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

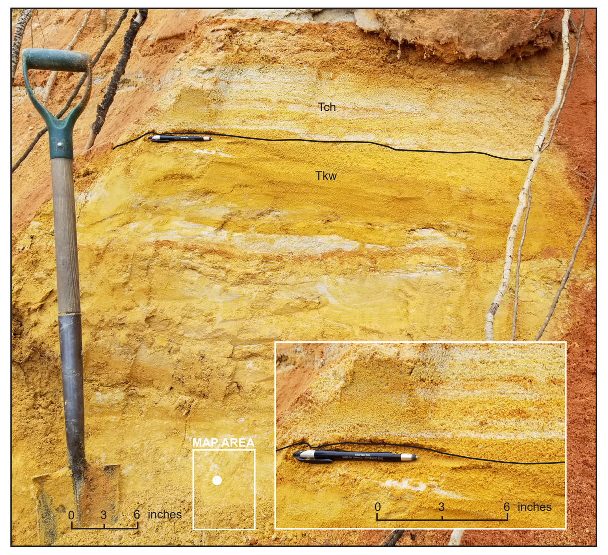

Figure 1. Various shades of yellow and light grey, very fine- to fine- grained, micaceous quartz sand of the Kirkwood Formation (Tkw) overlain by orange, yellow, and red, medium- to coarse- grained quartz sand of the Cohansey Formation (Tch). Contact between the Kirkwood and Cohansey formations is traced in black. Inset on the left shows the location of this site on the map. Inset on the right shows a close-up of the contact.

Figure 2. Grey and yellow, very fine grained, micaceous sand of the Kirkwood Formation (Tkw) overlain by Quaternary fluvial deposits consisting of poorly sorted sand and gravel. Contact traced in black at the base of the poorly sorted sand and gravel material. Inset shows the location of this site on the map.

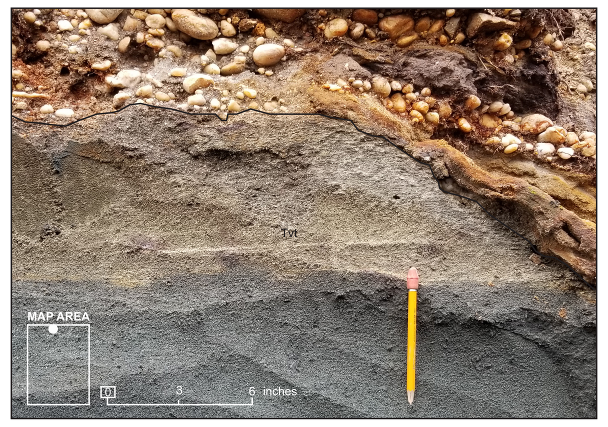

Figure 3. Greyish olive green glauconite quartz sand of the Vincentown Formation (Tvt) overlain by Quaternary fluvial deposits consisting of poorly sorted sand and gravel. Top 12 inches of Vincentown sand is brownish grey due to weathering. Contact traced in black at the base of the poorly sorted sand and gravel material. Inset shows the location of this site on the map.

CORRELATION OF MAP UNITS

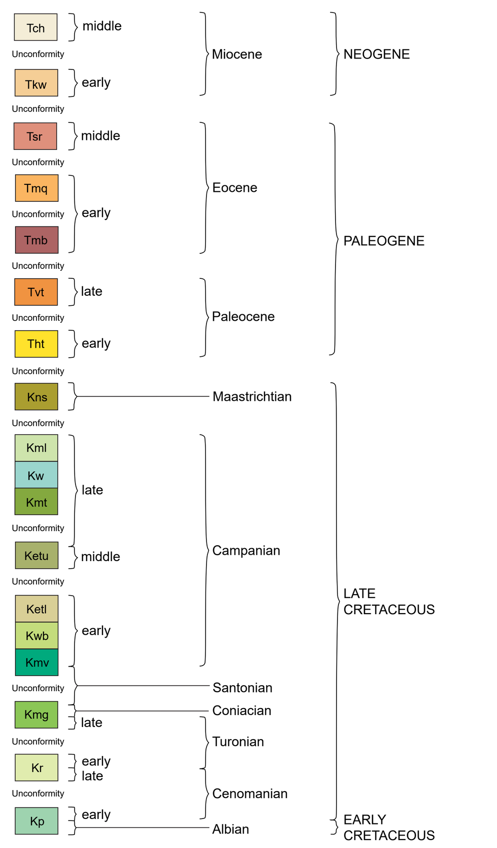

Figure 4. Bright olive-green sandy glauconite clay of the Hornerstown Formation (Tht) overlain by Quaternary fluvial deposits consisting of poorly sorted sand and gravel. Contact traced in black at the base of the poorly sorted sand and gravel material. Inset shows the location of this site on the map.

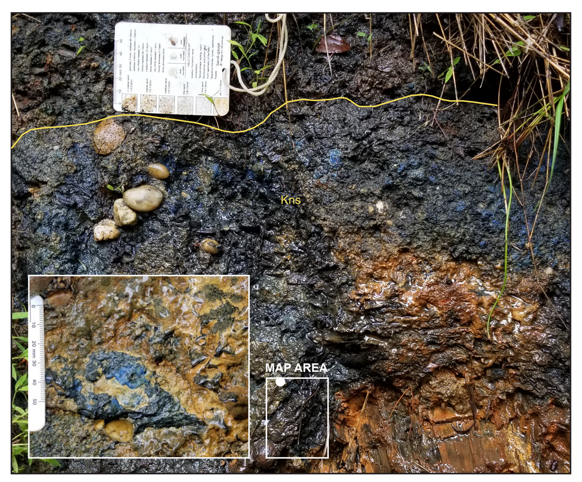

Figure 5. Vivianite precipitation within a dark brown clayey glauconite sand of the Navesink Formation (Kns) overlain by Holocene alluvium, consisting of brown and black organic silt and quartz pebbles. Contact traced in yellow. Inset on the left shows a close-up of another vivianite precipitation patch found approximately 5 feet to the southwest from where the main picture was taken. Inset on the right shows the location of this site on the map.

