DEPARTMENT OF ENVIRONMENTAL PROTECTION
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SURFICIAL GEOLOGY OF THE PLAINFIELD QUADRANGLE MIDDLESEX, UNION, AND SOMERSET COUNTIES, NEW JERSEY OPEN-FILE MAP OFM 77

Pamphlet containing table 1 accompanies map

INTRODUCTION

Surficial deposits are unconsolidated sediments that overlie bedrock formations and are parent materials for agronomic soils. In the Plainfield quadrangle they include 1) a preglacial fluvial deposit of Pliocene age (5 to 2 million years ago), 2) weathered-rock material and hillslope deposits that range from early to late Pleistocene in age (2 million to 10,000 years ago), 3) fluvial, eolian, and glacial sediments laid down during the late Wisconsinan glaciation (25,000 to 18,000 years ago), 4) postglacial alluvial and swamp deposits, and 5) artificial fill. A significant rearrangement of the river network, and extensive regional erosion, occurred in the early and middle Pleistocene, a second significant river rerouting occurred during the late Wisconsinan glaciation, and a period of stream incision followed shortly after this glaciation.

The accompanying map and sections show the surface extent and subsurface relations of these deposits. Their composition and thickness are described in the *Description of Map Units*. Well and boring data used to construct bedrock-surface-elevation contours and to infer the subsurface distribution of the deposits are provided in table 1 (in pamphlet). Figure 1 shows the surface texture of fluvial deposits and geomorphic features in the quadrangle. Figure 2 shows the drainage history of the Raritan River in the vicinity of the quadrangle. The chronologic relationships of the deposits and episodes of erosion are detailed in the *Correlation of Map Units*. The hydrology of the deposits and the history of river drainage and glacial events in the quadrangle and adjacent areas are described below.

HYDROLOGY OF SURFICIAL MATERIALS

Glaciofluvial sand and gravel (unit Qpf) yields water to several public-supply wells (wells 119, 120, 121) in South Plainfield. These wells yield 1420, 1600, and 1055 gallons per minute, respectively. They produce from a basal sand and gravel at depths between 50 and 100 feet, which is overlain by finer-grained sand and clay. These wells are in the buried preglacial Raritan valley (see next section), which contains the thickest section of sand and gravel in the quadrangle. Additional water may be available in this buried valley where sand and gravel is more than 50 feet thick, which generally occurs where the bedrock surface is below the zero-foot elevation. Logs of several other wells (wells 40, 49, and 58) in the buried valley west of South Plainfield record finer-grained material overlying basal sand and gravel, like the sequence in the South Plainfield area, although none of these wells produces from the sand and gravel. East of the South Plainfield wells, the buried-valley deposits are overlain by till of the terminal moraine (unit Qtmr, section AA'). Till is less permeable than sand and gravel, potentially limiting production in this part of the buried valley.

Elsewhere in the quadrangle, surficial materials are too thin or fine-grained to be aquifers. However, the Plainfield deposit (Qpf) and Rahway Till (Qr, Qtmr) in the northern half of the quadrangle are widespread, generally more than 20 feet thick, and more porous and permeable than the underlying shale bedrock. They thus provide storage for, and recharge to, the bedrock aquifer. Public-supply wells completed in bedrock along Green, Cedar, and Stony Brooks, and several in the terminal moraine (wells 115, 116, and 141) are recharged from this surficial reservoir.

Hydraulic conductivity of the surficial deposits may be estimated from statewide glacial aquifer-test data on file at the N. J. Geological Survey (Mennel and Canace, 2002) and published aquifer-test and laboratory data summarized by Stanford (2000). Sand and gravel (parts of Qpf, Qal, Qrtl, Qtl, Tp) are highly permeable; estimated hydraulic conductivities range from 10^1 to 10^3 feet per day (ft/d). Sandy till and silty sand till (parts of Qr and Qtmr) are also permeable; estimated hydraulic conductivities range from 10^{-1} to 10^2 ft/d. Silty and clayey alluvial deposits (parts of units Qpfl, Qal, Qs), and clayey-silty weathered rock and colluvium (parts of Qwb, Qws, Qcb, and Qcbl) are of low permeability, having hydraulic conductivities of 10^{-2} to 10^{-1} ft/d. Fine-sandy and silty alluvial, eolian, and wetland deposits (parts of units Qal, Qe, Qs, Qpf, Qpfl, and Tp), silty to sandy-silty till (parts of Qr, Qtmr, Qrc), and silty weathered rock and colluvium (parts of Qwb, Qws, Qcb, and Qcbl) are somewhat more permeable, having estimated hydraulic conductivities of 10^{-2} to 10^{-1} ft/d. Fill has variable hydraulic conductivity that depends on its clay and silt content. Fill composed of sand, cinders, gravel, demolition debris, slag, and trash, may be highly permeable.

GEOMORPHIC HISTORY

The oldest surficial deposit in the quadrangle is the Pensauken Formation (Tp), a fluvial quartz-pebble gravel and sand preserved as erosional remnants on uplands in the southeastern sector of the map area. These remnants are on the northwest edge of a large fluvial plain laid down by a southwesterly flowing river which likely received drainage from what is now the Hudson River basin and from southern New England (Stanford, 1993). This plain covered the entire quadrangle to the south and east of First Watchung Mountain, and had a surface elevation of between 140 and 160 feet. Fossil pollen, correlation to marine sediments in the Delmarva peninsula, and topographic relation to marine and glacial deposits in northern and central New Jersey, indicate that it was deposited between 5 and 2 million years ago (Stanford and others, 2002).

The Pensauken river was rerouted southeastward in the New York City area, most likely in the late Pliocene or early Pleistocene (between about 2 million and 800,000 years ago), during the earliest glaciation to reach this area. The segment of the Pensauken plain between New York City and Trenton, including the part in the Plainfield quadrangle, became inactive. A new local river network formed, draining northeastward to the rerouted Pensauken river. This new network included the Raritan River and its tributaries. The Raritan established a northeasterly course from the Bound Brook area (just west of the Plainfield quadrangle) to the New York City area and, in the early and middle Pleistocene (about 2 million to 125,000 years ago), eroded a valley network as much as 150 feet deep into the abandoned Pensauken plain. The buried valley between Oak Tree and Middlesex (fig. 1, marked by the zero bedrock-surface contour on the map) is the former Raritan main stem; former tributaries are indicated by embayments in the 50-foot bedrock-surface contour north and south of the main valley (fig. 1).

During the Illinoian glaciation about 150,000 years ago, ice probably advanced into the Raritan valley northeast of the Plainfield quadrangle. Glaciolacustrine and glaciofluvial sediments may have been deposited in the valley in the Plainfield quadrangle during this glaciation, but they are not exposed at the surface and cannot be distinguished from overlying later deposits in wells and borings. If present, they are included in unit Qpf.

The most recent glacier, known as the late Wisconsinan, advanced from the east into the northeastern part of the Plainfield quadrangle about 20,000 radiocarbon years ago. During its advance, the glacier margin, which trended north-south in this area, blocked the preglacial Raritan valley. A shallow lake probably formed in the valley upstream of the ice dam, in which both the Raritan River and meltwater from the glacier deposited fine sand, silt, and clay atop earlier, pre-dam fluvial sand and gravel. Fine sediment overlying sand and gravel in the main valley (see above section) may have been deposited in this lake.

The Raritan, its preglacial discharge augmented by meltwater draining from the glacier within the valley, and from glacial lakes in the Passaic basin to the north of the Plainfield quadrangle, was diverted by the ice dam across the low divide to the southeast of its former valley. An early diversion, before the glacier had advanced to its maximum position, may have eroded the Metuchen buried valley (fig. 2), which leads eastward from South Plainfield to the Arthur Kill lowland in the Woodbridge area (Stanford, 1999), and so provides a more southerly outlet than the preglacial Raritan valley. Continued advance of the glacier, however, soon blocked this valley, and the Raritan adopted a more southerly route, forming the New Brunswick gorge (fig. 2). This gorge was cut across a low divide at the head of a former tributary valley. Evidence of this former tributary includes 1) gravel lags on rock-cut straths at two spots within the New Brunswick gorge in the Plainfield quadrangle (fig. 1, symboled as a dot pattern on the map), between 40 and 60 feet above the present river, and 2) a fluvial sand and gravel with cross-bedding indicating northward paleoflow, on a rock-cut terrace in New Brunswick at 50 feet above the present river (Stanford and others, 1998).

As the glacier advanced to, and stood at, the terminal moraine, meltwater draining westward in the former Raritan valley laid down the Plainfield glaciofluvial deposit (Qpf), which formed a broad sand plain. This deposit grades from pebble and cobble gravel near the moraine, to pebbly sand, sand, and silty sand downvalley to the west (fig. 1). Silt and clay (Qpfl) were deposited in slackwater areas at the edges of the plain. More extensive silt and clay were deposited in lower parts of the Metuchen valley (section BB') which, after it was blocked by the glacier at Metuchen (just east of the Plainfield quadrangle), drained northward and may have become ponded as glaciofluvial sediment aggraded at its mouth.

At Bound Brook, just west of the Plainfield quadrangle, the Plainfield deposit merges with the lower Raritan stream-terrace deposit (unit Qrtl), which consists of nonglacial sediment from the Raritan basin. In the New Brunswick gorge this deposit was mostly eroded by the Raritan in postglacial time, but a few remnants are preserved in wider parts of the gorge, and a small, sloping rock bench just above the modern floodplain in Johnson Park may be a correlative strath.

