WATER LEVELS IN MAJOR ARTESIAN AQUIFERS OF THE NEW JERSEY COASTAL PLAIN, 1988

By Robert Rosman, Pierre J. Lacombe, and Donald A. Storck

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West Trenton, New Jersey

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609 0.18	kilometer
square mile (mi^2)	2.590	square kilometer
foot per mile (ft/m)	0.1894	meter per kilometer
foot per second (ft/s)	0.3048	meter per second
million gallons per day (Mgal/d)	0.0438	cubic meter per second
million gallons per year (Mgal/yr)	3.78×10^3	cubic meter per year

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

U.S. DEPARTMENT OF THE INTERIOR

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ABSTRACT

Water levels in 1,251 wells in the New Jersey Coastal Plain, in Philadelphia County, Pennsylvania, and in Kent and New Castle Counties, Delaware, were measured from October 1988 to February 1989 and compared with 1,071 water levels measured from September 1983 to May 1984. Water levels in 916 of the wells measured in the 1983 study were remeasured in the 1988 study. Alternate wells were selected to replace wells used in 1983 that were inaccessible at the time of the water-level measurements in 1988 or had been destroyed. New well sites were added in strategic locations to increase coverage where possible.

Potentiometric-surface maps constructed from the water levels measured during 1988-89 show that large cones of depression have formed or expanded in the major artesian aquifers that underlie the New Jersey Coastal Plain. Hydrographs for observation wells typically show water-level declines over the 7-year period October 1, 1982, through September 30, 1989.

The lowest water levels in the confined Cohansey aquifer were more than 20 feet below sea level in Cape May City, Cape May County. Water levels in this area declined as much as 8 feet over the 5-year period between the 1983 study and this study.

Water levels in the Atlantic City 800-foot sand define an extensive, elongated cone of depression. Two offshore wells were drilled for the U.S. Geological Survey in 1985 to further define the cone in this area. Water levels in these wells, located 1.9 and 5 miles from Atlantic City, were 63 and 77 feet below sea level, respectively. Water levels were as much as 96 feet below sea level near Margate and Ventnor, Atlantic County. Water levels declined from 1983 to 1988 as much as 31 feet in the coastal region of Ocean County, 21 feet in Atlantic County, and 7 feet in Cape May County.

Water levels in the Piney Point aquifer were as much as 56 feet below sea level in Seaside Park, Ocean County, and 45 feet below sea level in southern Cumberland County. Water level declines in the Piney Point aquifer in Cumberland County may be in response to large ground-water withdrawals in Kent County, Delaware.

The lowest water levels in the Vincentown aquifer, as much as 9 feet below sea level, were measured in wells in the outcrop area of Salem County. Water levels revealed no significant change in static heads over the 5-year period.

Deep cones of depression in the Wenonah-Mount Laurel aquifer in coastal areas of Monmouth and Ocean Counties and in the Englishtown aquifer system are similar in location and shape because of a hydraulic connection between the aquifers. Water levels declined as much as 52 feet in the Wenonah-Mount Laurel aquifer and 34 feet in the Englishtown aquifer system over the 5-year period. The lowest water levels in the Wenonah-Mount Laurel aquifer and the Englishtown aquifer system were 218 and 256 feet below sea level, respectively.

The potentiometric surfaces in the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system form large cones of depression centered in Monmouth and Middlesex Counties and in Camden County. Water levels declined as much as 46 feet in the Monmouth County and Middlesex County area and 17 feet in the Camden County area over the 5-year period. The lowest water levels measured in the Monmouth and Middlesex Counties area and the Camden County area were 116 and 107 feet below sea level, respectively.

INTRODUCTION

Ground water is the major source of water for public supply in the Coastal Plain of New Jersey. Ground-water withdrawals from the Coastal Plain aquifers have increased steadily from 1900 to the late 1970's. By the late 1950's, withdrawals had produced large regional cones of depression in the major artesian aquifers (Meisler, 1980, p. 21). During the 1970's increased withdrawals caused these cones to deepen and widen. In the late 1970's and the 1980's, ground-water withdrawals from most of the Coastal Plain aquifers changed little. Despite the small changes, cones of depression continued to follow the trends of the early 1970's. In 1988, 83.7 percent of all ground-water withdrawals in the New Jersey Coastal Plain were from the Potomac-Raritan-Magothy aquifer system. Withdrawals from the Potomac-Raritan-Magothy aquifer system decreased from 226.47 Mgal/d in 1983 to 221.51 Mgal/d in 1988. Withdrawals from the remaining aquifers increased slightly from 42.52 Mgal/d in 1983 to 43.12 Mgal/d in 1988. (Withdrawal data are from the site-specific water-use-data system data base on file at the U.S. Geological Survey (USGS), New Jersey District office in West Trenton, New Jersey.)

Regional water-level changes in the New Jersey Coastal Plain have been documented by the USGS since 1973. Every 5 years, the USGS conducts a study to assess long-term changes in ground-water levels in the New Jersey Coastal Plain. This study was conducted in cooperation with the New Jersey Department of Environmental Protection.

Purpose and Scope

This report documents water levels and evaluates changes in water levels in the major artesian aquifers in the Coastal Plain of New Jersey. Tables listing well descriptions and water-level data are included. Water levels in 1,251 wells measured from October 1988 to February 1989 are compared with water levels in 1,071 wells measured from September 1983 to May 1984. Hydrographs of water levels in 43 observation wells for the 7-year period October 1, 1982, through September 30, 1989, and potentiometric-surface maps for each of the nine artesian aquifers also are included.

Study Area

The study area, which covers about 4,000 mi^2, includes the Coastal Plain of New Jersey (fig. 1). The study area is bounded by the Atlantic Ocean to the east and the Fall Line to the northwest (fig. 1). The area of study in the Coastal Plain includes Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Monmouth, Ocean, Salem, and parts of Mercer and Middlesex Counties. Areas in Kent and New Castle Counties, Delaware, and Philadelphia County, Pennsylvania, also have been included to identify water-level changes across the Delaware River and Delaware Bay.

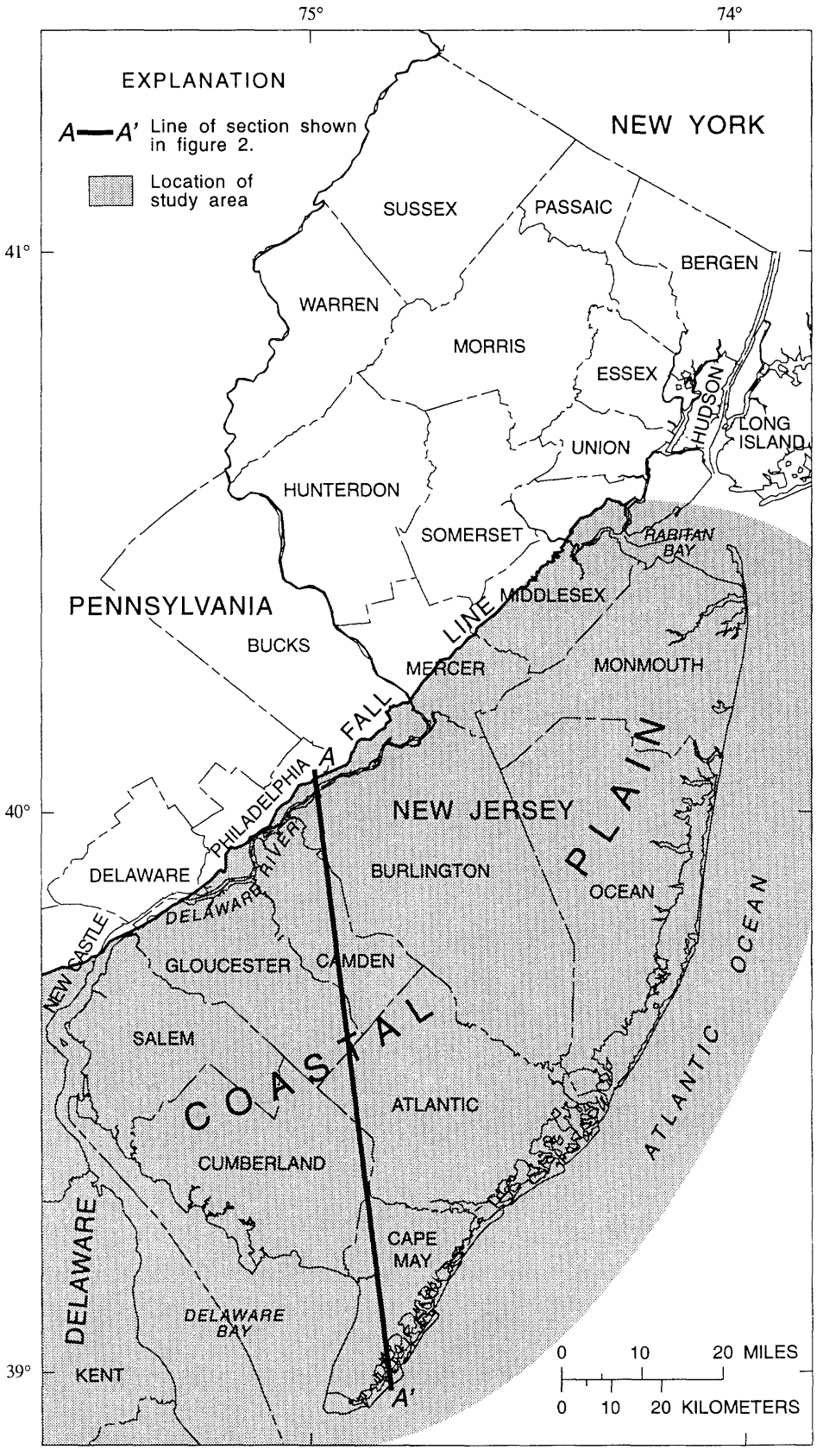


Figure 1. Location of study area.

Previous Investigations

The geology of ground-water resources in the New Jersey Coastal Plain aquifers is discussed in reports on county-wide investigations which include those on Atlantic County (Clark and others, 1968), Burlington County (Rush, 1968), Camden County (Farlekas and others, 1976), Cape May County (Gill, 1962), Gloucester County (Hardt and Hilton, 1969), Middlesex County (Barksdale and others, 1943), Monmouth County (Jablonski, 1968), Ocean County (Anderson and Appel, 1969), and Salem County (Rosenau and others, 1969).

Regional studies were conducted to investigate the hydrogeology and water resources of the New Jersey Coastal Plain. Zapecza (1989) defined the hydrogeologic framework of the entire New Jersey Coastal Plain. Walker (1983) used water-level data collected in 1978 to produce potentiometric-surface maps and compared the data from 1978 to water-level data collected in 1970 and 1973; Eckel and Walker (1986) used water-level data collected in 1983 to produce potentiometric-surface maps and compared the 1983 water levels with those from 1978. Barksdale and others (1958) studied the ground-water resources of an area adjacent to the lower Delaware River Basin. Parker and others (1964) discussed water resources in the Delaware River Basin.

Regional studies also were conducted to investigate the characteristics of specific aquifers. Nemickas and Carswell (1976) investigated the hydrogeology of the Alloway Clay Member of the Kirkwood Formation and the Piney Point aquifer. Nemickas (1976) described a digital simulation of ground-water flow in the Wenonah-Mount Laurel aquifer and presented water-level data for part of the aquifer for 1959 and 1970. Nichols (1977a, 1977b) reported on the geohydrology of the Englishtown aquifer system in the northern Coastal Plain and constructed a computer-simulation model of the aquifer. Gill and Farlekas (1976) constructed geohydrologic maps of the Potomac-Raritan-Magothy aquifer system. Farlekas (1979) investigated the geohydrology and constructed a digital-simulation model of the Farrington aquifer in the northern Coastal Plain. Luzier (1980) used a digital model to simulate water-level changes in the Potomac-Raritan-Magothy aquifer system.

Other reports focus on the Kirkwood-Cohansey aquifer system in the Atlantic City area. Barksdale and others (1936) and Thompson (1928) discuss ground-water supplies in the Atlantic City region. Clark and Paulachok (1989) present potentiometric-surface maps for the principal aquifers in the Atlantic County area.

Well-Numbering System

The well-numbering system used in this report is based on the system used by the USGS in the respective states. In New Jersey and Pennsylvania, a well number consists of a county code and a sequence number for the wells inventoried in that county. The county codes for New Jersey counties included in this report are Atlantic, 1; Burlington, 5; Camden, 7; Cape May, 9; Cumberland, 11; Gloucester, 15; Mercer, 21; Middlesex, 23; Monmouth, 25; Ocean, 29; and Salem, 33. The county code for Philadelphia County, Pennsylvania, is PH. In Delaware, the well number consists of a grid location and a sequence number for the wells inventoried in each grid.

Methods of Data Collection

Static water levels were measured in 1,251 wells screened in the major artesian aquifers in the New Jersey Coastal Plain. Most of the wells are water-supply wells, including public supply, industrial, commercial, irrigation, and domestic wells. More than 24 percent of the wells included in this study are observation wells. Water-level data were collected from October 17, 1988, through February 22, 1989 (hereafter referred to as "the 1988 study"). Water levels generally were measured during fall, after heavy summer withdrawals had lessened. Water levels in the study area typically reach their annual highs in winter and early spring. Water-level measurements for the 1983 and 1988 studies were made on the same date or as close to the same date as possible. For the 1983 study, water levels were measured in 1,071 wells from September 29, 1983, to May 31, 1984. Water levels were measured in 916 of the same wells for both studies. Alternate wells were selected to replace wells used in 1983 that were inaccessible at the time of the water-level measurements or had been destroyed. For this report, the term "static water level" is the height of a vertical column of freshwater in a well casing above a standard datum that can be supported by the pressure at a given point.

Water-level data and construction details for these wells are stored in the Ground-Water Site Inventory data base (GWSI) at the New Jersey District office of the USGS. Wells selected for the study were chosen on the basis of areal distribution, focusing on areas with large withdrawals and areas with limited data points for each aquifer. Aquifer designations for wells used in this report were obtained from the GWSI data base and were determined from geologic and geophysical data. New well sites selected to improve the distribution in areas of sparse coverage were added to the GWSI data base. Suggestions for including wells appropriate to the study were obtained through the Delaware River Basin Commission, the New Jersey Department of Environmental Protection, and local well owners.

Static heads were measured by three methods, most accurate of which is the wetted-steel-tape method. For some wells, an electric tape water-level finder is more effective, although slightly less accurate, than a wetted-steel tape. The third and least accurate method is the airline method in which the vertical length of the well's airline must be known. The airline method was used only when wells were inaccessible with the steel tape or electric tape. Downhole recorders were used to collect water-level data in two offshore wells screened in the Atlantic City 800-foot sand.

Large-capacity withdrawal wells screened in the same aquifer and located less than 0.25 mi from the well being measured were shut down for a minimum of 1 hour prior to measurement. During the 1983 study, all wells within a 1-mi radius and screened in the same aquifer were shut down. USGS investigations conducted after the 1983 study revealed that the pumping of large-capacity wells produced little effect on water levels in wells located more than 0.25 and less than or equal to 1 mi away (R.L. Walker, U.S. Geological Survey, oral commun., 1988). Therefore, to simplify procedures without reducing quality for the 1988 study, only those wells within a 0.25-mi radius were shut down.

Several measurements were made in each well until two similar readings were obtained at least 5 minutes apart to assure that the aquifer had recovered sufficiently from its stressed condition. In most Coastal Plain

aquifers, water levels in the large-capacity wells can be expected to recover to within 90 to 95 percent of the static head in about 1 hour. The Englishtown aquifer system and Wenonah-Mount Laurel aquifer in Monmouth and Ocean Counties, however, contain silt and clay that cause low transmissivities and increase recovery time to 3 to 5 hours (R.L. Walker, U.S. Geological Survey, oral commun., 1988).

Water levels were referenced to land-surface datum at each measuring site. The altitude of land surface was used to adjust the measured water levels to sea-level datum. Altitudes of land surface were obtained from the GWSI file, field-checked against topographic maps, and corrected if necessary. Some well owners provided accurate altitudes from leveling surveys; however, most land-surface altitudes were estimated from USGS 7-1/2-minute topographic maps, which are considered to be accurate to within half the contour interval of the map, usually 10 to 20 ft. The datum used in this report is sea level. Selected wells screened in each aquifer are shown in figure 3 and on plates 1 through 8 (farther on).

Description of Data Presented

Water levels, water-level changes, potentiometric-surface maps, and water-level hydrographs are grouped by aquifer and discussed in the sections representing these aquifers. A table containing well and water-level data is presented at the end of each section. These tables include the well number for each site, which is used for reference throughout the report; site location (latitude and longitude); owner's name; local well number; year drilled; altitude of land surface; and screened interval. Changes in water levels from 1983 to 1988 are given for these sites. Water levels in some wells were measured in 1984 and 1989 because of problems encountered at the sites. These wells are so noted in the tables. Descriptive information in the tables has been updated to reflect new information obtained during the 1988 study.

