DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATER RESOURCES MANAGEMENT
NEW JERSEY GEOLOGICAL AND WATER SURVEY

INTRODUCTION

The "Framework and Properties of Aquifers in the Coastal Plain of Mercer and Middlesex counties, New Jersey" is the final map in a series of maps characterizing aquifers of the New Jersey Coastal Plain (NJCP) (fig. 1). Previous aquifer framework maps include Cumberland, Salem, Gloucester, and Camden counties (Sugarman and Monteverde, 2008), Monmouth and Ocean counties (Sugarman and others, 2013), Cape May County (Sugarman and others, 2016), Burlington County (Sugarman and others, 2018), and Atlantic County (Sugarman and others, 2020). The hydrostratigraphic frameworks illustrated on these maps were developed by integrating bedrock geologic maps (e.g., Owens and others, 1998), geophysical logs (Zapecza, 1989; 1992) and stratigraphic test wells (e.g., Sugarman and others, 2010) to better define and delineate the aquifers within the NJCP. This map includes groundwater withdrawal information (figs. 3-4), pump test data (table 1), water quality data (tables 2 and 3), and cross sections illustrating geologic formations and hydrostratigraphic units (Sheet 2, figs. 6-16), and a revised geologic map of Mercer and Middlesex counties (fig. 2) based on recent geologic quadrangle mapping of the Trenton West and East (Volkert and Stanford, 2018), Allentown (Owens and Minard, 1966), Hightstown (Sugarman and others, 2015), Jamesburg (Stanford and Sugarman, 2008), Freehold (Sugarman and Owens, 1996), Keyport (Sugarman and others, 2014), Monmouth Junction (Beetle-Moorcroft and others, 2018), South Amboy (Sugarman and others, 2005a), New Brunswick (Stanford and others, 1998), Perth Amboy (Volkert and others, 2017), and Princeton (Monteverde and others, 2012) quadrangles. Previous framework studies of Mercer and Middlesex counties that established the hydrogeologic framework in these areas included Widmer (1965), Vecchioli and Palmer (1962), Barksdale and others (1943), Gronberg and others (1989, 1991), Zapecza (1989), and Farlekas (1979).

Mercer County (approximately 230 square miles; population 368,000 as of 2020) and Middlesex County (approximately 323 square miles; population 825,000 as of 2020) are in central New Jersey and are bordered by the Delaware River to the southwest, and Raritan Bay and Arthur Kill to the northeast. Large cities such as Trenton and New Brunswick are supplied mostly by surface water sources. These include the Delaware River for Trenton and the Delaware and Raritan Canal and Farrington Lake for New Brunswick. Groundwater withdrawal trends show a steady decrease starting in the early 2000's and then appear to remain variable but relatively stable over the more recent years depicted (fig. 3). The other water use groups show variable but relatively stable withdrawal trends for both the NJCP aquifers and bedrock aquifers of the Newark Basin (Note: only the NJCP aquifers are discussed and illustrated in this map). Finally, groundwater withdrawals in this study area are dominated by potable water needs, with small amounts withdrawn for agricultural and non-agricultural irrigation, and commercial and industrial uses (fig. 4).

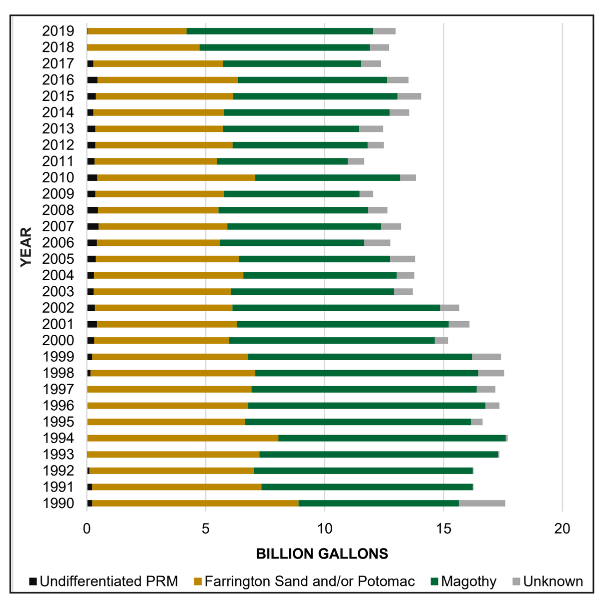

Figure 3. Annual groundwater withdrawals by Coastal Plain aquifers within Mercer and Middlesex counties. Data collected from 1990 to 2019. Data sourced from the New Jersey Water Transfer Data Model (NJWaTr) (New Jersey Geological Survey, 2011), a database managed by NJGWS (New Jersey Geological and Water Survey) that contains measured and estimated monthly withdrawals, use, and return volumes.

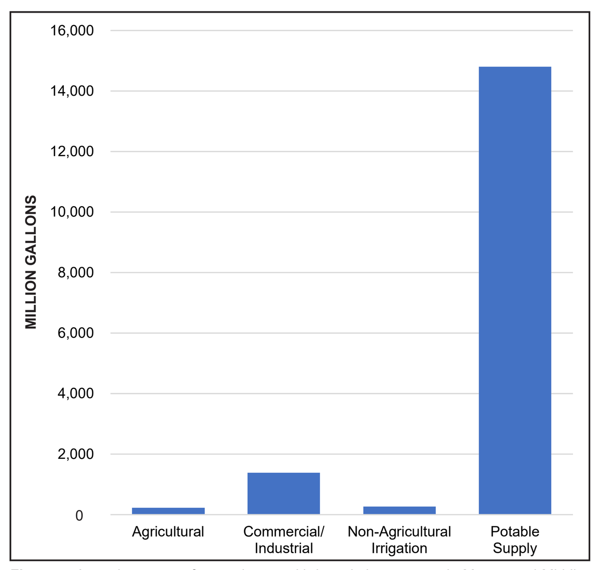

Figure 4. Annual average of groundwater withdrawals by use type in Mercer and Middlesex counties. Data collected from 2010 to 2019. Data sourced from the New Jersey Water Transfer Data Model (NJWaTr) (New Jersey Geological Survey, 2011).

METHODS

An improved understanding of the hydrostratigraphy for Mercer and Middlesex counties is presented here and based on integrating geophysical logs from some of the water wells shown in table 4 (Sheet 2) with recent geologic maps of the study area as listed above. Additional well information was taken from Gronberg and others (1989). Elevations of basement rock are from Volkert and others (1996) and well records on file at the New Jersey Geological and Water Survey (NJGWS). Topographic profiles on cross-sections are from NJDEP Digital Elevation Model (DEM) 10-meter by 10-meter data spacing cast on the Universal Transverse Mercator (UTM) projection. Advances in the understanding of the water-bearing properties of the aquifers are based on aquifer test data submitted to the NJGWS in support of Water Allocation Permit applications. NJGWS evaluates this data based on 1) hydrogeology of the area, 2) screen lengths of the pumping and observation wells, 3) test duration, 4) number of pumping and observation wells, 5) proximity of observation wells to the pumping wells, 6) influence of other pumping wells, and 7) data reliability. Results of ten aquifer tests are summarized in table 1. Additional information for each test is in the NJGWS hydro database under the file numbers indicated in table 1 (Mennel and Canace, 2002).

Downhole geophysical logs have proven invaluable in the delineation and evaluation of Coastal Plain aquifers (Zapecza, 1989; 1992; Sugarman and others, 2005b, 2013, 2016; Sugarman and Monteverde, 2008) by allowing correlation of sands (aquifers) and clays (confining units) over long distances. Of the many kinds of downhole geophysical logs, natural gamma and electric have proven to be the most effective in subsurface mapping and, used in combination with well records, are the significant tools in the identification of lithologies encountered in boreholes needed to develop a hydrostratigraphic framework. Thorough discussions of the relationship between borehole geophysical measurements and lithologies are in Keys (1990) and Rider (2002).

The natural gamma tool measures gamma radiation from radioactive minerals in the surrounding sediments and is especially useful because it can be measured through well casings. Elevated gamma readings generally correlate well with the clays of confining units due to the higher concentration of potassium, uranium, and thorium in clays than in quartz sands (Keys and MacCary, 1971). Confirming the applicability of gamma logs to NJCP sediments, Lanci and others (2002) showed that the radioactive signatures of the Coastal Plain clay and sand mixtures and, where present, glauconite are consistent with those observed in gamma logs. Two different units of measurement are used for gamma response: American Petroleum Institute (API) units and counts per second (CPS). CPS units are more commonly used in local investigations where curve matching allows unit identification and were used in this study.

Electric logs are commonly used in combination with natural gamma logs in groundwater studies (Keys, 1990). Combining electrical and gamma data enables one to decipher the lithological makeup and therefore differentiate between aquifers and confining units. The single-point resistance logs shown on the cross sections (Sheet 2) measure the electrical potential drop between two electrodes, one at the surface and the second within the tool. Results are measured in millivolts and subsequently converted to ohms (Keys and MacCary, 1971; Keys, 1990). Values recorded by the single-point resistance probe correlate to a volume of borehole and rock material that is five to ten times the diameter of the probes. Resistance values decrease as porosity and formation water content increase. In contrast to natural gamma values, which are generally higher in clays, resistance values are generally lower in clays because the clays have higher overall conductivity. Quantitative measurements of porosity and/or salinity, though, cannot be calculated from single-point resistance probes because the current's travel path parameters are not defined (Keys, 1990). If borehole fluid is homogeneous, variations in resistance are caused by lithology. Increasing pore water salinity will cause a decrease in resistance.

DESCRIPTION OF COASTAL PLAIN GEOLOGIC UNITS AND THEIR CONTAINED AQUIFERS

In Mercer and Middlesex counties, the NJCP is separated from older consolidated sedimentary and crystalline rocks (shown in white on the map) of the Piedmont at the Fall Line, an escarpment marked by a series of waterfalls and rapids along the Atlantic Seaboard. Approximately 40% of Mercer County, and 70% of Middlesex County is within the Coastal Plain. This map covers only Coastal Plain geology and hydrostratigraphy. All the outcropping bedrock formations are Cretaceous deposits that become younger in outcrop downdip toward Monmouth County (fig. 2). The surficial Pensauken Formation overlies the NJCP bedrock formations in much of the map area. It is composed of sand and gravel and is as much as 120 feet thick. Where it is shown on the map (fig. 2) as a belt between Mercerville and Milltown, it is thick enough to potentially be a locally unconfined aquifer. A generalized correlation of geologic and hydrostratigraphic units developed from Figure 2 and cross sections (Sheet 2) is shown in Figure 5. Eleven cross-sections were developed illustrating the relationship between geologic and hydrostratigraphic units (figs. 6-16, Sheet 2). Superimposed on the geologic formations are colored sand patterns that map the sand bodies within the Englishtown aquifer, Magothy aquifer, and Potomac aquifer system (fig. 5).