INTRODUCTION

The Clementon Quadrangle is situated in the Coastal Plain physiographic province of New Jersey. Bedrock in this quadrangle consists of coastal, near-shore marine, and continental shelf sediments deposited during the Early Cretaceous to middle Miocene. Units that crop out within the quadrangle include the Cohansey, Kirkwood, Manasquan, Vincentown, Hornerstown, Navesink, and Mount Laurel formations. Other units mapped in the subsurface within the quadrangle and shown in cross section include the Marlboro Clay, Shark River, Wenonah, Marshalltown, upper and lower Englishtown, Woodbury, Merchantville, Magothy, Raritan, and Potomac formations. These formations are described in the Description of Map Units below. Lithologies for the outcropping units are based on field observations while lithologies for the units only present in the subsurface are based on well records, adjacent geologic maps, and nearby coreholes studies at Ancora, New Jersey, which is approximately 8 miles southeast of Berlin (Miller and others, 1999) and Medford, New Jersey, which is approximately 4.5 miles northeast of Tomlinson Mill (Sugarman and others, 2010). Dates of the units are based on other studies focused in New Jersey. Surficial deposits within the quadrangle consist of fluvial, wetland, and eolian sediments that were deposited from the late Miocene to present day and are shown on this map as a combined unit (blue dot pattern on map). Surficial deposits are mapped and described in Carone (2021). Excavation perimeters were mapped using aerial photography and 1-meter resolution LiDAR.

Cross sections A-A', B-B', and C-C' show formations down to elevations of 1,000 feet, 600 feet, and 400 feet below sea level, respectively. These cross sections were constructed through use of geophysical logs (gamma, single-point resistance, and spontaneous potential) and well records on file at the New Jersey Geological and Water Survey and correlated to stratigraphic coreholes at Ancora, New Jersey and Medford, New Jersey. Clarification on how the geophysical logs are shown on the cross sections is provided in the Explanation of Geophysical Logs.

Table 1 (in pamphlet) reports the geologic formations penetrated by wells and Department of Transportation soil borings shown on the map, as interpreted from geophysical logs and drillers' lithologic descriptions. Wells within this list are drilled to depths in between 15 feet and 1,090 feet, while soil borings extend to depths between 11 feet to 45 feet.

DESCRIPTION OF MAP UNITS

OUTCROPPING UNITS

(Shark River and Marlboro formations do not outcrop but are included here for stratigraphic continuity)

Tch **COHANSEY FORMATION** – Quartz sand. Grain size ranges from medium- to coarse-sand with fines present in places. Newell and others (1989) identified two facies at the pit shown in figure 1 that consist of 1) interbedded medium- to coarse- grained sand with trough cross beds and 2) burrowed fine to coarse grained sand. Sand is well rounded to sub-rounded quartz with trace amounts of feldspar and chert. Sand color includes various shades of white, orange, yellow, and red (fig. 1). Very fine pebbles (2-4mm) of sub-angular, transparent to slightly opaque white and grey quartz are present in places. Gravel occurs locally throughout and/or at the base of the formation. Gravel consists of sub-rounded, mostly white and smoky grey quartzite with lesser amounts of quartz. Gravel consists of mostly fine pebbles (5-10mm). Heavy-mineral content varies from 3 to 10%. Well stratified to unstratified; thin- to thick- horizontal bedding and trough and planar cross bedding where stratified. Maximum thickness in this quadrangle is approximately 110 feet. At a site near Haines Corner, New Jersey, Newell (2005) mapped this formation as "wind-blown dune sand". These deposits are assigned here to the Cohansey Formation based on regional mapping using auger holes and well records. Strontium isotope ratios derived from the underlying Kirkwood Formation (Sugarman and others, 1993) suggest that the Cohansey Formation is middle Miocene or younger in age. Unconformably overlies the Kirkwood Formation.

Tkw **KIRKWOOD FORMATION** – Quartz sand, silty quartz sand, and silty clay. Sand is micaceous, very fine- to fine- grained, and mostly well rounded. Sand and silt are dark grey in color but weathers to various shades of yellow, white, and light grey (figs. 1 and 2). Mica content ranges from 5 to 10%. Mica flakes are white in color and can be very fine- to coarse- grained. Heavy-mineral content is as much as 5%. Glauconite present at base of unit where reworked from underlying formations (e.g. Vincentown and/or Shark River formations). Sands are well stratified to unstratified; typically, horizontally bedded and trough cross bedded where stratified. Silty clays are grey, thinly bedded to massive, occasionally lignitic, and shelly (Miller and others, 1999). Newell (2005) reported planar cross beds and burrows in a micaceous, very fine grained silty sand to very fine grained sand that had weathered to various shades of pale-orange to pale-reddish grey at an old building site near Haines Corner, New Jersey. Maximum thickness in this quadrangle is approximately 105 feet. Early Miocene in age based on strontium isotope ratios (Sugarman and others, 1993). Unconformably overlies the Shark River, Manasquan, Marlboro, and Vincentown formations.

Tsr **SHARK RIVER FORMATION** – Quartz sand underlain by glauconitic clays and silty clays. Sands are thickly bedded and medium- to coarse- grained; contain shells, less than 2% glauconite, and trace amounts of clay in places (Miller and others, 1999). Underlying clays and silty clays contain as much as 40% glauconite (Miller and others, 1999). Sands are greenish-grey in color; clays and silty clays are greenish-grey, greyish-green, pale green, and pale olive in color. Gamma-ray response generally shows a gradual grain size increase towards the top of the formation except in wells 31-30020 and 31-29979. The formation has been eroded away in the most northern parts of the map area but reaches a total thickness of approximately 125 feet down-dip (cross section A-A'). Middle Eocene in age based on nannofossils (Browning and others, 2011). Unconformably overlies the Manasquan Formation.

Tmq **MANASQUAN FORMATION** – Sandy, silty clay. Silt content generally ranges from 50% to 90% while sand content is much lower, ranging from 10% to 40% (Miller and others, 1999). Various shades of dark brown and grey where weathered; olive and green in color where unweathered. Glauconite content ranges from 10 to 50%. As much as 35 feet thick in the southeastern part of the quadrangle but has been eroded away in the most northern parts of the map area (cross sections A-A'). Early Eocene in age based on calcareous nannofossils (Owens and others, 1998). Unconformably overlies the Marlboro Formation.

Tmb **MARLBORO FORMATION** – Sandy clay. Contains two facies: a lower white and green kaolinitic clay and an upper olive-green sandy clay. Higher percentage of glauconite occurs in the upper facies (Sugarman and others, 2010). Lower facies contain trace amounts of mica (Sugarman and others, 2010). As much as 25 feet thick in the southeastern part of the quadrangle but has been eroded away in the most northern parts of the map area as shown in cross sections A-A'. Cramer and others (1999) associate this clay with the Paleocene/Eocene Thermal Maximum. Early Eocene in age based on dinoflagellates and acritarchs (Edwards, 1996). Unconformably overlies the Vincentown Formation.