Water levels can vary seasonally as much as 25 ft in some aquifers. The potentiometric-surface maps do not reflect these large seasonal changes because water levels were measured in the fall when they were about average for the year. Examples of these seasonal fluctuations can be seen by examining the water-level hydrographs at the end of each aquifer description. Water levels measured at the same time of the year can be used for evaluating long-term trends. Differences in heads in a few randomly spaced wells may be caused by local variations in withdrawal or recharge, measurement-accuracy limitations, or differences in the recovery periods at recently pumped wells.

Total withdrawals from the major artesian aquifers were 268.99 Mgal/d in 1983 and 264.63 Mgal/d in 1988 (R.M. Clawges, U.S. Geological Survey, written commun., 1991). Ground-water withdrawals from the Vincentown aquifer; Wenonah-Mount Laurel aquifer; Englishtown aquifer system; and the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system decreased or stabilized; however, water levels continued to decline. Withdrawals from the major artesian aquifers in 1983 and 1988 are listed in table 1.

A 1:250,000-scale potentiometric-surface map for 1988 is shown for each aquifer (fig. 3 and pls. 1-8). These maps were prepared from the water-level data listed in tables 3 to 11 (farther on) and show only selected

Table 1. Ground-water withdrawals from the New Jersey Coastal Plain, by county and aquifer, 1983 and 1988[1]

[Withdrawals in million gallons per day; --, indicates no data; ground-water withdrawals in this table have been updated from Eckel and Walker (1986) to reflect withdrawals from the Vincentown aquifer and to include data unavailable at the time of their publication]

	Cohansey aquifer (confined)		Atlantic City 800-foot sand		Piney Point aquifer		Vincentown aquifer	
County	1983	1988	1983	1988	1983	1988	1983	1988
Atlantic	--	--	8.34	10.14	0.10	0.32	--	--
Burlington	--	--	--	--	.01	.01	--	--
Camden	--	--	--	--	--	--	--	--
Cape May	6.08	6.10	6.50	6.29	--	--	--	--
Cumberland	--	--	--	--	--	--	--	--
Gloucester	--	--	--	--	--	--	--	--
Mercer	--	--	--	--	--	--	--	--
Middlesex	--	--	--	--	--	--	--	--
Monmouth	--	--	--	--	--	--	0.28	0.07
Ocean	--	--	4.13	3.81	1.64	1.51	.49	.35
Salem	--	--	--	--	--	--	--	--
Total	6.08	6.10	18.97	20.24	1.75	1.84	.77	.42

					Potomac-Raritan-Magothy aquifer system					
	Wenonah-Mount Laurel aquifer		Englishtown aquifer system		Upper		Middle		Lower	
County	1983	1988	1983	1988	1983	1988	1983	1988	1983	1988
Atlantic	--	--	--	--	--	--	--	--	--	--
Burlington	2.11	2.18	0.35	0.13	5.97	6.10	22.64	22.88	6.34	6.54
Camden	.63	1.38	.18	.39	9.32	11.80	11.89	8.61	49.70	43.65
Cape May	--	--	--	--	--	--	--	--	--	--
Cumberland	--	--	--	--	--	--	--	--	--	--
Gloucester	.09	.07	--	--	12.87	11.91	7.27	7.30	7.73	8.46
Mercer	--	--	--	--	1.72	1.98	6.41	7.60	--	--
Middlesex	--	--	--	--	24.04	23.64	18.96	14.34	--	--
Monmouth	1.47	1.00	5.25	5.05	18.05	18.04	6.34	8.79	--	--
Ocean	.09	--	3.75	3.48	2.71	2.64	2.13	5.22	5.27	5.01
Salem	.58	.26	--	--	3.20	2.46	3.01	3.91	.90	.63
Total	4.97	4.89	9.53	9.05	77.88	78.57	78.65	78.65	69.94	64.29

[1] Excludes withdrawals from domestic wells

wells from these tables, although data from all the wells were used in contouring. The accuracy of the potentiometric contours depends on the distribution of wells, accuracy of land-surface-altitude data, and accuracy of the water-level measurements. These maps show potentiometric-head distribution for the confined part of each aquifer. Potentiometric-surface maps are useful in defining recharge and discharge areas, the generalized path of ground-water flow from recharge to discharge areas, and the hydraulic gradient along these flow paths. The hydraulic gradient can be used to determine the average ground-water velocity along a given path if the local hydraulic conductivity and porosity of the aquifer are known.

Water-level hydrographs for selected observation wells from the USGS observation-well network show water-level trends for each aquifer for the 7-year period, 1983 through 1989. The hydrographs are based on water-level data recorded by three methods: (1) lowest monthly water levels from sites with automatic digital recorders, (2) lowest water levels and manual measurements from sites with extremes recorders, and (3) hourly water levels recorded by an offshore downhole recorder. Individual hydrographs based on lowest monthly and hourly water levels from automatic digital recorders and downhole recorders show seasonal water-level variations and local long-term trends for each aquifer.

Although the period between studies is about 5 years, the hydrographs represent a 7-year period in order to show water-level conditions in the aquifers in the water year prior to the 1983 water-level measurements and in the water year after the 1988 water-level measurements. Therefore, water-level changes defined by the hydrographs do not always agree with those values listed in the tables for the 5-year period. The water year is represented by the 12-month period from October 1 through September 30. The water year is designated by the calendar year in which it ends. Thus, the 12-month period ending September 30, 1988, is called the 1988 water year.

Acknowledgments

The authors thank well owners who provided information and granted access to their wells for water-level measurements. Water-level data and hydrographs for selected observation wells were compiled by Walter D. Jones of the USGS.

HYDROGEOLOGY OF THE COASTAL PLAIN

The Coastal Plain aquifers are part of the wedge-shaped mass of sediments composed of alternating layers of sand, silt, and clay that overlie pre-Cretaceous crystalline rock southeast of the Fall Line in New Jersey (table 2). The Cretaceous and Tertiary sediments, in general, strike northeast-southwest, dip to the southeast from 10 to 60 ft/mi, and underlie essentially flat-lying Quaternary deposits (Zapecza, 1989, p. 5). The sediments that compose the Coastal Plain range in thickness from less than 50 ft at the Fall Line to more than 6,500 ft in Cape May County (Gill and Farlekas, 1976).

Figure 2 is a generalized hydrogeologic section that shows aquifers and several areally extensive confining layers that form their upper and lower hydrologic boundaries. The hydrogeologic framework of the New Jersey Coastal Plain is discussed in detail by Zapecza (1989).

Table 2. Geologic and hydrogeologic units in the Coastal Plain of New Jersey

[Modified from Zapecza, 1989, table 2]

SYSTEM	SERIES	GEOLOGIC UNIT	LITHOLOGY	HYDROGEOLOGIC UNIT	HYDROLOGIC CHARACTERISTICS
Quaternary	Holocene	Alluvial deposits	Sand, silt and black mud.	undifferentiated	Surficial material, commonly hydraulically connected to underlying aquifers. Locally some units may act as confining units. Thicker sands are capable of yielding large quantities of water.
		Beach sand and gravel	Sand, quartz, light-colored, medium- to coarse-grained pebbly.		
	Pleistocene	Cape May Formation	Sand, quartz, light-colored, heterogeneous, clayey, pebbly.		
Tertiary	Miocene	Pennsauken Formation		Kirkwood-Cohansey aquifer system	A major aquifer system. Ground water occurs generally under water-table conditions. In Cape May County, the Cohansey Sand is under artesian conditions.
		Bridgeton Formation			
		Beacon Hill Gravel	Gravel, quartz, light-colored, sandy.		
		Cohansey Sand	Sand, quartz, light-colored, medium- to coarse-grained, pebbly, local clay beds.		
		Kirkwood Formation	Sand, quartz, gray and tan, very fine to medium-grained, micaceous, and dark-colored diatomaceous clay.	Confining unit	Thick diatomaceous clay bed occurs along coast and for a short distance inland. A thin water-bearing sand is present in the middle of this unit.
				Rio Grande water-bearing zone	
				Confining unit	
				Atlantic City 800-foot sand	A major aquifer along the coast.
				Composite confining unit	Poorly permeable sediments.
	Oligocene	Piney Point Formation[1] / Shark River Formation	Sand, quartz and glauconite, fine- to coarse-grained.	Piney Point aquifer	Yields moderate quantities of water.
	Eocene				
		Manasquan Formation	Clay, silty and sandy, glauconitic, green gray, and brown, contains fine-grained quartz.		Poorly permeable sediments.
	Paleocene	Vincentown Formation	Sand, quartz, gray and green, fine- to coarse-grained, glauconitic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite.	Vincentown aquifer	Yields small to moderate quantities of water in and near its outcrop area.
		Hornerstown Sand	Sand, clayey, glauconitic, dark-green, fine- to coarse-grained.		Poorly permeable sediments.
Cretaceous	Upper Cretaceous	Tinton Sand	Sand, quartz, glauconitic, brown and gray, fine- to coarse-grained, clayey, micaceous.	Red Bank Sand	Yields small quantities of water in and near its outcrop area.
		Red Bank Sand			
		Navesink Formation	Sand, clayey, silty, glauconitic, green and black, medium- to coarse-grained.		Poorly permeable sediments.
		Mount Laurel Sand	Sand, quartz, brown and gray, fine- to coarse-grained, slightly glauconitic.	Wenonah-Mount Laurel aquifer	A major aquifer.
		Wenonah Formation	Sand, very fine- to fine-grained, gray and brown, silty, slightly glauconitic.		
		Marshalltown Formation	Clay, silty, dark-greenish-gray; contains glauconitic quartz sand.	Marshalltown-Wenonah confining unit	A leaky confining unit.
		Englishtown Formation	Sand, quartz, tan and gray, fine- to medium-grained; local clay beds.	Englishtown aquifer system	A major aquifer. Two sand units in Monmouth and ocean Counties.
		Woodbury Clay	Clay, gray and black, and micaceous silt.	Merchantville-Woodbury confining unit	A major confining unit. Locally the Merchantville Formation may contain a thin water-bearing sand.
		Merchantville Formation	Clay, glauconitic, micaceous, gray and black; locally very fine grained quartz and glauconitic sand are present.		
		Magothy Formation	Sand, quartz, light-gray, fine- to coarse grained. Local beds of dark gray lignitic clay. Includes Old Bridge Sand Member.	Potomac-Raritan-Magothy aquifer system: Upper aquifer	A major aquifer system. In the northern Coastal Plain, the upper aquifer is equivalent to the Old Bridge aquifer and the middle aquifer is equivalent to the Farrington aquifer. In the Delaware River Valley, three aquifers are recognized. in the deeper subsurface, units below the upper aquifer are undifferentiated.
		Raritan Formation	Sand, quartz, light-gray, fine- to coarse-grained, poorly arkosic; contains red, white, and variegated clay. Includes Farrington Sand Member.	Confining unit / Middle aquifer / Confining unit	
	Lower Cretaceous	Potomac Group	Alternating clay, silt, sand, and gravel.	Lower aquifer	
Pre-Cretaceous		Bedrock	Precambrian and lower Paleozoic crystalline rocks, schist and gneiss; locally Triassic sandstone and shale, and Jurassic diabase are present.	Bedrock confining unit	No wells obtain water from these consolidated rocks, except along Fall line.

[1]of Olsson and others, 1980

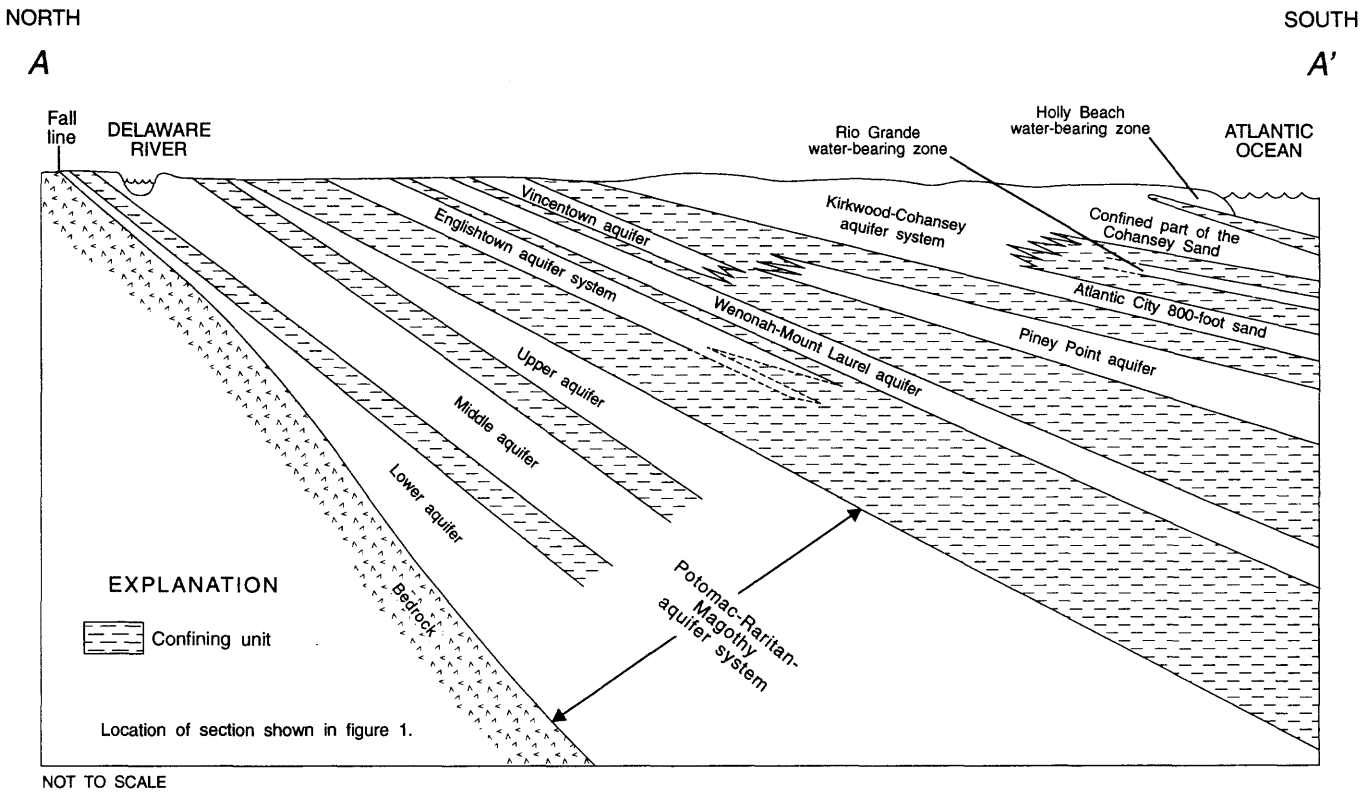


Figure 2. Diagrammatic hydrogeologic section of the New Jersey Coastal Plain. (From Zapecza and others, 1987)

Description of Aquifers and Confining Units

The Kirkwood-Cohansey aquifer system consists of coarse gravel to dense clays of Miocene age. The aquifer system is present throughout the Coastal Plain southeast of the outcrop of the Kirkwood Formation and functions as a water-table or semiartesian aquifer in most areas (Walker, 1983). Only the artesian part of the aquifer in Cape May County is discussed in this report. The thickness of the confined Cohansey aquifer in Cape May County ranges from about 50 ft to about 225 ft.

The Atlantic City 800-foot sand is composed of gray, medium- to coarse-grained sand and gravel with interspersed fragmented shell material of the Kirkwood Formation of middle Miocene age. The Atlantic City 800-foot sand is recognizable in the subsurface only where it is overlain by a thick, massive clay bed in the southeastern part of the Coastal Plain (Zapecza, 1989). The thickness of the aquifer is greater than 200 ft at Cape May City, Cape May County. The Atlantic City 800-foot sand is the principal confined aquifer tapped for water supply along the barrier beaches from Stone Harbor, Cape May County, to Harvey Cedars, Ocean County.

The Piney Point aquifer is composed of fine- to coarse-grained glauconitic quartz sand and shell beds of the Piney Point Formation of late Eocene age. The Piney Point Formation does not crop out in the New Jersey Coastal Plain. The thickness of the Piney Point aquifer is greater than 200 ft in southwestern Cumberland County. The Piney Point Formation is overlain unconformably by silty clay of the basal part of the Kirkwood Formation (Zapecza, 1989).

The Vincentown aquifer consists of moderately permeable sediments of the Vincentown Formation of Paleocene age. The formation consists of two lithofacies--a massive, sparsely glauconitic quartz sand and a fossiliferous calcareous quartz sand (Parker and others, 1964, p. 58). Throughout most of its subsurface extent, the Vincentown Formation functions primarily as a confining unit. The outcrop area extends in an irregular and discontinuous band from northeastern Monmouth County to the Delaware River adjacent to Salem County. The thickness of the Vincentown aquifer ranges from about 20 ft in the outcrop to more than 80 ft in Salem County and northern Burlington County. The confining unit overlying the Vincentown aquifer includes sediments of the Manasquan and basal Kirkwood Formations (Zapecza, 1989).