Quaternary Deposits - includes estuarine deposits of Holocene age and underlying fluvial and glaciofluvial deposits of late Pleistocene age. Estuarine deposits as much as 100 feet thick and consist of brown to dark gray organic clay and silt with some peat and minor sand and shells. Fluvial and glaciofluvial deposits as much as 40 feet thick and consist of gray and brown sand and pebble gravel with minor cobble gravel. Sand is chiefly quartz with some shale fragments and feldspar and minor glauconite and mica. Gravel is chiefly quartz and quartzite with some red and gray mudstone and shale and minor ironstone, chert, gneiss, and sandstone. Shown where generally greater than 25 feet thick on cross sections only since not an aquifer.

Pensauken Formation - sand, minor silt and clay; yellow, reddish yellow; pebble gravel and minor cobble gravel, particularly at the base of the deposit. Sand is chiefly quartz with some weathered feldspar and minor glauconite and mica. Gravel is chiefly quartz and quartzite with some chert and ironstone, and minor amounts of deeply weathered sandstone, mudstone, diabase, and gneiss. Locally iron-cemented. Locally includes beds of dark gray to reddish yellow clay as much as 6 feet thick. Total thickness as much as 140 feet. Shown on map only where generally greater than 50 feet and on cross sections where generally greater than 25 feet thick. Of Pliocene age.

Wenonah and Marshalltown Formations – fine grained, locally medium, quartz sand, clayey and silty, with high percentages of glauconite in the basal part of the Marshalltown (Kmt), and high percentages of mica in the Wenonah (Kw). Deposited in shelf to near shore environments, these upper Cretaceous predominantly fine-grained sediments form the Marshalltown-Wenonah confining unit. Only a few occurrences of these two formations are found in the southeastern border of Middlesex County with Monmouth County. Campanian in age.

Englishtown Formation – fine- to medium-grained quartz sand, locally coarse, interbedded with thin to thick dark clay beds. Functions as a single aquifer in Middlesex County (Nichols, 1977), but downdip in Monmouth and Ocean counties contains two water bearing sands separated by a clay-silt unit (Nichols, 1977), and hence is termed an aquifer system. Maximum thickness is 100 feet on section FF' (fig. 11, Sheet 2) in Middlesex County. Campanian in age.

Woodbury Formation – clay-silt, micaceous, with thin lenses of glauconite sand. Iron oxides fill fractures and form thin layers; small siderite concretions occur randomly throughout the formation. Contains finely disseminated pyrite, carbonaceous material, and lignite. Forms the upper part of the Merchantville-Woodbury confining unit. Campanian in age.

Merchantville Formation – interbedded thick glauconite sands with thinner beds of micaceous, carbonaceous clay-silts that contain siderite concretions. Forms the middle to lower, but not lowermost, part of the Merchantville-Woodbury confining unit. Lower Campanian in age. On mapped area, the Cheesequake Formation, a micaceous clay silt unit below the Merchantville, is included in the Merchantville Formation. Maximum thickness of the Merchantville-Woodbury confining unit is approximately 200 feet (section EE'; fig. 10, Sheet 2) at the Middlesex-Monmouth County border. Campanian to Santonian in age.

Magothy Formation – fine- to coarse-grained light-colored quartz sand, crossbedded, interbedded with thin- to thick, dark colored carbonaceous silt and clay beds. The Magothy is divided into five (Owens and others, 1998) or six (Sugarman and others, 2021) informal members. Detailed description of these members is provided in Sugarman and others (2021). The lower permeability upper members including the Cliffwood beds, Morgan beds, and Amboy Stoneware Clay are included in the Merchantville-Woodbury confining unit by hydrogeologists, and form the base of it (Zapecza, 1989). The Magothy is a major aquifer in the study area, and the most productive sands are correlated with the lower part of the Magothy including the Old Bridge Sand Member, and the Sayreville Sand (Barksdale and others, 1943; Zapecza, 1989). The Sayreville Sand Member was previously assigned to the Raritan Formation but has subsequently been reassigned to the Magothy Formation (Sugarman and others, 2021). The upper aquifer of the Potomac-Raritan-Magothy aquifer system corresponds to the Magothy Formation and is termed the Magothy aquifer in this study. It includes the Sayreville Sand and Old Bridge Sand members. Maximum thickness is 300 feet. The Magothy is upper Turonian (?) to Coniacian in age (Sugarman and others, 2021).

Raritan Formation – consists of two members – the upper Woodbridge Clay and the lower Farrington Sand. Upper Cretaceous, upper Cenomanian to lower Turonian in age.

Woodbridge Clay Member – dark-clayey silt, thin- to thick bedded, with thin to thick interbeds of very fine- to fine quartz sand. Very micaceous and lignitic, with localized bands of siderite concretions that contain casts of marine mollusks. Forms a confining unit between the middle and upper aquifers in the Potomac-Raritan-Magothy aquifer system (Zapecza, 1989), and the Magothy aquifer and the Potomac aquifer system in this study. Maximum thickness is approximately 150 feet in this study area. In some areas, the Woodbridge Clay can contain roughly equal percentages of sand and clay, reducing its effectiveness as a confining unit (e.g., wells 39-41 on section AA'; fig. 6, Sheet 2), and allowing more interconnection between the upper and middle aquifers. Maximum thickness is 150 feet. Barksdale and others (1943) give the maximum thickness as 90 feet. Cenomanian to Turonian in age.

Farrington Sand Member – fine- to medium grained quartz sand, light colored, cross-bedded, and micaceous. Barksdale and others (1943) describes the lower 10 to 20 feet of the Farrington in outcrop as a "…coarse, arkosic, light-gray or light-yellow sand usually containing a considerable sprinkling of small pebbles." and considers the maximum thickness as 80 feet. Owens and others (1998) give the maximum thickness of the Farrington as approximately 34 feet and consider the Farrington as age equivalent with the Woodbridge Clay based on pollen (both assigned to Pollen Zone IV). Stanford and others (1998) list the maximum thickness of the Farrington sand as approximately 100 feet but indicate that the lower part of the Farrington may be time equivalent to the Potomac Formation, unit 3. These three studies offer various thicknesses of the Farrington, in part due to the lack of outcrops, limited biostratigraphic data, and rapid facies changes in both the Farrington Sand member and Potomac Formation in the map area.

In previous studies (e.g., Barksdale, 1943; Zapecza, 1989) the Farrington sand member is the Farrington aquifer or middle aquifer in the Potomac-Raritan-Magothy aquifer system. In this study, we recognize the Farrington Sand member as the upper part of the Potomac aquifer system and include sands within the Potomac Formation as the major component of this aquifer. In Mercer and Middlesex counties, this includes Potomac unit 3 and to a lesser extent unit 2 sands. This approach is taken based on pollen studies in outcrop and the shallow subsurface constraining the thickness and extent of sands assigned to pollen Zone IV. In downdip areas southeast of Mercer and Middlesex counties, the Farrington sand becomes increasingly difficult to identify (Sugarman and others, 2021; Miller and others, 2006) due to a lack of sand beds at the base of the Raritan that contain pollen assigned to Zone IV.

Potomac Formation – light-colored fine- to coarse- gravelly sand, cross bedded, interbedded with various colored clays, including white, red, and yellow, and locally dark gray (with wood). Separated into units 3, 2, and 1 based on pollen in New Jersey (Owens and others, 1998), but only unit 3 (Upper Cretaceous, lower Cenomanian) is found to outcrop in this study area. In the subsurface, the Potomac is not subdivided in this study, but unit 3 is the dominant component, with unit 2 present in deeper downdip wells closer to the border with Monmouth County (e.g., well 52, section II', Sheet 2). In contrast to previous studies (Farlekas, 1979; Zapecza, 1989), we place the Farrington Sand in the Potomac aquifer system for reasons stated above. Where the Farrington sand is present, it forms the uppermost part of the Potomac aquifer system and is typically 30 to 40 feet thick. Maximum thickness of Potomac aquifer, including the Farrington sand, is 250 feet (cross sections A-A' and B-B', Sheet 2).

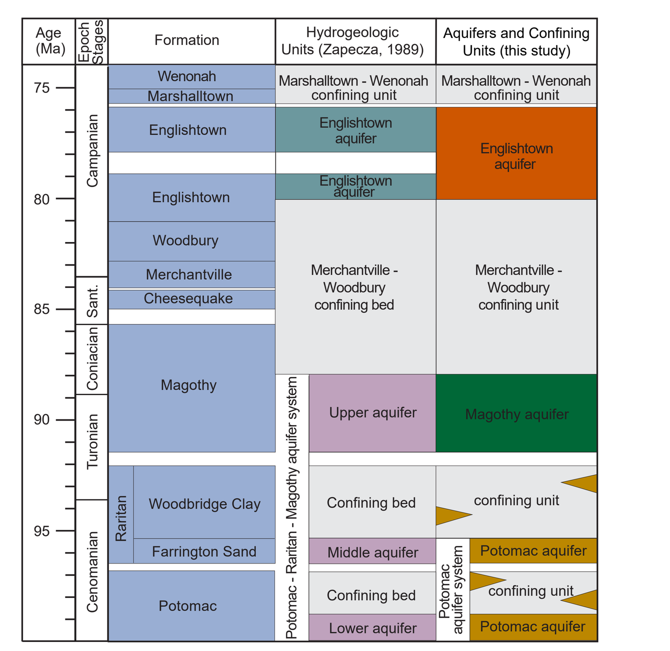

Figure 5. Generalized comparison of geologic formations, aquifers, and confining units in the study area. Also shown is the hydrogeologic framework modified from Zapecza (1989). Breaks in the column are due to nondepositional unconformities. "Ma" = million years ago; "Sant." = Santonian.

POTOMAC-RARITAN-MAGOTHY (PRM) AQUIFER SYSTEM PROPERTIES

The NJGWS Hydro database (http://www.state.nj.us/dep/njgs/geodata/dgs02-1.htm) includes ten aquifer tests for the Coastal Plain portion of Mercer and Middlesex counties. The database provides estimates of hydraulic properties of the principal aquifers used for water supply. Three tests were performed in the Magothy aquifer and seven in the Potomac aquifer system. Table 1 provides the summary of the aquifer test analyses and the correlative hydraulic properties of the aquifers. Each aquifer test has a corresponding number and can be located on the map. The following descriptions separate aquifer tests by the hydrogeologic conditions.

Two aquifer tests (100 and 201) were completed in unconfined aquifers in the outcrop area of the Magothy Formation. Hydrogeologic data collected at these sites show that there are no continuous confining layers separating the aquifers from the land surface. These aquifers are recharged by precipitation and are in direct connection with surface water. Analyses of time-drawdown and recovery data confirm the hydrogeologic characterization.