In the Ambrose Brook valley, aggradation of the Plainfield deposit at the downstream end caused alluviation upstream, marked today by a terrace deposit 5 to 10 feet above the present floodplain (unit Qtl). In the same way, aggradation of the lower Raritan terrace caused alluviation in the Mile Run valley, marked today by a narrow terrace there (Qtl).

As ice advanced to the terminal position, it overran, but did not fully erode, previously deposited glaciofluvial sand. Much of the till deposited by the glacier at its maximum extent (unit Qr), slightly beyond the moraine (M1 on fig. 1), and in the moraine (unit Qtmr) is sandy because it incorporates this underlying sand. Along the prominent frontal ridge of the moraine (M2 on fig. 1), which rises as much as 100 feet above the plain to the west, an apron of till-like debris-flow material (unit Qrc) was laid down as sediment slid down the front of the glacier. As the ice front retreated, the moraine blocked free drainage of meltwater, and a series of lakes formed to the northeast of the Plainfield quadrangle (Stanford, 1991, 1999). The lakes trapped sediment, and deposition of the Plainfield deposit ended. Water draining from the lake spillways (one at Oak Tree, another north of Plainfield) continued to traverse the plain for a while, possibly cutting the channels now occupied by Green and Bound Brooks.

Two other surficial deposits in the quadrangle are linked to the cold, tundra-like climate during glaciation. During and after deposition of the Plainfield deposit, wind blowing from northwest to southeast blew fine sand and silt from the surface of the plain onto the upland to the south, forming sheet deposits and dunes (Qe). Most of the dunes have been leveled or removed during urbanization, but some remain on vacant land. Eolian deposition ended when the Plainfield plain was stabilized by the growth of grass and shrubs after retreat of the glacier from the moraine.

On steep slopes on First and Second Watchung Mountains, creep and solifluction of weathered basalt, and tumbling of basalt rock rubble, transported debris downhill. This material collected in footslope aprons of colluvium (Qcb). Although these processes operate in both temperate and glacial climates, they are more widespread and rapid in cold conditions. At two sites, weathered colluvium containing decomposed fragments of basalt was observed beneath fresh-clast colluvium. This stratigraphy records multiple periods of colluviation, probably during the Illinoian and pre-Illinoian glaciations, and intervening periods of stability and soil development during warmer interglacials.

As climate warmed and forest grew in postglacial time (since about 14,000 years ago), mass movement on hillslopes largely ceased. On the Watchung ridges, ground-water seepage in swales and on footslopes winnowed silt and clay from the colluvium and from the weathered rock mantle, producing cobbly channel lags and silty overbank deposits in swales (Qcal) and thin silty-clayey seepage deposits on gentle toeslopes (Qcbl). In valleys, streams incised as much as 20 to 30 feet into glacial terraces and deposited alluvium (Qal) in flood plains, and small fans (Qaf) at the mouth of tributary streams. Peat and organic silt and clay (Qs) accumulated in wetlands. Deposition of these alluvial and wetland sediments continues today. Most landscape shaping in historic times has been by human activity, as material is excavated from pits, quarries, and highway and railroad cuts, and is deposited in highway and railroad embankments, construction-site fills, and solid-waste landfills.

DESCRIPTION OF MAP UNITS

ARTIFICIAL FILL--Artificially emplaced sand, gravel, silt, clay, and rock fragments, and man-made materials including cinders, ash, brick, concrete, wood, slag, asphalt, metal, glass, and trash. Color variable but generally dark brown, gray, or black. As much as 20 feet thick. Many small areas of fill are not mapped. A few areas of fill are inferred by comparing the extent of swamps and alluvial deposits shown in Salisbury (1895) to their current extent.

TRASH FILL--Trash mixed and covered with sand, silt, clay, and gravel. As much as 30 feet thick. In solid-waste landfills.

Qal ALLUVIUM--Sand, silt, clay, pebble gravel, locally pebble-to-cobble gravel; dark brown, brown, reddish-brown, yellowish-brown, gray, dark gray, black; moderately to well sorted, moderately stratified. Contains varying amounts of organic matter. In basins underlain by shale bedrock, gravel consists of chips and small flagstones of red and gray shale and white, yellow, and gray quartz and quartzite pebbles. In basins underlain by basalt bedrock, gravel consists of pebbles and cobbles of gray and orange-stained basalt. In basins underlain by glacial deposits, gravel consists of red and gray shale, siltstone, and sandstone, and minor white to gray gneiss, white and yellow quartz, and gray to purple quartzite and conglomerate. Locally contains demolition debris and trash. Typically, consists of a basal sand and gravel deposited in the stream channel, overlain by silt, sand, and clay deposited on the flood plain. Along the Raritan River, levees of fine sand and silt as much as 8 feet high border the channel where the floodplain is wide. As much as 15 feet thick.

Qaf ALLUVIAL FAN DEPOSITS--Sand, silt, shale-chip gravel; reddish-brown, brown, yellowish-brown; moderately sorted, stratified. As much as 15 feet thick (estimated). Some small alluvial fans are included in unit Qal.

Qs SWAMP AND MARSH DEPOSITS--Peat and organic silt, clay, and minor fine sand; black, dark brown, and gray. As much as 5 feet thick. In a small basin on the terminal moraine and in a large wetland in the headwaters of Bound Brook, known locally as Dismal Swamp. This wetland occupies a flood plain eroded into the Plainfield plain shortly after glacial deposition ended, before the onset of crustal rebound. This valley segment drains northward and so was ponded when rebound raised the north end of the valley relative to the south end, creating the wetland.

Qcal ALLUVIUM AND COLLUVIUM, UNDIVIDED--Interbedded colluvium as in units Qcb and Qcbl, and alluvium consisting of dark brown to yellowish-brown or reddish-brown silty sand, sandy silt, to clayey silt, with beds and lag veneers of angular to subangular basalt pebbles and cobbles. As much as 15 feet thick. In swales and valley bottoms on First and Second Watchung Mountains.

Qe EOLIAN DEPOSITS--Very-fine-to-fine sand, silty fine sand, very fine sandy silt, minor fine-to-medium sand; reddish-brown, light reddish-brown, yellowish-brown, very pale brown; unstratified to weakly stratified. As much as 20 feet thick, generally less than 5 feet thick. Deposited in sheets and low dunes south of the Plainfield plain. In places, overlies the southern edge of the Plainfield deposit (section BB') and local stream deposits. Unit "Qe/Qws" indicates areas where eolian deposits are generally continuous but less than 3 feet thick over weathered shale.

Qpf PLAINFIELD DEPOSIT--Fine-to-medium sand, silt, pebbly sand, medium-to-coarse sand, pebble-to-cobble gravel, minor clay; reddish-brown, light reddish-brown, light gray, gray. Silt and fine sand are laminated to thinly bedded; sand and pebbly sand are plane-bedded to cross-bedded; pebble-to-cobble gravel is thickly bedded or present as channel lags and lenses within cross-bedded sand. As much as 90 feet thick. Deposit grades from pebble-to-cobble gravel near the terminal moraine to sand at the west edge of the quadrangle, and its surface slopes from an elevation of 105-110 feet to an elevation of 55-60 feet over the same distance. Pebbles chiefly consist of red siltstone, sandstone, and shale; some (5-20%) gray siltstone and sandstone; a little (<5%) gray and white gneiss, purple and gray quartzite and conglomerate, black and brown chert, white and yellow quartz; and a trace (<0.5%) of basalt. Gneiss, quartzite, and conglomerate are more abundant in the cobble fraction. The Plainfield deposit is chiefly glaciofluvial braided-stream sediment; lower parts of the deposit may be glaciolacustrine.

Qpfl PLAINFIELD DEPOSIT, FINE-GRAINED FACIES--Silt, very-fine-to-fine sand, and clay; reddish-brown, light gray, gray. Laminated to thinly bedded. As much as 40 feet thick. Fine-grained sediment also occurs as beds and lenses within unit Qpf; it is mapped separately as Qpfl where it is thick and continuous.

Qtl LOWER STREAM-TERRACE DEPOSITS--Fine-to-medium sand, silt, pebbly sand, silty clay, minor coarse sand; reddish-brown, light reddish-brown, yellowish-brown, light gray. Moderately sorted, stratified. As much as 15 feet thick. Forms stream terraces along Ambrose Brook and Mile Run with surfaces 5 to 10 feet above the modern floodplain. Interfingers with, or grades to, the Plainfield and lower Raritan terrace deposits.

Qrtl LOWER RARITAN TERRACE DEPOSIT--Fine-to-medium sand, silt, pebbly sand; reddish-brown, yellowish-brown. Moderately sorted, stratified. As much as 15 feet thick. Forms stream terraces with surfaces 10 to 15 feet above the Raritan River flood plain.

Qr RAHWAY TILL (Stone and others, 2002)--Silty sand to clayey sandy silt, locally fine-to-medium sand with little to no clay or silt; reddish-brown, light reddish-brown, yellowish-brown; containing some (5-10% by volume) to many (10-30%) subrounded and subangular pebbles and cobbles and very few (<1%) subrounded boulders. Matrix is compact, nonsticky to slightly sticky where sandy; nonplastic to slightly plastic where clayey; nonjointed, and may have subhorizontal fissility. Gravel clasts consist chiefly of red and gray sandstone and siltstone, and a little gray gneiss, white and yellow quartz, purple and gray conglomerate and quartzite, and black and brown chert. Boulders are chiefly gneiss and some conglomerate; a very few are gray and red sandstone. As much as 40 feet thick (estimated). Exposed on a low upland adjacent to the terminal moraine in Plainfield, likely also present beneath the east edge of the Plainfield plain. Deposited at farthest advance of late Wisconsinan ice, before a slight retreat to the position of the terminal moraine.