The Wenonah-Mount Laurel aquifer is composed primarily of fine- to coarse-grained sand of the Wenonah Formation and Mount Laurel Sand of Upper Cretaceous age. The Mount Laurel Sand consists of coarser grained sediments than those of the Wenonah Formation and is the principal component of the aquifer. These units crop out in an irregular band that extends from Raritan Bay to the Delaware River adjacent to Salem County. The thickness of the aquifer ranges from about 40 ft at the outcrop area near Raritan Bay to more than 130 ft in north-central Salem County. The aquifer is overlain by a composite confining unit of Upper Cretaceous to Miocene age. This layer consists of the Navesink Formation and other units, depending on location within the Coastal Plain (Zapecza, 1989, table 2).

The Englishtown aquifer system consists of medium- to fine-grained quartz sand and clayey silt of the Englishtown Formation of Upper Cretaceous age. The formation crops out in an irregular band that extends from Raritan Bay to the Delaware River adjacent to Salem County. The thickness of the

Englishtown aquifer system is greater than 140 ft in Monmouth and Ocean Counties. The aquifer system thins to the south and is absent in the southeastern part of the Coastal Plain. A leaky confining unit overlying the Englishtown aquifer system is composed of the Marshalltown Formation and the fine-grained sediments of the lower part of the Wenonah Formation (Walker, 1983).

The upper aquifer of the Potomac-Raritan-Magothy aquifer system consists of sand with some silt and clay mainly of the Magothy Formation of Upper Cretaceous age. The upper aquifer is the most extensive unit of the aquifer system. The outcrop of the upper aquifer extends in a narrow band from Raritan Bay to the Delaware River adjacent to Salem County. The thickness of the upper aquifer ranges from less than 50 ft in Cape May County to greater than 200 ft in northeastern Monmouth County. The confining unit overlying the upper aquifer is composed primarily of fine-grained sediments of the Merchantville Formation and the Woodbury Clay of Upper Cretaceous age (Zapecza, 1989).

The middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system consist primarily of sand with discontinuous silt and clay layers of the Potomac Group and Raritan Formation. The outcrop of the middle aquifer extends in a narrow band from Raritan Bay in the northeastern part of Coastal Plain to the Delaware River adjacent to Salem County. The thickness of the middle aquifer ranges from less than 50 ft near the outcrop to greater than 150 ft near the junction of Mercer, Middlesex, and Monmouth Counties. The confining unit overlying the middle and undifferentiated parts of the aquifer system is equivalent primarily to the Woodbridge Clay Member of the Raritan Formation in the northeastern part of the Coastal Plain and the Bass River Formation in Burlington, Ocean, and Monmouth Counties (Zapecza, 1989).

The lower aquifer of the Potomac-Raritan-Magothy aquifer system consists mainly of sand and gravel locally interbedded with silt and clay of the Potomac Group and Raritan Formation. The lower aquifer lies unconformably on pre-Cretaceous bedrock or weathered bedrock, which acts as the lower confining layer (Zapecza, 1989). The thickness of the lower aquifer is greater than 250 ft in Salem County. The confining unit overlying the lower aquifer is composed primarily of very fine-grained silt and clay of the Potomac Group and the Raritan Formation.

Recharge to the Coastal Plain aquifer is largely by infiltration of precipitation on the outcrop areas and leakage from the overlying surface-water bodies. At several locations, recharge from surface-water bodies is induced by the lowering of potentiometric heads in the aquifers as a result of ground-water withdrawals. Ground water is released from the Coastal Plain aquifers by discharge to overlying surface-water bodies, by evapotranspiration, and by withdrawals from wells.

Location of Freshwater/Saltwater Interface

The estimated location of the 250-mg/L isochlor in the confined Cohansey aquifer in Cape May County is shown in figure 3. The location of the isochlor is based on water-quality data from an investigation of the water resources of Cape May County (P.J. Lacombe, U.S. Geological Survey, written commun., 1993).

The estimated location of the 250-mg/L isochlor in the Atlantic City 800-foot sand is shown on plate 1. The location of the isochlor is based on water-quality data from an investigation of the water resources of the Atlantic City region (S.D. McAuley, U.S. Geological Survey, written commun., 1991) and Cape May County (P.J. Lacombe, U.S. Geological Survey, written commun., 1993).

The approximate seaward limit of freshwater is delineated by chloride concentrations of 10,000 mg/L in the Piney Point, Vincentown, and Wenonah-Mount Laurel aquifers; the Englishtown aquifer system; and the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system (pls. 2-8). The locations of chloride-concentration contours are based on results of the Regional Aquifer System Analysis investigation by Martin (1990) and on data from Schaefer (1983), Pucci (1993), Gill and Farlekas (1976), and A.D. Gordon (U.S. Geological Survey, written commun., 1993).

WATER LEVELS IN ARTESIAN AQUIFERS OF THE COASTAL PLAIN

Cohansey Aquifer in Cape May County

Water Levels

Water-level measurements for 37 wells screened in the confined Cohansey aquifer in southern Cape May County are listed in table 3. Most of the wells are located in Lower and Middle Townships, between Cape May City and Rio Grande. Most of the withdrawals from the Cohansey aquifer are from the area south of Cape May Court House (fig. 3). Water levels in these wells were used to define the potentiometric surface shown in figure 3, though only 27 wells are plotted.

Water levels in a cone of depression centered in Cape May City were as low as 20 ft below sea level. The cone extends north of Rio Grande, where water levels were from 5 to 6 ft below sea level. The highest water levels, ranging from 4 to 6 ft above sea level, were measured in wells located between Cape May Court House and Woodbine.

Water-Level Fluctuations

Water-level changes in 28 wells were calculated for the 5-year period. Water levels rose in 20 wells, declined in 3 wells, and were unchanged in 5 wells. Water levels in the Cohansey aquifer were measured 2 to 3 weeks later in 1988 than in 1983, and therefore had more time to recover from the heavy withdrawals of the summer pumping period. This resting period probably accounts for the increase in water levels in most wells. Ground-water levels in Cape May County are affected by the tide. Tidal cycles that range from about 6 to 8 ft per day can result in water-level variations of 1 to 2 ft per day in wells screened in the Cohansey aquifer.

Water levels measured during the 1988 study were 7 to 13 ft higher in and around the cone of depression in Cape May City than those measured during the 1983 study, probably because they were measured later and because ground-water withdrawals decreased in Cape May City. Water levels declined 1 to 2 ft in four wells, and water levels were unchanged in several wells located away from the center of the cone of depression in Cape May City.

Hydrographs of water levels in four observation wells screened in the Cohansey aquifer are shown in figure 4; well locations are shown on figure 3. Well 9-49 is located northwest of the center of the cone of depression in Cape May City. The hydrograph shows little change in water level over the 7-year period from 1983 to 1989. Seasonal variations ranging from 10 to 14 ft result from variations in ground-water withdrawals and tidal fluctuations. The hydrograph for well 9-89, which is located about 4 mi southwest of Cape May City, shows no long-term change in water levels. Water levels in well 9-99, located northeast of Cape May Court House, show seasonal variations of as much as 17 ft resulting from the combination of tides and local ground-water withdrawals. Long-term trends indicate that water levels have declined 1 ft. The hydrograph for well 9-150, located west of Cape May City, shows a slight upward trend for the period. Seasonal variations of as much as 17 ft can be attributed to ground-water withdrawals and tidal fluctuations.

Atlantic City 800-Foot Sand

Water Levels

Water-level measurements for 79 wells screened in the Atlantic City 800-foot sand aquifer are listed in table 4. The number of these wells by county is as follows: Atlantic, 32; Cape May, 29; and Ocean, 18. Water levels in these wells were used to define the potentiometric surface, though only 47 wells are plotted on plate 1.

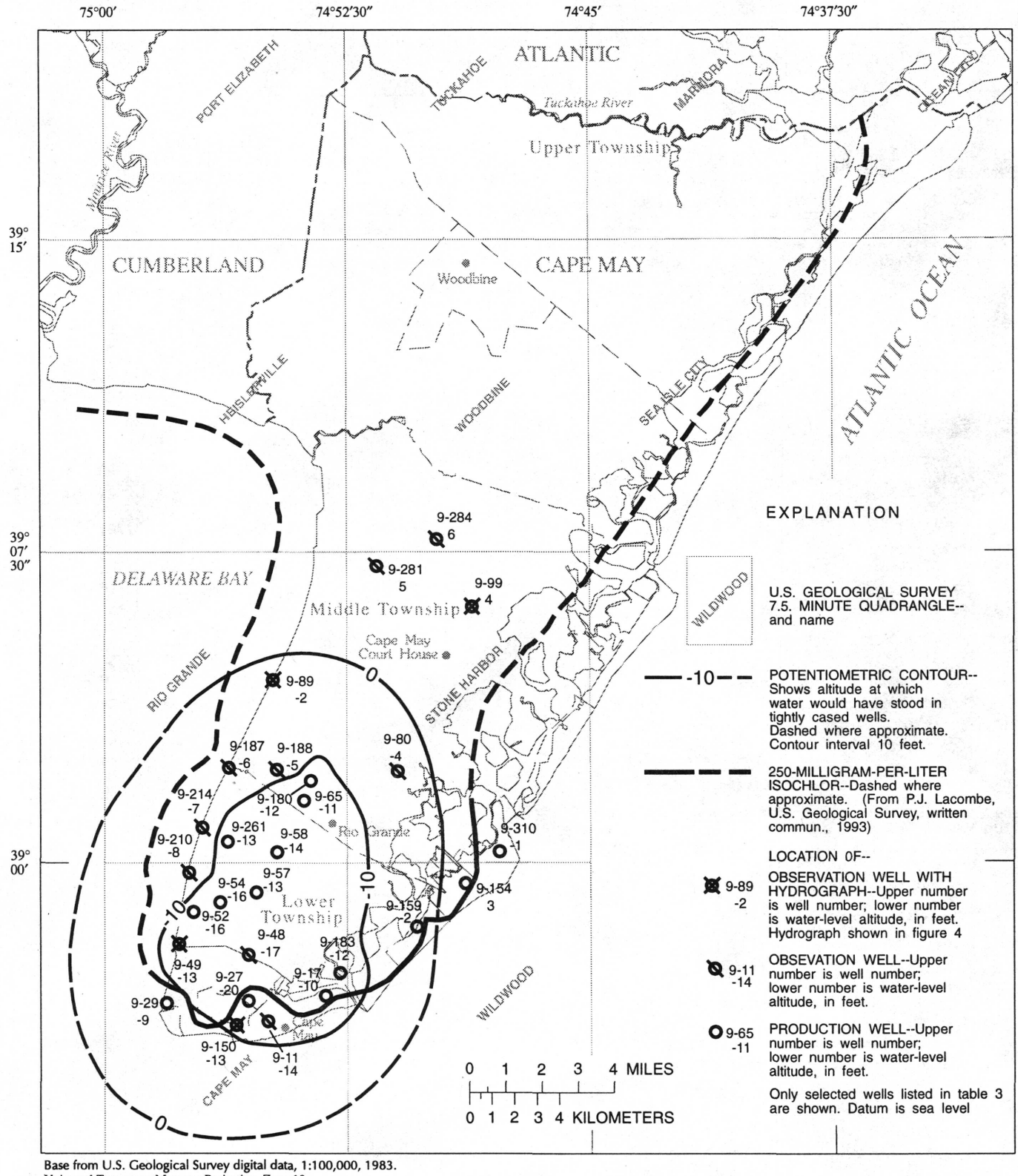
The potentiometric-surface map of the Altantic City 800-foot sand (pl. 1) shows a cone of depression underlying the coast from central Cape May to southern Ocean County, west to Egg Harbor, and east into the Atlantic Ocean. Potentiometric-surface contours that extend offshore were based on water levels in two offshore observation wells located 1.9 and 5 mi east of Atlantic City.

Water levels in this aquifer were lowest between Atlantic City and Ocean City, Atlantic County; heads were as low as 96 ft below sea level (well 1-593). Near Beach Haven, Ocean County, heads were as low as 31 ft below sea level. The highest heads, 19 ft above sea level, were measured in Egg Harbor City in central Atlantic County.

Water-Level Fluctuations

Water-level changes over the 5-year period were calculated for 56 wells screened in the Atlantic City 800-foot sand. Water levels rose in 13 wells, declined in 37 wells, and were unchanged in 6 wells. The greatest declines in head were in the Pleasantville, Ventnor, and Margate areas. Water levels declined as much as 21 ft in these areas over the 5-year period.

Water levels near the coast in Ocean County rose 3 to 5 ft. A major exception is at Harvey Cedars, where water levels rose 12 ft. Ground-water withdrawals near Beach Haven, Ocean County, probably caused water levels to decline 1 to 5 ft in this area (well 29-12). Heads in inland wells declined as much as 3 ft (well 29-774).



Base from U.S. Geological Survey digital data, 1:100,000, 1983.
Universal Transverse Mercator Projection, Zone 18

Figure 3. Potentiometric surface of the confined Cohansey aquifer, Cape May County, New Jersey, 1988.

Table 3. Water-level data for wells screened in the confined Cohansey aquifer in Cape May County, 1983 and 1988

[CONSRV, Conservation; CO, County; ft, feet; GARD, Garden; LK, Lake; mo, month; MUA, Municipal Utilities Authority; NW, Northwest; TWP, Township; USGS, U.S. Geological Survey; WD, Water Department; --, missing data; NM, not measured; NA, not applicable; wells marked with an asterisk (*) are shown on figure 3]

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983-88) (ft)
*9- 11	385612	745457	CAPE MAY CITY WD	CMCWD 1 OBS	1940	7	281- 321	-21	11/10	-14	12/01	7
*9- 17	385651	745310	US COAST GUARD	USCG 1	1943	11	292- 322	-15	11/16	-10	12/01	5
*9- 27	385643	745533	CAPE MAY CITY WD	CMCWD 3	1950	7	277- 306	-30	11/10	-20	12/07	10
9- 28	385641	745749	NW MAGNESITE	NW MAG 2	1953	10	235- 265	-13	11/14	-6	12/01	7
*9- 29	385640	745805	NW MAGNESITE	NW MAG 1	1942	10	296- 321	-9	11/14	-9	12/01	0
9- 36	385701	745528	CAPE MAY CITY WD	CMCWD 2	1966	10	174- 282	-33	11/10	-20	12/07	13
9- 42	385723	745240	BORDON	SNOW 3	1969	5	259- 289	-18	11/16	-12	12/04	6
9- 43	385724	745521	CAPE MAY CITY WD	CMCWD 5	1967	15	246- 276	-28	11/10	-16	12/07	12
*9- 48	385748	745533	USGS	CANAL 5 OBS	1957	17	242- 252	-23	11/10	-17	12/01	6
*9- 49	385804	745742	USGS	HIGBEE BCH 3 OBS	1957	6	241- 250	-15	11/15	-13	12/01	2
*9- 52	385851	745715	LOWER TWP MUA	LTMUA 1	1956	18	241- 262	-15	11/15	-16	12/07	-1
*9- 54	385905	745625	LOWER TWP MUA	LTMUA 2	1962	14	212- 247	-18	11/15	-16	12/07	2
*9- 57	385919	745518	LOWER TWP MUA	LTMUA 3	1974	20	263- 303	-13	11/15	-13	12/07	0
*9- 58	390015	745440	CAPE MAY CO	1	1942	20	248- 275	-15	11/21	-14	12/08	1
9- 59	[4]390015	745440	CAPE MAY CO	2	1942	20	252- 278	-15	11/21	-14	12/08	1
9- 60	390056	745426	USGS	AIRPORT 7 OBS	1957	13	242- 257	-12	11/17	-12	12/08	0
*9- 65	390130	745350	WILDWOOD WD	RIO GRANDE 34	1966	12	172- 242	-16	11/17	-11	12/06	5
*9- 80	390213	745056	USGS	CAPE MAY 42 OBS	1957	14	242- 252	-2	11/16	-4	12/08	-2
*9- 89	390425	745446	USGS	OYSTER LAB 4 OBS	1957	7	195- 210	-2	11/17	-2	12/01	0
*9- 99	390611	744838	USGS	CM CO PK 8 OBS	1957	11	214- 230	5	11/17	4	12/01	-1
*9-150	385607	745556	USGS	WEST CM 1 OBS	1957	7	283- 293	-19	11/10	-13	12/01	6
*9-154	385932	744851	WILDWOOD WD	WWD 2	1928	10	293- 354	1	11/18	3	12/08	2
9-155	385935	744954	WILDWOOD CLAM	3-1971	1971	5	311- 331	-5	11/22	-3	12/08	2
*9-159	385830	745021	WILDWOOD WD	WWD 35	1967	8	249- [3]360	-2	11/21	-2	12/06	0
*9-180	390159	745337	WILDWOOD WD	RIO GRANDE 42	1979	15	[3]250	-14	11/17	-12	12/06	2
9-182	385841	745000	STOKES LAUNDRY	2	1980	7	320- 350	-9	11/22	-5	12/06	4
*9-183	385724	745243	BORDEN	4	1979	5	260- 290	-17	11/16	-12	12/04	5
*9-187	390218	745609	CAPE MAY CO	CAPE MAY F-35	1965	10	186- 190	NM	NM	-6	12/08	NA
*9-188	390215	745440	CAPE MAY CO	CAPE MAY F-36	1965	10	229- 233	NM	NM	-5	12/08	NA
*9-210	385946	745725	CAPE MAY CO	CAPE MAY C-1	1965	11	216- 221	NM	NM	-8	12/08	NA
*9-214	390051	745659	CAPE MAY CO	CAPE MAY F-44	1965	20	205- 210	NM	NM	-7	12/08	NA
*9-261	390032	745612	CAPE MAY CO LIBRARY	LIBRARY 1024	1982	10	145- 160	NM	NM	-13	12/01	NA
9-273	390226	745102	GARD LK MOBILE HOMES	GARDEN LK PK	1985	15	220- 260	NM	NM	-1	12/13	NA
*9-281	390710	745134	SOIL CONSRV SERVICE	BD-21CH	1967	11	176- 181	NM	NM	5	12/08	NA
9-284	390749	744943	SOIL CONSRV SERVICE	BD-20CH-1	1967	17	127- 132	NM	NM	6	12/09	NA
*9-285	390749	744943	SOIL CONSRV SERVICE	BD-20CH-2	1967	17	201- 206	NM	NM	4	12/08	NA
*9-310	390018	744748	WILDWOOD WD	RIO GRANDE 39N	1986	5	279- 357	NM	NM	-1	12/09	NA

[1] Datum is sea level.