Seven aquifer tests are located at/or near the outcrop areas of leaky-confined aquifers. Time-drawdown and recovery data collected during these tests indicate a strong hydraulic connection between the aquifer and shallow water table. The interbedded clays in these aquifers are often thin-bedded and of limited areal extent, therefore unconfined to leaky-confined aquifer response to pumping is consistent with the hydrogeology. Hydrogeologic data from five Potomac aquifer system aquifer tests (i.e. 172, 222, 224, 252, and 393) indicate that the aquifers are recharged by significant leakage which likely is derived from flow originating in the outcrop areas and flow through overlying semi-confining units. Analyses of the time-drawdown and recovery data from these aquifer tests confirm this leaky aquifer characterization. Furthermore, the hydraulic properties calculated from these aquifer tests agree with previously reported values for the PRM aquifer (Pucci and others, 1989; Farlekas, 1979; Mennel and Canace, 2002) elsewhere in New Jersey.

One aquifer test (291) within the Upper PRM or Magothy aquifer was completed downdip, approximately 2.7 miles from the outcrop area where it is separated from overlying aquifers by more continuous, thick confining units. Analysis of the time-drawdown and recovery data confirm the confined hydrogeologic characterization with calculated aquifer parameters consistent with the hydrogeologic data.

WATER QUALITY

NJGWS reviewed available water quality data from NJDEP and USGS NWIS (National Water Information System; 2022) data bases for the Magothy (Upper PRM) and Potomac aquifer systems (middle and lower PRM). The statistical summary of major inorganic constituents and physical parameters analyzed in water samples from these aquifers is presented in table 2. The groundwater from these aquifers has a pH in the range of 4.0 to 7.8 with median pH of 5.4. Water samples collected in outcrop or near outcrops of both the Magothy and Potomac aquifers are characterized as acidic with a pH lower than 7. Hardness ranges from 3 to 1,570 milligrams per liter (mg/L) with a median hardness of 33 mg/L. Most of the waters are characterized as soft to moderately hard, with few exceptions where waters could be classified as hard to very hard (210 to 1,570 mg/L). Limited water quality data for the Potomac aquifer show a pH of 5.4, and hardness of 18.1 mg/L, which are within the range reported for this aquifer in other areas of the NJCP. The Total Dissolved Solids Concentrations (TDS) for the Magothy and Potomac (upper and middle PRM) aquifers are in the range from 23 to 6,450 mg/L with a median of 97 mg/L. A water sample collected in 1986 has high TDS of 6,450 mg/L and is correlated with high chloride concentration in the Sayreville area where saltwater intrusion is occurring. Saltwater intrusion into the Magothy and Potomac (upper and middle PRM) aquifers is occurring in Sayreville Borough, the Amboys, and in Old Bridge Township. The most recent NJDEP data show chloride concentration of 2,880 mg/L and sodium of 1,264 mg/L in the Sayreville area (NJDEP, Water Supply Monitoring Report, 2021). Chlorides in the range of 31 mg/L to 91 mg/L are recorded for Perth Amboy and Old Bridge townships (NJDEP Water Supply Monitoring report, 2021). The NJDEP chloride and sodium results are not included in table 2 but provided here as an example of persistent local water quality issues.

Water from all the Magothy and Potomac aquifers has iron concentrations in the range from 0.01 to 110 mg/L with a median concentration of 0.5 mg/L. Manganese ranges from 0.002 to 3 mg/L with a median concentration of 0.07 mg/L. From 75 water samples reviewed, water from about 50% of the wells exceeds the NJ Secondary Maximum Contaminant Level (SMCL) for iron of 0.3 mg/L and manganese of 0.05 mg/L. Additionally, water from about 12% of wells exceeds the USEPA (2018) Health Advisory limit for manganese of 0.3 mg/L. Iron and manganese concentrations above SMCL and Health advisory limits primarily occur in wells located in the outcrops or near outcrops of the Magothy, Raritan, and Potomac Formations in Mercer and Middlesex counties.

Additionally, water from Magothy and Potomac aquifers locally exceeds the New Jersey MCL (Maximum Contaminant Level) for gross alpha and radium, especially in water samples collected from wells located in or near the outcrop areas. Available hydrogeologic data suggest a high degree of connection between unconfined and underlying leaky confined aquifers. At these wells, pH is acidic, in the range of 3.9 to 5.6. NJDEP and USGS studies (Szabo and others, 2011) indicate that radium is likely bound to iron and manganese oxyhydroxides within the aquifer matrix. When oxidized and acidic waters recharge into the aquifer, iron and manganese are dissolved from the aquifer material into groundwater. As a result, iron, manganese, and radium concentrations increase in groundwater. Szabo and others (2011) state that elevated radium concentrations occur in highly oxidized-low pH environments. There is an inverse correlation between pH and radium concentration in this type of aquifer. The lower the pH, the higher the radium concentrations will be. Examples include the Bordentown well field (aquifer test 393), Hamilton Township well field (aquifer test 224), and the Monroe Township well field (aquifer tests 252, 222, 172). Uranium is not a water quality issue under these geochemical conditions. Table 3 provides gross alpha and radium concentrations for Bordentown and Monroe townships well fields.

In the confined portion of the Magothy and Potomac aquifers, the hydrogeochemical conditions are different, less acidic, and less oxidizing and when pH increases (6.0-7.5) there will be less radium dissolved in groundwater.

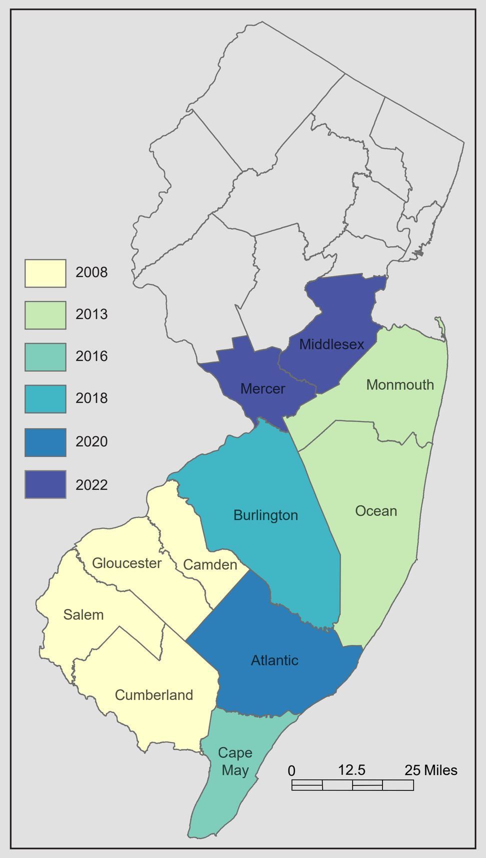

Figure 1. County-wide aquifer maps categorized by publication date.

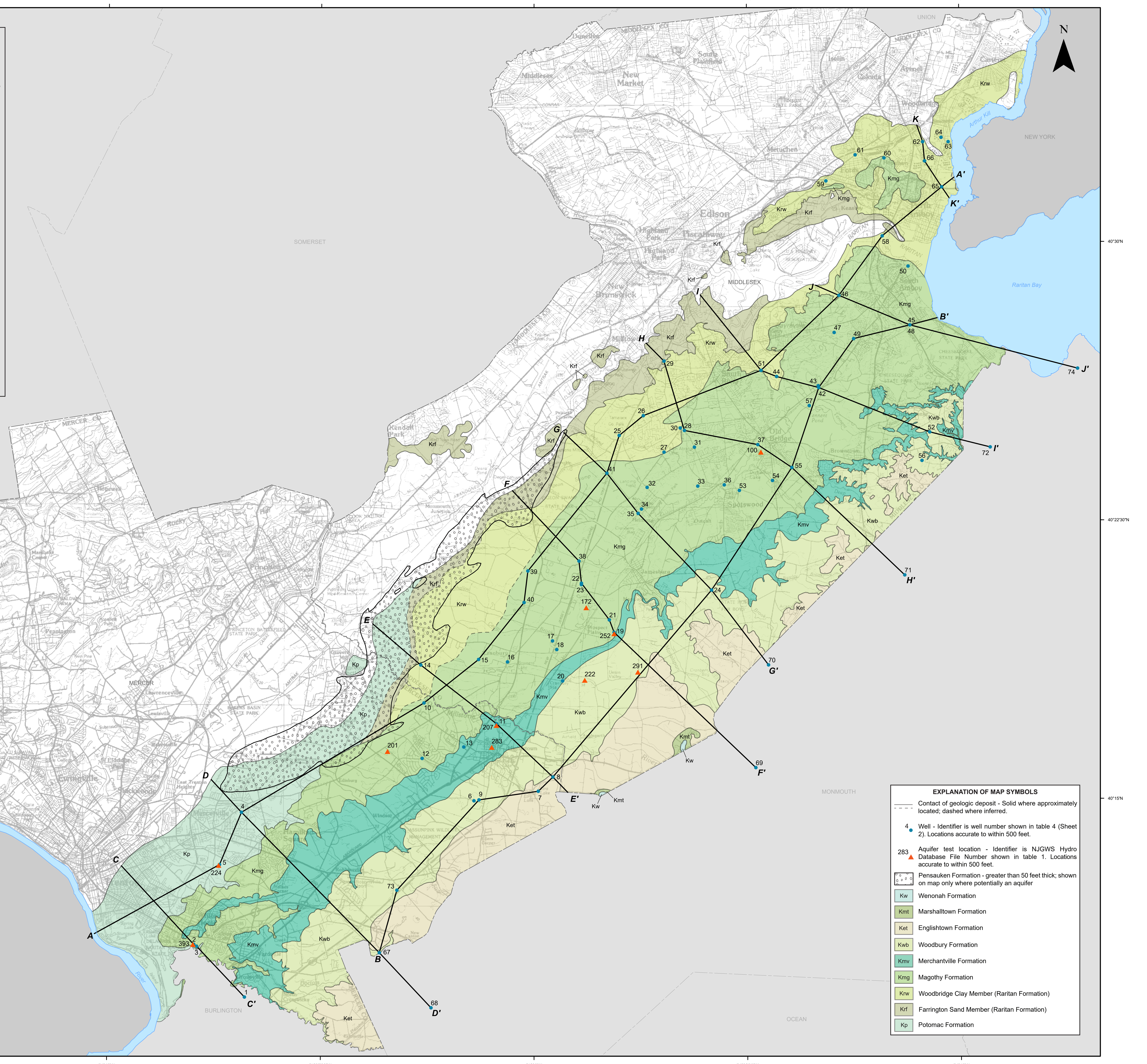

Figure 2. Coastal Plain bedrock geology and location of cross sections.
Base map produced from compilation of U.S. Geological Survey 1:100,000-scale topographic maps for Newark, NJ-NY, 1986 and Trenton, NJ-PA-NY, 1986.

Bedrock geology produced from compilation of 1:24,000-scale geologic maps published by the N.J. Geological and Water Survey. Geology shown on the bedrock geologic maps for the Hightstown and Perth Amboy quadrangles was slightly modified. Surficial geology produced from 1:100,000-scale surficial geologic map of New Jersey (New Jersey Geological Survey, 2007).