Tvt **VINCENTOWN FORMATION** – Glauconitic quartz sand. Sand is mostly medium- to coarse- grained and well rounded. Fine pebbles (2-4mm) of sub-rounded to well rounded slightly opaque yellow and white quartz present in places. Sand is various shades of green but weathers to various shades of grey (fig. 3) and yellow. Greacen (1941) describes a sandy, limey facies along a small tributary to the North Branch of Big Timber Creek just west of Clementon. Such sand is reported to have trace amounts of glauconite, high clay content, and vast quantities of bryozoan fossils as well as pink casts of pelecypods, and gastropods. This fossil presence suggests that the patch reef biomicrite consisting of bryozoans and bivalves found at the Medford corehole site, which is located approximately 10.5 miles northeast of Clementon, may extend into this quadrangle (Sugarman and others, 2010). Glauconite is fine- to medium- grained and ranges from 5 to 50% (Sugarman and others, 2010). Thickness ranges from approximately 10 to 30 feet. Late Paleocene in age, based on foraminifera (Olsson and Wise, 1987). Unconformably overlies the Hornerstown Formation.

Tht **HORNERSTOWN FORMATION** – Glauconite sand. Trace amounts of fine- to medium- grained, well rounded quartz sand. Bright olive-green in color (fig. 4) but weathers to dark olive-brown and various shades of yellow. Clay beds are thin and heavily bioturbated in places. Glauconite mostly forms soft grains in the size of medium- to coarse- sand and ranges from 50 to 70%. Thickness ranges from approximately 10 to 20 feet. Early Paleocene in age based on foraminifera (Olsson and others, 1997). Unconformably overlies the Navesink Formation.

Kns **NAVESINK FORMATION** – Clayey glauconite sand to glauconitic sandy clay (where deeply weathered). Trace amounts of very fine- to fine- grained quartz sand. Glauconite content is typically 70% (Sugarman and others, 2010). Olive green, black, and dark brown in color but weathers to various shades of olive-brown and olive-yellow. Highly weathered remnants of calcareous fossils present. Vivianite present along highly weathered stream banks that expose the formation (fig. 5). Bottom contact marked in subsurface by a large, positive gamma spike. Thickness ranges from approximately 25 to 40 feet. Late Cretaceous (Maastrichtian) in age, based on foraminifera (Olsson, 1964). Strontium isotope dating estimates 69 to 67 million years old (Sugarman and others, 1995). Unconformably overlies the Mount Laurel Formation.

Kml **MOUNT LAUREL FORMATION** – Glauconitic quartz sand. Sand is chiefly medium grained, with lesser amounts of coarse and fine sand. Finer sand more abundant in the lower portion of the formation. Light grey in color but weathers to yellowish-brown and yellowish-red. Glauconite content ranges from 5 to 10%. Shells and planktonic foraminifers common throughout (Sugarman and others, 2010; Miller and others, 1999). Thickness ranges from approximately 50 to 70 feet. Late Cretaceous (late Campanian) in age based on nannoplankton (Sugarman and others, 1995). Grades downward into the Wenonah Formation.

UNITS IN SUBSURFACE ONLY

(Shown in cross-sections)

Kw **WENONAH FORMATION** – Silty quartz sand. Very fine- to fine- grained. Contains mica, shells, and trace amounts of glauconite (Sugarman and others, 2010). Mica content increases down section (Sugarman and others, 2010). Dark grey and pale olive in color; weathers to light olive-grey, brownish-grey, pale brown, and yellow. Thickness ranges from approximately 30 to 40 feet. Late Cretaceous (late Campanian) in age based on pollen (Wolfe, 1976) and ammonite fossils (Kennedy and Cobban, 1994). Grades downward into the Marshalltown Formation.

Kmt **MARSHALLTOWN FORMATION** – Glauconitic clay and clayey quartz sand. Sand is fine- to medium- grained (Sugarman, 2011; Stanford and Sugarman, 2005). Dark grey to very dark olive-grey in color; weathers to greenish-grey, olive-brown, and light brown. Contains mica, pyrite, and shell fragments. Glauconite content ranges from 10 to 50% (Sugarman and others, 2010). Thickness ranges from approximately 20 to 25 feet. Late Cretaceous (middle Campanian) in age, based on nannoplankton (Sugarman and others, 1995). Unconformably overlies the Englishtown Formation.

Ketu **ENGLISHTOWN FORMATION, UPPER** – Quartz sand underlain by silt and clay. Sand is sub-angular to well rounded and fine- to medium- grained (Sugarman and others, 2010). Silts and clays are thinly to thickly bedded; contain shells and moderate bioturbation (Sugarman and others, 2010). Formation is slightly micaceous with as much as 10% glauconite. Sand is greenish-grey and greyish-brown in color; silts and clays are very dark grey, very dark greyish-brown, and black in color. Typically, 80 to 90 feet thick in this quadrangle but can be as much as 100 feet thick. Late Cretaceous (middle to late Campanian) in age based on nannofossils (Miller and others, 2006). Unconformably overlies the lower Englishtown Formation.

Ketl **ENGLISHTOWN FORMATION, LOWER** – Quartz sand with some interbeds of clay and silt. Sand is sub-angular to well rounded and fine- to medium- grained (Sugarman and others, 2010). Contains shells, some mica, and as much as 10% glauconite; heavily bioturbated in places (Sugarman and others, 2010). Light and dark grey, dark greyish-brown, and black in color. As much as 35 feet thick in the northern part of the quadrangle, as shown in cross-section B-B', but thins down-dip to approximately 10 feet as shown in cross section A-A'. Quartz sand bodies tend to be thickest in up-dip areas of the quadrangle. Late Cretaceous (early Campanian) in age based on pollen (Wolfe, 1976). Grades downward into the Woodbury Formation.

Kwb **WOODBURY FORMATION** – Clay. Dark grey to black in color but weathers to various shades of pale yellowish brown and dark yellowish orange (Sugarman, 2011). Clay is laminated, very micaceous, and contains shells, trace amounts of very fine quartz sand with burrows and pyrite in places (Miller and others, 1999). Glauconite content ranges from trace amounts to 20% (Miller and others, 1999; Sugarman and others, 2010). Thickness ranges from approximately 25 to 40 feet. Late Cretaceous (early Campanian) in age based on pollen (Wolfe, 1976). Grades downward into the Merchantville Formation.

Kmv **MERCHANTVILLE FORMATION** – Glauconitic sand, silt, and clayey silt. Sand is greyish-olive, greenish-black or dark greenish-grey; clay and silt are various shades of black and grey. Where weathered, these sands, clays, and silts are olive-brown to yellowish-brown. Glauconite content ranges from 40 to 60%. Contains trace amounts of mica and pyrite, shells, extensive burrowing in places, and iron cementation. Thickness ranges from approximately 40 to 65 feet. Late Cretaceous (late Santonian to early Campanian) in age based on nannofossils (Mizintseva and others, 2009). Unconformably overlies the Magothy Formation.

