols on the map. Other permafrost-related features include thermokarst basins and cryoturbation structures. Thermokarst basins are shallow depressions that form when subsurface ice lenses melt (Wolfe, 1953). These basins (shown by a pattern on the map) typically form in sandy deposits in lowlands where the water table is shallow, or, more rarely, in upland settings where a perched water table forms atop shallow clay layers. A very few basins, for example, those bordering eolian deposits in the Chamberlain Branch valley, were probably formed or enlarged by wind erosion (French and Demitroff, 2001). Cryoturbation structures are folds and involutions in the upper several feet of surface materials. These structures formed by density flow of waterlogged

### DESCRIPTION OF MAP UNITS

ARTIFICIAL FILL—Sand, pebble gravel, minor clay and peat; gray, brown, very pale brown, white. In places includes minor amounts of man-made materials such as concrete, asphalt, brick, cinders, and glass. Unstratified to poorly stratified. As much as 15 feet thick. In road and railroad embankments, dams, dikes around cranberry bogs, and filled low ground.

TRASH FILL—Trash mixed and covered with silt, clay, sand, and minor

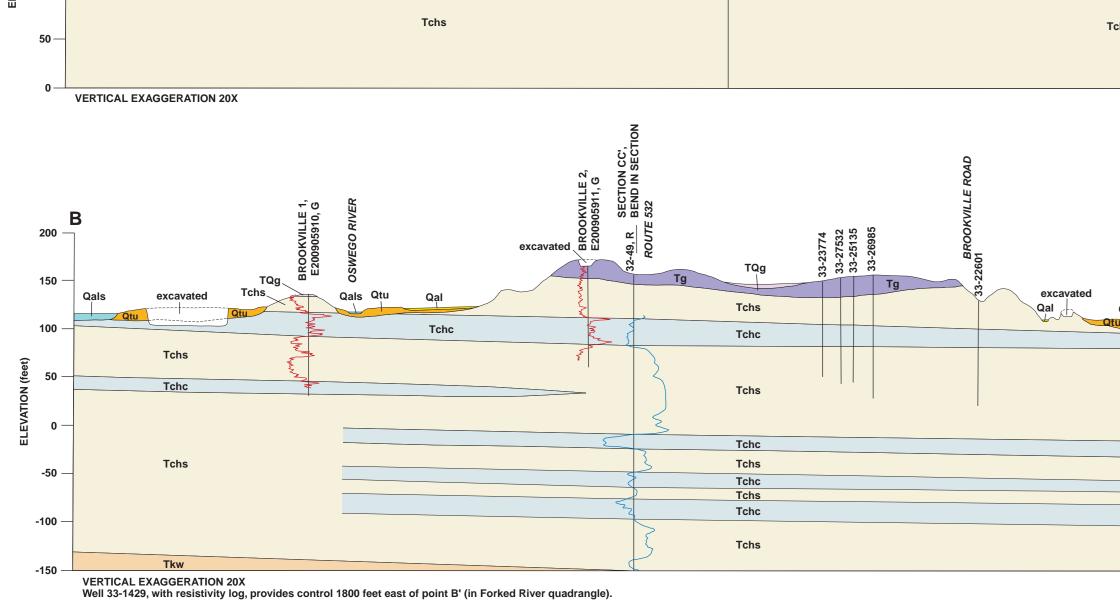
sediment during melting of permafrost (French and others, 2005).

gravel. As much as 50 feet thick. ALLUVIUM—Fine-to-medium sand and pebble gravel, minor coarse sand; light gray, yellowish-brown, brown, dark brown. As much as 5 feet thick. Overlain and interbedded in places with peat and gyttja (colloidal organic material) less than 2 feet thick. Sand and gravel consist chiefly of quartz. In

seasonally wet channels and floodplains.