[2] Depth below land surface.

[3] Well depth.

[4] Revised from Eckel and Walker, 1986.

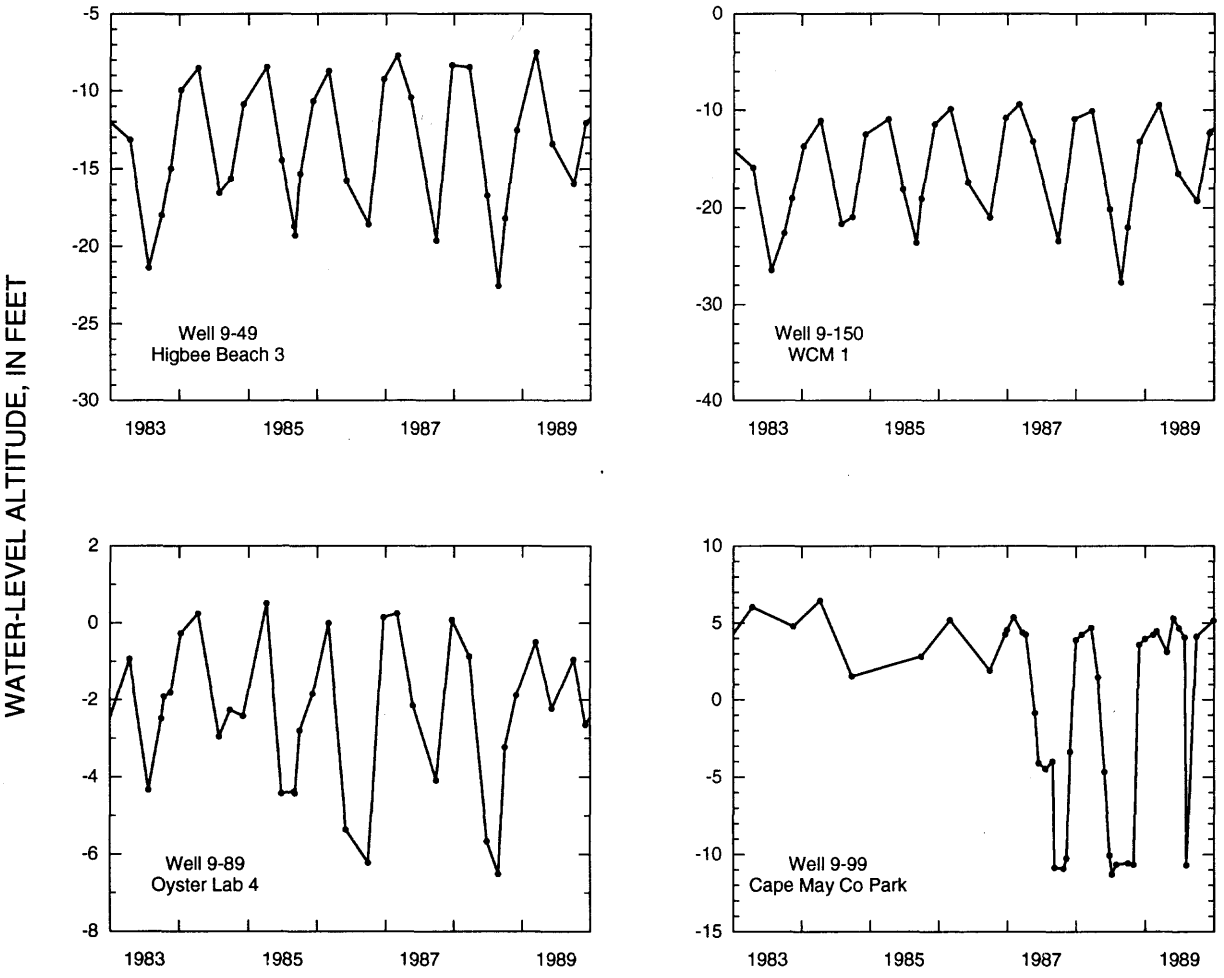


Figure 4. Water-level hydrographs for observation wells screened in the confined Cohansey aquifer, Cape May County, New Jersey, 1983-89.

Water levels near Stone Harbor and Sea Isle City, Cape May County, did not change significantly over the 5-year period. Head changes ranged from a rise of 3 ft to a decline of 2 ft. Water levels in south-central Cape May County declined 3 to 6 ft.

Hydrographs of water levels in four observation wells screened in the Atlantic City 800-foot sand are shown in figure 5; well locations are shown on plate 1. Observation well 1-37 is located in the northern part of Atlantic City; well 1-180 is located near Absecon, Atlantic County; well 1-578 is located inland, near the Atlantic County-Cape May County border; and well 1-703 is located in Pomona, Atlantic County. The four hydrographs show long-term water-level declines that range from 7 to 14 ft. Seasonal water-level variations, which range from 8 to 35 ft, are affected by local ground-water withdrawals.

The hydrograph for observation well 1-711, located 1.9 mi offshore from Atlantic City and screened in the Atlantic City 800-foot sand, shows annual declines in water levels of 20 to 25 ft. These declines coincide with ground-water withdrawals in the Atlantic City area that begin in late May or early June (fig. 6). Ground-water levels begin to recover when withdrawals are reduced in September. Water levels have remained relatively stable over the 3-year period of record from 1987 through 1989.

Piney Point Aquifer

Water Levels

Water-level measurements for 34 wells screened in the Piney Point aquifer are listed in table 5. The number of wells in New Jersey in which water levels were measured, by county, is as follows: Atlantic, 4; Burlington, 4; Camden, 1; Cumberland, 7; and Ocean, 16. Water levels also were measured in two wells in Kent County, Delaware. The water levels in these wells were used to define the potentiometric surface shown on plate 2, though only 28 are plotted. Reported withdrawals from the Piney Point aquifer were greatest in Ocean and Atlantic Counties, 0.32 and 1.51 Mgal/d, respectively (table 1; pl. 2).

Two cones of depression in coastal Ocean County (pl. 2) define the principal areas of ground-water withdrawal from the Piney Point aquifer in New Jersey. Water levels as low as 60 ft below sea level were measured in wells located southeast of Toms River. At the center of a small cone of depression at Barnegat Light, Ocean County, the water level was 34 ft below sea level.

Water levels in observation wells 11-44 and 11-163 in northern Cumberland County, located about 12 mi from the nearest pumping center in Buena Borough (well 1-838), were 7 and 8 ft above sea level, respectively. Water levels were as low as 45 ft below sea level in southern Cumberland County (well 11-61). Water use in this area is mostly for domestic purposes, and withdrawals are not large enough to produce such low water levels. Large ground-water withdrawals are reported in the State of Delaware, however. The potentiometric contours in Cumberland County indicate that the hydraulic gradient is toward Delaware where extensive cones of depression are centered in Kent County (Leahy, 1979). Water levels in Kent County, Delaware, were as low as 132 ft below sea level.

Table 4. Water-level data for wells screened in the Atlantic City 800-foot sand, 1983 and 1988

[AMER, American; CONV, Convalescent; E, East; ELEC, Electric; ft, feet; HBR, Harbor; INT, International; mo, month; MUA, Municipal Utility Authority; TWP, Township; USGS, U.S. Geological Survey; WC, Water Company; WD, Water Department; WW, Water Works; --, missing data, NM, not measured, NA, not applicable; wells marked with an asterisk are shown on plate 1]

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983-88) (ft)
*1- 15	392058	742711	PRESIDENT HOTEL	PRESIDENT	1955	10	779- 831	NM	NM	-77	11/30	NA
1- 25	392128	742557	CLARIDGE HOTEL	CLARIDGE	1930	8	785- 845	NM	NM	-58	11/30	NA
*1- 37	[3]392151	742459	ATLANTIC CITY WD	GALEN HALL OBS	1904	10	782- 837	-70	11/29	-80	11/29	-10
*1- 39	392329	742348	BRIGANTINE WD	NEW 4	1966	10	733- 788	-65	11/09	-74	12/01	-9
1- 40	392342	742328	BRIGANTINE WD	BAYSHORE 3	1952	10	697- 765	-63	11/09	-71	12/08	-8
1- 41	392431	742153	BRIGANTINE WD	BRIG WD 1	1925	9	736- 806	-54	11/09	-57	12/01	-3
*1- 42	392456	742121	BRIGANTINE WD	BWD 2-14TH ST	1929	12	718- 778	-44	11/09	-46	12/01	-2
1-116	[3]393212	743829	EGG HBR WW	EGG HARBOR 3	1942	40	342- 394	21	12/07	18	11/30	-3
*1-117	[3]393213	743832	EGG HBR WW	OW41 5	1964	40	350- 432	21	12/07	19	11/30	-2
*1-180	392754	742701	USGS	OCEANVLLE 1 OBS	1959	27	560- 570	-32	11/29	-39	11/29	-7
*1-367	391859	743122	LONGPORT WD	LONGPORT 2	1947	10	750- 800	-68	11/28	-75	12/02	-7
1-370	391928	743055	MARGATE CITY WD	MCWD 6	1962	10	748- 798	NM	NM	-84	12/01	NA
1-372	[3]391932	743059	MARGATE CITY WD	MCWD 7	1963	5	760- 800	-75	11/28	-91	12/01	-16
1-375	392002	743012	MARGATE CITY WD	MCWD 4	1955	10	745- 795	NM	NM	-81	12/01	NA
1-376	392008	743017	MARGATE CITY WD	MCWD 5	1958	10	741- 791	-74	11/29	-81	12/01	-7
1-568	392448	743028	ATLANTIC CITY MUA	ACMUA 15	1961	8	583- 633	-48	11/14	-58	12/08	-10
*1-578	391826	743709	USGS	JOBS POINT OBS	1959	10	670- 680	-51	11/14	-55	11/29	-4
1-593	392018	742945	VENTNOR CITY WD	VCWD 10	1965	9	740- 790	-75	11/28	-96	12/07	-21
1-598	[3]392030	742852	VENTNOR CITY WD	VCWD 9	1965	8	740- 800	-76	11/29	-81	12/08	-5
*1-600	392045	742840	VENTNOR CITY WD	VCWD 8	1931	8	750- 810	-73	11/28	-79	12/08	-6
1-648	392125	742604	BALLY PARK PLACE	BALLY 1	1979	7	775- 835	-74	11/16	-80	11/30	-6
*1-650	392651	744254	HAMILTON TWP WD	TEST 2-73	--	20	[4]380	18	[5]02/14	14	11/21	-4
1-680	392120	742606	CARNIVAL CLUB	2	1910	8	773- 835	NM	NM	-76	11/30	NA
1-682	392134	742521	RESORTS INT	1-1980	1980	8	[4]840	-72	11/16	-80	11/30	-8
*1-683	392410	742227	BRIGANTINE WD	NEW 5	1980	8	725- 775	NM	NM	-64	12/01	NA
*1-700	392933	744604	USGS	ACGS 4	1984	40	479- 539	NM	NM	17	11/28	NA
*1-702	392032	743008	USGS	BURKE AV TW OBS	1985	5	740- 750	NM	NM	-87	12/01	NA
*1-703	392639	743232	USGS	FAA POMONA OBS	1985	38	560- 570	NM	NM	-45	11/29	NA
*1-704	392343	743733	USGS	EGG HARBOR HS	1985	51	596- 606	NM	NM	-38	11/22	NA
*1-706	392933	743130	USGS	STKTN ST COLL	1985	40	520- 530	NM	NM	-25	11/29	NA
*1-710	391726	742221	USGS	ACOW 2	1985	0	973-1003	NM	NM	-63	[6]01/31	NA
*1-711	391955	742507	USGS	ACOW 1 OBS	1985	0	820- 850	NM	NM	-77	11/29	NA
*9- 2	390420	744435	AVALON WD	AVALON WD 7-71	1971	5	821- 861	-40	11/15	-46	12/07	-6
*9- 4	390528	744338	AVALON WD	AVALON WD 6	1968	10	880- 920	-42	11/15	-40	12/07	2
9- 5	390545	744326	AVALON WD	AVALON WD 8-76	1976	8	784- 839	-48	11/15	-40	12/07	8
*9- 8	390621	744248	AVALON WD	AVALON WD 3	1930	10	845- 925	-38	11/15	-41	12/07	-3
*9- 92	[3]390525	744851	NJ AMER WC	NEPTUNUS 7	1967	17	681- 791	-31	12/07	-34	12/13	-3
*9-100	390647	744438	MIDDLE TWP WD	AVALON M WW 1	1963	5	763- 815	-42	11/18	-42	12/14	0
*9-106	391343	743755	NJ AMER WC	SHORE DIV 7	1924	8	760- 810	-46	12/07	-51	12/13	-5
*9-108	391500	743645	NJ AMER WC	SHORE DIV 14	1970	7	774- 840	-57	11/29	-58	12/13	-1
9-109	391535	743611	NJ AMER WC	SHORE DIV 9	1946	8	749- 809	-55	11/29	-57	12/14	-2
*9-110	391604	743539	NJ AMER WC	SHORE DIV 12	1965	7	759- 814	-53	11/13	-60	12/14	-7
9-116	391638	743451	NJ AMER WC	SHORE DIV 8	1937	7	760- 810	-62	11/30	-64	12/13	-2
9-117	391642	743447	NJ AMER WC	SHORE DIV 10	1950	5	746- 798	NM	NM	-69	12/13	NA
9-121	391649	743449	NJ AMER WC	SHORE DIV 4	1910	8	[4]825	-59	11/30	-66	12/13	-7
9-122	391710	743408	NJ AMER WC	SHORE DIV 5	1923	6	[4]825	NM	NM	-68	12/13	NA
9-124	391712	743340	NJ AMER WC	SHORE DIV 13	1970	8	774- 840	-70	11/30	-70	12/13	0
*9-125	391726	743352	NJ AMER WC	SHORE DIV 11	1962	10	[4]800	NM	NM	-66	12/13	NA
*9-126	390747	744241	SEA ISLE CITY WD	SICWD 5	1957	7	736- 802	-44	11/17	-46	12/05	-2
*9-127	390847	744200	SEA ISLE CITY WD	SICWD 4	1954	7	742- 830	-44	11/17	-44	12/05	0
*9-129	390926	744131	SEA ISLE CITY WD	SICWD 2	1926	7	801- 861	-40	11/17	-37	12/05	3
*9-132	390301	744545	STONE HBR WD	SHWD 4	1955	10	830- 880	-31	11/14	-32	12/07	-1
9-135	390323	744525	STONE HBR WD	SHWD 3	1949	9	838- 878	-34	11/15	-31	12/07	3
*9-136	391152	743927	CORSONS INLET WC	CIWC 1	1904	7	802- 834	-45	11/29	-45	12/13	0
*9-144	391703	743756	ATLANTIC CITY ELEC	ACEC 5	1975	9	650- 690	-54	11/10	-50	12/21	4
9-148	391707	743756	ATLANTIC CITY ELEC	ACEC 3-LAYNE 4	1964	9	645- 675	-55	11/10	-58	12/21	-3
*9-161	390704	744750	E SHORE CONV HOME	1	1983	16	639- 654	-26	11/17	-32	12/06	-6
9-166	390351	744504	STONE HARBOR WD	SHWD 5	1976	7	820- 860	-42	11/15	-41	12/07	1
9-173	390314	744532	STONE HARBOR WD	SHWD 6	1981	10	810- 860	-32	11/15	-31	12/07	1
*9-185	391621	744355	USGS	MACNAMARA W A	1985	15	640- 650	NM	NM	-35	11/29	NA
*9-296	390500	744946	NJ AMER WC	HAND AVE 8	1986	20	682- 812	NM	NM	-27	12/10	NA
*29- 9	393346	741430	BEACH HAVEN WD	BHWD 8	1957	5	572- 656	-30	11/05	-31	11/28	-1
29- 12	393346	741434	BEACH HAVEN WD	BHWD 7	1940	5	572- 665	-25	11/05	-30	11/29	-5
*29-111	394134	740832	HARVEY CEDARS WD	HCWD 4	1968	9	465- 500	NM	NM	-23	11/28	NA