Kmg **MAGOTHY FORMATION** – Quartz sand, clay and silt. Sand is fine- to very coarse-grained and consists of mostly quartz with minor amounts of feldspar (Sugarman, 2011). Clay and silt are micaceous and are thinly to thickly bedded (Stanford and Sugarman, 2005). Sand is light to medium grey and brownish-grey; clays are olive-black to greyish-black. Where weathered, the sand is white, yellow, and light grey; clays and silts are white, yellow, brown, and reddish-yellow. Thickness ranges from approximately 80 to 120 feet. Late Cretaceous (Turonian to Coniacian) in age based on pollen (Sugarman and others, 2021). Unconformably overlies the Raritan Formation in most of the quadrangle except the northwestern corner where the Raritan Formation pinches out leaving the Magothy Formation to unconformably overlie the Potomac Formation.

Kr **RARITAN FORMATION** – Sandy silty clay and clayey sand. Sand is very fine- to fine- grained (Sugarman and others, 2010). Contains burrows, iron concretions, pyrite, and mica. Clay laminations containing organics are common throughout. Maximum thickness in this quadrangle is approximately 85 feet. Pinches out in the northern part of the quadrangle between Gibbsboro and Woodcrest Acres. Late Cretaceous (late Cenomanian to early Turonian) in age based on pollen (Miller and others, 1999). Unconformably overlies the Potomac Formation.

Kp **POTOMAC FORMATION** – Quartz sand with intermittent clays and silts. Sand is fine- to coarse- grained (Sugarman, 2011). Clay and silt are thinly to thickly bedded. Contains minor amounts of granules and pebbles. The Potomac Formation in the Clementon quadrangle includes unit 3 and likely unit 2 (Sugarman and others, 2018). Although not differentiated in cross section due to lack of data, unit 2 has been identified in wells and coreholes adjacent to the map area based on the presence of a thick sand at the base of unit 3. Unit 3 is Late Cretaceous (early Cenomanian) in age based on pollen (Doyle and Robbins, 1977; Owens and others, 1998) and unit 2 is Early Cretaceous (Albian) in age based on pollen (Sugarman and others, 2010). Unconformably overlies Cambrian and Late Proterozoic bedrock.

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EXPLANATION OF MAP SYMBOLS

Contact of bedrock formation - Approximately located.

Material observed in exposure, excavation, or hand auger hole - Hand auger holes extend to 5 feet in depth or until refusal.

Material formerly observed in outcrop or excavation - Field notes on file at N.J. Geological and Water Survey.

1 Photograph location - Identifier refers to figure number.

31-30020, E201110064 Well with geophysical log(s) - Identifier corresponds to well permit number issued by N.J. Department of Environmental Protection. Locations accurate to within 500 feet. Inferred stratigraphy listed in Table 1 (in pamphlet).

31-12301, E201212785, P200907938 Well with lithologic log - Identifier corresponds to well permit number issued by N.J. Department of Environmental Protection. Locations accurate to within 500 feet. Inferred stratigraphy listed in Table 1 (in pamphlet).

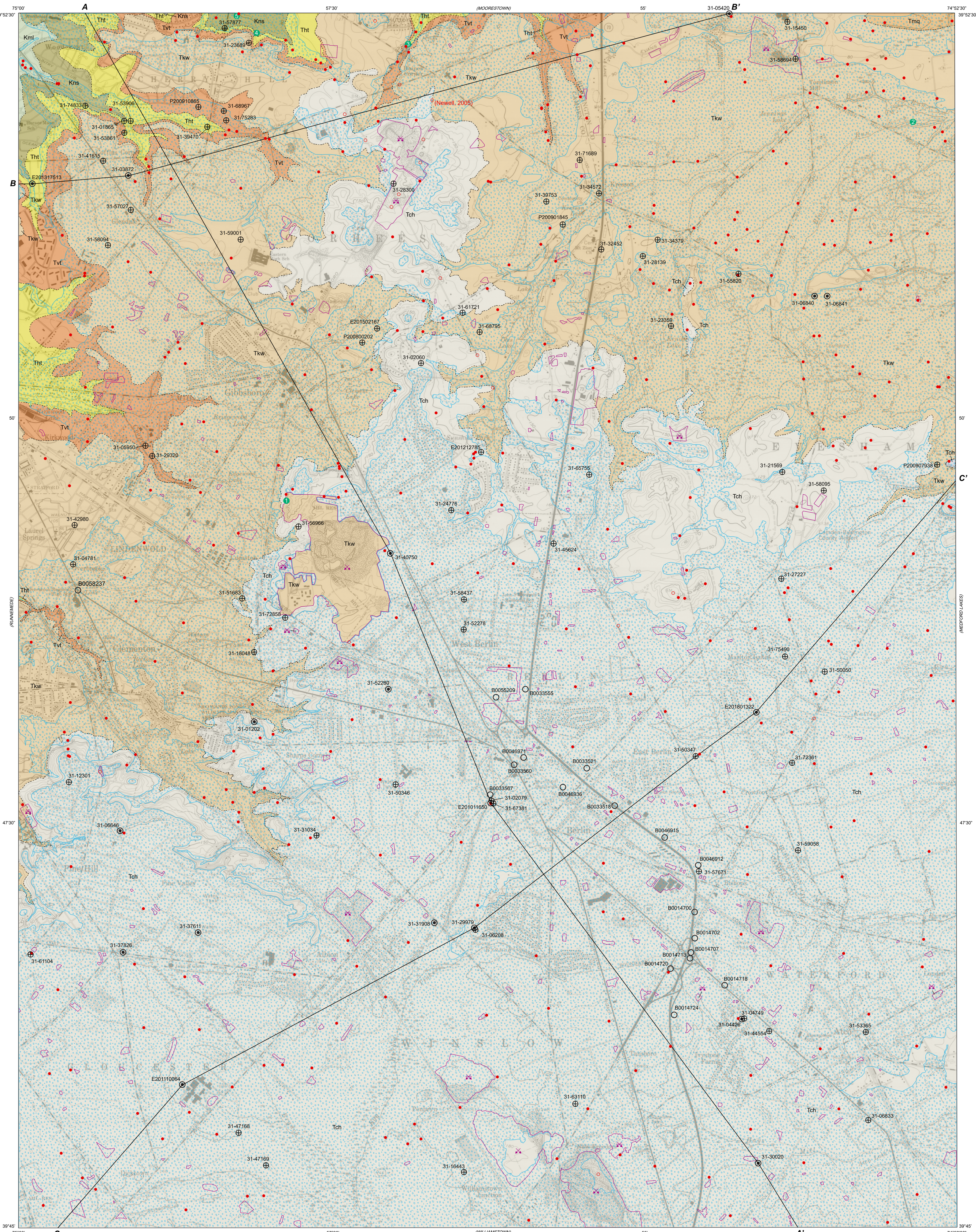
B0014724 Soil boring with lithologic log - Identifier corresponds to N.J. Department of Transportation Log ID number. Locations accurate to within 100 feet. Inferred stratigraphy listed in Table 1 (in pamphlet).