- WETLAND AND ALLUVIAL DEPOSITS—Fine-to-medium sand and pebble Qals gravel, minor coarse sand; light gray, yellowish-brown, brown, dark brown; overlain by brown to black peat and gyttja. Peat is as much as 8 feet thick. Sand and gravel consist chiefly of quartz and are generally less than 3 feet thick. Sand and gravel are stream-channel deposits; peat and gyttja form from the vertical accumulation and decomposition of plant debris in swamps and marshes. In alluvial wetlands on modern valley bottoms.
- DRY-VALLEY ALLUVIUM—Fine-to-medium sand and pebble gravel, minor coarse sand; very pale brown, white, brown, dark brown, light gray. As much as 5 feet thick. Sand and gravel consist chiefly of quartz. In dry valley bottoms forming headwater reaches of streams. These valleys lack channels or other signs of surface-water flow. They may have formed under cold-climate conditions when permafrost impeded infiltration, increasing surface runoff. The deposits are therefore largely relict.
- EOLIAN DEPOSITS—Fine-to-medium quartz sand; very pale brown, white. As much as 15 feet thick. Form small dunefields in the Chamberlain Branch and Oyster Creek valleys where sand of the Cohansey Formation or upper terrace deposits was exposed to wind erosion.
- LOWER TERRACE DEPOSITS—Fine-to-medium sand, pebble gravel, minor coarse sand; light gray, brown, dark brown. As much as 10 feet thick. Sand and gravel consist chiefly of quartz. Form terraces and pediments in valley bottoms with surfaces 2 to 5 feet above modern wetlands. Include both stratified streamchannel deposits and unstratified pebble concentrates formed by seepage erosion of older surficial deposits. Sand includes gyttja in places, and peat less than 2 feet thick overlies the sand and gravel in places. The gyttja and peat are younger than the sand and gravel and accumulate because of poor drainage. Gravel is more abundant in Lower Terrace Deposits than in Upper Terrace Deposits due to winnowing of sand from the upper terraces by seepage erosion.
- UPPER TERRACE DEPOSITS—Fine-to-medium sand, pebble gravel, minor coarse sand; very pale brown, brownish-yellow, yellow. As much as 20 feet thick, generally less than 10 feet thick. Sand and gravel consist chiefly of quartz. Form terraces and pediments with surfaces 5 to 25 feet above modern wetlands. Include stratified stream-channel deposits and poorly stratified to unstratified deposits laid down by groundwater seepage on pediments.
- CAPE MAY FORMATION, UNIT 1—Fine-to-medium sand, pebble gravel; yellowish-brown, yellow, very pale brown. As much as 20 feet thick. Forms terraces with surfaces up to 65 feet in elevation in the Forked River and Oyster Creek valleys. These are the inland edge of a marine terrace formed during a middle Pleistocene sea-level highstand.
- UPLAND GRAVEL, LOWER PHASE—Fine-to-medium sand, slightly clayey in places, and pebble gravel; minor coarse sand; yellow, very pale brown, reddish-yellow. Sand and gravel consist chiefly of quartz with a trace (<1%) of white weathered chert in the coarse sand-to-fine pebble gravel fraction. Claysize material is chiefly from weathering of chert. As much as 10 feet thick, generally less than 5 feet thick. Occurs as erosional remnants on lower interfluves and hilltops, and as more continuous deposits in headwater valleys, between 70 and 170 feet in elevation. Includes stratified stream-channel deposits, poorly stratified deposits laid down by groundwater seepage on pediments, and pebble concentrates formed by winnowing of sand from older surficial deposits and the Cohansey Formation by groundwater sapping or surface runoff.
- UPLAND GRAVEL, HIGH PHASE—Fine-to-medium sand, some coarse sand, clayey in places, and pebble gravel; yellow, brownish-yellow, reddish-yellow, very pale brown. Sand and gravel consist chiefly of quartz, and as much as 5 percent chert, and traces of weathered feldspar, in the coarse sand-to-fine pebble gravel fraction. Most chert is weathered to white and yellow clay-size material, some chert pebbles are gray to dark gray and unweathered to partially weathered. Rarely, chert pebbles contain fossil molds of brachiopods, pelecypods, and corals of Paleozoic age. Clay-size material chiefly is from weathering of chert and feldspar. As much as 25 feet thick. Occurs as erosional remnants on interfluves and hilltops, and as more continuous deposits on uplands adjacent to the Beacon Hill Gravel, between 110 and 180 feet in elevation. Includes stratified and cross-bedded stream-channel deposits (fig. 3) and poorly stratified to unstratified pebble concentrates formed by washing of sand and clay from the Beacon Hill Gravel by groundwater sapping or surface

runoff (upper material in fig. 4).