Qtmr TILL OF THE TERMINAL MORAINE--Rahway Till as above, forming ridge-and-swale topography of the terminal moraine. As much as 120 feet thick. Basal parts may contain deformed lenses and blocks of sand and silty sand eroded from underlying Plainfield deposit.

Qrc TILL COLLUVIUM--Rahway Till as above, but less compact and more gravelly, forming footslope apron along the front of the terminal moraine in Plainfield. Deposited by downslope movement of material from the front of the glacier. Overlain by 1-3 feet of yellowish-brown silt from postglacial slope wash and seepage. As much as 10 feet thick (estimated).

Qcb BASALT COLLUVIUM, BLOCKY PHASE--Clayey silt, silty clay, minor fine-sandy silt, with some to many subangular basalt pebbles and cobbles; reddish-brown, reddish-yellow, yellowish-brown, brown. As much as 40 feet thick. Includes chips and angular pebbles to fine cobbles of red shale and mudstone in deposits on the southeastern slopes of First and Second Watchung Mountain. In places, the interior parts of thick deposits consist of deeply weathered basalt and shale clasts, beneath a surface colluvium containing fresh clasts. This stratigraphy indicates repeated deposition of colluvium during glacial periods, and slope stability and weathering during interglacials.

Qcbl BASALT COLLUVIUM, SILTY PHASE--Clayey silt to silty clay, minor fine sandy silt, with few subangular basalt pebbles; reddish-yellow, reddish-brown, light gray, very pale brown. As much as 10 feet thick. At foot of long, gentle slopes, or at distal edge of aprons of blocky colluvium. Deposited in part by ground-water seepage. Mapped only where continuous and generally more than 3 feet thick. Occurs discontinuously along lower parts of most slopes on basalt bedrock.

Qwb WEATHERED BASALT--Clayey silt, silty clay, clayey coarse sand, with some to many angular pebbles and cobbles of basalt; reddish-yellow, reddish-brown, light gray, yellowish-brown. Most clasts have orange weathered rinds. Includes mixed clast-and-matrix sediment, fractured rock rubble, and saprolite that preserves original rock structure. Generally less than 10 feet thick over fractured, slightly weathered bedrock, which may be as much as 60 feet thick.

Qws WEATHERED SHALE--Clayey silt, silty clay, minor sandy clay to clayey sand with some to many red to gray shale and siltstone chips and flagstones; reddish-brown, brown, yellowish-brown. In places, includes a trace to some white and yellow-stained quartz pebbles left from erosion of the Pensauken Formation. As much as 15 feet thick, generally less than 5 feet thick. Thickest weathered shale underlies the Pensauken Formation and weathered Coastal Plain formation, where the weathered zone is protected from erosion.

Qwcp WEATHERED COASTAL PLAIN FORMATION--Fine-to-medium sand, clayey coarse sand, minor clay; yellow, white, pink, red. As much as 10 feet thick. Marks feather-edge outcrop of Farrington Sand member of the Raritan Formation in southeast corner of quadrangle.

Tp PENSAUKEN FORMATION (Salisbury and Knapp, 1917)--Clayey fine-to-medium sand, clayey medium-to-coarse sand, some fine sand and silt, with some to many pebbles and few cobbles; reddish-yellow, yellowish-brown, reddish-brown, very pale brown, light gray. Sand consists of quartz with some feldspar; the feldspar grains are weathered or fully decomposed to clay. Gravel consists chiefly of well-rounded white to gray quartz and quartzite and dark gray chert, with few to some shale, sandstone, and gneiss. The shale, sandstone, and gneiss are deeply weathered to fully decomposed. As much as 40 feet thick. The Pensauken is preserved in erosional remnants of an aggraded valley fill and fluvial plain deposited by a southwest-flowing river. Base of the formation ranges from an elevation of 50 feet along Mill Brook in the southeast corner of the quadrangle, which is in the axis of the former valley fill, to about 130 feet at New Durham, which is a remnant of the fluvial plain. The Pensauken plain formerly covered the entire quadrangle south and east of First Watchung Mountain, below 160 feet in elevation. Quartz and quartzite pebbles from the Pensauken are reworked into younger surficial deposits in this area, and also occur as lags mixed into weathered shale.

MAP SYMBOLS

Contact--Long-dashed where approximately located, short-dashed where gradational or feather-edged.

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

Excavation perimeter--Line at limit of excavation. Outlines quarries and former sand and gravel pits. Topography within these areas may differ from that on the base map.

Bedrock ridge--Line on crest. Marks low ridges parallel to strike of shale bedrock (within unit Qws) and ridges and scarps formed on resistant flow units within the Orange Mountain Basalt on First Watchung Mountain (within unit Qwb).

Quarry--Inactive in 2005.

Sand and gravel pit--Inactive in 2005.

•32 **Well with log in table 1**--Location accurate within 100 feet.

÷197 **Well with log in table 1**--Location accurate within 500 feet.

⊿25 **Elevation of bedrock surface in well or boring**--From Nemickas (1974). Shown only where other data are sparse.

▲74 **Elevation of bedrock surface in well or boring**--From N. J. Geological Survey permanent notes.

Qcb/Qwb• **Multiple surficial units exposed or penetrated in auger hole**--Unit to left of slash overlies unit to right. Number following unit symbol is thickness of upper unit in feet.

Qcb/Qwb○ **Multiple surficial units formerly exposed**--From N. J. Geological Survey permanent notes. Symbols as above.

50 **Elevation of bedrock surface**--Contour interval 50 feet. Includes top surface of weathered bedrock. Shown only where depth to rock exceeds 25 feet.

Large bedrock outcrop--Many small outcrops within units Qwb and Qws are not shown.

47 **Well on sections**--Projected to line of section. Owing to projection, depths of contacts on section may not be identical to those in well.

{Qrtu} **Gravel lag**--Pebbles and cobbles of gray and white quartz and quartzite, and a few weathered red and gray siltstone and sandstone pebbles, on surface and mixed into the upper several feet of weathered shale. On rock bench in Raritan valley, about 50 feet above the modern floodplain. Remnant of former tributary-stream deposit laid down before glacial diversion of the Raritan River in the late Wisconsinan. Corresponds to unit Qtu in New Brunswick (Stanford and others, 1998).

Thermokarst or eolian basin--Line on rim, pattern within basin. Shallow basins formed by melting of ground ice or by wind erosion.

Paleocurrent measurement--Arrow indicates flow direction. Measured on tabular, planar cross-beds at point "x".

Topographic features of the terminal moraine--Drawn from stereo airphotos taken in 1979. Additional features shown in Salisbury (1902, plate XXVII) have been destroyed by urbanization.

- Narrow ridge--Line on crest.
- Broad ridge--Line on crest.
- Asymmetric ridge--Line on crest, barbs on gentle slope.
- Scarp--Balls on slope.
- h — Hill--Line at base, lettering on summit.
- kh — Kettle hole--Line on perimeter, lettering in basin.
- p — Plateau--Lettering on level summit.

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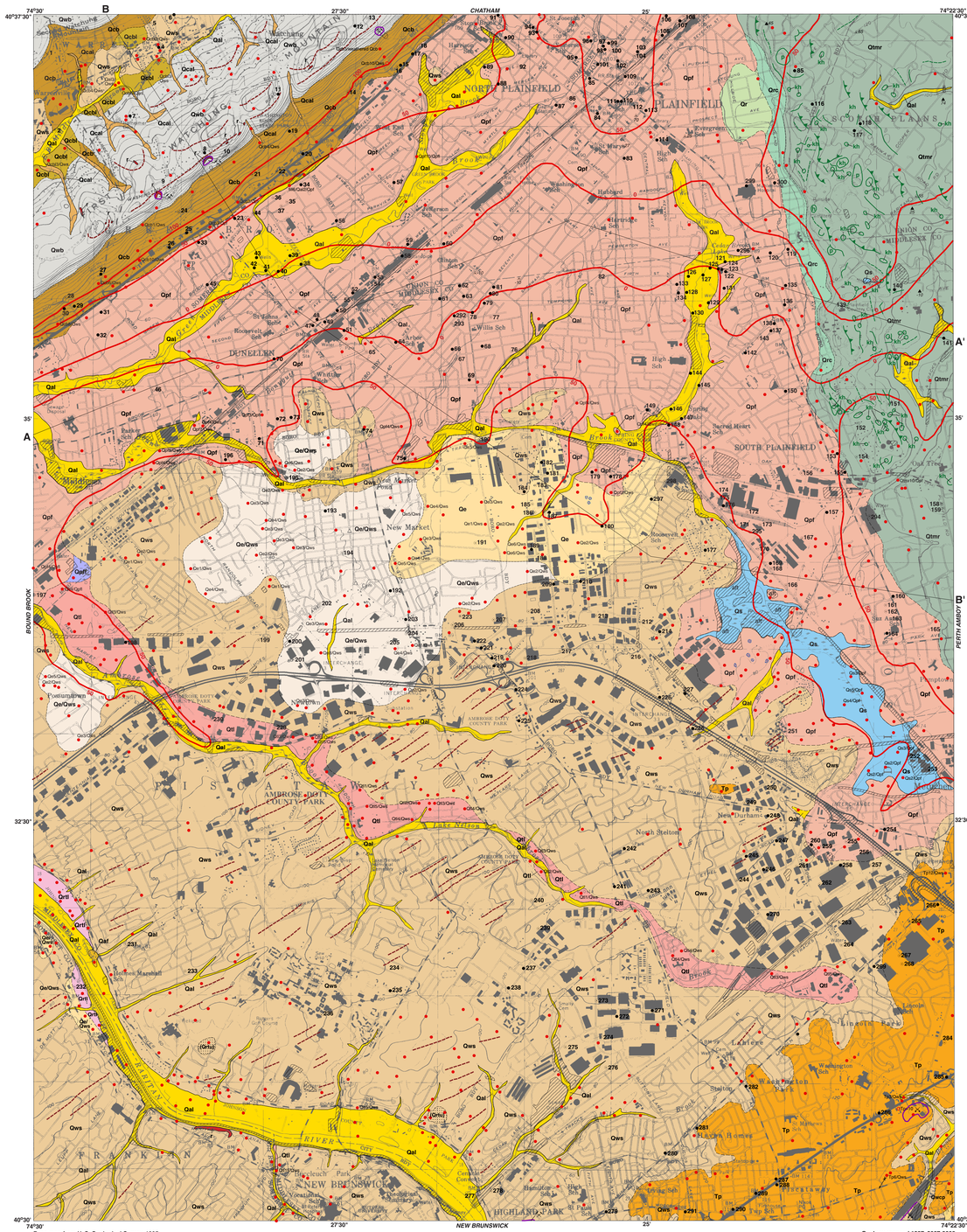