Excavation perimeter of stormwater management basins or man-made ponds - Line encloses area of excavation.

Excavation perimeter of sand or gravel pits active in 2020 - Line encloses area of excavation.

Excavation perimeter of sand or gravel pits inactive in 2020 - Line encloses area of excavation.

Surficial deposits generally more than three feet thick overlying bedrock formations. Surficial deposits mapped and described in Carone (2021).



Basemap mapped, edited, and published by the U.S. Geological Survey, 1967; photorevised 1981. Coordinate tick marks are on 1927 North American datum.

SCALE 1 :24 000

1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology mapped 2017-2019.
Cartography by Alexandra R. Carone. Assistance in data collection provided by NJGWS employee Colleen Lane. Helpful external reviews provided by Peter McLaughlin of the Delaware Geological Survey and Marcie Occhi of the Virginia Division of Geology and Mineral Resources.

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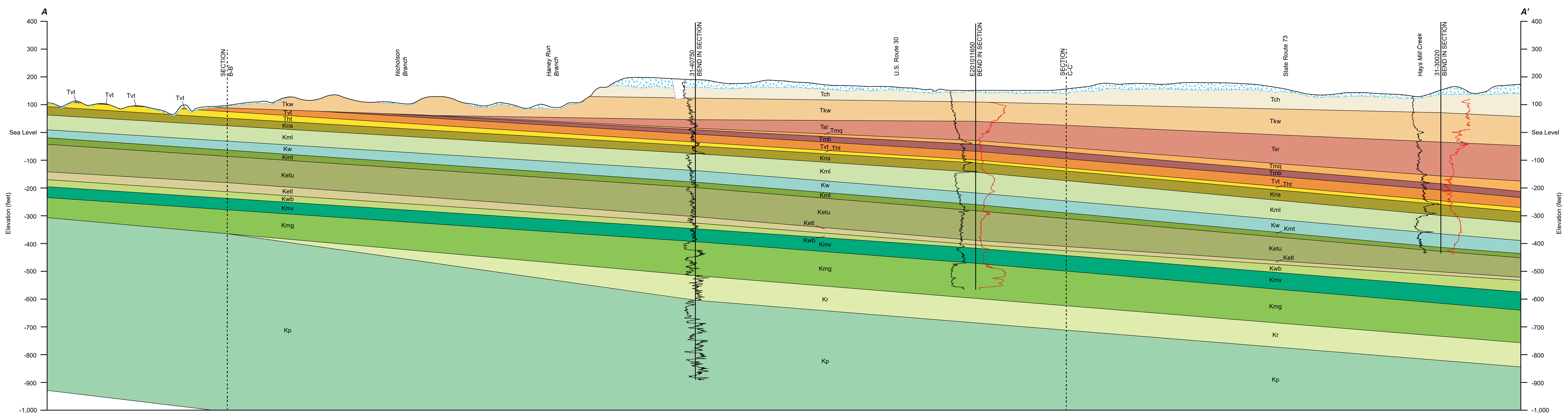
BEDROCK GEOLOGY OF THE CLEMENTON QUADRANGLE BURLINGTON AND CAMDEN COUNTIES, NEW JERSEY

By

Alexandra R. Carone
2021

APPROXIMATE MEAN DECLINATION, 2019

LOCATION IN NEW JERSEY



VERTICAL EXAGGERATION 10X

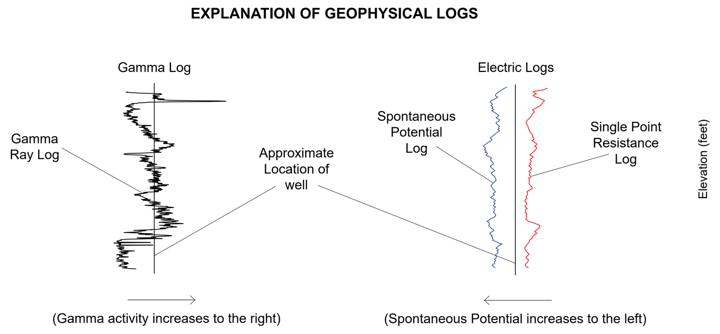
EXPLANATION OF CROSS SECTION SYMBOLS

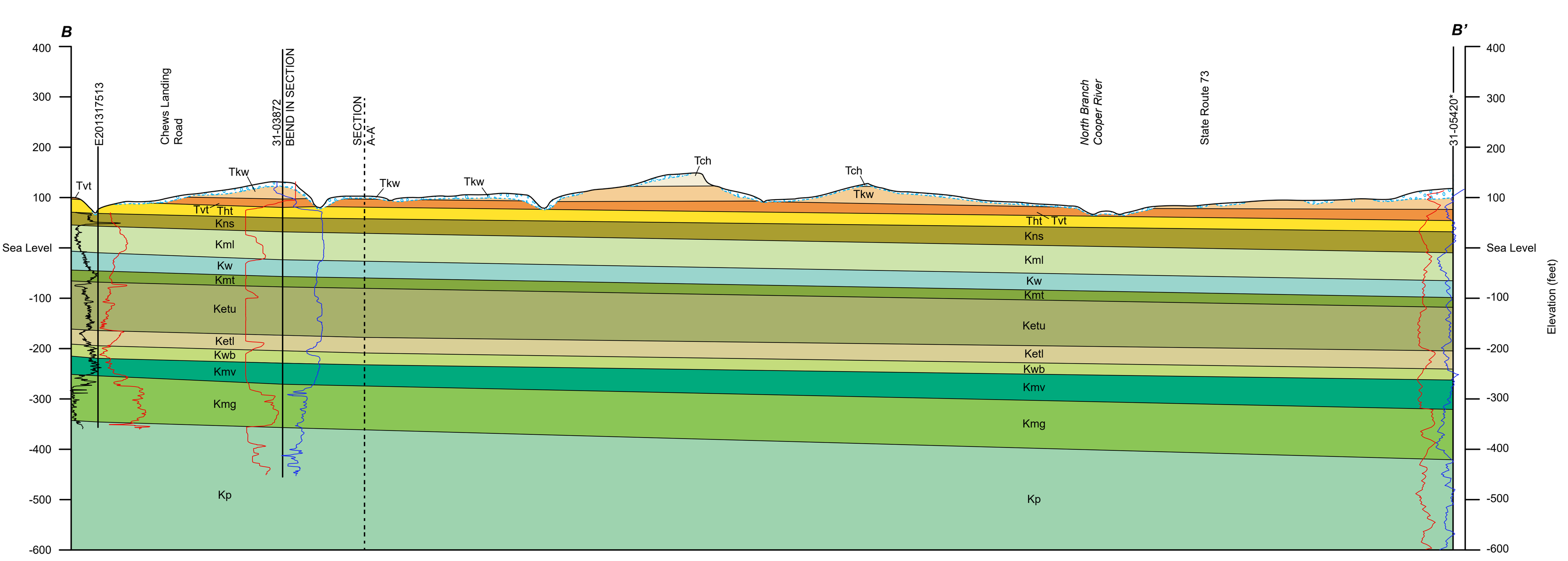
Statigraphic contact - Approximately located.