SCALE 1:100 000
1 0 1 2 3 4 5 6 7 8 MILES
1 0 1 2 3 4 5 6 7 8 9 10 KILOMETERS
CONTOUR INTERVAL 10 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Cartography by Alexandra R. Carone.
Assistance in data collection provided by R.S. Pristas, S.D. Stanford, Z.C. Schagrin, and K. Kopcznski.

FRAMEWORK AND PROPERTIES OF AQUIFERS IN THE COASTAL PLAIN PORTION OF MERCER AND MIDDLESEX COUNTIES, NEW JERSEY

By

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2022

LOCATION IN NEW JERSEY

Table 1. Summary of pumping tests and hydraulic properties of aquifers within the Coastal Plain part of Mercer and Middlesex counties. Test locations shown on figure 2 as orange triangles. *Single well test; accurate storativity and leakance values cannot be estimated.

NJGWS Hydro Database File Number	Site Name	Aquifer	Condition	Specific Capacity (gpm/ft)	Transmissivity (ft^2/day)	Storativity	Leakance (per day)	Specific Yield
100	East Brunwick Twp., PW-11	Magothy, Upper PRM	unconfined	27.3	8,475	4.8E-04	-	3.5E-02
201	Village Grande at Bear Creek, Test Well 1	Magothy, Upper PRM	unconfined	15.7	4,556	1.69E-04	-	5.55E-02
291	Concordia Golf Course, TW-4	Magothy, Upper PRM	confined	15.4	8,278	3.2E-04	-	-
207*	East Windsor MUA, Well 7	Potomac, Middle PRM	leaky confined	22.7	6,870	N/A	N/A	-
222	Monroe Twp., Well 20	Potomac, Middle PRM	leaky confined	24.2	8,307	3.41E-04	1.44E-04	-
252	Monroe Twp., Well 21	Potomac, Middle PRM	leaky confined	27.0	10,948	4.5E-04	1.33E-04	-
172	Monroe Twp., Well 19	Potomac, Middle PRM	leaky confined	40.0	11,907	1.91E-04	1.77E-03	-
393	Bordentown Twp., PW-5R	Potomac, Lower PRM	leaky confined	26.6	17,777	4.1E-04	1.96E-04	-
283	Hightstown Boro., Well 3	Potomac, Lower PRM	leaky confined	25.1	9,632	3.59E-05	9.88E-06	-
224	Hamilton Twp., Well 14	Potomac, Lower PRM	leaky confined	52.3	10,668	7.81E-04	5.36E-04	-

Table 2. Summary of major inorganic ion concentrations, iron, manganese, and physical parameters from wells completed in the Magothy and Potomac aquifers within the Coastal Plain part of Mercer and Middlesex counties. Concentrations are in mg/L where applicable. *Results from a water sample collected in 1986 from an observation well in Sayreville, Middlesex County, NJ.

Number of samples=31	Magothy or Upper PRM aquifer									
	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Iron	Manganese	pH	Hardness
Minimum	0.4	0.4	2.3	0.3	2.4	0.3	0.6	0.02	4.0	3
Maximum	120	43	330	14	990	110	110	2.4	7.0	478
Median	7.1	4	7.5	2.3	18	23	1.6	0.1	5.2	36
Number of samples=44	**Potomac or Middle PRM aquifer**									
	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Iron	Manganese	pH	Hardness
Minimum	0.5	0.4	0.5	0.3	2.3	0.2	0.01	0.002	4.3	5
Maximum	330*	180*	1,600*	18*	3,200*	590*	59	3	7.8	1,570*
Median	5.7	2.8	4.9	1.7	9.8	9.5	0.3	0.04	5.5	28

Table 3. Summary of data collected from wells completed in PRM aquifers at Bordentown and Monroe townshipsaq well fields. Gross alpha and radium locally exceed New Jersey's MCL (maximum contaminant level) for gross alpha of 15 pCi/L and total radium of 5 pCi/L. *N/T - Not Tested.

Site	pH	Gross Alpha Final (pCi/L)	Radium224 (pCi/L)	Radium226 (pCi/L)	Radium228 (pCi/L)	Total Radium (pCi/L)
Bordentown Well Field	5.4	12.5-23.7	2.5-5.6	1.3-2.4	2.2-3.3	6.0-11.2
Monroe Well Field	4.7	2.3-31.9	N/T*	0.4-2.9	0.5-5.6	0.9-8.5

REFERENCES

Barksdale, H.C., Johnson, M.E., Schaefer, E.J., Baker, R.C., and DeBuchananne, G.D., 1943, The ground-water supplies of Middlesex County, N.J.: New Jersey State Water Policy Supply Commission Special Report 8, 160 p.

Beetle-Moorcroft, Fern, Monteverde, D.H., and Stanford, S.D., 2018, Bedrock Geologic Map of the Monmouth Junction quadrangle, Somerset, Middlesex, and Mercer counties, New Jersey: New Jersey Geological and Water Survey Geologic Map-Series GMS 18-4, scale 1 to 24,000.

Farlekas, G.M., 1979, Geohydrology and digital-simulation of the Farrington aquifer in the Northern Coastal Plain of New Jersey: U.S. Geological Survey Water-Resources Investigations 79-106, 55 p.

Gronberg, J.M., Birkelo, B.A., and Pucci, A.A., Jr., 1989, Selected borehole geophysical logs and drillers' logs, northern Coastal Plain of New Jersey: U.S. Geological Survey Open-File Report 87-243, 134 p.

Gronberg, J.M., Pucci, A.A., Jr., and Birkelo, B.A., 1991, Hydrogeologic framework of the Potomac-Raritan-Magothy aquifer system, northern Coastal Plain of New Jersey: U.S. Geological Survey Water-Resources Investigations Report 90-4016, 37 p.

Keys, W.S., 1990, Borehole geophysics applied to ground-water investigations: National Water Well Association, Dublin, Ohio, 314 p.

Keys, W.S., and MacCary, L.M., 1971, Application of borehole geophysics to water-resource investigations, *in* Techniques of Water-Resource Investigations of the U.S. Geological Survey: chapter E1, TWR12-E1A, 126 p.

Lanci, L., Kent, D.V., and Miller, K.G., 2002, Detection of Late Cretaceous and Cenozoic sequence boundaries on the Atlantic Coastal Plain using core-log integration of magnetic susceptibility and natural gamma ray measurements at Ancora, New Jersey: Journal of Geophysical Research, v. 107, no. B10, 2216, doi:10.1029/2000JB000026.

Mennel, W.J., and Canace, Robert, 2002, New Jersey Geological Survey hydro database: N. J. Geological Survey Digital Geodata Series DGS 02-1, www.state.nj.us/dep/njgs/geodata/dgs02-1.zip.

Miller, K.G., Sugarman, P.J., Browning, J.V., Aubry, Marie-Pierre, Brenner, G.J., Cobbs, Gene, III, de Romero, Linda, Feigenson, M.D., Harris, Ashley, Katz, M.E., Kulpecz, Andrew, McLaughlin, P.P., Jr., Misintseva, Svetlana, Monteverde, D.H., Olsson, R.K., Patrick, Lesley, Pekar, S.J., and Uptegrove, Jane, 2006, Sea Girt Site: *in* Miller, K.G., Sugarman, P.J., Browning, J.V. and others, eds., Proc. ODP, 174AX (Suppl.), College Station, TX (Ocean Drilling Program), 104 p.

Monteverde, D.H., Herman G.C., Volkert, R.A. and Stanford, S.D., 2012, Bedrock Geologic Map of the Princeton quadrangle, Mercer and Middlesex counties, New Jersey: New Jersey Geological and Water Survey Open-File Map Series OFM 93, scale 1 to 24,000.

New Jersey Geological Survey, 2007, Surficial geology of New Jersey: New Jersey Geological Survey Digital Geodata Series DGS 07-2, scale 1:100,000.

New Jersey Geological Survey, 2011, New Jersey water transfer model withdrawal, use, and return data summaries: New Jersey Geological Survey Digital Geodata Series, DGS 10-3, www.state.nj.us/dep/njgs/geodata/dgs10-3.htm, last updated 02/2011.

Nichols, W.D., 1977, Geohydrology of the Englishtown Formation in the northern Coastal Plain of New Jersey: U.S. Geological Survey Water-Resources Investigations 76-123, 62 p.

Owens, J.P., and Minard, J.P., 1966, Pre-Quaternary geology of the Allentown quadrangle, New Jersey: U.S. Geological Survey Geologic Quadrangle Map GQ-566, scale 1 to 24,000.

Owens, J.P., Sugarman, P.J., Sohl, N.F., Parker, R.A., Houghton, H.F., Volkert, R.A., Drake, A.A., Jr., and Orndorff, R.C., 1998, Bedrock geologic map of central and southern New Jersey: U.S. Geological Survey Miscellaneous Investigations Series Map I-2540-B, scale 1 to 100,000.

Pucci, A.A., Jr., Murashige, J.E., and Pope, D.A., 1989, Hydraulic properties of the middle and upper aquifers of the Potomac-Raritan-Magothy aquifer system in the northern Coastal Plain of New Jersey: New Jersey Geological Survey Geological Survey Report 18, 74 p.

Rider, M.H., 2002, The geological interpretation of well logs: Rider-French Consulting, Sutherland, Scotland, 2nd ed., 280 p.

Stanford, S.D., Monteverde, D.H., Volkert, R.A., Sugarman, P.J., and Brenner, G.J., 1998, Geology of the New Brunswick quadrangle, Middlesex and Somerset counties, New Jersey: New Jersey Geological and Water Survey Open-File Map Series OFM 23, scale 1 to 24,000.

Stanford, S.D. and Sugarman, P.J., 2008, Bedrock geology of the Jamesburg quadrangle, Middlesex, Monmouth, and Mercer counties, New Jersey: New Jersey Geological Survey Open-File Map Series OFM 72, scale 1 to 24,000.

Sugarman, P.J., Carone, A.R., Stroiteleva, Yelena, and Pristas, R.S., Monteverde, D.H., Domber, S.E., Filo, R.M., Rea, F.A., and Schagrin, Z.C., 2018, Framework and properties of aquifers in Burlington County, New Jersey: New Jersey Geological and Water Survey Geologic Map Series GMS 18-3, scale 1 to 100,000.

Sugarman, P.J., Johnson-Bowman, Mizane, Malerba, N.L., Stroiteleva, Yelena, Barr, Kent, Filo, R.M., Carone, A.R., Monteverde, D.H., Castelli, M.V., and Pristas, R.S., 2020, Framework and properties of aquifers in Atlantic County, New Jersey: New Jersey Geological and Water Survey Open-File Map Series OFM 130, scale 1 to 100,000.

Sugarman, P.J., Miller, K.G., Browning, J.V., Aubry, M.-P., Brenner, G.J., Bukry, D., Butari, B., Feigenson, M.D., Kulpecz, A.A., McLaughlin, P.P., Jr., Mizintseva, S., Monteverde, D.H., Olsson, R.K., Pusz, A.E., Tomlinson, J., Uptegrove, J., Rancan, H., and Velez, C.C., 2010, Medford Site: *in* Miller, K.G., Sugarman, P.J., Browning, J.V., and others, eds., Proceedings of the Ocean Drilling Program, Initial reports, Volume 174AX (Suppl.): College Station, TX, Ocean Drilling Program, p. 1-93.