Footnotes at end of table

Table 4. Water-level data for wells screened in the Atlantic City 800-foot sand, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983-88) (ft)
*29-112	394218	740808	HARVEY CEDARS WD	HCWD 3	1956	5	451- 493	-36	11/03	-24	11/28	12
*29-457	393510	741327	LONG BEACH WC	TERRACE 3	1970	8	551- 650	-27	11/08	-27	11/29	0
*29-464	393428	742202	LITTLE EGG HRBR MUA	MYSTIC 2	1963	[3]19	485- 542	[3]-17	11/05	-23	11/30	-6
*29-544	393839	741052	SHIP BOTTOM WD	SBWD 4	1953	5	536- 578	-33	11/04	-29	11/28	4
29-549	393848	741053	SHIP BOTTOM WD	SBWD 5	1974	5	528- 588	NM	NM	-29	12/14	NA
*29-557	394042	741411	STAFFORD TWP MUA	STAFFORD 3	1965	8	385- 428	16	11/14	16	11/29	0
29-559	393912	741022	SURF CITY WD	SCWD 3	1947	5	516- 557	-27	11/04	-23	11/28	4
29-560	393938	741006	SURF CITY WD	SCWD 4	1964	5	514- 554	-31	11/04	-26	11/28	5
*29-561	393948	740954	SURF CITY WD	SCWD 5	1970	10	520- 562	-28	11/04	-24	11/28	4
*29-565	393610	742031	TUCKERTON MUA	TMUA 4(OW1)	1964	10	463- 497	-7	10/28	-8	11/30	-1
29-597	393610	742021	TUCKERTON MUA	TMUA 5(OW2)	[3]1978	25	400- 500	-6	10/28	-3	12/09	3
*29-598	394201	741212	AMER T & T	TEST 1960	--	5	-- - --	NM	NM	-18	11/29	NA
29-774	394042	741411	STAFFORD TWP MUA	STAFFORD 4	1982	8	434- 484	20	11/14	17	11/28	-3
*29-936	393724	741151	LONG BEACH WC	BRANT BEACH 4	1988	9	528- 594	NM	NM	-25	11/29	NA
29-939	393507	741332	LONG BEACH WC	TERRACE 4	1987	8	533- 593	NM	NM	-27	11/29	NA

[1] Datum is sea level.

[2] Depth below land surface.

[3] Revised from Eckel and Walker, 1986.

[4] Well depth.

[5] Water level measured in 1984.

[6] Water level measured in 1989.

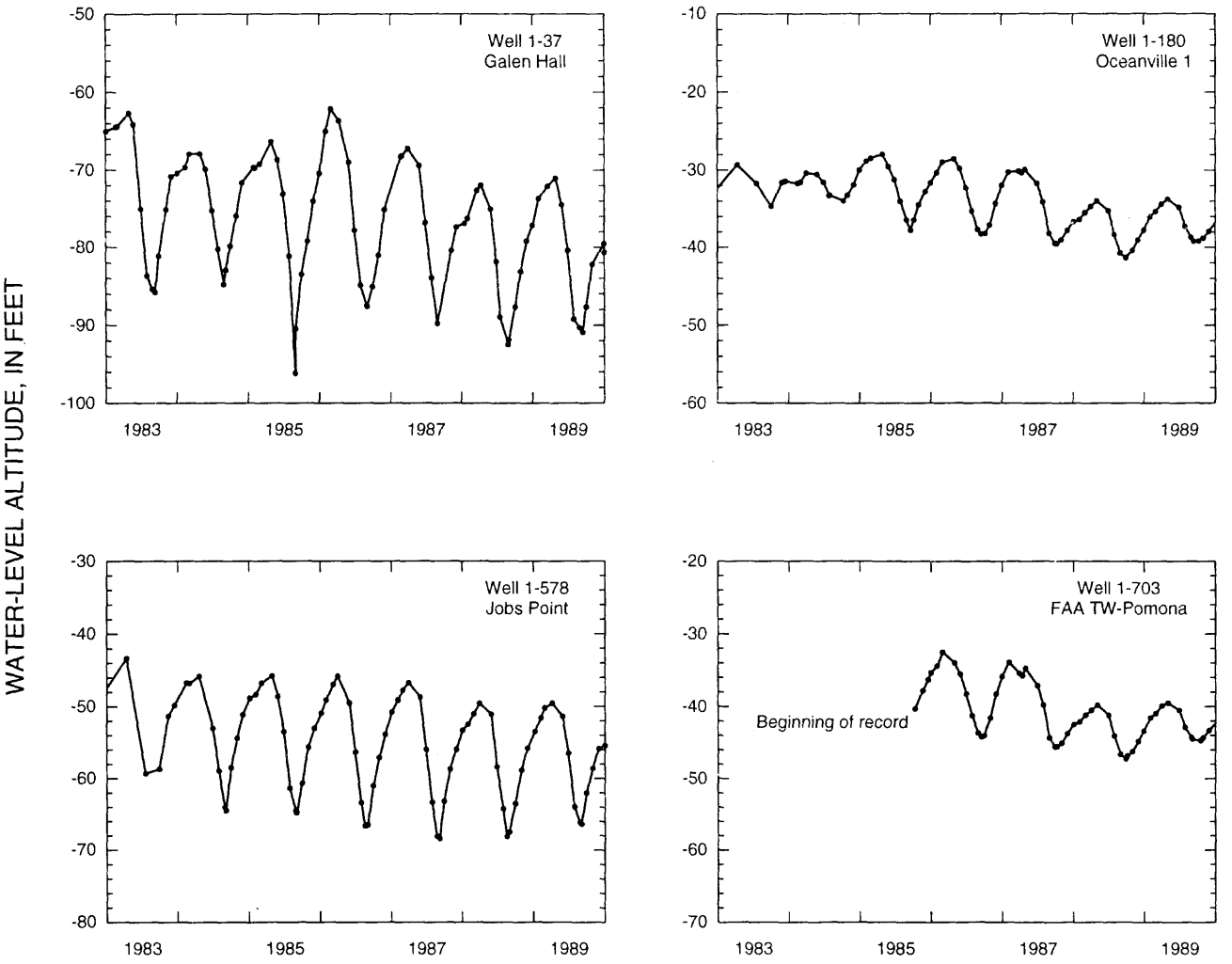


Figure 5. Water-level hydrographs for observation wells screened in the Atlantic City 800-foot sand, 1983-89.

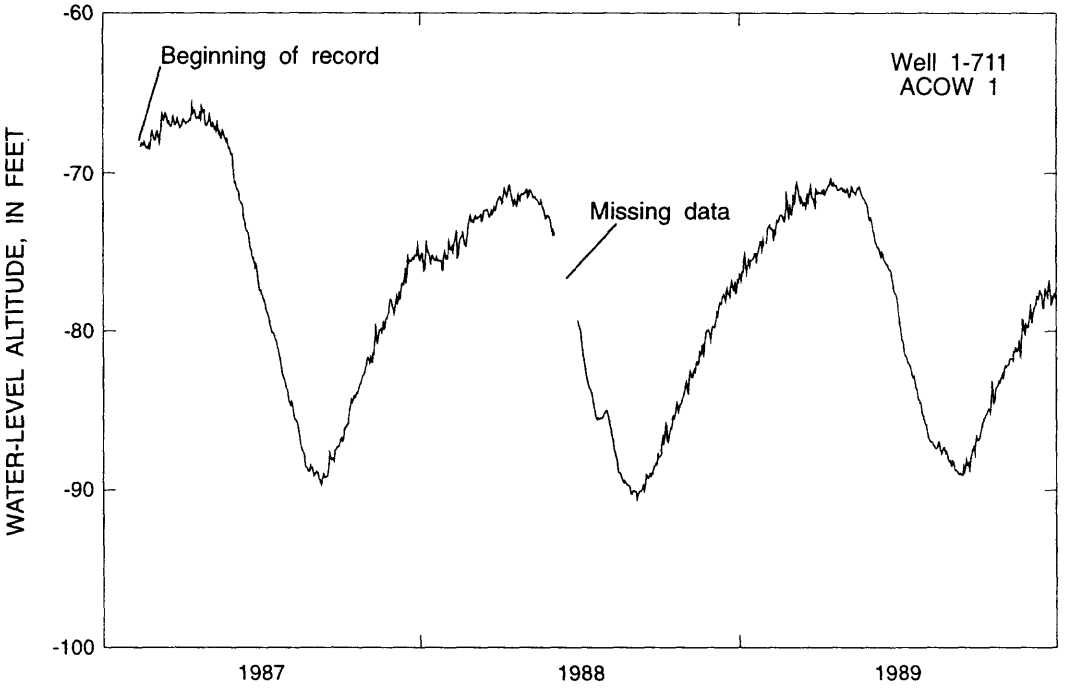


Figure 6. Water-level hydrograph for an offshore observation well screened in the Atlantic City 800-foot sand, 1987-88.

The highest water levels were measured in western Ocean and eastern Burlington Counties at the northernmost extent of the aquifer (pl. 2). Water levels were as much as 118 ft above sea level. Many of the potentiometric contours for areas outside Ocean County are approximations because water-level data are sparse.

Water-Level Fluctuations

Water-level changes in 27 wells were calculated for the 5-year period. Water levels rose in 6 wells, declined in 15 wells, and were unchanged in 6 wells.

The greatest water-level decline occurred in Seaside Park, Ocean County; heads declined as much as 26 ft from 1983 to 1988. The potentiometric surfaces indicate the cone of depression has expanded to the south since 1983 (Eckel and Walker, 1983, pl. 6). This expansion probably resulted from changes in the pattern of ground-water withdrawals from well fields supplying this area.

Water levels in Burlington and Atlantic Counties remained relatively constant over the 5-year period (table 1). Water levels in southern Atlantic County declined to below sea level, probably as a result of major ground-water withdrawals in Kent County, Delaware, and public-supply withdrawals from the Piney Point aquifer in Buena Borough. Water levels in Cumberland County declined 5 to 10 ft, in part because of ground-water withdrawals in Delaware.

Hydrographs for two observation wells screened in the Piney Point aquifer are shown in figure 7; well locations are shown on plate 2. Well 11-96 is located in south-central Cumberland County. The hydrograph shows a water-level decline of about 8 ft during the 5-year period. The decline probably is attributable to ground-water withdrawals in Kent County, Delaware, as reported by Eckel and Walker (1986, p. 43). Water levels in observation well 29-585, located in eastern Ocean County between two pumping centers, fluctuated about 1 ft seasonally with a slight downward trend during 1983-89.

Vincentown Aquifer

The Vincentown aquifer was included in the 1988 study to expand the water-level data for the Coastal Plain. Within its outcrop area and extending 8 to 10 mi downdip from the outcrop, the Vincentown aquifer has been tapped for local public-supply, domestic, and industrial use. Wells in Howell and Jackson Townships, Monmouth County, are used for public supply, whereas wells near the outcrop area in Monmouth and Ocean Counties are used primarily for domestic water supplies. In Salem County, the Vincentown aquifer is used for public supply as well as domestic purposes.

Table 5. Water-level data for wells screened in the Piney Point aquifer, 1983 and 1988

[AM, American; DEL, Delaware; ft, feet; HGTS, Heights; ISL, Island; LT, Light; mo, month; MUA, Municipal Utility Authority; NJ, New Jersey; TWP, Township; USGS, U.S. Geological Survey; VIL ASSOC, Village Associates; WC, Water Company; WD, Water Department; --, missing data; NM, not measured; NA, not applicable; wells marked with an asterisk are shown on plate 2]

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
*1-270	393712	744720	AM HOME PRODUCTS	1958 WELL	1958	90	390- 410	30	11/04	30	11/29	0
*1-713	392902	745051	USGS	MIZPAH DEEP	1985	100	525- 535	NM	NM	-2	11/28	NA
*1-834	392017	743002	USGS	MARGATE FH1 OBS	1988	5	970- 991	NM	NM	-28	11/29	NA
*1-836	393148	745617	BUENA BORO MUA	BBMUA 2	1985	118	405- 455	NM	NM	-8	12/01	NA
*5-407	394422	744309	USGS	ATSION 1 OBS	1963	47	240- 260	51	11/10	51	12/09	0
*5-488	393838	743855	STATE OF NJ	BATSTO 2	1972	35	419- 449	48	11/09	48	11/27	0
*5-676	394914	742546	USGS	COYLE AIRPT OBS	1961	199	530- 540	119	10/20	118	11/09	-1
*5-800	394732	744526	SHAMONG TWP	1	1978	85	200- 210	73	11/04	72	11/04	-1
*7-572	394100	745035	ELMTOWNE VIL ASSOC	1	[3]1979	110	304- 314	62	11/10	57	11/17	-5
*11- 44	392732	750929	CUMBERLAND COUNTY	VOCA SCH 3 OBS	1972	82	361- 376	12	11/15	7	11/16	-5
*11- 61	391926	751921	GRIFFITH, MAE	SEA BREEZE	1976	4	281- 354	-35	11/16	-45	11/22	-10
*11- 92	391746	751510	BAY PT ROD GUN	BAY POINT 2	1970	5	397- 417	-28	11/14	-37	11/22	-9
*11- 96	391829	751208	CUMBERLAND COUNTY	JONES ISL 2 OBS	1971	10	365- 375	-20	11/09	-28	11/22	-8
*11-163	392526	750643	CUMBERLAND COUNTY	FAIR GRDS 3 OBS	1972	80	463- 473	13	11/15	8	11/23	-5
11-341	[3]391938	751923	SOBUSIAK, WALTER	2	1974	4	300- 357	-35	11/15	-44	11/22	-9
*11-349	[3]391647	751233	VANDVELT, THOMAS	BEACH FRONT DOM	1979	5	380- 410	-28	11/21	-35	11/22	-7
*29- 2	394522	740636	BARNEGAT LT WD	BLWD 3	1969	7	597- 654	-40	11/03	-33	11/28	7
29- 4	394524	740632	BARNEGAT LT WD	BLWD 2	1954	7	593- 646	NM	NM	-33	11/28	NA
*29- 18	394829	740535	USGS	ISL BCH 2 OBS	1962	9	468- 474	0	[4]01/31	0	10/28	0
*29- 23	395423	740458	SHORE WC	SWC 2	1973	7	490- 527	-42	[4]01/31	-60	[5]01/04	-18
*29-115	395639	740854	ISL HGTS WD	IHWD 8	1963	12	115- 292	6	10/26	5	11/04	-1
29-117	395641	740853	ISL HGTS WD	IHWD 7	1910	3	299- 339	-1	10/24	-1	11/04	0
*29-425	395322	742252	USGS	WEBBS MLS 2 OBS	1962	128	[6]348	121	[4]04/03	118	11/01	-3
*29-537	395636	740439	SEASIDE HGTS WD	SHWD 2	1941	4	400- 430	-35	10/20	-30	11/30	5
29-541	395451	740455	SEASIDE PARK WD	SPWD 2	1932	10	[6]525	-30	[4]01/31	-56	11/30	-26
*29-582	395547	740434	SEASIDE PARK WD	4-R	1977	12	435- 485	-75	[4]01/31	-43	[5]01/04	32
*29-585	395028	741044	STATE OF NJ	DOE-FRKD R OBS	1978	15	412- 422	15	[4]03/08	15	10/28	0
*29-607	394454	740655	BARNEGAT LT WD	BLWD 4	1980	5	597- 662	-41	11/03	-34	11/28	7
*29-616	395528	740820	OCEAN GATE BORO WD	OGB 2	1937	7	340- 360	-6	10/21	-2	11/09	4
*29-739	400044	740957	OCEAN CO COLLEGE	REC FIELD 1	1970	20	200- 220	13	10/26	11	10/27	-2
29-808	395606	740445	SEASIDE PARK WD	SPWD 7	1979	5	395- 475	-58	[4]01/31	-30	11/30	28
29-809	395527	740826	OCEAN GATE BORO WD	OGBWD 4	1984	10	330- 370	NM	NA	+6	11/09	
*Id55-01	391026	753049	CITY OF DOVER	WHITE OAK RD	1965	20	329- 349	NM	NM	-132	11/15	NA
*Jd25-09	390834	753053	USGS (DEL)	ROOSEVELT AV 1	--	26	400- 440	NM	NM	-129	11/15	NA

[1] Datum is sea level.