Excavation - Indicates depth of largely excavation areas that are not reflected in the basemap.

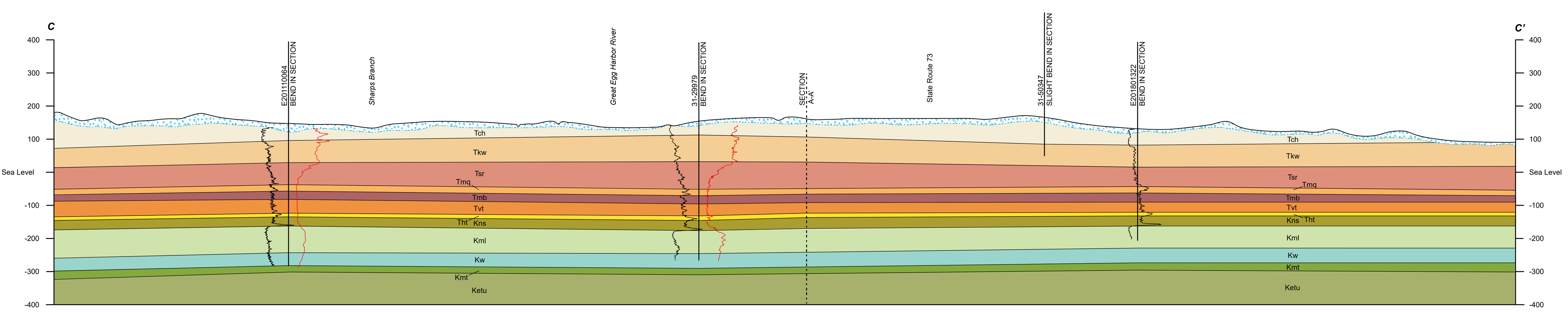
Surficial deposits generally more than three feet thick overlying bedrock formations. Surficial deposits mapped and described in Carone (2021). Base of deposits inferred.

EXPLANATION OF GEOPHYSICAL LOGS





VERTICAL EXAGGERATION 10X. *Total depth of well 31-05420 is 698 feet.



VERTICAL EXAGGERATION 10X

Bedrock Geology of the Clementon Quadrangle
Burlington and Camden Counties, New Jersey

New Jersey Geological and Water Survey
Geologic Map Series GMS 21-5
2021

Pamphlet containing table 1 to accompany map.

Table 1. Selected well and boring records. Footnotes at end of table (p. 3-4).

Identifier[1]	**Inferred Stratigraphy**[2]
31-01202	53 Tch; 90 Tkw; 120 Tsr; 150 Tmq + Tmb; 180 Tvt; 230 Tht + Kns; 305 Kml; 325 Kw; 355 Kmt; 460 Ketu; 480 Ketl
31-01865	5 Surf; 21 Kns; 59 Kml; 142 Kw + Kmt; 321 Ket + Kwb + Kmv; 386 Kmg
31-02060	100 Tch + Tkw; 135 Tsr + Tmq + Tmb; 165 Tvt; 180 Tht
31-02079	8 Surf; 113 Tch + Tkw; 176 Tsr; 197 Tmq; 220 Tmb; 292 Tvt + Tht + Kns; 411 Kml + Kw + Kmt; 540 Ketu; 555 Ketl; 566 Kwb; 621 Kmv; 955 Kmg + Kr + Kp
31-03872, E	35 Surf + Tkw; 50 Tvt; 75 Tht; 100 Kns; 155 Kml; 185 Kw; 215 Kmt; 305 Ketu; 335 Ketl; 360 Kwb; 400 Kmv; 490 Kmg; 587 Kp
31-04426, G	12 Surf; 105 Tch; 202 Tkw; 339 Tsr; 351 Tmq; 368 Tmb; 403 Tvt; 460 Tht + Kns
31-04749	14 Surf; 105 Tch; 205 Tkw; 337 Tsr; 366 Tmq + Tmb; 408 Tvt; 460 Tht + Kns + Kml
31-04781	5 Surf; 29 Tkw; 65 Tsr; 86 Tmq + Tmb; 115 Tvt; 125 Tht; 143 Kns; 210 Kml + Kw
31-05420, E	40 Surf + Tkw; 65 Tvt; 90 Tht; 130 Kns; 185 Kml; 220 Kw; 240 Kmt; 325 Ketu; 360 Ketl; 380 Kwb; 440 Kmv; 540 Kmg; 698 Kp
31-05950	8 Surf; 81 Tvt + Tht + Kns; 123 Kml; 222 Kw + Kmt; 321 Ketu; 350 Ketl; 444 Kwb + Kmv; 567 Kmg; 655 Kr; 1127 Kp
31-06208	15 Surf; 113 Tsr + Tkw; 203 Tsr; 290 Tmq + Tmb + Tvt + Tht; 336 Kns; 425 Kml; 513 Kw + Kmt; 672 Ketu; 684 Ketl; 707 Kwb; 747 Kmv
31-06646, E	34 Surf; 87 Tch; 152 Tkw; 199 Tsr; 275 Tmq + Tmb + Tvt; 303 Tht; 391 Kns + Kml; 449 Kw + Kmt; 584 Ket; 657 Kwb + Kmv; 773 Kmg; 783 Kr
31-06833	9 Surf; 50 Tch
31-06840, E	25 Surf + Tkw; 147 Tsr + Tmq + Tmb + Tvt + Tht; 177 Kns; 267 Kml + Kw; 305 Kmt; 444 Ket; 463 Kwb; 509 Kmv; 631 Kmg
31-06841, E	172 Surf + Tsr (?) + Tmq + Tmb + Tvt +Tht + Kns; 308 Kml + Kw + Kmt; 452 Ket; 474 Kwb; 514 Kmv; 602 Kmg
31-12301	29 Surf; 118 Tch; 177 Tkw; 225 Tsr; 295 Tmq + Tmb + Tvt; 417 Tht + Kns + Kml; 463 Kw + Kmt; 592 Ket; 661 Kwb + Kmv; 744 Kmg; 784 Kr
31-15450	60 Surf + Tkw + Tvt; 80 Tht; 133 Kns; 185 Kml; 225 Kw; 375 Kmt + Ket; 405 Kwb; 465 Kmv; 512 Kmg
31-16443	22 Surf; 95 Tch; 180 Tkw; 294 Tsr; 340 Tmq + Tmq; 394 Tvt; 448 Tht + Kns
31-18048	27 Surf; 61 Tkw; 115 Tsr; 168 Tmq + Tmb + Tvt; 230 Tht + Kns + Kml
31-21569	10 Tch; 86 Tkw; 115 Tsr
31-23359	20 Surf; 105 Tkw + Tmq + Tmb; 160 Tvt + Tht + Kns; 190 Kml
31-23689	45 Tkw + Tvt; 60 Tht; 80 Kns; 104 Kml
31-24776, G & E	60 Surf + Tch; 130 Tkw; 170 Tsr; 200 Tmq + Tmb; 220 Tvt; 240 Tht; 266 Kns; 324 Kml; 360 Kw; 384 Kmt; 454 Ketu
31-27227	20 Surf +Tch; 80 Tkw
31-28139	32 Surf + Tkw; 69 Tsr; 88 Tmq + Tmb; 138 Tvt + Tht + Kns; 175 Kml
31-28300	15 Tch; 37 Tkw; 50 Tvt; 80 Tht; 103 Kns; 166 Kml
31-29320	16 Surf; 34 Tvt; 172 Tht + Kns + Kml; 214 Kw + Kmt; 252 Ketu