Base map from U. S. Geological Survey, 1995
Corner ticks are on North American Datum of 1983. Geology and base map do not edge-match adjoining published quadrangles with corner ticks on North American Datum of 1927. Overlap of information occurs at the west edge of the quadrangle, and a gap of information occurs at the east edge.

SCALE 1:24 000

1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology mapped 1987, 2007-2008
Cartography by S. Stanford and M. Girard

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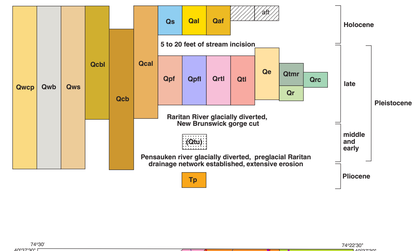
CORRELATION OF MAP UNITS



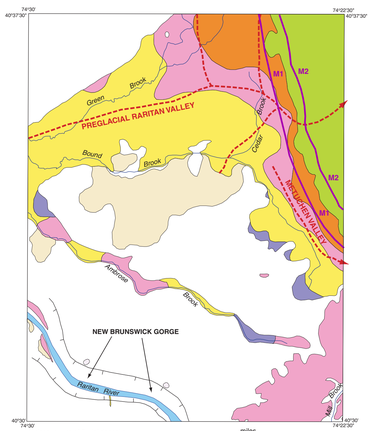


Figure 1.--Surface texture of fluvial deposits (excluding unit Qal), extent of till and windblown sediment, buried valleys, and glacier margins in the Plainfield quadrangle. M1=glacier margin at maximum extent of late Wisconsinan glacier, M2=glacier margin at deposition of frontal ridge of terminal moraine.

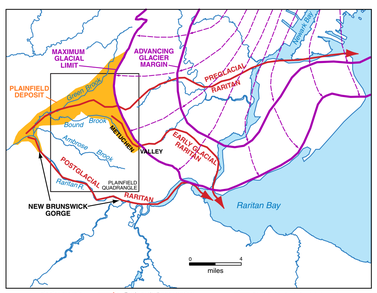
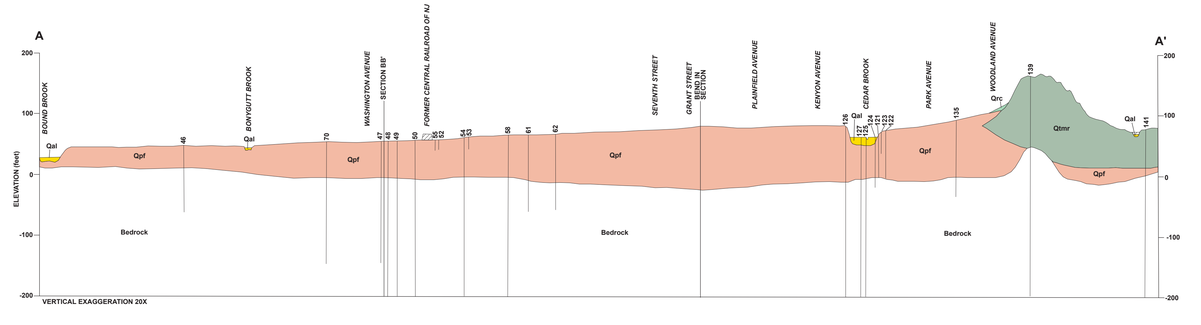
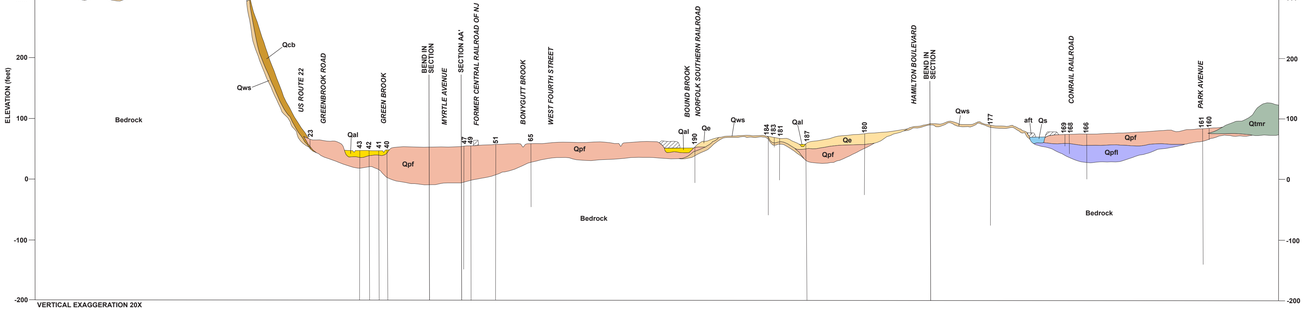


Figure 2.--Preglacial and glacially diverted drainage routes of the Raritan River in the vicinity of the Plainfield quadrangle, and associated late Wisconsinan glacier margins. The Metuchen valley became the route of the Raritan when the preglacial Raritan valley was blocked by the advancing glacier margin. The New Brunswick gorge was cut when the Metuchen valley was blocked as the glacier advanced to its maximum position. Deposition of the terminal moraine and the Plainfield glaciofluvial deposit filled the preglacial Raritan valley and the Metuchen valley.

SURFICIAL GEOLOGY OF THE PLAINFIELD QUADRANGLE MIDDLESEX, UNION, AND SOMERSET COUNTIES NEW JERSEY

by
Scott D. Stanford
2009





Surficial Geology of the Plainfield Quadrangle
Middlesex, Union, and Somerset Counties, New Jersey

New Jersey Geological Survey
Open-File Map OFM 77
2009

pamphlet to accompany map

Table 1.--Selected well and boring records.

Well no.	Identifier[1]	Driller's log with depth and description[2]	
1	25-118	0-33	red clay (Qcb over Qws)
		33-134	red shale and sandstone
2	25-1683	0-35	clay (Qal over Qws)
		35-62	shale
		62-75	rock (basalt)
3	25-29675	0-4	sand and gravel fill
		4-9	red medium-to-fine sand, some silt, little coarse-to-medium shale fragments (Qws)
		9-16	highly fractured shale
4	25-28207	0-14	red clayey silt (Qws)
		14-28	red soft micaceous shale
5	25-1487	0-35	soft brown clay (Qws)
		35-110	red shale
		110-128	sandstone
6	25-7731	0-15	dirt (Qws)
		15-123	red rock
7	25-24207	0-25	overburden (Qwb)
		25-470	trap rock
8	25-43429	abbreviated log	
		0-16	fill
		16-32	brown clayey silt, fine-to-coarse sand, some gravel, trace boulders (Qwb)
		at 32	refusal (basalt)
9	25-19215	0-20	overburden (Qwb)
		20-250	trap
10	25-8733	0-10	soil, rock fragments, boulders (Qwb)
		10-152	diabase
11	25-31049	0-10	loose rock (Qwb)
		10-400	trap rock
12	25-15341	0-40	overburden (Qwb)
		40-270	blue rock (basalt)
		270-560	red shale
13	25-9662	0-33	overburden (Qwb)
		33-115	trap
14	25-14773	0-40	overburden and rock (Qcb)
		40-125	shale
15	25-39884	0-5	brown silty clay (Qcb)
		5-9	reddish brown clay (Qcb or Qws)