[2] Depth below land surface.

[3] Revised from Eckel and Walker (1986).

[4] Water level measured in 1984.

[5] Water level measured in 1989.

[6] Well depth.

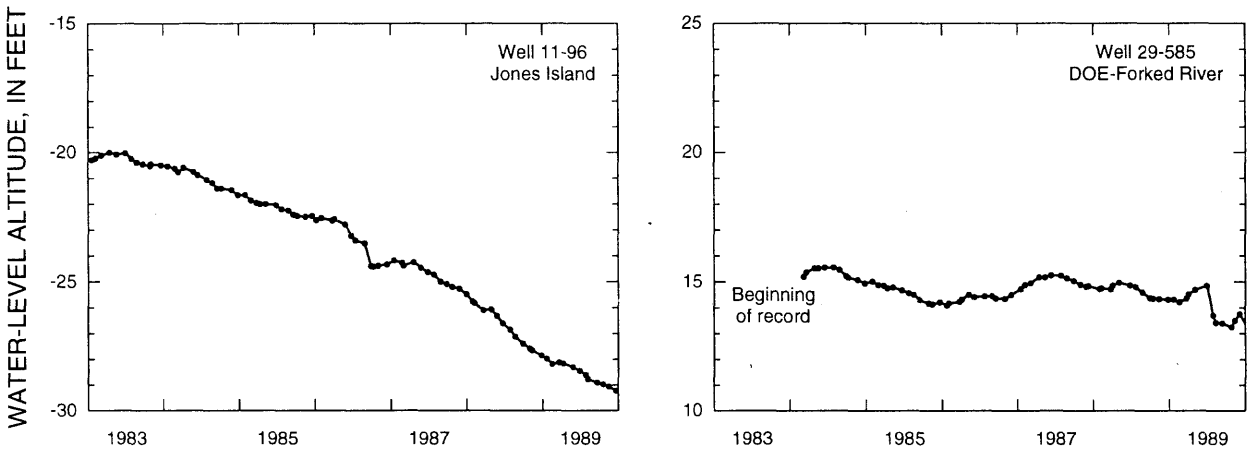


Figure 7. Water-level hydrographs for observation wells screened in the Piney Point aquifer, 1983-89.

Water Levels

Water-level measurements for 15 wells screened in the Vincentown aquifer are listed in table 6. The number of wells in New Jersey in which water levels were measured, by county, is as follows: Monmouth, 7; Ocean, 5; and Salem, 3. Water levels in these wells were used to define the potentiometric surface shown on plate 4, though only 14 wells are plotted. In 1988, 0.35 Mgal/d was withdrawn through public supply wells in Ocean County, compared to 0.07 Mgal/d in Monmouth County (table 1).

The outcrop area of the Vincentown aquifer trends northeast-southwest through the center of Monmouth County. Water levels in the county ranged from 27 to 91 ft above sea level; the highest water levels were measured in areas of high elevation or near areas of recharge (pl. 3). The lowest water levels were measured in wells far from the outcrop areas and at low elevations near the Atlantic Ocean.

The outcrop area of the Vincentown aquifer in Ocean County is a thin strip that trends northeast-southwest along the northwestern boundary of the county. Water levels measured during September 1988 through February 1989 ranged from 75 to 129 ft above sea level.

Water levels in wells in Salem County owned by the Salem City Water Department ranged from 1 ft above sea level to 9 ft below sea level. The water level in well 33-41 was 5 ft below sea level.

Water-Level Fluctuations

The water-level change was calculated for only one well (29-139) because the Vincentown aquifer was not included in the 1983 study. The water level in this USGS observation well did not change.

A hydrograph for observation well 29-139 screened in the Vincentown aquifer is shown in figure 8, and the well location is shown on plate 3. This well is located in western Ocean County. Seasonal water levels varied 1 to 2 ft. The hydrograph indicates that water levels varied little over the 5-year period.

Wenonah-Mount Laurel Aquifer

Water Levels

Water-level measurements for 138 wells screened in the Wenonah-Mount Laurel aquifer are listed in table 7. The number of wells in New Jersey in which water levels were measured, by county, is as follows: Burlington, 31; Camden, 18; Cumberland, 1; Gloucester, 14; Monmouth, 32; Ocean, 17; and Salem, 24. Water levels also were measured in one well in New Castle County, Delaware. The water levels in these wells were used to define the potentiometric surface shown on plate 4, though only 106 wells are plotted. Withdrawals from the Wenonah-Mount Laurel aquifer were greatest in Burlington, Camden, Monmouth, and Salem Counties (table 1; pl. 4).

Table 6. Water-level data for wells screened in the Vincentown aquifer, 1983 and 1988

[CH, Church; ft, feet; GC, Golf Course; INC, Incorporated; LIT LEAG, Little League; mo, month; MUA, Municipal Utility Authority; PK, Park; SYS, System; TWP, Township; TP, Trailer Park; USGS, U.S. Geological Survey; WC, Water Company; WD, Water Department; --, missing data; NM, not measured; NA, not applicable; wells marked with an asterisk are shown on plate 3]

Well number	Location: Lati-tude	Location: Longi-tude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Alti-tude[1] (ft)	1983: Date (mo/day)	Water level 1988: Alti-tude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
*25- 51	401507	740117	HOLLYWOOD GC	HOLLYWOD GLF 1	1954	50	124- 166	NM	NM	27	10/20	NA
*25-511	400953	741405	ALDRICH WC	ALDRICH W C 3A	1971	115	140- 195	NM	NM	90	10/25	NA
*25-636	401105	741202	USGS	HOWELL TWP 2 OBS	1987	112	85- 95	NM	NM	59	10/20	NA
*25-685	401708	740754	BAILEY, R E	OVERBROOK FM 1	1984	80	68- 76	NM	NM	61	10/21	NA
*25-688	401326	740834	CARY CHEMICALS	CARY CHEM 1	1985	110	11- 23	NM	NM	96	10/26	NA
25-691	401104	741109	MONMOUTH CO PK SYS	HOWELL PK GC 1	1986	50	5- 25	NM	NM	43	10/24	NA
*25-707	401056	741323	HOWELL TWP	HOWELL TWP MW-11	1984	114	66- 68	NM	NM	91	[3]02/22	NA
*29-139	400414	742702	USGS	COLL MILLS 2 OBS	1964	136	161- 171	129	10/27	129	10/27	0
*29-658	400700	741846	JACKSON BAPTIST CH	1	1977	115	202- 215	NM	NM	96	10/27	NA
*29-698	400616	742334	INDIAN ROCK TP	1	1979	130	120- 132	NM	NM	119	10/28	NA
*29-916	400850	741646	HOLBROOK LIT LEAG	HOLBROOK L LEAG	1983	125	139- 155	NM	NM	106	10/27	NA
*29-917	400850	741516	JACKSON TWP MUA	JACKSON MUA 11	1986	75	126- 186	NM	NM	75	10/25	NA
*33- 41	393016	752621	BURRELL, E	EB 1	1959	10	114- 165	NM	NM	-5	[3]01/10	NA
*33-240	393253	752425	SALEM CITY WD	SWD 3	1900	7	[4]140	NM	NM	1	[3]01/05	NA
*33-248	393339	752718	SALEM CITY WD	SCWD 2	1965	1	20- 24	NM	NM	-9	[3]01/05	NA

[1] Datum is sea level.

[2] Depth below land surface.

[3] Water level measured in 1989.

[4] Well depth.

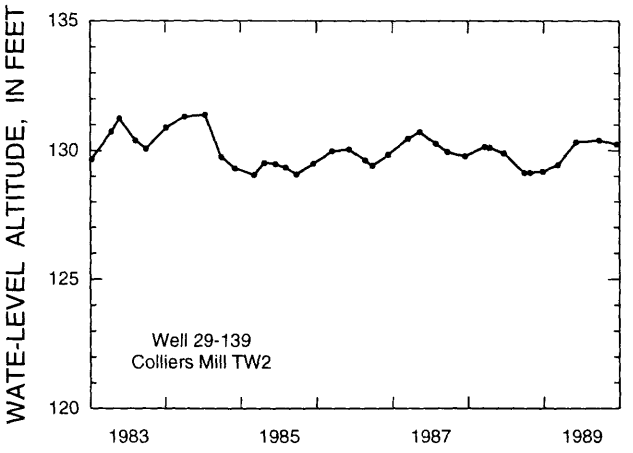


Figure 8. Water-level hydrograph for an observation well screened in the Vincentown aquifer, 1983-89.

The deepest and most extensive cone of depression in the Wenonah-Mount Laurel aquifer is in northeastern Ocean and southeastern Monmouth Counties (pl. 4). The deepest water level, 218 ft below sea level, was measured in well 25-391 in the Spring Lake Heights area. Water levels in the areas extending from Avon-by-the-Sea in the north to Point Pleasant in the south ranged from 155 ft to 180 ft below sea level. This cone coincides with the major cone of depression in the Englishtown aquifer system (pl. 5). The similarity of head distribution and the absence of significant local ground-water withdrawals from the Wenonah-Mount Laurel aquifer give validity to the vertical hydraulic connection between the two aquifers noted by Walker (1983, p. 37). A less prominent and more localized cone of depression with water levels as low as 62 ft below sea level (well 5-367) is centered in northeastern Burlington County.

A localized cone of depression with water levels more than 40 ft below sea level formed in northern Camden County between 1983 and 1988. This cone probably is the result of increased ground-water withdrawals for local industry and public supply.

The highest water levels were measured in wells along the outcrop areas that, for the most part, coincide with the topographic highs in northern Burlington and Monmouth Counties. Water levels were more than 120 ft above sea level in Burlington County and 140 ft in western Monmouth County.

Water-Level Fluctuations

Water-level changes in 94 wells over the 5-year period were calculated. Water levels rose in 13 wells, declined in 77 wells, and were unchanged in 4 wells. Regional ground-water withdrawals increased during 1983-88 as indicated by the increase in the number of wells in which water levels declined (Eckel and Walker, 1986, table 7).

Low transmissivities in the Wenonah-Mount Laurel aquifer cause water levels to recover slowly (after high-capacity pumps are shut down). Average time to obtain 90 to 95 percent recovery of static water-level conditions is usually 3 to 5 hours.

Water-level declines were greatest in the Spring Lake Heights area of Monmouth County; the maximum water-level decline over the 5-year period was 52 ft in well 25-391. Such a large decline may be explained by one, or any combination, of these factors: (1) increased ground-water withdrawals in the area; (2) increased vertical leakage to, and withdrawals from, the underlying Englishtown aquifer system; (3) slower than expected recovery time for production wells in the area of Spring Lake Heights; and (4) inaccurate airline measurements and difficulty in duplicating water-level (tape) measurements as a result of well-construction characteristics.

In Burlington County, water levels declined as much as 31 ft in wells 5-464 and 5-720. Local ground-water pumping at the time of each water measurement played a major role in this large decline (L.A. Sioma, U.S. Geological Survey, oral commun., 1988). In general, water-level declines in the county ranged from 1 to 13 ft.

Water levels in Camden County declined as much as 29 ft, and declines of 20 ft or more were common over much of the county. Water-level changes in wells adjacent to the outcrop area in Camden County ranged from 5-ft declines to no change for the 5-year period.

Water-level data for 1983 and 1988 are sparse for Gloucester County. Water levels probably remained relatively stable over the 5-year period because the Wenonah-Mount Laurel aquifer has remained undeveloped with respect to large-scale, public-supply withdrawals.

In Salem County at Artificial Island, water levels rose as much as 11 ft. These increases probably were caused by reduced local withdrawals and do not reflect regional trends. Water levels were unchanged or declined 2 to 3 ft over the 5-year period in wells located far from pumping centers.

Hydrographs for five wells screened in the Wenonah-Mount Laurel aquifer are shown in figures 9A and 9B, and well locations are shown on plate 4. Water levels in observation well 7-478, located about 5 mi from local pumping centers in south-central Camden County, indicate a downward trend. The hydrograph for well 7-478 shows that static head declined more than 18 ft over the 5-year period. The decline probably is the result of an increase in local ground-water withdrawals from the aquifer. Water levels in observation wells 25-353, 25-486, and 29-140 are affected by ground-water withdrawals. The water-level hydrograph for well 25-353 shows a 3-ft decrease in head from 1984 through 1988 (table 7). The water-level hydrograph shows seasonal variations of as much as 4 ft. Observation well 25-486 is located in southeastern Monmouth County along the Atlantic Coast near the center of the cone of depression. Seasonal water-level variations are about 12 ft. Well 29-140 is located in northwestern Ocean County about 6 mi east of the outcrop. Water levels rose about 3 ft from 1983 to 1985, declined throughout 1985, and remained relatively unchanged from 1986 through 1988.

Heads in the underlying Englishtown aquifer system are 20 ft lower than those in the Wenonah-Mount Laurel aquifer in southeastern Monmouth County. (See tables 9 and 10 for wells 25-429 and 25-426, respectively.) Similar patterns can be seen in the hydrographs for well 29-140 (fig. 9A), screened in the Wenonah-Mount Laurel aquifer, and well 29-138 (fig. 11, farther on), which is at the same location but screened in the Englishtown aquifer system. The difference in head between the aquifers indicates significant downward vertical leakage through the confining layer between these aquifers (Nemickas, 1976; Nichols, 1977a).

Observation well 33-252 is screened in the shallow area of the confined part of the Wenonah-Mount Laurel aquifer at Salem, Salem County. The hydrograph shows little change in water levels over the 5-year period (fig. 9B). Seasonal water levels vary as much as 2.5 ft.

Englishtown Aquifer System

Water Levels

Water-level measurements for 89 wells screened in the Englishtown aquifer system are listed in table 8. The number of wells in New Jersey in which water levels were measured, by county, is as follows: Burlington, 9;

Table 7. Water-level data for wells screened in the Wenonah-Mount Laurel aquifer, 1983 and 1988

[AMER, America; BD ED, Board of Education; CHP, Chapel; CHEM, Chemical; CH, Church; COMP, Company; CORP, Corporation; D, Domestic; DEL, Delaware; E-G, Electric-Gas; ENG, Engineering; ft, feet; FP, Food Production; HT, Heights; INC, Incorporated; LK, Lake; MUA, mo, month; Municipal Utility Authority; NJ, New Jersey; REST, Restaurant; SCH, School; TC, Treatment Center; TWP, Township; USGS, U.S. Geological Survey; UNIV, University; VIL, Village; VOC, Vocational; WC, Water Company; WD, Water Department; --, missing data; NM, not measured; NA, not applicable; wells marked with an asterisk are shown in plate 4]