Sugarman, P.J., Miller, K.G., Browning, J.V., Kulpecz, A.A., McLaughlin, P.P., Jr., and Monteverde, D.H., 2005b, Hydrostratigraphy of the New Jersey Coastal Plain: Sequences and facies predict continuity of aquifers and confining units: Stratigraphy, v. 2, no. 3, p 259-275.

Sugarman, P.J., Miller, K.G., Browning, J.V., McLaughlin, P.P., Jr., and Kulhanek, D., 2021, Late Cretaceous (Turonian-Coniacian) sequence stratigraphy, sea level, and deltaic facies, Magothy Formation, U.S. Middle Atlantic Coastal Plain: Stratigraphy. v. 18 (1), p. 1–27.

Sugarman, P.J. and Monteverde, D.H., 2008, Correlation of deep aquifers using coreholes and geophysical logs in parts of Cumberland, Salem, Gloucester, and Camden counties, New Jersey: New Jersey Geological Survey Geologic Map Series GMS 08-1, scale 1 to 100,000.

Sugarman, P.J., Monteverde, D.H., Boyle, J.T., and Domber, S.E., 2013, Aquifer correlation map of Monmouth and Ocean counties, New Jersey: New Jersey Geological and Water Survey Geologic Map GMS Series 13-1, scale 1 to 100,000.

Sugarman, P.J., Monteverde, D.H., Stanford, S.D., Johnson, S.W., Stroitleva, Yelena, Pristas, R.S., Vandegrift, Kathleen, and Domber, S.E., 2016, Geologic and aquifer map of Cape May County, New Jersey: New Jersey Geological and Water Survey Geologic Map Series GMS 16-1, scale 1 to 100,000.

Sugarman, P.J., and Owens, J.P., 1996, Bedrock geologic map of the Freehold and Marlboro quadrangles, Middlesex and Monmouth counties, New Jersey: New Jersey Geological Survey Geologic Map Series GMS 96-1, scale 1: to 24,000.

Sugarman, P.J., Stanford, S. D., Monteverde, D.H., and Volkert, R.A., 2015, OFM 107, Bedrock geologic map of the Hightstown quadrangle, Middlesex and Mercer counties, New Jersey: New Jersey Geological and Water Survey Open-File Map Series OFM 107, scale 1 to 24,000.

Sugarman, P.J., Stanford, S. D., Muller, F.M., and Hlavaty, Corie, 2014, Bedrock geologic map of the Keyport quadrangle, Middlesex and Monmouth counties, New Jersey: New Jersey Geological and Water Survey Geologic Map Series GMS 14-2, scale 1 to 24,000.

Sugarman, P.J., Stanford, S.D., Owens, J.P., and Brenner, G.J., 2005a, Bedrock geology of the South Amboy quadrangle, Middlesex and Monmouth counties, NJ: New Jersey Geological Survey Open-File Map Series OFM 65, scale 1 to 24,000.

Szabo, Z., DePaul, V.T., Fischer, J.M., Kraemer, T.F., Jacobsen, E., 2011, Occurrence and geochemistry of radium in water from principal drinking-water aquifer systems of the United States: Applied Geochemistry, v. 27, p. 729-752.

U.S. EPA, 2018, Drinking Water Standards and Health Advisories, 2018 edition, https://www.epa.gov/system/files/documents/2022-01/dwtable2018.pdf.

U.S. Geological Survey, 2022, NWIS Site Information for New Jersey: Site Inventory, USGS- Site Inventory for New Jersey, https://waterdata.usgs.gov/nj/nwis/inventory.

Vecchioli, John, and Palmer, M.M., 1962, Ground-water resources of Mercer County, N.J.: State of NJ Department of Conservation and Economic Development, Division of Water Policy and Supply Special Report 19, 71 p.

Volkert, R.A., Drake, A.A., Jr., and Sugarman, P.J., 1996, Geology, geochemistry, and tectonostratigraphic relations of the crystalline basement beneath the coastal plain of New Jersey and contiguous areas: U.S. Geological Survey Professional Paper 1565-B, 48 p.

Volkert, R.A., Monteverde, D.H., and Stanford, S.D., 2017, Bedrock geologic map of the Perth Amboy and Arthur Kill quadrangles, Middlesex and Union Counties, New Jersey: New Jersey Geological and Water Survey Open-File Map Series OFM 117, scale 1 to 24,000.

Volkert, R.A., and Stanford, S.D., 2018, Bedrock geologic map of the New Jersey part of the Trenton West and Trenton East quadrangles, Mercer and Burlington counties, New Jersey: New Jersey Geological and Water Survey Open-File Map Series OFM 122, scale 1 to 24,000.

Widmer, Kemble, 1965, Geology of the ground water resources of Mercer County: New Jersey Geological Survey Geologic Report Series No. 7, 115 p.

Zapecza, O.S., 1989, Hydrogeologic framework of the New Jersey Coastal Plain: U.S. Geological Survey Professional Paper 1404-B, 49 p.

Zapecza, O.S., 1992, Hydrogeologic units in the Coastal Plain of New Jersey and their delineation by borehole geophysical methods, *in* Gohn, G.S., ed., Proceedings of the 1988 U.S. Geological Survey workshop on the geology and geohydrology of the Atlantic Coastal Plain: U.S. Geological Survey Circular 1059, p. 45-52.

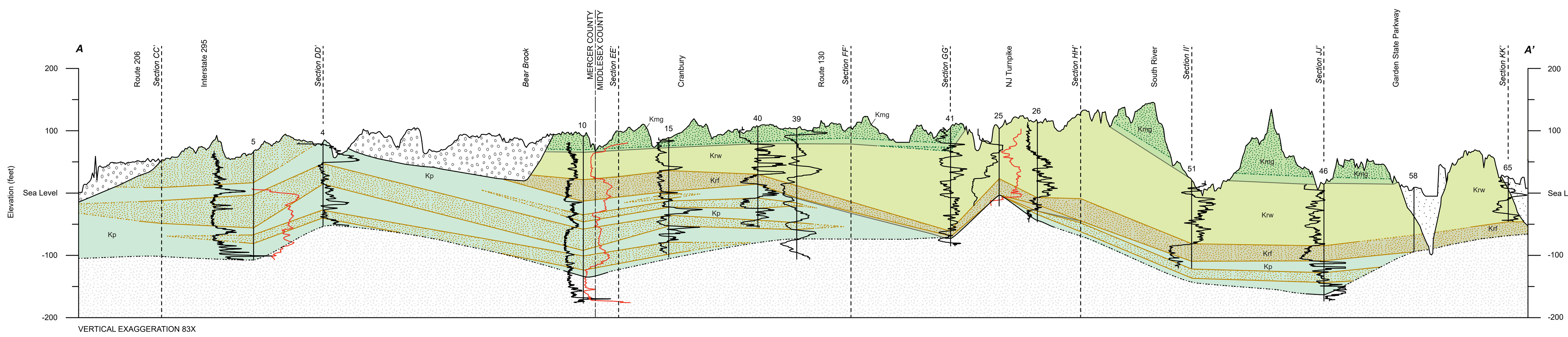

Figure 6. Geologic and hydrogeologic cross section AA'.

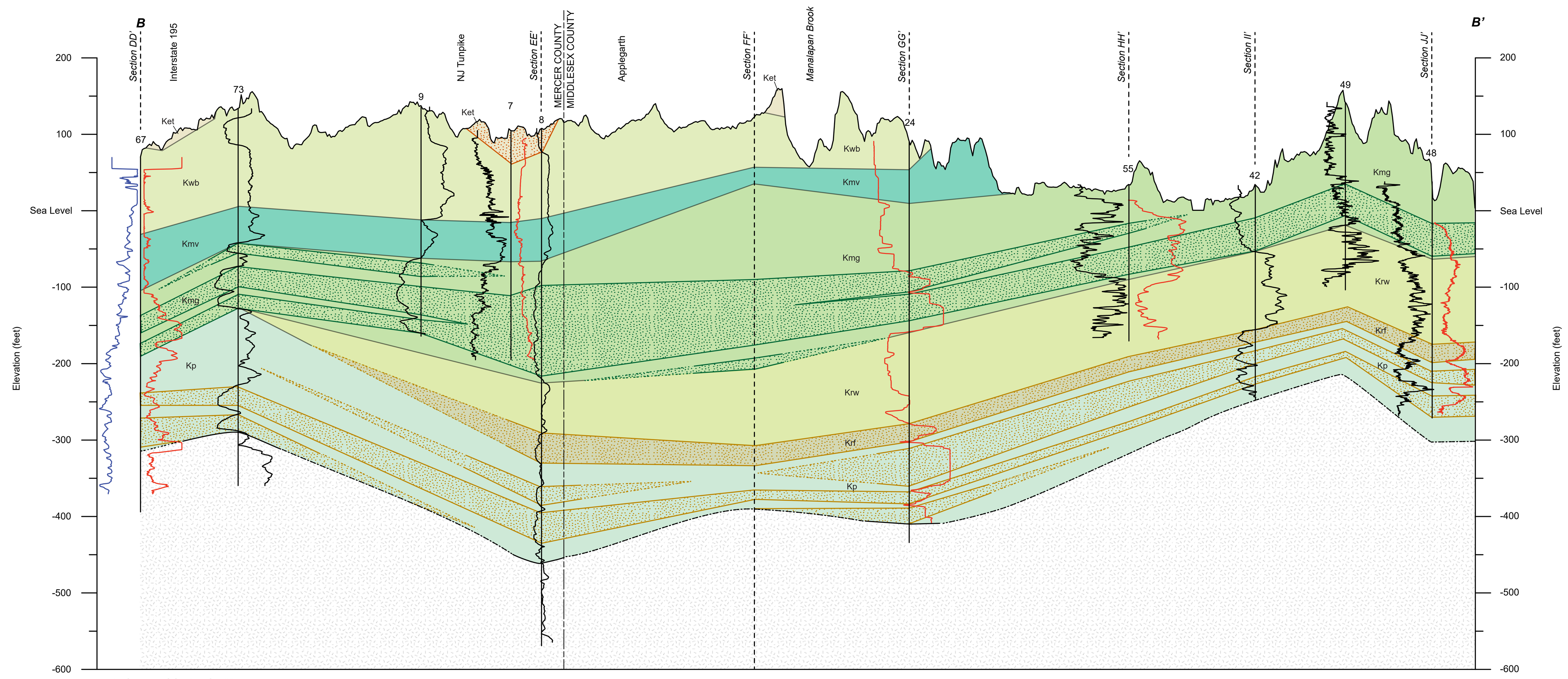

Figure 7. Geologic and hydrogeologic cross section BB'.

EXPLANATION OF CROSS SECTION SYMBOLS

Hydrogeologic contact - Solid where approximately located; dashed where inferred.

Geologic contact - approximately located.