31-29979, G & E	40 Surf + Tch; 120 Tkw; 205 Tsr; 225 Tmq; 250 Tmb; 285 Tvt; 300 Tht; 330 Kns; 405 Kml; 420 Kw
31-30020, G & E	80 Surf + Tch; 185 Tkw; 310 Tsr; 335 Tmq; 360 Tmb; 400 Tvt; 410 Tht; 455 Kns; 515 Kml; 550 Kw; 570 Kmt; 588 Ketu
31-31034	10 Surf; 47 Tch; 75 Tkw
31-31908, G & E	10 Surf; 20 Tch; 80 Tkw; 140 Tsr; 180 Tmq +Tmb; 205 Tvt
31-32452	29 Tkw; 78 Tsr (?) + Tmq (?) + Tmb; 146 Tvt + Tht + Kns; 200 Kml
31-34379	38 Tkw; 62 Tsr (?) + Tmq (?) + Tmb; 90 Tvt; 105 Tht; 135 Kns; 173 Kml
31-34572	18 Surf; 35 Tkw; 83 Tsr + Tmq + Tmb + Tvt; 105 Tht; 125 Kns; 165 Kml
31-37611, G & E	41 Surf + Tch; 106 Tkw; 171 Tsr; 186 Tmq; 211 Tmb; 241 Tvt; 281 Tht + Kns; 356 Kml; 366 Kw
31-37826, G & E	25 Surf + Tch; 102 Tkw; 164 Tsr; 180 Tmq; 224 Tmb + Tvt; 238 Tht; 266 Kns; 364 Kml; 378 Kw; 394 Kmt; 540 Ket + Kwb; 590 Kmv; 678 Kmg; 762 Kr
31-39470	8.5 Surf; 15 Tht + Kns (?)
31-39753	15 Surf; 30 Tkw; 62 Tsr (?)Tmq (?) + Tmb; 90 Tvt; 134 Tht + Kns; 172 Kml
31-40750, G	67 Surf + Tch; 145 Tkw; 175 Tsr; 180 Tmq; 200 Tmb; 225 Tvt; 240 Tht; 270 Kns; 330 Kml; 360 Kw; 390 Kmt; 490 Ketu; 515 Ketl; 540 Kwb; 585 Kmv; 705 Kmg; 795 Kr; 1081 Kp
31-41615	26 Surf; 30 Tkw
31-42980	27 Tkw; 56 Tsr; 84 Tmq + Tmb; 130 Tvt + Tht + Kns; 152 Kml
31-44554	22 Surf; 92 Tch
31-45624	64 Surf + Tch
31-47168	9 Surf; 31 Tch; 97 Tkw
31-47169	32 Surf + Tch; 100 Tkw
31-50050	15 Surf + Tch; 70 Tkw; 120 Tsr; 170 Tmq + Tmb; 320 Tvt + Tht +Kns + Kml
31-50346	30 Surf; 55 Tch; 93 Tkw
31-50347	16 Surf; 82 Tch; Tkw 118
31-51683	24 Surf; 50 Tkw; 80 Tsr; 100 Tmq + Tmb; 150 Tvt + Tht; 190 Kns; 240 Kml
31-52278	25 Surf; 69 Tch
31-52280, G	25 Surf; 70 Tch
31-53365	20 Surf; 100 Tch
31-53861	18 Surf + Tvt + Tht; 35 Kns; 100 Kml; 150 Kw + Kmt; 250 Ket; 405 Kwb + Kmv + Kmg
31-53906	9 Surf; 18 Tht; 35 Kns; 100 Kml; 150 Kw + Kmt; 250 Ket; 405 Kwb + Kmv + Kmg
31-55820	50 Surf + Tkw; 75 Tsr; 180 Tmq + Tmb + Tvt + Tht + Kns; 200 Kml
31-56966	20 Tch; 61 Tkw; 103 Tsr; 122 Tmq + Tmb; 145 Tvt; 165 Tht; 202 Kns; 232 Kml
31-57027	10 Surf; 35 Tkw
31-57671	38 Surf; 134 Tch + Tkw; 235 Tsr; 255 Tmq; 295 Tmb; 320 Tvt; 355 Tht + Kns; 400 Kml
31-57877	18 Surf; 30 Kns
31-58094	19 Surf + Tkw; 22 Tvt
31-58095	30 Tch; 110 Tkw; 150 Tsr; 195 Tmq + Tmb; 270 Tvt + Tht + Kns; 300 Kml
31-58437	24 Surf; 31 Tch; 107 Tkw; 150 Tsr; 175 Tmq +Tmb; 200 Tvt; 255 Tht + Kns; 295 Kml
31-58694	15 Surf; 60 Tkw + Tmq (?) + Tvt; 130 Tht + Kns; 160 Kml
31-59001	45 Tkw; 63 Tvt; 122 Tht + Kns; 172 Kml
31-59058	67 Surf + Tch; 171 Tkw; 293 Tmq + Tmb; 336 Tvt + Tht; 385 Kns + Kml
31-61104	28 Surf; 48 Tch; 109 Tkw; 192 Tsr; 226 Tmq + Tmb; 256 Tvt; 261 Tht; 300 Kns; 382 Kml; 400 Kw
31-61721	6 Surf; 68 Tch + Tkw; 72 Tsr + Tmq + Tmb; 95 Tvt; 140 Tht + Kns; 182 Kml
31-63110	20 Surf; 104 Tch
31-65755	38 Surf + Tch; 125 Tkw; 160 Tsr; 180 Tmq + Tmb; 225 Tvt + Tht; 265 Kns; 320 Kml
31-67381	5 Surf; 45 Tch; 175 Tkw + Tsr; 215 Tmq + Tmb; 296 Tvt + Tht + Kns; 398 Kml + Kw
31-68795	21 Surf; 68 Tkw; 72 Tmq + Tmb; 95 Tvt; 140 Tht + Kns; 176 Kml
31-68967	12 Surf; 18 Tvt
31-71689	30 Tkw; 75 Tsr (?) + Tmq (?) + Tmb (?); 110 Tvt; 150 Tht + Kns; 200 Kml