#### BEACON HILL GRAVEL—Medium-to-very-coarse sand, some fine-tomedium sand, clayey to very clayey in places, pebble gravel; reddish-yellow, yellow, brownish-yellow, red, very pale brown. Clay-size material chiefly is from weathering of chert and feldspar. Sand and gravel consist chiefly of quartz with as much as 15 percent brown and dark gray chert; gravel includes rare (<0.01%) red and gray sandstone and siltstone, and white granite and gneiss; sand includes traces of weathered feldspar. Rarely, chert pebbles contain fossil molds of brachiopods, pelecypods, and corals of Paleozoic age. Most chert is weathered to white and yellow clay-size material. As much as 30 feet thick. Generally unstratified, or poorly stratified, owing to weathering, cryoturbation, and bioturbation. Preserved on plateau-like upland on Cedar Creek-Oswego River divide, above 165-180 feet in elevation.

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Table 1.—Lithologic logs of test borings. Gamma-ray logs shown on sections

Lithologic Log

quartz pebbles (TQg over Tchs)

some medium-to-coarse sand (Tchc)

47-64 gray to brown fine sand to silty fine sand (Tchs)

68-90 gray to brown fine sand to silty fine sand (Tchs)

90-104 white, yellow, reddish-yellow to brown and gray

within Tchs)

(Tg over Tchs)

Description (map unit assignment in parentheses)

very pale brown to yellowish-brown medium sand,

some fine sand and coarse sand, with few to some

yellowish-brown clayey fine-to-medium sand,

white, yellow, reddish-yellow to dark brown and

gray clay interbedded with fine sand (clay beds

clay interbedded with gray to brown fine sand

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423-436.

N. J. Permit

Identifier

E200905910

E200905911 0-5

E200905912 0-40

Brookville 3

Brookville 2

Brookville 1

below

64-68

5-56

Number and

M.-P., Olsson, R. K., Van Sickel, B. Metzger, K., Feigenson, M. D., Tiffin, S.,

COHANSEY FORMATION—Fine-to-medium quartz sand, with some strata of medium-to-very-coarse sand, very fine sand, and interbedded clay and sand, deposited in estuarine, bay, beach, and inner shelf settings. The Cohansey is here divided into two map units: a sand facies and a clay-sand facies, based on test drilling, gamma-ray well logs, and surface mapping using 5-foot hand-auger holes, exposures, and excavations. Total thickness of the Cohansey in the Brookville quadrangle is as much as 350 feet.

Sand Facies—Fine-to-medium sand, some medium-to-coarse sand, minor very fine sand, minor very coarse sand to very fine pebbles, trace fine-to-medium pebbles; very pale brown, brownish-yellow, white, reddish-yellow, rarely reddish-brown. Well-stratified to unstratified; stratification ranges from thin, planar, subhorizontal beds (fig. 4) to large-scale trough and planar crossbedding. Sand consists chiefly of quartz; coarse-to-very-coarse sand may include as much as 5 percent weathered chert and a trace of weathered feldspar. Coarse-to-very-coarse sands commonly are slightly clayey; the clays occur as grain coatings or as interstitial infill. This clay-size material is from weathering of chert and feldspar rather than from sedimentary deposition. Pebbles are chiefly quartz with minor gray chert and rare gray quartzite. Some chert pebbles are light gray, partially weathered, pitted, and partially decomposed; some are fully weathered to white clay. In a few places, typically above clayey strata, sand may be hardened or cemented by iron oxide, forming reddish-brown hard sands or ironstone masses. Locally, sand facies includes isolated lenses of interbedded clay and sand like those in the clay-sand facies described below. The sand facies

Clay-Sand Facies—Clay interbedded with clayey fine sand, very-fine-to-fine sand, fine-to-medium sand, less commonly with medium-to-coarse sand and pebble lags (fig. 5). Clay beds are commonly 0.5 to 3 inches thick, rarely as much as 2 feet thick, sand beds are commonly 1 to 6 inches thick but are as much as 2 feet thick. Clays are white, yellow, pink, very pale brown, reddishyellow, light gray; sands are yellow, brownish-yellow, very pale brown, reddishyellow. Rarely, clays are brown to dark brown and contain organic matter. As much as 25 feet thick.

is as much as 120 feet thick.

deposits.