Bedrock contact - Solid where approximately located; dashed where inferred.

11 Approximate location of well - Identifier is well number shown in table 4. Locations accurate to within 500 feet.

Geologic Formations

- Quaternary deposits - generally greater than 25 thick (Shown on cross sections only)
- Pensauken Formation - generally greater than 25 feet thick
- Kw Wenonah Formation
- Kmt Marshalltown Formation
- Ket Englishtown Formation
- Kwb Woodbury Formation
- Kmv Merchantville Formation
- Kmg Magothy Formation
- Krw Woodbridge Clay Member (Raritan Formation)
- Krf Farrington Sand Member (Raritan Formation)
- Kp Potomac Formation
- Proterozoic-Mesozoic undifferentiated rock

Hydrogeologic Units

- Potential surficial aquifer - only where shown in figure 2
- Englishtown Aquifer
- Magothy Aquifer
- Potomac Aquifer System

EXPLANATION OF GEOPHYSICAL LOGS

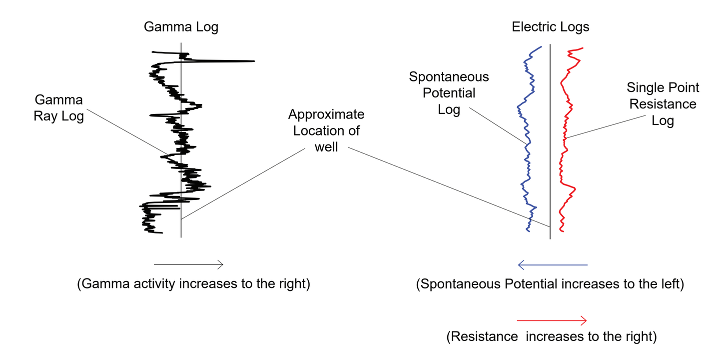

Table 4. List of wells shown in Figure 2 (Sheet 1) as small blue circles. N/A = not available; *Depth correlated from nearby well record.

Station	NJDEP Permit Number	County	Municipality	Latitude	Longitude	Depth (ft)	Approx. Depth to Bedrock (ft)	Cross Section
1	28-57004	Burlington	Chesterfield Twp.	400940	744010	397	N/A	CC'
2	E201602939	Mercer	Hamilton Twp.	401105	744157	242	240	CC'
3	E201610279	Mercer	Hamilton Twp.	401102	744151	230	N/A	CC'
4	28-23665	Mercer	Hamilton Twp.	401420	743820	134	N/A	AA', DD'
5	28-49883	Mercer	Hamilton Twp.	401314	744103	174	N/A	AA'
6	28-35403	Mercer	East Windsor Twp.	401458	743207	472	N/A	
7	28-13642	Mercer	East Windsor Twp.	401513	742951	299	N/A	BB'
8	28-06864	Mercer	East Windsor Twp.	401536	742920	677	570	BB', EE'
9	28-06162	Mercer	East Windsor Twp.	401459	743156	298	N/A	BB'
10	E202100357	Mercer	East Windsor Twp.	401734	743357	260	226	AA'
11	28-13434	Mercer	East Windsor Twp.	401702	743119	365	357	EE'
12	28-05897	Mercer	East Windsor Twp.	401606	743356	265	229	
13	29-09493	Mercer	Hightstown Boro	401625	743228	403	386	
14	28-20220	Middlesex	Cranbury Twp.	401837	743359	191	N/A	EE'
15	28-18282	Middlesex	Cranbury Twp.	401846	743157	192	N/A	AA'
16	28-7800	Middlesex	Cranbury Twp.	401842	743056	260	N/A	
17	28-00266	Middlesex	Cranbury Twp.	401916	742921	143	N/A	
18	28-05007	Middlesex	Cranbury Twp.	401902	742912	399	N/A	
19	28-45484	Middlesex	Monroe Twp.	401930	742711	540	440	FF'
20	28-50046	Middlesex	Monroe Twp.	401811	742860	460	449	
21	28-11719	Middlesex	Monroe Twp.	401950	742721	440	420	FF'
22	28-18602	Middlesex	Monroe Twp.	402049	742820	372	350	FF'
23	28-07539	Middlesex	Monroe Twp.	402047	742820	365	340	
24	28-01653	Middlesex	Monroe Twp.	402038	742345	525	500	BB', GG'
25	28-08704	Middlesex	East Brunswick Twp.	402448	742700	125	125	AA'
26	28-06734	Middlesex	East Brunswick Twp.	402520	742609	160	160	AA'
27	28-08816	Middlesex	East Brunswick Twp.	402421	742525	196	247	
28	28-01492	Middlesex	East Brunswick Twp.	402456	742442	235	N/A	HH'
29	N/A	Middlesex	East Brunswick Twp.	402648	742525	178	83*	HH'
30	48-00078	Middlesex	East Brunswick Twp.	402500	742451	45	N/A	
31	48-00079	Middlesex	East Brunswick Twp.	402429	742421	85	N/A	
32	48-00081	Middlesex	East Brunswick Twp.	402324	742601	115	N/A	
33	48-00082	Middlesex	East Brunswick Twp.	402326	742414	100	N/A	
34	48-00088	Middlesex	East Brunswick Twp.	402249	742613	130	N/A	
35	48-00090	Middlesex	East Brunswick Twp.	402242	742620	149	N/A	GG'
36	28-09117	Middlesex	Spotswood Boro	402328	742318	328	324	
37	N/A	Middlesex	East Brunswick Twp.	402433	742207	330	307*	HH'
38	N/A	Middlesex	South Brunswick Twp.	402125	742825	315	295	FF'
39	28-04249	Middlesex	South Brunswick Twp.	402109	743013	207	N/A	AA'
40	28-10532	Middlesex	South Brunswick Twp.	402018	743021	160	N/A	AA'
41	28-10350	Middlesex	South Brunswick Twp.	402347	742726	190	175	AA', GG'
42	28-06400	Middlesex	Borough of Sayreville	402605	741958	276	280	BB', II'
43	28-06401	Middlesex	Borough of Sayreville	402608	741959	278	285	
44	N/A	Middlesex	Borough of Sayreville	402623	742127	155	N/A	II'
45	29-05043	Middlesex	Borough of Sayreville	402746	741645	248	N/A	BB', JJ'
46	26-04461	Middlesex	Borough of Sayreville	402834	741915	187	188	AA', JJ'
47	N/A	Middlesex	Borough of Sayreville	402734	741925	146	N/A	
48	29-10500	Middlesex	Borough of Sayreville	402746	741645	309	N/A	BB', JJ'
49	N/A	Middlesex	Borough of Sayreville	402724	741844	245	N/A	BB'
50	26-04485	Middlesex	South Amboy City	402923	741651	206	N/A	
51	28-05987	Middlesex	South River Boro	402633	742200	140	N/A	AA', II'
52	E202200174	Middlesex	Old Bridge Twp.	402453	741603	515	N/A	II'
53	N/A	Middlesex	Old Bridge Twp.	402319	742246	224	316	
54	N/A	Middlesex	Old Bridge Twp.	402335	742136	98	347	
55	28-07471	Middlesex	Old Bridge Twp.	402356	742055	204	N/A	BB', HH'
56	N/A	Middlesex	Old Bridge Twp.	402407	741620	195	N/A	
57	N/A	Middlesex	Old Bridge Twp.	402536	742018	159	N/A	
58	N/A	Middlesex	Borough of Sayreville	403010	741743	104	132	AA'
59	26-12460	Middlesex	Edison Twp.	403139	741942	27	N/A	
60	26-00866	Middlesex	Woodbridge Twp.	403216	741739	108	N/A	
61	26-00484	Middlesex	Woodbridge Twp.	403221	741840	200	195	
62	N/A	Middlesex	Woodbridge Twp.	403242	741617	36	N/A	KK'
63	26-28367	Middlesex	Woodbridge Twp.	403242	741523	42	N/A	
64	26-28359	Middlesex	Woodbridge Twp.	403249	741538	45	N/A	
65	26-04688	Middlesex	Perth Amboy City	403129	741537	71	N/A	AA', KK'
66	26-00124	Middlesex	Perth Amboy City	403211	741613	90	67	KK'
67	28-08915	Monmouth	Allentown Boro	401052	743526	465	385	BB', DD'
68	28-32000	Monmouth	Upper Freehold Twp.	400923	743337	360	N/A	DD'
69	28-08484	Monmouth	Manalapan Twp.	401551	742212	700	N/A	FF'
70	28-52083	Monmouth	Manalapan Twp.	401837	742145	667	N/A	GG'
71	29-47696	Monmouth	Marlboro Twp.	402102	741657	746	N/A	HH'
72	29-09580	Monmouth	Matawan Boro	402428	741356	498	N/A	II'
73	28-06030	Mercer	Robbinsville Twp.	401233	743449	493	424	BB'
74	29-08985	Monmouth	Borough of Keyport	402635	741050	580	N/A	JJ'

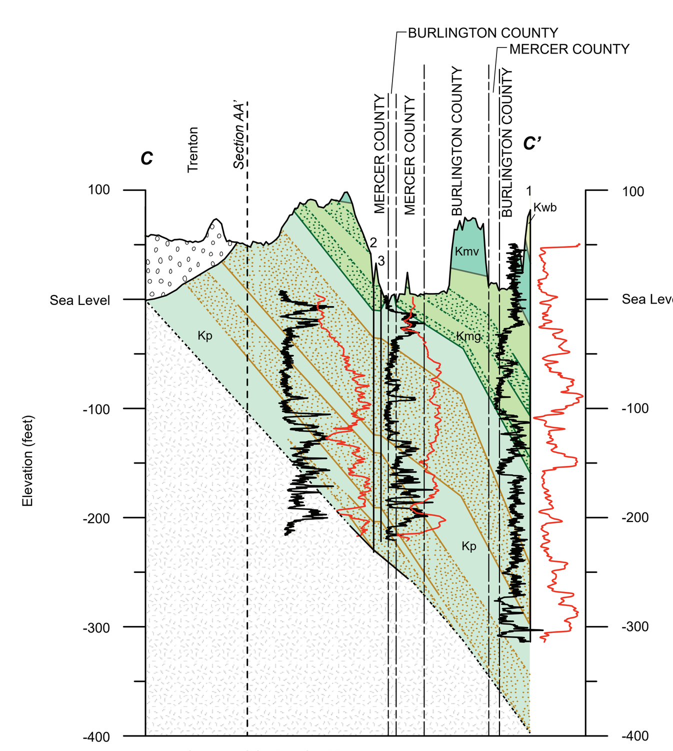

Figure 8. Geologic and hydrogeologic cross section CC'.