		9-25	very soft red shale
16	25-42166	0-7	fill dirt (fill or Qcb)
		7-9	wet sandy soil, orange (Qcb)
		9-10	weathered sandstone
17	25-1370	0-30	clay (Qcb)
		30-162	red shale
18	25-7372	0-8	sand (Qcb)
		8-100	red shale
19	25-26968	0-83	sand, gravel (Qcb)
		83-295	shale
20	25-32990	0-24	brown and red clays (Qcb)
		at 24	shale
21	25-1024	0-20	yellow with streaks of white clay mixed with loose rocks (Qcb)
		20-45	red clay, very hard, with some gravel and sand (Qcb over Qws)
		45-150	red shale and sandstone
22	25-30608	0-40	overburden (Qcb)
		40-225	red rock
23	25-35138	0-12	sand, gravel, clay (Qpf over Qws)
		at 12	red rock
24	25-3992	0-71	yellow clay, very stony (Qcb)
		71-137	clay and shale mixed (Qws over shale)
25	25-19749	0-24	sand and clay (Qcb)
		24-175	red shale
26	25-31549	0-6	red fine sand, trace silt (Qcb)
		6-48	weathered shale
27	25-524	0-60	clay and mountain stone (Qcb)
		60-179	red shale
28	25-11466	0-25	clay and small boulders (Qcb)
		25-200	shale
29	25-3879	0-50	red clay (Qcb)
		50-140	red shale
30	25-3291	0-30	yellow clay (Qcb)
		30-115	red shale
31	25-2072	0-35	brown sand and gravel (Qpf)
		35-90	clay and shale mixture (Qws over shale)
32	25-1394	0-60	sand and gravel (Qpf)
		60-84	red shale
33	25-22840	0-20	fine red sand (Qpf)
		20-150	red shale
34	25-21764	0-40	sand (Qpf)
		40-105	red shale
35	25-1100	0-15	yellow sandy clay (Qpf)
		15-20	dirty muddy brown quick sand (Qpf)
		20-32	hard red clay (Qpf over Qws)
		32-100	red shale and sandstone
36	25-1023	0-10	yellow and blue clay (Qpf)
		10-25	hard red clay (Qpf over Qws)
		25-100	red shale and sandstone
37	25-1101	0-15	yellow sandy clay (Qpf)
		15-20	dirty muddy brown quick sand (Qpf)
		20-32	hard red clay (Qpf over Qws)

		32-100	red shale and sandstone
38	25-2716	0-40	sand and gravel (Qal over Qpf)
		40-64	clay and sand (Qpf)
		64-507	red rock
39	25-2715	0-10	yellow clay (Qal)
		10-52	red clay with little gravel (Qpf)
		52-60	soft red rock (Qws)
		60-445	red shale
40	25-2718	0-23	sand and clay (Qal over Qpf)
		23-40	sand and gravel (Qpf)
		40-45	clay (Qpf over Qws)
		45-510	red rock
41	25-572	0-9	clay (Qal)
		9-23	sand and gravel (Qpf)
		23-30	red clay (Qpf over Qws)
		30-68	soft red shale rock (Qws)
		68-454	red shale rock
42	25-632	0-8	yellow clay (Qal)
		8-20	sand and gravel (Qpf)
		20-26	red clay (Qpf over Qws)
		26-390	red shale rock
		390-473	brown shale rock
43	25-633	0-12	gray sand and clay (Qal)
		12-30	sand and gravel, some clay (Qpf)
		30-545	red shale
44	25-10576	0-10	sand (Qpf)
		10-30	soft shale
		30-125	hard shale
45	25-45	0-39	fine brown sand (Qpf)
		39-48	red clay (Qpf over Qws)
		48-140	red shale
46	25-11215	0-35	sand and gravel (Qpf)
		35-110	shale
47	25-27396	0-60	sand and gravel (Qpf)
		60-200	shale
48	25-44317	0-60	sand and gravel (Qpf)
		60-280	red shale
49	25-14905	0-18	fine sand and clay (Qpf)
		18-35	red silt and sand (Qpf)
		35-45	silt, sand, and gravel (Qpf)
		45-54	sand, gravel, silt, and clay mix (Qpf)
		54-57	dirty sand and gravel (Qpf)
		57-600	red shale
50	25-611A	0-15	sand (Qpf)
		15-64	sand, gravel, and clay (Qpf)
		64-304	red shale
51	25-762	0-50	sand, gravel, and clay (Qpf)
		50-326	red rock
52	25-44353	abbreviated log	
		0-18	red and gray medium-to-coarse sand (Qpf)
53	25-37014	0-10	red-brown clayey silt, some fine sand (Qpf)
		10-20	gray fine sand, trace silt
54	25-11751	0-61	sand, gravel, and a little clay (Qpf)
		61-436	red shale
55	25-34649	abbreviated log	

		0-17	gray fine-to-coarse sand, silty sand, some pebbles (Qpf)
56	25-12665	no log of surficial material, cased to 42, then red sandstone to 350 (Qpf to 42)	
57	25-10086	0-45	sand and gravel (Qpf)
		45-98	shale
58	25-91	0-30	fine sand (Qpf)
		30-60	sand and gravel (Qpf)
		60-67	soft red rock (Qws)
		67-600	red sandstone
59	25-39068	0-18	red-brown medium-to-fine sand, trace silt (Qpf)
60	25-33345	0-40	sandy soil (Qpf)
		40-180	NBS (“New Brunswick shale”)
61	25-8861	0-78	sand and gravel (Qpf)
		78-128	red shale
62	25-8170	0-80	sand (Qpf)
		80-125	shale
63	25-6471	0-80	sand (Qpf)
		80-118	red shale
64	25-21914	0-60	medium-to-fine brown sand and gravel (Qpf)
		60-175	red shale
65	25-7609	0-26	sand (Qpf)
		26-102	shale
66	25-8431	0-50	sand (Qpf)
		50-115	shale
67	25-12498	0-29	red sand (Qpf)
		29-92	red shale
68	25-8202	0-42	sand (Qpf)
		42-90	red shale
69	25-6996	0-60	sand and gravel (Qpf)
		60-120	red shale
70	25-385	0-53	dirt (Qpf)
		53-200	red shale
71	25-32529	0-30	sand (Qpf)
		30-150	shale
72	25-13167	0-15	sand and gravel (Qpf)
		15-110	red shale
73	25-1121	0-8	fill
		8-18	yellow sandy clay (Qpf)
		18-31	dirty muddy sand (Qpf)
		31-47	hard red clay (Qpf over Qws)
		47-49	soft red rock (Qws)
		49-100	red sandstone
74	25-42464	abbreviated log	
		0-3	brownish-red clayey silt, trace fine fragments of red shale (Qws)
		3-9	red shale
75	25-40109	0-7	fill (af)
		7-15	red-brown medium-to-fine sand; red rock fragments (Qpf over Qws)
		15-18	soft red shale
76	25-16311	0-24	sand and gravel (Qpf)
		24-387	shale
77	25-9060	0-43	sand and gravel (Qpf)
		43-110	red shale

78	25-8621	0-65	sand (Qpf)
		65-143	red shale
79	25-11102	0-20	sand and gravel (Qpf)
		20-40	sand and medium clay [sic] (Qpf)
		40-50	soft shale (Qws)
		50-128	medium hard shale
80	25-39268	0-3	miscellaneous fill, coarse-to-fine gravel with sand
		3-20	red-brown silty medium-to-fine sand (Qpf)
81	25-39178	0-23	pea gravel and orange-brown sands, silts, and gravels (Qpf)
82	25-13899	0-70	red sand and gravel (Qpf)
		70-155	red sand and gravel and shale (Qpf over shale)
		155-350	red shale
83	25-2545	0-63	brown sand (Qpf)
		63-200	red shale
84	25-39368	0-9	fill
		9-20	sand, red gravel (Qpf)
		20-28	sand, red gravel, cobbles (Qpf)
85	25-651	0-40	sandy soil and clay (Qpf)
		40-427	red shale rock
86	25-15820	0-50	red hardpan (Qpf)
		50-205	red sandstone
87	25-39952	0-50	overburden (Qpf)
		50-200	red shale
88	25-13898	0-30	sand and gravel (Qpf)
		30-220	hard shale and sandstone
89	25-13106	0-5	sand and hardpan (Qpf)
		5-400	sandstone and shale
90	25-19211	0-7	fill
		7-25	gravel and sand (Qpf)
		25-280	red shale
91	25-39570	0-4	tan clayey silt (Qpf)
		4-10	red-brown coarse-to-fine sand, gravel, cobbles, some silt, trace clay (Qpf)
		10-15	gravel and rock fragments (Qpf)
		15-20	soft red shale
92	25-7817	0-46	gravel (Qpf)
		46-99	shale
93	25-42005	0-27	overburden (Qpf)
		27-275	red shale
94	25-25872	0-20	silt, sand, gravel (Qpf)
95	25-40781	abbreviated log	
		0-34	reddish-brown fine-to-coarse sand and gravel, trace clay (Qpf)
96	25-16706	0-50	sand and gravel (Qpf)
		50-200	shale
97	25-2902	0-10	fill
		10-15	red sandy clay (Qpf)
		15-20	sandy clay (Qpf)
		20-29	coarse sandy clay, red (Qpf)
		29-35	coarse sand, layers of small gravel at 31-33 (Qpf)
		35-37	red shale
98	25-2955	0-8	red hardpan (Qpf)
		8-18	red sandy clay (Qpf)