256 Tchs

KIRKWOOD FORMATION—Fine sand, fine-to-medium sand, sandy clay, and clay; gray, dark gray, brown. Sand consists chiefly of quartz with some mica. Contains mollusk shells in places. In subsurface only, penetrated by wells 32-49, 32-8457, 33-43, and 33-26823. Approximately 200 feet thick in map area. Kirkwood sediments in the Brookville quadrangle are in the "lower Kirkwood sequence" of Sugarman and others (1993) and in the lower and Shiloh Marl members of Owens and others (1998). These members are of early Miocene age, based on strontium stable-isotope ratios and diatoms (Sugarman and others, 1993). The Cohansey-Kirkwood contact in test holes 32-49 and 33-43 as identified by Johnson (1961) and Kasabach and Scudder (1961) is 200 feet higher than shown on this map. The higher placement of the contact was based on color change from yellow in the Cohansey to gray in the Kirkwood. The contact here is placed instead at the textural change from dominantly sand in the Cohansey to dominantly silty-clayey fine sand in the Kirkwood, corresponding to the Wildwood and Shiloh Marl members of the Kirkwood as mapped regionally by Owens and others (1998).

# MAP SYMBOLS

Contact of surficial deposits—Solid where well-defined by landforms visible on 1:12,000 stereo airphotos, long-dashed where approximately located, shortdashed where gradational or featheredged, dotted where formerly present but removed by excavation

Contact of Cohansey facies—Approximately located. Dotted where concealed by surficial deposits. (Tchc) Concealed Cohansey Formation, clay-sand facies—Concealed by surficial

•3 Material penetrated by hand-auger hole, or observed in exposure or excavation. Number indicates thickness of surficial material, in feet, where penetrated. Symbols within surficial deposits without a thickness value indicate that surficial material is more than 5 feet thick.

figure 4 • Photograph location • 33-17494, G Well or test boring showing formations penetrated—Location accurate to within 200 feet. Identifiers of the form 32-xxxx and 33-xxxx are N. J. Department of Environmental Protection well-permit numbers. Identifiers of the form 32-xxxxx and 33-xx-xxx are New Jersey Atlas Sheet coordinates for test borings in the N. J. Geological Survey permanent note collection. "G' following identification indicates gamma-ray log available, "R" indicates resistivity log available. Borings E200905910 through 5912 were drilled for this study. Lithologic logs for these wells are provided in table 1. Number followed by map-unit symbol is depth, in feet below land surface, of base of unit. Final number is total depth of well rather than base of unit. Unit symbol "Tch" indicates that sand facies and clay-sand facies cannot be identified separately from the well log. Owing to the discontinuous geometry of the clay-sand facies, and to variability in the detail and accuracy of drillers' logs, units shown for some wells may not match the map and sections. Notation "TD" indicates total depth of test holes that penetrate below the Kirkwood Formation. 33-21-614 Well or test boring showing formations penetrated—Location accurate to within 500 feet. Identifiers and symbols as above.

> Geophysical log-On sections. Gamma-ray log is shown by red line, with radiation intensity increasing to right. Resistivity log is shown by blue line, with resistance increasing to right. Paleocurrent direction—Arrow indicates direction of stream flow, as inferred

Well on section—Some wells are projected short distances to the line of section.

from dip of planar, tabular cross beds observed at point marked by x. Head of seepage valley—Line at top of scarp at head of small valleys and hillslope embayments formed by seepage erosion. Scarps that do not occur above active seeps are relict. They mark valleys formed during times when the

water table was higher than at present. Active seepage scarp—Line at foot of scarp, at position of groundwater emergence. Water drains downslope from this position.

Inactive seepage scarp—Line at foot of scarp. No seepage occurs today along these scarps. Shallow topographic basin—Line at rim, pattern in basin. Includes thermokarst

basins formed from melting of permafrost and a few deflation basins formed by wind erosion. Excavation perimeter—Line encloses excavated area.

 $\times$  Sand pit—Active in 2010.  $\times$  Sand pit—Inactive in 2010.