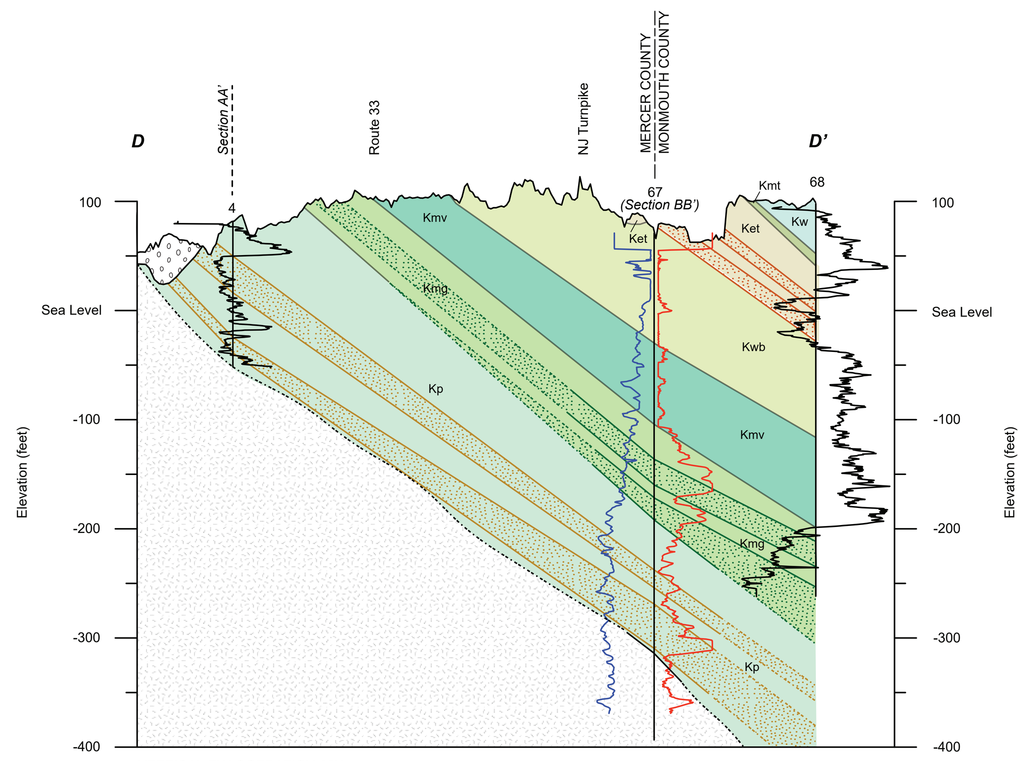

Figure 9. Geologic and hydrogeologic cross section DD'.

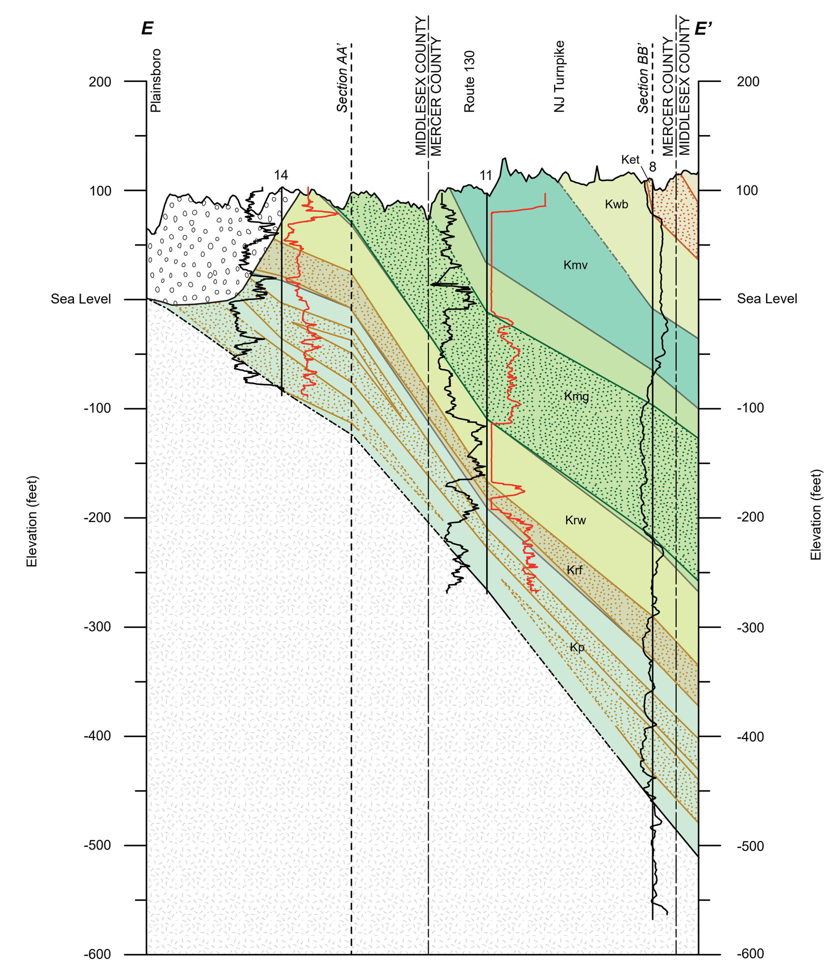

Figure 10. Geologic and hydrogeologic cross section EE'.

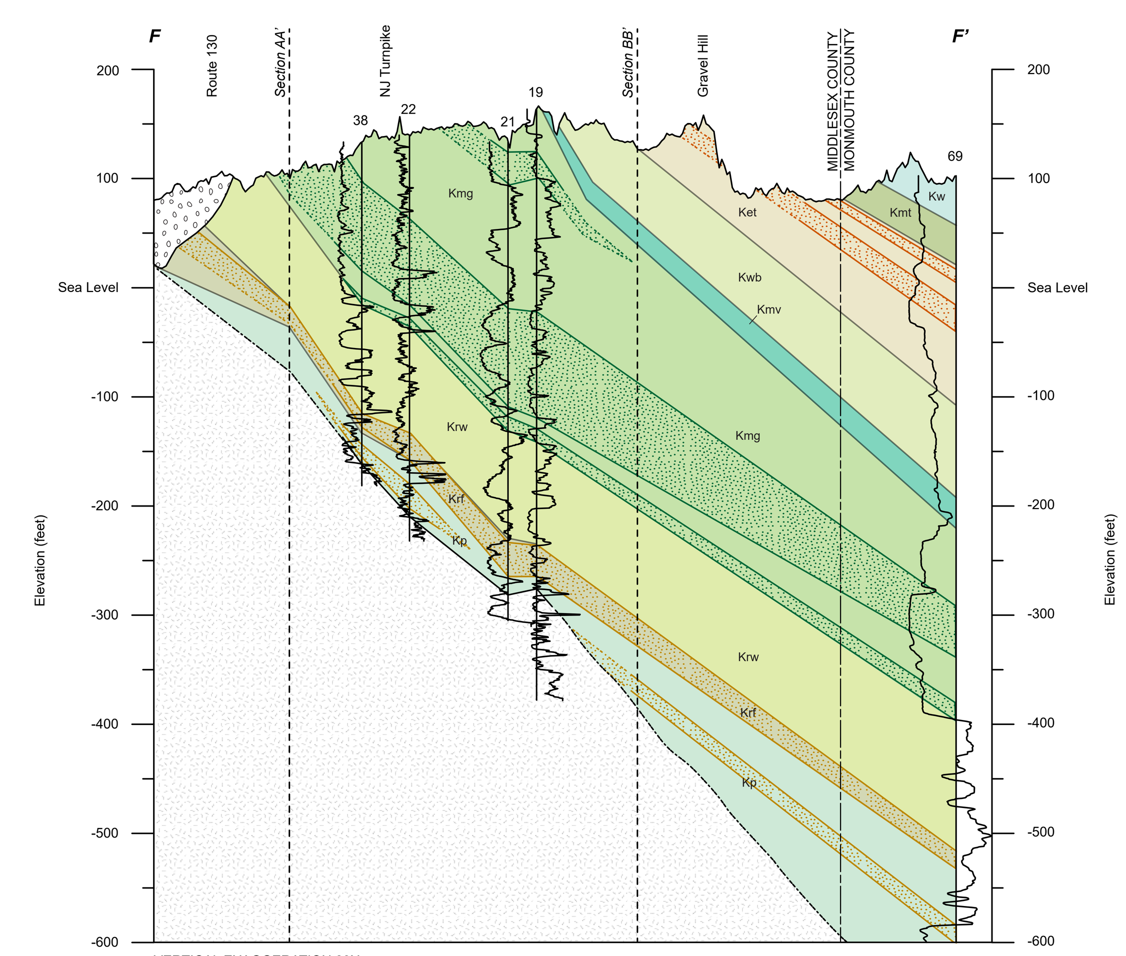

Figure 11. Geologic and hydrogeologic cross section FF'.

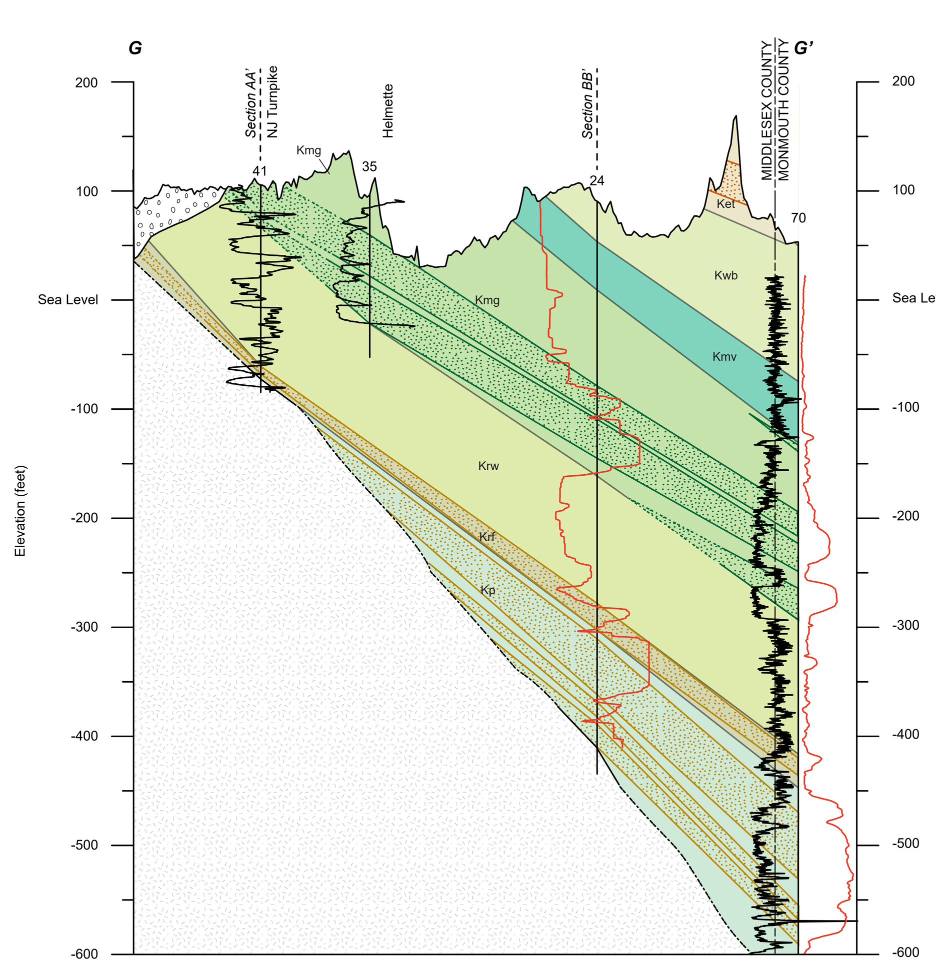

Figure 12. Geologic and hydrogeologic cross section GG'.