		18-23	cemented sand and gravel (Qpf)
		23-32	sandy clay (Qpf)
		32-34	sand and gravel (Qpf)
		34-39	coarse water-bearing sand
		39-43	red shale
99	25-2957	0-10	red hardpan with large gravel (Qpf)
		10-31	red sandy clay (Qpf)
		31-33	coarse sand and small gravel (Qpf)
		33-34	coarse sand, large gravel, big pieces of shale (Qpf)
		34-36	coarse sand, large and small gravel (Qpf)
		36-39	medium sand with small gravel (Qpf)
		39-40	fine soupy sand (Qpf)
		40-44	red shale
100	25-1922	0-10	fill
		10-48	sand and gravel (Qpf)
		48-501	red rock
101	25-606	0-40	red earth (Qpf)
		40-301	red shale
102	25-39576	0-10	gravel, cobbles (Qpf)
		10-34	sand, gravel (Qpf)
103	25-41523	0-13	fill: sand, gravels
		13-32	red-brown fine-to-coarse sand (Qpf)
104	25-34453	abbreviated log	
		0-35	red-brown coarse-to-fine sand, some coarse-to-fine gravel (Qpf)
		35-37	red shale
105	25-39832	0-25	red clay, silt, cobbles, small stone (Qpf)
		25-30	coarse sand, silt, traces clay (Qpf)
106	25-22005	0-63	sand and gravel (Qpf)
		63-200	shale
107	25-37920	0-15	brown medium-to-fine sand, trace clay (Qpf)
		15-23	brown medium-to-fine sand with shale fragments (Qpf)
		23-42	glacial till (Qpf)
108	25-41252	0-5	red clay and gravel (Qpf)
		5-16	fine red dry sand (Qpf)
		16-28	coarse red wet sand (Qpf)
109	25-42261	abbreviated log	
		0-6	fill: cinders, rock, black silt
		2-30	red-brown coarse-to-fine sand, trace gravel (Qpf)
110	25-38698	abbreviated log	
		0-34	red-brown coarse-to-fine sand, little silt, little coarse-to-fine gravel (Qpf)
111	25-32181	0-3	fill
		3-18	sand, gravel, clay (Qpf)
		18-100	clay (depth anomalous, “clay” may be shale bedrock, not contoured)
112	25-40	0-37	sand and gravel (Qpf)
		37-310	red shale
113	25-876	0-25	earth and clay and sand (Qpf)
		25-303	red sandstone rock
114	25-37055	abbreviated log	
		0-30	red-brown fine-to-coarse sand with fine-to-coarse gravel (Qpf)
115	25-8185	0-6	dirt and stones (Qtmr)
		6-114	clay and gravel mixed (Qtmr)
		114-605	red shale
116	25-9037	0-40	overburden (Qtmr)
		40-105	red sandy clay (Qtmr)
		105-350	red rock

117	25-25524	0-55	overburden (Qtmr)
		55-125	shale
118	25-17070	0-62	mud gravel (Qtmr)
		62-105	shale
119	25-11464	0-6	sandy clay (Qpf)
		6-38	red, brown sand (Qpf)
		38-60	red sandy clay (Qpf)
		60-99	sand, gravel (Qpf)
		99-105	fine reddish sand (Qpf)
		105-110	hard clay to shale (Qws)
		screened 95-104, yield 300 gpm (production well at same site yields 1420 gpm)	
120	25-9603	0-18	sandy hardpan with rocks (Qpf)
		18-25	fine sand, dirty (Qpf)
		25-38	fine sand (Qpf)
		38-40	silty clay (Qpf)
		40-42	fine sand (Qpf)
		42-49	silty clay (Qpf)
		49-59	fine-to-medium sand with layers of sand and clay with stones (Qpf)
		59-70	sandy clay with stones, some sand seams (Qpf)
		70-80	fine-to-medium sand, some gravel (Qpf)
		80-90	fine-to-coarse sand and some gravel with clay seams (Qpf)
		90-99	coarse sand and gravel (Qpf)
		at 99	shale
		screened 80-100, yield 1600 gpm	
121	25-66173	0-4	fill
		4-11	sand with some clay (Qal)
		11-29	sandy clay (Qpf)
		29-44	sandy clay, some stones, hard clay seams (Qpf)
		44-61	sand and gravel, some fine clay seams (Qpf)
		61-65	sandy clay (Qpf)
		65-73	sand and gravel (Qpf)
		at 73	shale
		screened 58-73, yield 1055 gpm	
122	25-40339	0-7	brown fine-to-coarse sand, trace silt (Qpf)
		7-82	red-brown fine-to-medium sand, trace silt (Qpf)
		at 82	refusal (probable shale)
123	25-40341	abbreviated log	
		0-34	red-brown fine-to-medium sand, some silt (Qpf)
124	25-40345	0-62	red-brown fine-to-coarse sand, trace silt (Qpf)
		62-80	red-brown weathered shale (Qpf over Qws)
		80-85	red-brown shale
125	25-12130	0-3	cinders
		3-13	sandy clay (Qal)
		13-35	soupy red sand, fine (Qpf)
		35-42	sand and gravel, clay binder (Qpf)
		42-60	sand and gravel, clean (Qpf)
		60-68	brown sand, medium (Qpf)
		68-70	red hardpan (Qws)
		70-500	red shale
126	25-12131	0-3	trap rock fill
		3-6	black topsoil (Qal)
		6-9	yellow clay (Qal)
		9-18	brown sandy clay (Qal)
		18-20	soft clay (Qpf)
		20-24	soupy fine sand and clay (Qpf)
		24-34	sand and gravel (Qpf)
		34-38	sand (Qpf)
		38-42	sand and clay (Qpf)
		42-48	gray sand (Qpf)
		48-51	sand and gravel (Qpf)
		51-54	gravel and sand (Qpf)
		54-65	red clay, sand, and gravel (Qpf)
		65-75	red shale and clay (Qws)

		75-501	red shale
127	25-12461	0-3	trap rock fill
		3-4	yellow sand and clay fill
		4-5	black loam (Qal)
		5-14	red clay, sand and gravel (Qal)
		14-25	red clay, fine sand (Qpf)
		25-27	fine red sandy clay, broken rock (Qpf)
		27-36	coarse sand and gravel (Qpf)
		36-44	fine sand, some clay (Qpf)
		44-56	coarse sand, some gravel (Qpf)
		56-63	red clay, soupy sand (Qpf)
		63-65	red hardpan (Qpf)
		65-69	fine sand and red clay (Qpf)
		69-500	red and brown rock
128	25-12119	0-3	fill
		3-5	black loam (Qal)
		5-12	brown soupy clay (Qal)
		12-29	red clay, fine sand (Qpf)
		29-33	streak of gray sand and gravel (Qpf)
		33-40	broken rock, hardpan (Qpf)
		40-50	red clay and sand (Qpf)
		50-68	red broken shale
		68-500	red and brown rock
129	25-11822	0-30	fine sand (Qal over Qpf)
		30-35	medium-to-coarse sand (Qpf)
		35-40	fine-to-coarse sand (Qpf)
		40-49	fine-to-coarse sand with clay binder (Qpf)
		49-51	coarse sand and gravel (Qpf)
		51-63	red hardpan (Qpf over Qws)
		63-501	red shale and sandstone
130	25-11816	0-5	fill
		5-12	dirty sandy gravel (Qal)
		12-38	reddish bulls liver (silt and fine sand, Qpf)
		38-43	red hardpan (Qpf over Qws)
		43-495	red shale
131	25-12120	0-5	yellow sandy clay (Qpf)
		5-34	red sandy clay, soupy (Qpf)
		34-58	brown medium sand and gravel (Qpf)
		58-76	red hardpan (Qpf over Qws)
		76-500	red shale
132	25-38087	0-13	miscellaneous fill
		13-37	red-brown fine-to-medium sand, some silt (Qpf)
133	25-6606	0-60	red clay (Qpf)
		60-125	red rock
134	25-32765	0-50	sand, gravel (Qpf)
		50-200	red shale
135	25-6981	0-90	sand and gravel (Qpf)
		90-125	red rock
136	25-38450	0-30	red sand with some gravel (Qpf)
		30-160	red shale (depth to rock anomalously shallow, not contoured)
137	25-10001	0-4	red soil (Qpf)
		4-29	red clay and sand (Qpf)
		29-52	red sandy hardpan (Qpf)
		52-59	medium-to-coarse sand (Qpf)
		59-65	coarse sand and gravel (Qpf)
		65-67	grayish-blue clay (Qpf or Qws)
		67-351	red, blue, brown shale
138	25-41954	abbreviated log	
		0-40	red-brown fine sand, some silt (Qpf)
		40-45	red-brown medium-to-coarse sand (Qpf)

139	25-6839	0-109	red clay and stones (Qtmr)
		109-600	red shale rock
140	25-30054	0-15	mixed red sand with some gravel (Qtmr)
		15-40	soft red shale
		40-185	hard red shale
141	25-66178	0-5	clay (Qtmr)
		5-65	fine sand and gravel (Qtmr, possibly over Qpf)
		65-72	sand, gravel, and clay (Qtmr or Qpf)
		72-508	red rock
142	25-23756	0-70	sand and gravel (Qpf)
		70-75	clay (Qpf or Qws)
		75-250	red rock
143	25-10314	0-46	red sandy clay (Qpf)
		46-49	red hardpan (Qpf)
		49-59	red sandy clay (Qpf)
		59-60	medium sand and gravel (Qpf)
		60-61	red fine sand and clay (Qpf)
		61-75	coarse sand and clay (Qpf)
		75-421	red shale
144	25-66175	0-7	sand fill
		7-10	black muck (Qal)
		10-15	soft sandy clay (Qal)
		15-25	red clay with sand (Qpf)
		25-32	fine soupy sand (Qpf)
		32-34	soft red shale with clay (Qws)
		34-500	red shale
145	25-66176	0-3	fill
		3-6	black loam and clay (Qal)
		6-19	brown mucky clay and some sand (Qal over Qpf)
		19-30	red clay and hardpan (Qpf over Qws)
		30-500	red and brown shale
146	25-11823	0-4	fill
		4-15	brown soupy sandy clay (Qal)
		15-24	red soupy sandy clay (Qpf)
		24-29	red hardpan (Qws)
		29-500	red and gray shale
147	25-11828	0-13	brown sand and fill
		13-14	black topsoil (Qal)
		14-17	gray clay, sand (Qal)
		17-27	red hardpan (Qpf)
		27-35	clay, red shale (Qws)
		35-504	red and gray shale
148	25-35804	0-10	dark reddish-brown very fine sand, 10% silt and clay (Qpf)
		10-12	red-brown silt, 20% clay, trace fine sand (Qpf)
		12-15	dark reddish-brown fine sand, 20% silt, 5% clay (Qpf)
		15-20	Brunswick shale
149	25-43760	abbreviated log	
		0-20	red fine-to-medium clayey sand (Qpf)
150	25-6538	0-60	sand (Qpf)
		60-126	red shale
151	25-21406	0-65	sand and gravel (Qtmr)
		65-150	red shale
152	25-33202	0-5	fill
		5-18	mixed sand and gravel (Qtmr)
		18-38	soft red shale
		38-150	medium hard red shale
153	25-35211	0-40	red-brown silty sand with varying amounts of gravel (Qpf over Qtmr)
154	25-32403	0-5	red silty fine sand with roots and organic mater (fill)