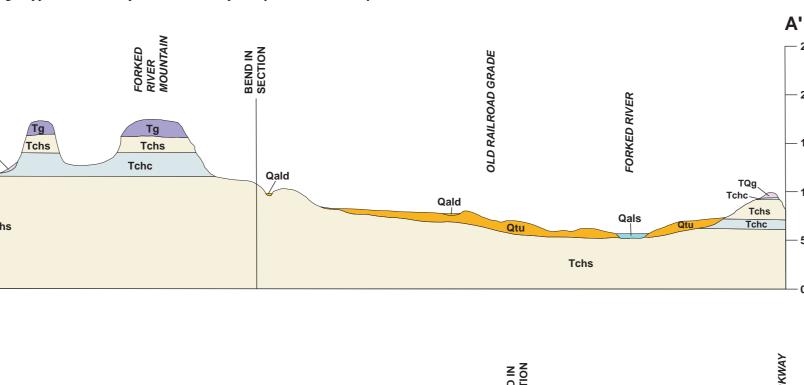
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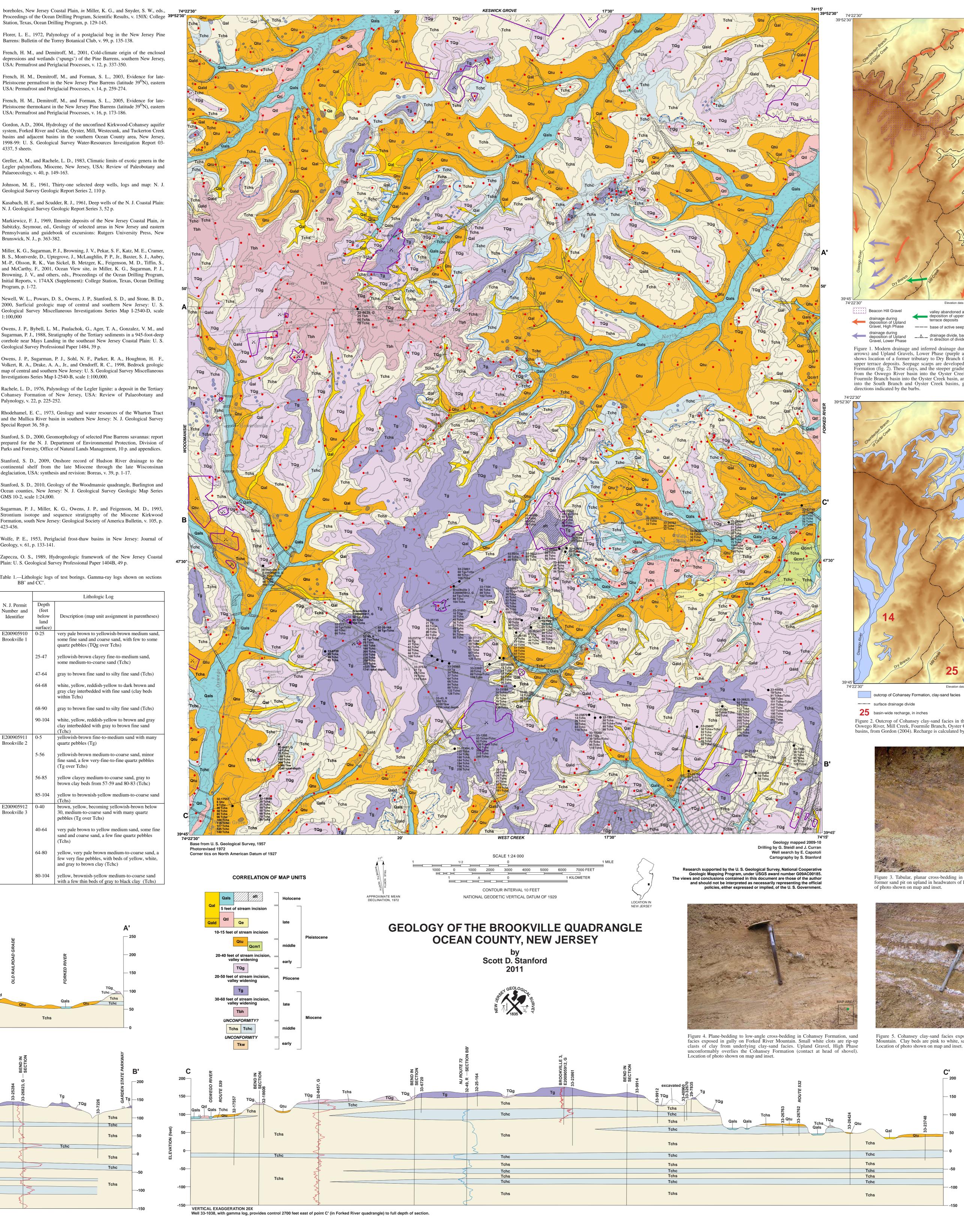