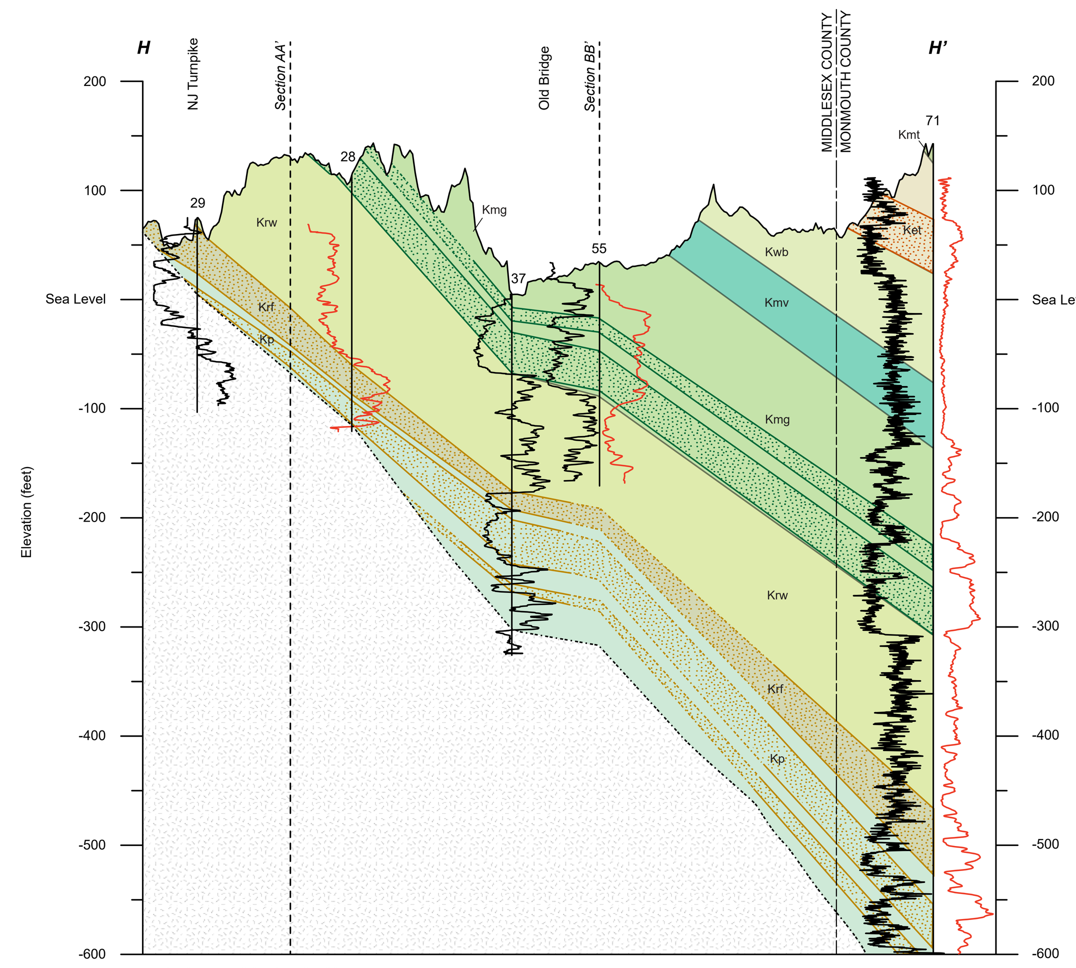

Figure 13. Geologic and hydrogeologic cross section HH'. Well 71 has been clipped and actually extends to an elevation of -604 feet.

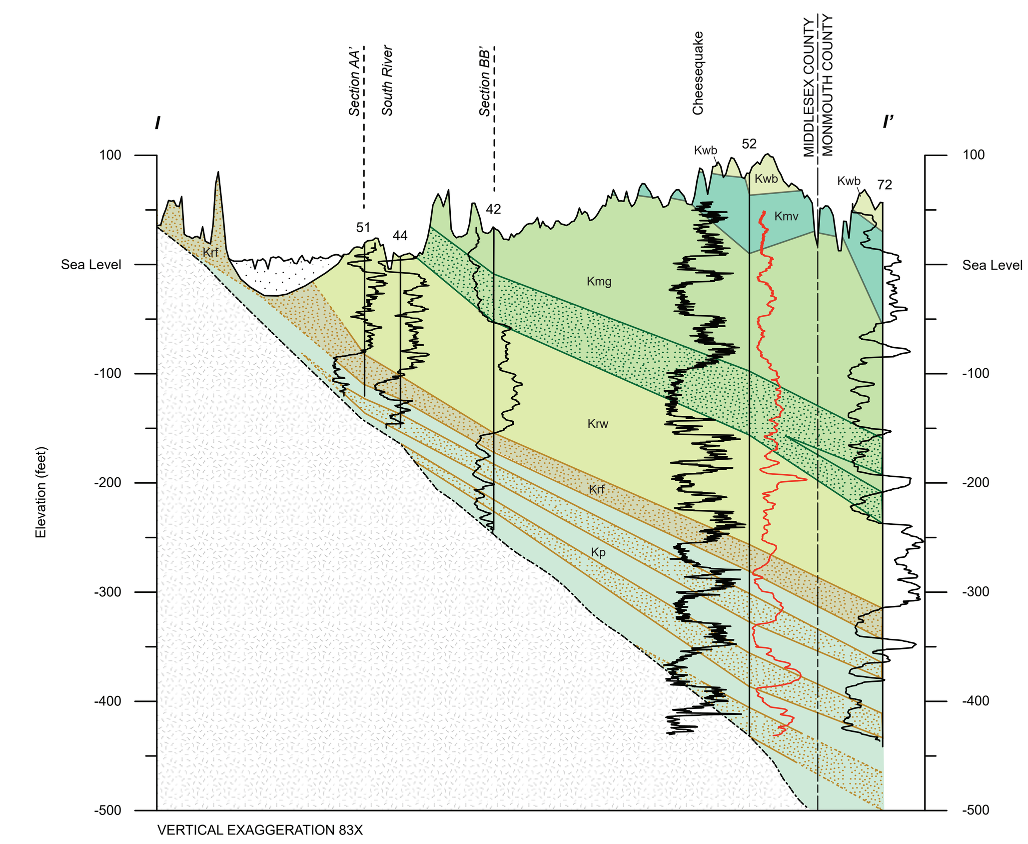

Figure 14. Geologic and hydrogeologic cross section II'.

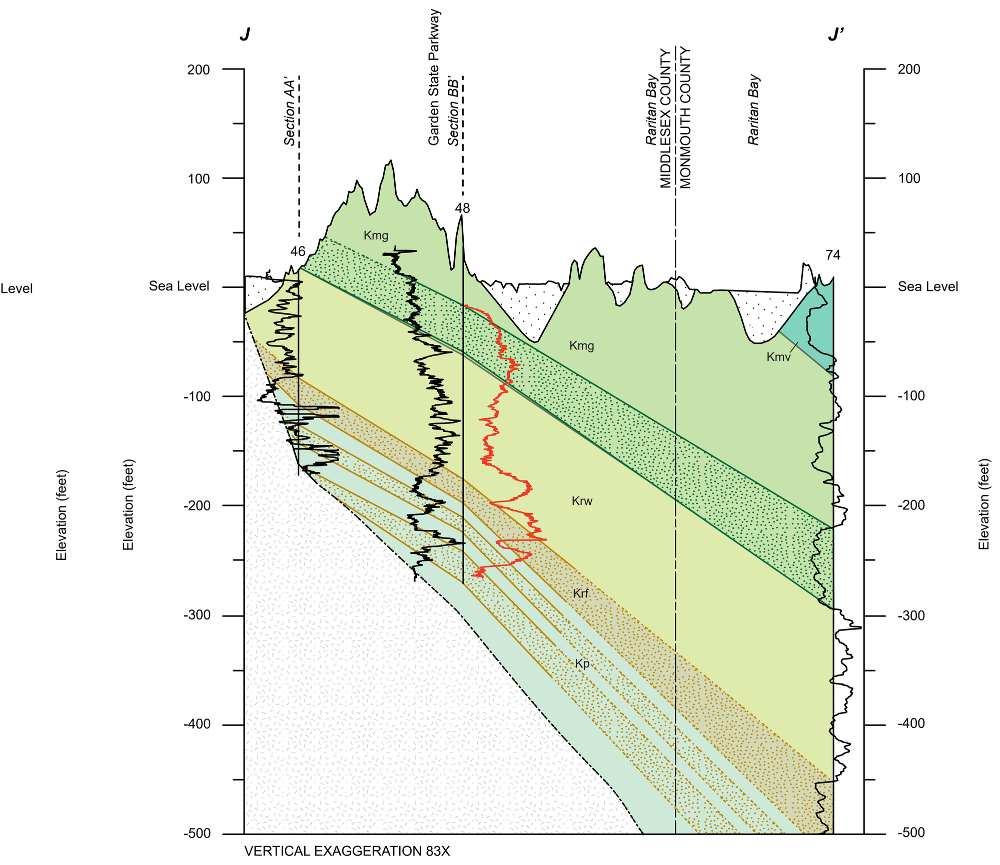

Figure 15. Geologic and hydrogeologic cross section JJ'. Well 74 has been clipped and actually extends to an elevation of -570 feet.

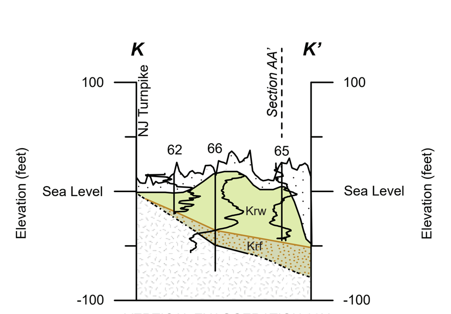

Figure 16. Geologic and hydrogeologic cross section KK'.

SCALE 1:100 000
1 0 1 2 3 4 5 6 MILES
1 0 1 2 3 4 5 6 7 8 9 10 KILOMETERS
CONTOUR INTERVAL 10 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

FRAMEWORK AND PROPERTIES OF AQUIFERS IN THE COASTAL PLAIN PORTION OF MERCER AND MIDDLESEX COUNTIES, NEW JERSEY

By

Peter J. Sugarman, Alexandra R. Carone, Yelena Stroiteleva, and Kent Barr

2022