Well number	Location: Lati-tude	Location: Longi-tude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Alti-tude[1] (ft)	1983: Date (mo/day)	Water level 1988: Alti-tude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
*5-245	395112	745123	MEDFORD TWP WD	MTWD 4/5	1950	57	230- 252	30	11/03	19	11/07	-11
*5-247	395145	745111	MEDFORD TWP WD	MTWD 2	1950	52	180- 200	NM	NM	24	11/07	NA
*5-257	395516	745103	JOHNSON, W E JR	JOHNSON NEW	1965	80	[3]90	25	11/02	27	10/25	2
5-352	395801	744120	PEMBERTON WD	PBWD 3	1968	62	132- 163	43	10/31	39	10/31	-4
*5-354	395813	743950	SUNBURY VILLAGE	SVWC 1	1953	62	178- 198	39	11/03	36	11/04	-3
*5-355	395826	744109	PEMBERTON WD	PBWD 1	1939	81	155- 185	38	10/31	38	10/31	0
*5-359	395727	744118	LAKE VALLEY WC	LVWC 1	1967	70	181- 242	35	11/07	37	10/31	2
*5-365	395752	743452	PEMBRTON TWP WD	PTWD 4	1960	93	290- 330	-5	11/02	-13	11/03	-8
*5-366	395755	743239	PEMBRTON TWP WD	PTWD 4 INCH OB	1972	90	301- 323	-48	11/02	-61	11/03	-13
5-367	395755	743239	PEMBRTON TWP WD	PTWD 6	1972	90	308- 338	NM	NM	-62	11/03	NA
5-368	395755	743239	PEMBRTON TWP WD	PTWD 7	1972	90	300- 332	NM	NM	-59	11/03	NA
*5-389	395958	743933	PEMBERTON TWP SCH	HIGH SCH 1	1959	80	140- 150	64	11/04	63	11/01	-1
*5-427	395330	744205	HAMPTON LAKE WC	HLWC 2	1971	70	260- 348	-8	10/31	-13	11/01	-5
5-428	395342	744253	HAMPTON LAKE WC	HLWC 1	1956	49	247- 268	9	10/31	4	11/01	-5
*5-430	395541	744415	VINCENTOWN WC	VINCENTOWN	1923	40	[3]153	27	11/02	25	11/01	-2
5-464	395120	744535	ALLENWOOD MOBEST	TRAILER PARK 1	1969	[4]120	[3]381	[4]4	11/04	-27	11/09	-31
*5-695	395328	743720	SUNY PINE CONT	TEST HOLE 1-74	1974	111	428- 496	27	12/29	24	11/14	-3
*5-720	395112	744535	ALLENWOOD MOBEST	ALLEN 2	1978	125	[3]410	22	11/04	- 8	11/15	-30
*5-724	395413	744231	HAMPTON LAKE WC	HLWC 3	1977	43	199- 275	15	10/31	6	11/01	-9
*5-725	400212	743708	WRIGHTSTOWN MUA	WMUA 2	1971	[4]145	142- 162	[4]126	10/26	125	10/27	-1
*5-744	395639	742953	WHITE J J COMP	DOMEST 66	1966	100	[3]456	-13	11/15	-21	11/04	-8
*5-796	[4]395829	743503	DEBORAH HOSP	3	1981	110	285- 315	0	11/15	-8	11/04	-8
*5-1004	395801	744344	LAKE VALLEY WC	LVWC-2	1982	65	209- 254	NM	NM	10	11/02	NA
5-1022	400232	743700	SPARTAN VILLAGE	SPARTAN 1-1965	1965	147	130- 150	NM	NM	128	10/27	NA
5-1076	400112	744356	STEVENSON SUPPLY	STEVENSON SUPP	1985	57	137- 142	NM	NM	34	11/03	NA
5-1079	395353	745112	HADDON HOUSE FP	HADDON HSE DOM	1984	65	101- 129	NM	NM	55	11/06	NA
*5-1080	395353	745112	HADDON HOUSE FP	HADDON HSE OFC	1984	65	99- 130	NM	NM	55	11/06	NA
*5-1082	395941	744720	TIDSWELL III, B	TIDSWELL DOM	1982	35	82- 92	NM	NM	9	11/04	NA
*5-1086	395753	743706	THOMPSON, STÉPHAN	THOMPSON DOM	1985	55	242- 247	NM	NM	6	11/04	NA
*5-1087	395333	744441	RED LION FAITH CHP	RED LION DOM	1984	55	227- 232	NM	NM	11	11/03	NA
*5-1090	395427	744425	MONROE, GEORGINA	NEW MONROE DOM	1988	46	165- 175	NM	NM	-24	11/28	NA
*7- 17	394705	745444	OWENS CORNING	1	1951	160	410- 440	NM	NM	-41	11/14	NA
*7- 22	394738	745614	BERLIN WD	BWD 8	1952	147	310- 360	31	[5]02/14	11	11/15	-20
*7-118	395229	745712	NJ AMER WC	HUTTON HL 2 OBS	1965	[4]158	137- 147	[4]70	12/09	68	11/18	-2
7-180	394923	745714	US AIR FORCE	RADAR 2	1960	193	280- 310	62	11/09	39	11/04	-23
7-181	394927	745715	US AIR FORCE	RADAR 1	1959	191	[3]290	56	11/09	41	11/04	-15
*7-228	394556	745835	CAMDEN CO BD ED	VOC&TECH H S 1	1967	145	325- 400	37	11/10	8	11/03	-29
7-305	394927	750024	NJ AMER WC	LAUREL 1	1918	77	[3]120	NM	NM	54	11/02	NA
7-307	394928	750021	NJ AMER WC	LAUREL 8	1920	77	105- 125	58	11/16	58	11/02	0
*7-308	394928	750021	NJ AMER WC	LAUREL 10	1923	77	[3]126	58	11/16	56	11/02	-2
7-391	394639	745750	L CAMDEN CO REG	OVERBROOK HS 1	1971	160	315- 335	29	11/10	8	11/15	-21
*7-401	394722	745810	PINE VALLEY GC	GOLF CLUB	1955	85	[3]267	43	11/21	23	11/01	-20
*7-414	394922	745633	NJ AMER WC	ELM TREE 26	1960	150	237- 275	51	11/09	36	11/04	-15
*7-421	395109	745715	RADIO CORP OF AMER	RCA	1955	175	220- 234	91	11/01	89	11/16	-2
*7-449	394618	745413	WINSLOW WC	WINSLOW TWP 5	1965	159	420- 460	19	11/04	-4	11/21	-23
*7-478	394215	745617	USGS	NEW BKLYN 3 OBS	1961	[4]111	520- 530	[4]39	11/08	21	11/18	-18
*7-512	394522	745625	JOHNS-MANVILLE	TEST HOLE 1	1963	160	[3]890	NM	NM	-11	11/03	NA
7-513	394532	745623	JOHNS-MANVILLE	3	1974	170	410- 460	NM	NM	-1	11/03	NA
*7-526	394932	745847	LINDENNWALD B MUA	SEWAGE PL2	1972	78	138- 158	66	11/01	61	11/01	-5
*11- 72	392442	751918	CUMBERLAND COUNTY	SHEPPARDS 1	1972	[4]32	603- 623	[4]10	10/05	8	11/22	-2
*15- 14	394827	750758	THOMPSON, MARION	DEPTFORD TWP	1953	102	83- 107	74	11/07	75	11/08	1
*15- 31	394001	751234	MOOD, RICHARD J	1	1954	125	[3]285	72	11/15	70	11/09	-2
*15-125	394324	751315	CHRISTIAN CH	1	1950	92	84- 105	61	11/07	59	11/09	-2
15-262	393955	751100	GANT, CARLTON	GANT DOM	1953	142	107- 125	NM	NM	27	11/18	NA
*15-367	394234	751307	GANGEMI, VICENT	1	--	73	[3]500	68	11/15	66	11/09	-2
*15-542	394147	750654	RON SON MUSHROOM	1	1980	150	265- 295	NM	NM	73	11/17	NA
*15-687	394638	751201	US EPA	KRAMER LF X-6S	1984	28	6- 24	NM	NM	21	12/13	NA
*15-910	394155	751401	WOLFSON, BENJAMIN	WOLFSON DOM 81	1981	84	140- 160	NM	NM	58	11/17	NA
*15-953	394718	750604	WEHRAN ENG	DW-2	1972	81	86- 100	NM	NM	56	11/16	NA
15-956	394722	750633	WEHRAN ENG	KINSLEY LNDFL 2	1973	72	60- 65	NM	NM	51	11/16	NA

Footnotes at end of table

Table 7. Water-level data for wells screened in the Wenonah-Mount Laurel aquifer, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983-88) (ft)
*15-1009	394426	750633	FLAHERTY, JOSEPH	FLAHERTY DOM	1984	100	149- 178	NM	NM	65	12/14	NA
15-1011	394023	751208	STAUB, JOHN R	STAUB DOMESTIC	1983	140	265- 275	NM	NM	66	11/18	NA
15-1038	394350	751910	GRASSO, JOSEPH S	GRASSO FOODS	--	94	[3]39	NM	NM	77	11/09	NA
*15-1040	394257	751825	SPRINGFIELD FARMS	SPRNGFLD FRMS 2	1988	120	77- 87	NM	NM	77	11/15	NA
25- 11	401136	740120	AVON WD	AWD 2	1925	22	419- 501	-165	10/25	-180	10/21	-15
*25- 164	400839	741439	HOWELL TWP MUA	ALDRICH W CO 1	1956	125	349- 370	-39	10/21	-56	10/25	-17
*25- 168	400957	741305	HOWELL TWP MUA	ALDRICH W CO 2	1960	150	354- 440	-54	10/21	-66	10/25	-12
*25- 173	401244	741135	NJ CONCRETE COMP	HOWELL TWP[4]	1965	90	226- 257	23	10/24	19	10/29	-4
25- 182	401629	741015	DISEPALO, MARTIN	1	1963	125	229- 236	63	10/19	[6]55	01/23	-8
*25- 185	401438	741025	NAD EARLE	TRANS DEPOT S7	1958	119	229- 250	60	10/26	56	10/25	-4
*25- 243	401854	741325	IENTILE, F J	MARLBORO TWP[4]	1963	120	[3]80	87	10/19	86	10/26	-1
*25- 335	401215	740409	WARDELL DAIRY	WARDELL 1	1941	80	465- 480	-128	10/26	-146	10/26	-18
*25- 353	401542	740530	US ARMY	FM 1-NCO OBS	1972	140	321- 327			-15	10/31	
*25- 366	402048	740109	RUMSON C C	RUMSON C C 1	1910	15	[3]165	12	10/20	11	10/20	-1
*25- 391	400928	740211	SPRING LK HT WD	SPRING LK HGT4	1974	20	485- 561	-166	10/26	-218	12/29	-52
*25- 392	400617	743037	HOPKINS, RUSSELL	U FREEHOLD TWP[4]	--	[4]80	[3]87	83	[5]02/03	80	10/28	-3
*25- 396	400658	743135	RUTGERS UNIV	1	1970	122	92- 102	85	10/26	83	10/27	-2
*25- 405	401005	742913	PUNK BROS	3	1964	158	[3]124	128	11/02	126	10/28	-2
25- 409	401000	742907	PUNK BROS	1	1965	140	[3]125	132	11/02	129	10/28	-3
*25- 412	401045	742821	ERB, GEORGE H	1	1966	190	100- 140	145	11/02	147	10/28	2
*25- 426	400817	740744	THOMPSON HOME	GERALDINE M H2	--	120	[3]580	-115	10/28	-129	10/24	-14
*25- 435	400942	740756	STATE OF NJ	ALLAIRE S P 4	1973	63	385- 414	-93	10/20	-104	10/26	-11
*25- 478	400642	741312	AMERADA HESS	2-79	1979	65	377- 392	-119	10/28	-124	10/27	-5
*25- 486	400711	740202	STATE OF NJ[4]	DOE-SEA GRT OBS	1978	10	604- 614	-171	[5]03/20	-185	10/28	-14
*25- 490	400958	740843	STATE OF NJ	ALLAIRE SP 1	--	50	[3]420	-88	11/03	-96	10/26	-8
25- 520	401026	741903	FRONC, WALTER	HOWELL TWP[4]	1980	150	232- 240	88	11/01	85	10/24	-3
*25- 521	401020	741937	AMARESCU, DONALD	FREEHOLD TWP	1979	150	222- 228	NM	NM	99	10/21	NA
*25- 524	401125	741703	CRONIN	FREEHOLD TWP[4]	1979	130	[3]205	64	11/01	61	10/27	-3
25- 529	400647	741313	GAS LITE REST	HOWELL TWP	1962	54	375- 385	-114	11/18	-118	[6]1/12	-4
*25- 533	400816	741334	MOON MOTEL	1	1966	120	349- 365	-61	11/01	-74	10/24	-13
25- 542	400953	740726	BRISBANE CHILD TC	2	--	70	430- 450	-97	10/28	-113	10/26	-16
*25- 546	400713	741016	DUTTON, ANTHONY	1	1983	40	420- 445	NM	NM	-143	10/28	NA
*25- 637	401105	741202	USGS	HOWLL TWP 3 OBS	1987	112	307- 317	NM	NM	-28	10/20	NA
*25- 687	401756	740258	EATONTOWN SR CTZ	EATONTOWN SR H	1985	40	177- 187	NM	NM	21	10/20	NA
25- 690	401211	741200	HARWOOD COMP	HARWOOD CO 7	1985	80	100- 110	NM	NM	54	10/29	NA
*25- 696	402019	740456	RED BANK BORO	RED BK LNDFL M3	1984	30	13- 33	NM	NM	13	10/25	NA
*29- 31	400234	740814	BRICK TWP BD ED	EMMA YOUNG 1	1965	17	605- 625	-120	11/18	-129	10/27	-9
*29- 36	[4]400410	740917	BRICK TWP BD ED	HIGH SCHOOL	1970	25	518- 548	-136	10/28	-151	10/27	-15
*29- 37	400429	740652	ST DOMINICS CH	1	1964	20	576- 591	-141	10/26	-155	10/02	-14
*29- 49	400505	740649	BRICK TWP BD ED	VET MEMORL SCH	1970	20	556- 586	-144	10/28	-158	12/02	-14
*29- 140	400414	742702	USGS	COLL MLLS 3 OBS	1964	[4]135	257- 267	[4]114	09/29	112	10/27	-2
29- 227	400604	741915	MEADOWBRK VILL	HOLMANSVILLE 1	1966	110	[3]358	38	10/24	48	11/19	10
*29- 234	400809	742532	GREAT ADVENTURE	[4]GA 2	1974	170	180- 200	160	10/31	131	10/25	-29
29- 603	400239	740820	BRICK TWP BD ED	DRUMPT SCHOOL	--	20	[3]580	-119	11/03	-113	10/27	6
*29- 699	400915	742336	JACKSON TWP BD ED	GETZ SCHOOL	1973	160	214- 226	124	11/02	121	10/27	-3
*29- 713	400636	742102	JACKSON TWP	LIBRARY	1978	130	318- 324	83	10/21	82	11/03	-1
*29- 740	400352	742145	OCEAN CO VOC SCH	JACKSON 2	1976	105	340- 380	41	10/20	39	11/03	-2
*29- 781	400622	741957	IVINE, WILLARD	JACKSON TWP	1977	110	302- 325	NM	NM	40	11/19	NA
*29- 782	400709	741525	POPOVITCH, DAN	JACKSON TWP	1978	120	375- 381	NM	NM	-41	11/01	NA
*29- 783	400745	741817	FOUNTAIN HEAD PK	JACKSON TWP	1979	[4]115	310- 325	[4]52	11/01	42	11/19	-10
*29- 784	400550	741808	EMMUS, ROLAND	JACKSON TWP	1980	90	341- 347	NM	NM	2	10/28	NA
*29- 786	[4]400630	741730	JACKSON TWP	HULSE RD 1	1977	110	364- 379	0	10/21	-3	11/19	-3
*29- 926	400610	742728	JELLYSTONE PARK	JELLYSTONE 3	1987	105	127- 160	NM	NM	109	10/27	NA
*33- 2	393202	751630	CUMBERLAND COUNTY	BOSTWICK NO 3	1972	85	462- 472	22	11/07	20	11/15	-2
*33- 8	393330	751817	STRANG, ARNOLD	STRANG 1	1949	70	322- 345	NM	NM	20	11/15	NA
*33- 20	393534	751752	HORNER, EPHRAIM	HORNER OBS	1929	[4]77	[3]283	[4]32	11/07	30	11/16	-2
*33- 22	393533	751018	ELMER WC	EWC 6	1963	105	460- 500	30	11/07	27	11/18	-3
*33- 32	392740	753201	PUBLIC SERV E-G	PW 3	1970	[4]12	242- 293	[4]-12	11/17	-1	11/21	11
*33- 33	392751	752441	L ALLOWAY CR SC	LACTES 1	1964	14	[3]340	4	12/08	7	11/22	3
33- 34	392742	753200	PUBLIC SERV E-G	PW 1	1968	17	248- 298	-5	11/17	4	11/21	9
33- 35	392744	753206	PUBLIC SERV E-G	PW 2	1970	[4]9	230- 281	[4]-14	11/17	-3	11/21	11
*33- 50	393538	752640	SALEM MEM HOSP	HOSP 1-1950	1950	20	73- 97	6	11/07	4	11/17	-2
*33- 56	393606	752524	MANNINGTN T E S	MTES 1	1959	25	[3]93	8	11/07	6	11/17	-2
*33- 192	394051	752148	KELLY BROTHERS	2-1954	1954	60	45- 65	44	11/17	43	11/15	-1
*33- 241	393253	752422	SALEM CITY WD	QUINTON	--	10	[3]248	4	11/09	6	11/17	2

Footnotes at end of table

Table 7. Water-level data for wells screened in the Wenonah-Mount Laurel aquifer, 1983 and 1988--Continued

Well number	Location: Lati-tude	Location: Longi-tude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Alti-tude[1] (ft)	1983: Date (mo/day)	Water level 1988: Alti-tude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
33-244	393404	752811	SALEM CITY WD	SWD 4	1947	10	93- 124	1	11/09	2	11/17	1
33-245	393337	752719	SALEM CITY WD	SCWD 5	1961	8	96- 168	0	11/09	-8	11/17	-8
33-249	393342	752718	SALEM CITY WD	SWD 2	1936	5	110- 150	-2	11/09	-5	11/17	-3
*33-252	393348	752755	USGS	SALEM 2 OBS	1965	[4]3	91- 96	0	09/29	0	11/22	0
*33-351	393903	751941	LAZOZ, TED	WOODSTOWN R&D	1950	45	84- 116	NM	NM	30	11/14	NA
*33-381	393453	752709	MANNINGTN MILLS	MILLS 6	1977	10	85- 125	0	11/07	1	11/17	1
*33-384	[4]393126	752521	WILD OAK CC	1-IRR-73	1973	20	[3]320	6	11/08	6	[6]01/10	0
*33-456	393507	751045	ELMER WC	EWC 8	1982	125	443- 503	28	11/07	27	11/18	-1
*33-553	393700	752538	SEABROOK, JOHN M	SALEM FARMS	1984	5	20- 50	NM	NM	1	12/13	NA
*33-664	393734	752111	RED BIRD EGG COMP	GRDN ST EGG 2	1975	65	123- 166	NM	NM	35	11/09	NA
33-665	393846	752012	BADER, LOUIS	BADER 30-02302	1980	60	103- 140	NM	NM	31	11/09	NA
*33-670	393355	751915	LICCIARDELLO, MARK	LICCIARDELLO DM	1987	64	310- 320	NM	NM	18	11/15	NA
*Gd33- 04	392212	753243	USGS (DEL)	DEAKYNEVILLE 4	--	18	394- 427	NM	NM	2	11/14	NA

[1] Datum is sea level.