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yellowish-brown fine-to-medium sand with many quartz pebbles (Tg) yellowish-brown medium-to-coarse sand, minor fine sand, a few very-fine-to-fine quartz pebbles 56-85 yellow clayey medium-to-coarse sand, gray to brown clay beds from 57-59 and 80-83 (Tchc) 85-104 yellow to brownish-yellow medium-to-coarse sand brown, yellow, becoming yellowish-brown below 30, medium-to-coarse sand with many quartz pebbles (Tg over Tchs) 40-64 very pale brown to yellow medium sand, some fine 39°45' sand and coarse sand, a few fine quartz pebbles 74º22'30' 54-80 vellow, very pale brown medium-to-coarse sand, a few very fine pebbles, with beds of yellow, white,

and gray to brown clay (Tchc) 80-104 yellow, brownish-yellow medium-to-coarse sand with a few thin beds of gray to black clay (Tchs)

5 feet of stream incision Qtl 10-15 feet of stream incision Qcm1 20-40 feet of stream incision, valley widening TQg 20-50 feet of stream incision, valley widening Тд 30-60 feet of stream incision valley widening Tbh UNCONFORMITY? Tchs Tchc UNCONFORMIT



Prepared in cooperation with the U. S. GEOLOGICAL SURVEY

### **GEOLOGY OF THE BROOKVILLE QUADRANGLE OCEAN COUNTY, NEW JERSEY OPEN FILE MAP SERIES OFM 81**

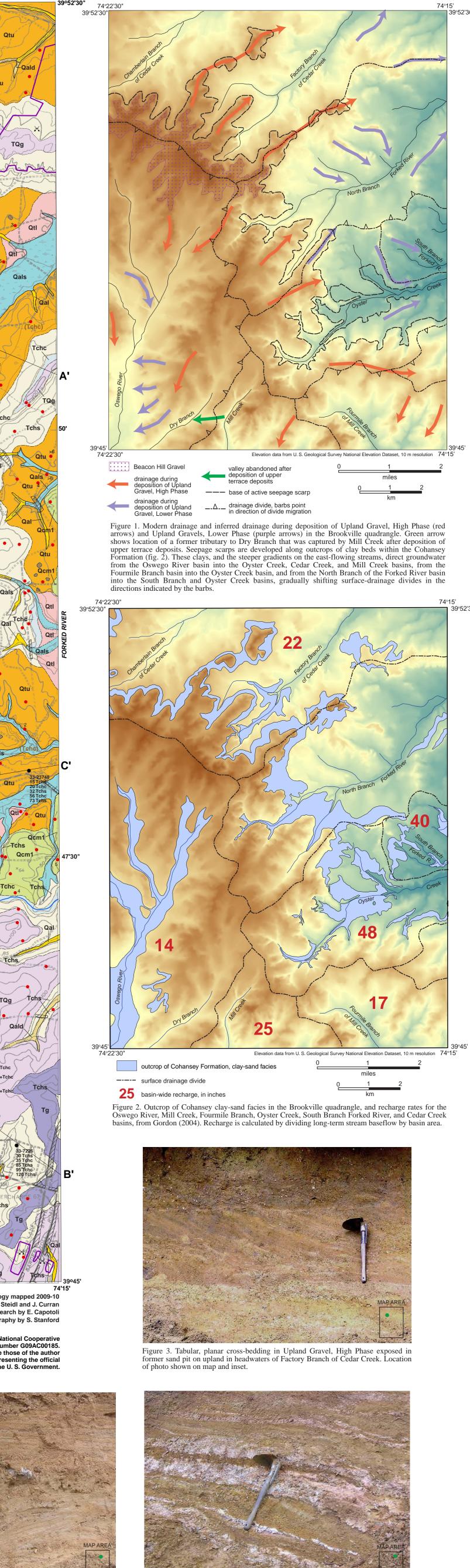


Figure 5. Cohansey clay-sand facies exposed in railroad cut near Forked River Mountain. Clay beds are pink to white, sand beds are brown to yellowish-brown.