		5-41	red sand with silt and gravel (Qtmr)
		41-100	red siltstone and shale
155	25-35258	0-24	gravel, cobbles, sand (Qtmr)
		24-100	red shale
156	25-11139	0-62	dirty sand and soft red clay (Qpf)
		62-200	red shale
157	25-22131	0-10	brown sand (Qpf)
		10-20	silt and sand (Qpf)
158	25-10088	0-42	sand and gravel (Qtmr)
		42-98	shale
159	25-10089	0-46	sand and gravel (Qtmr)
		46-98	red shale
160	25-30410	abbreviated log	
		0-14	brown clay, fine sand, silt (Qpf)
		14-15	weathered shale
161	25-21825	0-20	sand and gravel (Qpf)
		20-225	shale
162	25-22218	0-26	sand (Qpf)
		26-550	shale
163	25-7915	0-31	glacial clay (Qpf)
		31-250	Newark Triassic (shale)
164	25-37152	0-19	red-brown medium-to-fine sand, trace silt (Qpf)
		19-39	shale
165	25-13107	0-38	sand and gravel and clay (Qpf)
		38-125	red shale
166	25-42821	abbreviated log	
		0-18	red-brown fine sand, silt, gravel (Qpf)
		18-48	red-brown silty clay (Qpfl)
		48-74	red shale
167	25-15811	0-20	sand (Qpf)
		20-38	clay (Qpfl)
		38-252	sandstone
168	25-42230	abbreviated log	
		0-10	silty fine-to-medium sand (Qpf)
		10-33	fine-to-medium sand and fine-to-coarse gravel (Qpf)
169	25-42823	abbreviated log	
		0-16	fine-to-medium sand (Qpf)
		16-20	silty clay (Qpfl)
170	25-31765	0-7	red-brown coarse-to-fine sand, trace silt, trace clay, trace medium-to-fine gravel (Qpf)
		7-10	soft weathered red shale (Qws)
		10-16	red shale
171	25-22761	abbreviated log	
		0-10	fine-to-coarse red sand (Qpf)
		10-15	silty red clay (Qpfl)
		15-22	silty red clay with layers of coarse sand (Qpf)
		22-25	medium-to-coarse red sand and gravel (Qpf)
		25-27	red clay (Qpfl)
172	25-14113	0-23	sand (Qpf)
		23-35	clay (Qpfl)
		35-42	soft shale (Qws)
		42-250	shale
173	25-36010	abbreviated log	
		0-22	red-brown silty fine-to-coarse sand (Qpf)

174	25-845	0-23	sand and clay (Qpf)
		23-240	red rock
175	25-34998	abbreviated log	
		0-8	red-brown coarse-to-fine sand, trace fine gravel, trace silt (Qpf)
		8-12	red-brown fine sandy silt (Qpfl)
		12-13	shale
176	25-34967	abbreviated log	
		0-10	red-brown and gray silt, sand, and clay (Qpf)
		10-13	red-brown silty clay, trace rock fragments (Qws)
		13-30	red shale
177	25-30767	0-2	sandy red soil (Qws)
		65	red shale
178	25-21332	0-30	sand (Qpf)
		30-125	shale
179	25-13108	0-34	sand, gravel (Qpf)
		34-100	red shale
180	25-13094	0-24	sand, gravel, clay (Qe over Qpf)
		24-100	red shale
181	25-34911	abbreviated log	
		0-7	medium-to-fine sandy silt (Qe)
		7-8	soft shale
		8-70	shale
182	25-41528	0-9	brown to reddish-brown silt, little medium-to-fine sand (Qe)
		9-11	weathered red shale
		11-71	red shale
183	25-40944	0-13	red-brown clays, silts, and sands (Qe)
		13-18	red-brown shale
184	25-32832	0-2	brown topsoil (Qws)
		2-130	red shale
185	25-39174	0-8	reddish-brown fine sand with some silts, trace clay (Qe)
		8-15	reddish-brown fine sand with some silts and trace gravel, trace clay (Qe over Qtl)
186	25-38266	abbreviated log	
		0-12	red clay (Qe)
		12-13	hard silt with red shale fragments (Qws)
187	25-15307	0-20	sand (Qe)
		20-30	gravel (Qtl)
		30-270	shale
188	25-36487	0-6	sand (Qe)
		6-10	sandy clay (Qe over Qws)
		10-14	clay (Qws)
		at 15	rock
189	25-42184	0-8	red-brown medium-to-fine sand (Qe)
		8-14	red-brown silty clay (Qws)
		14-41	red shale
190	25-36752	0-5	fine-to-medium gray sand (Qe)
		5-16	reddish-brown decomposed shale (Qws)
		16-60	shale
191	25-37300	0-4	red-brown silty clay (Qe)
		4-25	weathered red shale
192	25-8633	0-48	sand (Qe, anomalously thick, not contoured)
		48-115	red shale
193	25-29697	0-4	sand and gravel (Qe over Qws)

		4-155	red shale
194	25-32438	0-5	overburden (Qe)
		5-200	shale
195	25-39055	0-5	fill
		5-20	red-brown silt, decomposed Brunswick shale (Qe over Qws)
196	25-20865	0-25	sand (Qpf)
		25-130	shale
197	25-21907	0-35	sand and gravel (Qpf)
		35-300	red shale
198	25-30449	0-5	brown silt, sandy clay (Qtl)
		5-14	silt, clay, trace of decomposed siltstone in layers of fine sand (Qtl)
		14-21	decomposed siltstone
199	25-33208	0-5	red-brown silt and clay, trace sand (Qws)
		5-15	weathered to competent Brunswick shale
200	25-37962	0-8	red-brown sand, trace silt (Qe)
		8-10	decomposed rock
		10-40	red-brown shale
201	25-41294	0-8	red-brown sandy silt, little clay (Qe)
		8-43	reddish-brown shale and siltstone
202	25-453	0-25	sandy soil, clay, and soft rock (Qe over Qws)
		25-48	soft red shale rock
		48-153	red shale rock
203	25-31729	0-3	dark brown silt, sand, clay fill (Qe)
		3-6	red-brown clayey silt and shale fragments (Qws)
		6-17	red shale
204	25-41157	0-6	brown medium-to-coarse sand, some silt, trace clay (Qe)
		6-13	red-brown clay (Qws)
		13-16	bedrock
205	25-33082	0-14	red-brown clay (Qe)
		14-40	red-brown shale
206	25-30822	0-5	red-brown clayey silt, trace coarse-to-fine sand, trace medium-to-fine gravel (Qws)
		5-250	red shale
207	25-42722	0-2	red-brown clay and silt, gravel (Qws)
		2-20	red shale
208	25-32484	0-3	silt, clay, fine sand (Qws)
		3-60	bedrock
209	25-44430	0-3	clay (Qws)
		3-35	shale
210	25-33273	0-6	sands, clay (Qws)
		6-13	weathered rock
		13-50	rock
211	25-35335	0-5	red-brown sandy clay (Qe)
		5-6	red-brown clayey silt (Qws)
		6-55	red shale
212	25-38001	0-3	clay (Qws)
		3-18	red shale
213	25-39731	0-3	red weathered shale (Qws)
		3-25	sandstone
214	25-38103	abbreviated log	
		0-6	red-brown clay, trace silt (Qws)
		6-14	mudstone

215	25-34157	0-3	silt, clay (Qws)
		3-160	red shale
216	25-40277	0-9	red-brown sands and silts with fractured rock (Qws)
		9-17	shale
217	25-35819	0-3	soft weathered shale (Qws)
		3-75	red shale
218	25-31655	0-3	red-brown silty clay, trace shale fragments (Qws)
		3-6	soft fractured and seamy shale
		6-60	red shale
219	25-38134	0-5	red silt, trace fine gravel, trace fine sand (Qws)
		5-8	red decomposed shale
		8-16	dark-brown siltstone
220	25-36208	abbreviated log	
		0-6	red clayey silt, trace fine gravel (Qws)
		6-12	red decomposed shale
		12-15	red shale and siltstone
221	25-39590	0-60	red shale
222	25-37951	0-2	gravel with brown fine-to-medium sand (Qws)
		2-13	red shale in various stages of decomposition
223	25-43763	0-3	silt and sandy clay (Qws)
		3-22	red shale
224	25-40054	0-4	red-brown silty clay, some medium-to-fine sand (Qws)
		4-18	red shale
225	25-44073	0-3	red-brown silt and clay with rock fragments (Qws)
		3-12	red-brown shale
226	25-39037	0-7	red-brown clay, trace sand (Qws)
		7-18	red-brown shale
227	25-33861	0-8	fill (af)
		8-165	hard red shale and some sandstone
228	25-27597	0-3	overburden (Qws)
		3-15	shale
229	25-38908	0-6	red-brown silty medium-to-fine sand (Qtl)
		6-8	red clay (Qws)
		at 8	rock
230	25-10303	0-5	earth and clay (Qtl)
		5-166	red shale
231	25-42195	0-2	fill
		2-5	soft shale (Qws)
		5-160	New Brunswick shale
232	25-23291	0-15	sand and gravel (Qrtl)
		15-200	shale
233	25-36589	0-5	overburden (Qws)
		5-150	red shale
234	25-32437	0-4	overburden (Qws)
		4-200	red shale
235	25-34699	0-5	overburden (Qws)
		5-150	red shale
236	25-32274	0-14	red-brown clay, trace of sand (Qws)
		14-28	red-brown shale
237	25-37647	0-4	overburden (Qws)