31-72361	29 Surf + Tch; 95 Tkw; 180 Tsr; 220 Tmq + Tmb; 290 Tvt + Tht + Kns; 340 Kml
31-72858	17 Surf; 32 Tch; 100 Tkw
31-74833	15 Surf; 30 Tht; 38 Kns
31-75283	5 Surf; 15 Tvt; 22 Tht
31-75490	19 Surf + Tch; 63 Tkw; 105 Tsr; 160 Tmq + Tmb; 185 Tvt; 240 Tht + Kns; 330 Kml
B0014700	20 Surf; 36.5 Tch
B0014702	36.5 Surf; 41.5 Tch
B0014707	17 Surf; 41 Tch
B0014713	15 Surf; 36.5 Tch
B0014718	16.5 Surf; 21.5 Tchs; Tchc 26.5; 31.5 Tchs
B0014720	11.5 Surf
B0014724	16.5 Surf; 41.5 Tch
B0033518	22 Surf; 40 Tch
B0033521	17 Surf
B0033555	10 Surf; 41 Tch
B0033560	12 Surf; 40 Tch
B0033567	6 Surf; 27 Tch
B0046912	17 Surf
B0046915	4.5 Surf; 16 Tch
B0046936	10 Surf; 22 Tch
B0046971	10 Surf; 40 Tch
B0055209	8.5 Surf; 31.5 Tch
B0058237	11 Surf; 25 Tkw
E201011650, G & E	42 Surf + Tch; 110 Tkw; 180 Tsr; 195 Tmq; 220 Tmb; 250 Tvt; 260 Tht; 295 Kns; 370 Kml; 400 Kw; 430 Kmt; 540 Ketu; 555 Ketl; 570 Kwb; 622 Kmv; 716 Kmg
E201110064, G & E	27 Surf; 50 Tch; 120 Tkw; 185 Tsr; 205 Tmq; 230 Tmb; 270 Tvt; 280 Tht; 305 Kns; 390 Kml; 420 Kw; 432 Kmt
E201212785	10 Surf; 15 Tch; 80 Tkw; 120 Tsr; 180 Tmq + Tmb + Tvt + Tht; 240 Kns + Kml
E201317513, G & E	8 Tht; 35 Kns; 80 Kml; 115 Kw; 150 Kmt; 240 Ketu; 270 Ketl 295 Kwb; 330 Kmv; 420 Kmg; 432 Kp
E201502167	7 Surf; 60 Tkw; 87 Tsr + Tmq + Tmb; 143 Tvt + Tht + Kns; 210 Kml; 250 Kw + Kmt
E201801322, G	11 Surf; 50 Tch; 115 Tkw; 175 Tsr; 195 Tmq; 220 Tmb; 250 Tvt; 260 Tht; 295 Kns; 338 Kml
P200800202	7 Surf; 70 Tkw + Tsr; 90 Tmq + Tmb; 110 Tvt; 145 Tht + Kns; 185 Kml
P200901845	15 Surf; 28 Tkw; 59 Tsr + Tmq + Tmb; 80 Tvt; 125 Tht + Kns; 165 Kml
P200907938	40 Surf + Tkw; 250 Tsr + Tmq +Tmb + Tvt + Tht + Kns; 300 Kml
P200910865	52 Surf + Tht + Kns; 105 Kml; 150 Kw + Kmt

[1]Identifiers of the form of 31-xxxxx, Exxxxxxxxx, and Pxxxxxxxxx are N.J. Department of Environmental Protection well permit numbers. Identifiers of the form B00xxxxx indicate N.J. Department of Transportation Test Hole Numbers / Boring Numbers which can be found at http://www.state.nj.us/transportation/refdata/geologic/. Identifiers are **bolded** when depicted on cross-sections. A "G" following the identifier indicates that a gamma ray log is on file at the New Jersey Geological and Water Survey; an "E" indicates that an electric log (single point resistance and spontaneous potential) is on file at the New Jersey Geological and Water Survey. Identifiers are ordered in increasing numeric value or alphabetical order when a letter leads the identifier. Well locations are shown on the map to an accuracy of within 500 feet. Soil boring locations are shown on the map to an accuracy of 100 feet.

[2]Numbers preceding the abbreviated formation name represent the depth (in feet below land surface) of the unit's base. For example, "15 Surf; 40 Tch; 100 Tkw" indicates surficial deposits from 0 to 15 feet below ground surface, Tch from 15 to 40 feet below ground surface, and Tkw from 40 to 100 feet below ground surface. The last number in the sequence represents the total depth reported in the log, which is not necessarily the base of the unit. A "+" sign between units indicates that such units could not be differentiated in the lithologic and/or geophysical log. A "(?)" sign indicates that the preceding unit (Tsr, Tmq and/or Tmb) may not be present at the well area according to cross section A-A'. "Ket" is listed if "Ketu" and "Ketl" cannot be differentiated. "Surf" refers to surficial units identified in Carone (2022). Many logs

do not distinguish surficial units from the uppermost bedrock unit. In these cases, the surficial unit is included in the uppermost bedrock unit. Unit abbreviations are explained in the Description of Map Units. Units are inferred from drillers', geologists', or engineers' lithologic descriptions on well records filed with the N.J. Department of Environmental Protection, N.J. Department of Transportation boring logs, or geophysical logs on file at the New Jersey Geological and Water Survey. Interpretation of sediments described in the logs may not match the map and sections due to variability in drillers' descriptions and lag time involved in the drilling process.