		4-3096	red and gray shale
238	25-34578	0-9	red clay (Qws)
		9-11	blackish clay (Qws)
		11-22	red shale
239	25-40516	0-4	clay, red silty shale (Qws)
		4-38	clay, red weathered shale
240	25-43964	0-2	topsoil (Qws)
		2-170	shale
241	25-39442	0-11	fill
		11-600	red shale
242	25-32301	0-2	overburden (Qws)
		2-200	shale
243	25-29472	0-20	gravel, soil (Qws)
		20-200	shale
244	25-36420	abbreviated log	
		0-8	red clay and soft red shale (Qws)
		8-14	very soft shale, purple-brown with white layers
		14-30	red and purple shale
245	25-41216	0-5	red silt and fine sand (Qws)
		5-38	red weathered shale
246	25-34835	0-3	reddish-brown clayey silt, trace medium-to-fine gravel, trace shale fragments (Qws)
		3-12	red shale
247	25-42104	0-7	clay (Qws)
		7-25	red shale
248	25-40587	0-3	topsoil (Qws)
		3-15	soft red shale
		15-720	red shale
249	25-34941	0-7	clay (Qws)
		7-80	red shale
250	25-42656	0-7	red-brown silty clay, trace medium-to-fine sand (Qws)
		7-19	red shale
251	25-31440	0-10	brown medium-to-fine sand, trace clay and silt (Qpf)
		10-22	red-brown decomposed shale
252	25-30188	0-3	reddish sand, clayey silt (fill)
		3-6	black organic-rich clay (Qs)
		6-15	dark gray to black clayey silty sand, some granules (Qs over Qpf)
		15-20	reddish silty clayey sand, becoming more silty and less sandy with depth (Qpf over Qpfl)
253	25-15138	0-50	red sand (Qpf)
		50-69	sand and clay seams (Qpfl)
		69-253	red shale
254	25-38794	abbreviated log	
		0-16	red medium-to-fine sand, some clayey silt (Qpf)
255	25-40906	0-15	clay (Qpf)
		15-18	bedrock
256	25-32236	abbreviated log	
		0-16	red clayey fine-to-medium sand (Qpf)
		16-18	red clay with shale fragments (Qws)
		18-22	weathered red shale
257	25-32237	0-6	overburden (Qws)
		6-65	weathered and competent Brunswick shale

258	25-36034	0-5	red clay (Qws)
		5-8	red clay, little fine sand (Qws)
		8-13	red clay, little coarse-to-fine sand (Qws)
		13-36	red shale
259	25-34678	0-3	fill, sands (Qpf)
		3-5	gray clay, little silt (Qpf)
		5-8	red-brown sands, silt (Qpf)
		8-10	shale and sandstone
260	25-35134	0-6	multicolored silty clay (Qpf)
		6-18	soft red shale
261	25-41534	abbreviated log	
		0-11	red-brown sandy silt, some clay (Qws)
		11-39	shale and siltstone
262	25-37974	abbreviated log	
		0-18	red-brown clayey silt with some fine sand (Qws)
		18-20	weathered red-brown shale
263	25-23710	0-12	brown medium-to-fine sand with trace of gravel and silt (Qws)
		12-15	red clayey silt with trace of fine gravel (Qws)
		15-60	decomposed red shale rock
264	25-31208	abbreviated log	
		0-9	red-brown clayey silt, some rock fragments, trace sand (Qws)
		9-65	weathered shale
265	26-20026	0-11	fine and coarse sand (Tp)
		11-14	weathered shale
		14-35	competent rock
266	25-44485	0-6	orange-brown to red-brown silts with fine sands and pea-size gravel (Tp)
		6-20	red-brown clayey silts grading into a highly weathered shale
267	25-40130	0-30	reddish-brown moist to wet till (Tp)
		30-35	weathered rock (Qws)
		35-55	red shale
268	25-41865	0-5	fill materials
		5-10	overburden (Tp)
		10-35	weathered shale and siltstone
		35-55	shale
269	25-40782	0-7	sand, clay, gravel (Qws)
		7-8	broken shale
		8-34	red shale
270	25-35250	0-2	red-brown clay (Qws)
		2-5	red-brown soft weathered shale
		5-14	red shale
271	25-43511	0-5	overburden (Qws)
		5-177	red shale
272	25-39347	0-8	reddish-brown silt and clay (Qws)
		8-75	red shale
273	25-38625	0-2	red-brown clay (Qws)
		2-25	red shale
274	25-40980	0-19	red fractured shale
275	25-34581	0-5	red silt clay (Qws)
		5-7	modeled red clay with gray streaks (Qws)
		7-10	weathered shale
		10-22	red shale
276	25-1777	0-5	red sandy clay (Qws)
		5-15	red hardpan (Qws)
		15-27	red hard clay (Qws)

		27-86	red hard sand rock
277	25-38352	0-8	red-brown silty clay (Qws)
		8-9	red-brown weathered shale
		9-45	Brunswick shale
278	25-38327	0-5	fine sand, some silt, clay (Qws)
		5-117	red shale
279	25-35218	0-3	firm, red homogeneous sandy gravel with clay mixture (Qws)
		3-16	red weathered shale
280	25-33776	abbreviated log	
		0-10	red clay and gravel (Qws)
		10-18	gray and red shale
281	25-31264	abbreviated log	
		0-9	red silty clay, trace medium-to-fine sand (Qws)
		9-18	red and gray shale
282	25-41087	0-5	red-brown silty clay (Qws)
		5-20	red shale
283	25-38723	abbreviated log	
		0-18	red-brown silty clay, with some sand below 6 feet and small pieces of bedrock below 12 feet (Qws)
284	25-37260	abbreviated log	
		0-24	red silty sand with fine-to-medium quartz gravel (Tp)
285	25-24514	abbreviated log	
		0-25	orange-brown, red-brown medium-to-fine sand and clayey silt, little medium-to-fine gravel (Tp)
286	25-40796	abbreviated log	
		0-18	red-brown, yellow sand, little silt and clay, some gravel (Tp)
		18-24	red-brown silt and clay, some gravel (Tp over Qws)
		24-30	weathered gravel-sized shale chips (shale)
287	25-42983	abbreviated log	
		0-25	red-brown, orange-brown clayey sand to silty sand, some quartz gravel (Tp)
288	25-26687	0-8	brown clayey silt (Tp)
		8-30	red silty clay (Tp)
		30-38	red clayey silt, some gravel (Tp)
289	25-34370	0-18	red-brown clay, silt, trace medium-to-fine sand, trace fine gravel (Tp)
		at 18	weathered shale
290	25-40312	0-11	small gravels and fine tan sand (Tp)
		11-20	red shale
291	25-40276	0-20	red-brown silty clay and sandstone gravels throughout (Tp)
292	25-29695	0-40	red-brown medium-to-fine sand, trace fine gravel, trace silt (Qpf)
		40-50	gray medium-to-fine sand, trace silt (Qpf)
		50-56	gray coarse-to-fine sand, trace fine gravel (Qpf)
		56-170	red shale
293	25-29889	0-5	fill
		5-45	red sand (Qpf)
		45-145	red shale
294	N25-34-684	0-3	topsoil, brown sand and gravel (Qpf)
		3-10	red clay, fine sand and gravel (Qpf or Qtmr)
		10-13	red clay with some sand and gravel (Qpf or Qtmr)
		13-23	red clay and fine sand (Qpf)
		23-24	red shale
295	N25-34-595	0-26	sandy clay (Qpf)
		at 26	red shale
296	N25-34-352	82 feet to rock	

297	25-40659	0-3 3-12	tight red sand (Qe) coarse brown sand (Qe)
298	25-41208	0-46	red sandstone
299	25-10488	0-47 47-502	sand and clay (Qpf) red shale
300	25-7004	0-35 35-220	clay (Qpf) red shale

[1]Identifiers of the form 25-xxxx and 26-xxxx are well permit numbers issued by the N. J. Department of Environmental Protection, Bureau of Water Allocation. Identifiers of the form Nxx-xx-xxx are N. J. Atlas Sheet grid coordinates of entries in the N. J. Geological Survey permanent note collection.

[2] The depth interval (in feet below land surface) and driller's or logger's description of materials penetrated in that interval are provided. Inferred map units and comments by author are in parentheses. Some inferred map units may not match the map and sections precisely due to scaling and lack of detail in drillers' descriptions. All descriptions are reproduced as they appear in the original source, except for minor format, punctuation, and spelling changes. Logs identified as "abbreviated" have been condensed for brevity. Many bedrock descriptions have been condensed; these are not identified as abbreviated. For wells completed in surficial materials, the screened interval and yield (in gallons per minute, gpm) are reported beneath the log. Notation "not contoured" indicates that the bedrock-surface elevation reported in the well log was not considered when constructing bedrock-surface elevation contours because it was anomalously deep or shallow compared to other nearby logs. Map units are inferred from the known extent of materials at the surface and from known depositional settings, in addition to the drillers' descriptions.