[2] Depth below land surface.

[3] Well depth.

[4] Revised from Eckel and Walker, 1986.

[5] Water level measured in 1984.

[6] Water level measured in 1989.

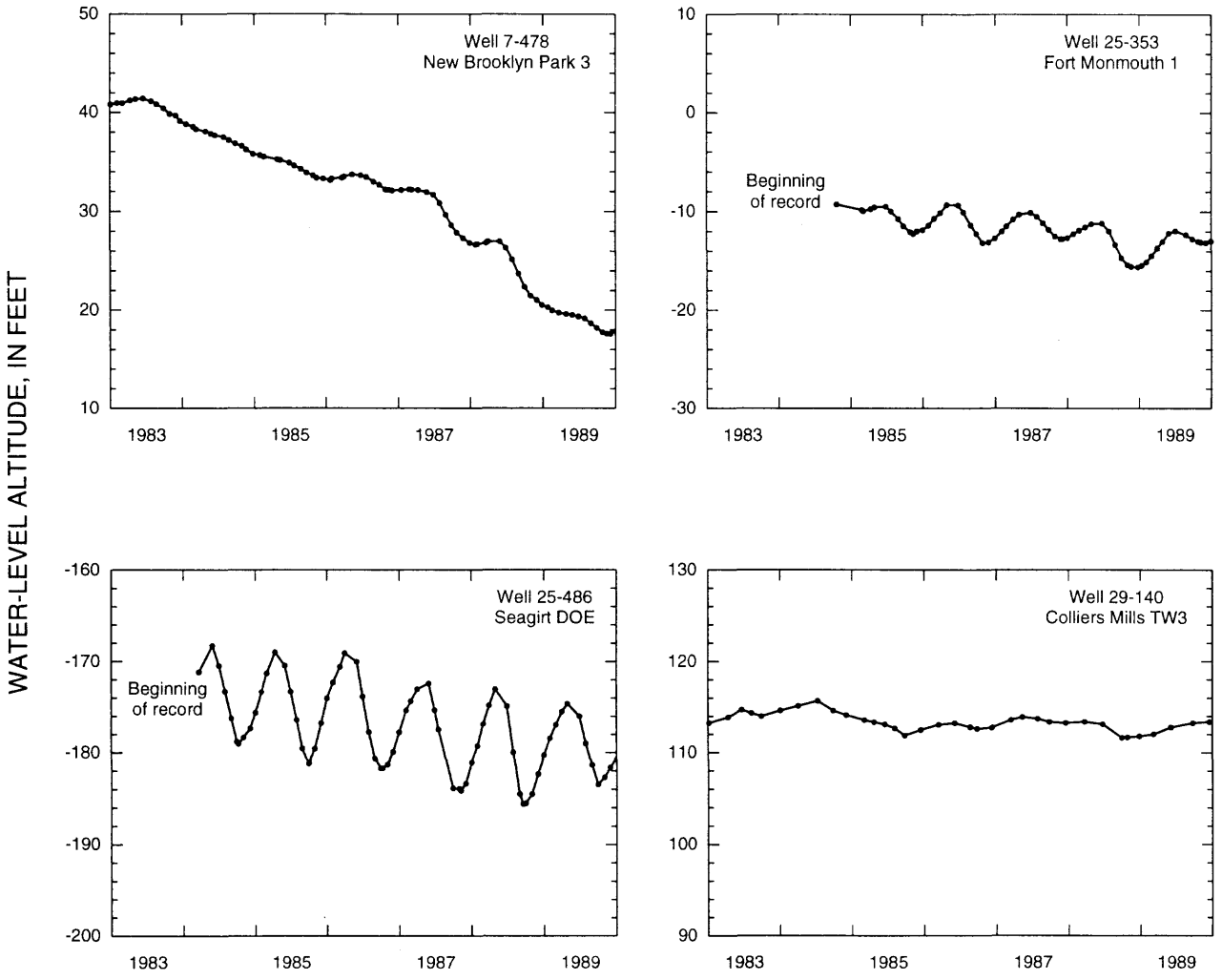


Figure 9A. Water-level hydrographs for observation wells screened in the Wenonah-Mount Laurel aquifer, 1983-89.

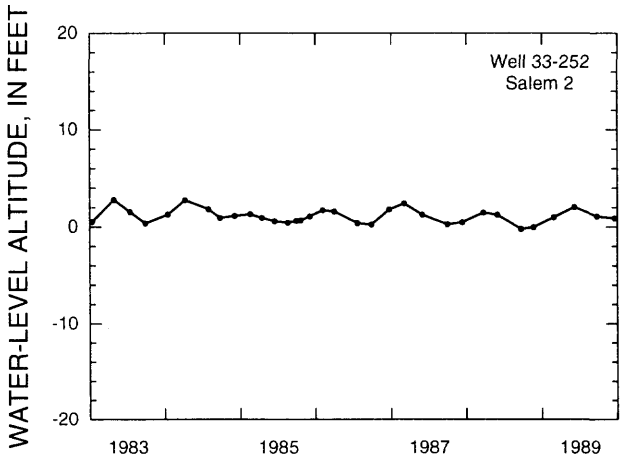


Figure 9B. Water-level hydrograph for an observation well screened in the Wenonah-Mount Laurel aquifer, 1983-

Camden, 4; Gloucester, 2; Middlesex, 2; Monmouth, 46; Ocean, 25; and Salem, 1. The water levels in these wells were used to define the potentiometric surface shown on plate 5, though only 75 wells are plotted. Withdrawals from the Englishtown aquifer system were greatest in southeastern Monmouth and northeastern Ocean Counties (table 1; pl. 5).

The center of the cone of depression in the Englishtown aquifer system is located near the Atlantic Coast in the Spring Lake Heights area of Monmouth County. Water levels greater than 200 ft below sea level were common in this area (pl. 5). Water levels in the Englishtown aquifer system were lower than those in the upper and middle aquifers of the Potomac-Raritan-Magothy aquifer system, but ground-water withdrawals from the Englishtown aquifer system were smaller (table 1). Low transmissivities of aquifer material in the Englishtown aquifer system account for the low water levels (Nichols, 1977b, p. 59). The highest water levels, as much as 122 ft above sea level, were measured in northwestern Ocean and Monmouth Counties near the outcrop area. Many of the potentiometric-surface contours in central and eastern Ocean County are approximations because water-level data for the region are sparse (pl. 5).

The Englishtown aquifer system consists of the upper and lower sand facies of the Englishtown Formation (Nichols, 1977a, p.20). The potentiometric surface shown on plate 5 represents the upper sand facies where it is separated from the lower sand facies by a confining unit; water levels in the lower sand facies, although shown on plate 5, were not used in contouring the potentiometric surface. Water levels measured in two public supply wells, 29-438 and 29-449, in the Lakewood area are a composite of the water levels in the upper and lower sands. The water level in observation well 29-441 located nearby, but screened only in the lower sand, was 21 ft higher than the water level in well 29-438 and 49 ft higher than that in well 29-449. In east-central Ocean County, the upper sand facies is thin and is not used for water supply. In wells 29-433, 29-452, 29-454, and 29-534, all screened in the lower sand, static heads were 86 to 184 ft below sea level.

Water-Level Fluctuations

Water-level changes for 70 wells were calculated for the 5-year period. Water levels rose in 20 wells, declined in 42 wells, and were unchanged in 8 wells. Some of the water-level changes listed in table 8 may be misleading for the following reasons. (1) The transmissivity of the Englishtown aquifer system is low, and water levels may still have been recovering at time of measurement. Average time for water-level recovery in the Englishtown aquifer system is 3 to 5 hours, whereas average recovery time in the Potomac-Raritan-Magothy aquifer system is 1 hour. (2) Accurate water-level measurements are progressively more difficult to obtain with increasing depth to water; airline measurements are the least accurate.

Water levels declined in southwestern Monmouth County. Heads declined as much as 26 ft in the Spring Lake Heights area (well 25-388) and 34 ft in the Belmar area (well 25-23).

As a result of the decrease in ground-water withdrawals from the Englishtown aquifer system in the Lakewood area, water levels rose 5 to 42 ft. Similar increases occurred in Point Pleasant Township. Water levels in wells near Lavallette and Brielle rose 11 to 24 ft (pl. 5; table 8).

Water levels in USGS observation wells in Camden, eastern Monmouth, and southeastern Ocean Counties, distant from pumping centers, were unchanged or rose over the 5-year period.

Hydrographs for five wells screened in the Englishtown aquifer system are shown in figures 10 and 11; well locations are shown on plate 5. Observation well 25-429 (fig. 10) is located in southern Monmouth County. Long-term water levels show a slight downward trend; however, water levels in this well can vary seasonally as much as 20 ft because of nearby ground-water withdrawals. Observation well 5-259 (fig. 11) is located in northern Burlington County, distant from any major pumping centers; however, water levels declined as much as 25 ft during summer in 1985, 1986, and 1987 when a nearby well was used for irrigation. The long-term trends indicate that these ground-water withdrawals have little effect on the regional water level. Observation well 29-138 is located in northwestern Ocean County about 12 mi west of Lakewood. The hydrograph for this well shows that water levels declined about 4 ft over the 5-year period. Observation well 29-534 in northern Ocean County is screened in the lower sand facies of the aquifer. Long-term water levels were unchanged over the 5-year period, whereas seasonal variations typically were less than 2 ft. Water levels in observation well 29-503 in Ocean County south of Point Pleasant varied as much as 16 ft as a result of nearby ground-water withdrawals. Long-term water levels remained unchanged.

Potomac-Raritan-Magothy Aquifer System

The Potomac Group and Raritan and Magothy Formations form the Potomac-Raritan-Magothy aquifer system which, depending on location, has been divided into two or three aquifers (Zapecza, 1989, p. 8-10). In the northern part of the New Jersey Coastal Plain, the upper and middle aquifers are laterally continuous with the Old Bridge aquifer (primarily the Old Bridge Sand Member of the Magothy Formation) and the Farrington aquifer (primarily the Farrington Sand Member of the Raritan Formation), respectively.

Withdrawals from the upper aquifer were greatest in the northwestern parts of Burlington, Camden, and Gloucester Counties and in Middlesex and Monmouth Counties (table 1; pl. 6). Withdrawals from the middle aquifer were greatest in the area from northwestern Burlington County to northwestern Gloucester County (table 1; pl. 7). The lower aquifer, which is present in the western parts of Burlington, Camden, Gloucester, and Salem Counties, is recognizable in the subsurface for about 8 to 12 mi downdip from the northwestern extent of the undifferentiated outcrop area of the Potomac Group and Raritan Formation (Zapecza, 1989, p. 8-10). Withdrawals from the lower aquifer were greatest in the northwestern parts of Gloucester, Camden, and Burlington Counties (table 1; pl. 8). Between Salem County and northern Burlington County, the middle aquifer is present in the subsurface within a 10- to 12-mi-wide band that parallels the outcrop area. Southeast of this band, the lower and middle aquifers have not been differentiated (Zapecza, 1989, pls. 3-7). In this report, all wells screened in the undifferentiated part of the Potomac-Raritan-Magothy aquifer system have been assigned to the middle aquifer in all tables, figures, and plates.

Table 8. Water-level data for wells screened in the Englishtown aquifer system, 1983 and 1988

[AMER, American; AUCT, Auctioneers; BDC, Bridge Development Corporation; BD, Board of Education; HS, High School; COMP, Company; CRNR, Corner; CORP, Corporation; CO, County; CC, Country Club; DEV, Development; DR, Drive; EL, Elementary; EPA, Environmental Protection Agency; ft, feet; GC, Golf Course; HT, Heights; HOSP, Hospital; INC, Incorporated; IND, Industrial; I, Institution; LF, Landfill; mo, month; MUA, Municipal Utility Authority; NJ, New Jersey; OLYMPIA & YORK, Olympia and York Bridge Development; PK, Park; PT, Point; SCH, School; SNR CTZ, Senior Citizens; ST, State; TELE, Telephone; TWP or T, Township; USGS, U.S. Geological Survey; WC, Water Company; WD, Water Department; --, missing data; NM, not measured; NA, not applicable; wells marked with an asterisk are shown on plate 5]

Well number	Location: Lati-tude	Location: Longi-tude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Alti-tude[1] (ft)	1983: Date (mo/day)	Water level 1988: Alti-tude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
*5-195	395833	745042	THOMAS, ALFRED	THOMAS D-1	1954	60	70- 74	23	10/31	22	10/25	-1
*5-197	395653	744921	JONES, LESTER	LUMBERTON TWP[3]	1953	41	148- 159	25	11/04	19	10/25	-6
*5-259	395524	745025	USGS	MEDFORD 2 OBS	1963	73	253- 263	20	09/30	24	11/07	4
*5-296	395521	745344	RUDDEROW, J E	SPRING VALLEY2	--	60	[4]135	NM	NM	57	12/19	NA
*5-375	395807	743837	BURLINGTON CO I	BUR CO INST 3	1956	70	343- 378	29	11/02	25	11/03	-4
5-378	395815	743840	BURLINGTON CO I	BUR CO INST 5	1972	65	328- 368	31	11/02	29	11/04	-2
*5-387	395943	744120	PEMBERTON TWP SCH	HIGH SCH 2 (3)	1973	50	208- 228	54	11/03	49	11/01	-5
*5-437	400210	744138	KAUFFMAN, MINTER	SPRINGFLD TWP[3]	1960	74	94- 105	61	11/01	61	11/03	0
*5-754	395941	743250	US ARMY	RANGE HQ 7	1975	100	419- 447	46	11/01	43	11/07	-3
*7-166	394807	745806	CLEMENTON WD	CWD 9	1954	150	367- 457	46	10/31	11	11/10	-35
*7-529	394832	745915	CLEMENTON WD	CWD11	1978	60	250- 283	55	10/31	31	11/10	-24
*7-672	394929	750023	NJ AMER WC	OBS WELL 1 EF2	1986	76	195- 215	NM	NM	50	11/14	NA
7-673	394929	750023	NJ AMER WC	TW-1 EF	1986	76	195- 215	NM	NM	50	11/14	NA
*15-188	394605	751057	YAHRLING, F	YAHRLING 1	1955	80	134- 160	NM	NM	31	11/10	NA
*15-676	394638	751201	US EPA	KRAMER LF X-6D	1984	28	68- 78	NM	NM	30	11/15	NA
*23-211	401819	742248	VLCEJ, STEPHEN	1972	1972	105	43- 49	93	10/19	91	10/19	-2
*23-605	402159	741908	OLD BRIDGE DEV CORP	O&Y CC2	1981	120	37- 47	NM	NM	86	10/21	NA
*25- 01	401401	740025	ALLENHURST WD	AWD 4	1950	17	525- 565	-82	11/01	-89	10/26	-7
*25- 09	402441	740234	ATL HIGHLANDS WD	AHWD 2	1923	15	[4]200	11	10/21	5	10/24	-6
*25- 16	401037	740148	BELMAR BORO WD	BWD 3 ELEC(12)	1949	20	563- 594	-196	10/28	-202	10/24	-6
25- 23	401040	740146	BELMAR BORO WD	BWD 13	1973	20	555- 605	-192	10/28	-226	10/24	-34
*25- 26	401102	740045	BELMAR BORO WD	BWD 4 ELEC(11)	1941	15	601- 671	-174	10/28	-173	10/24	1
*25- 28	400623	740429	BRIELLE WD	BWD 3	1967	90	770- 820	-220	10/26	-207	11/23	13
*25- 30	400645	740345	BRIELLE WD	BWD 2	1950	33	690- 750	-249	10/25	-225	11/23	24
*25- 38	401622	741156	HOMINY HILLS GC	GLF CLB 1-1941	1941	126	328- 338	57	10/19	50	10/24	-7
*25- 46	401747	741221	CEDAR DR EL SCH	COLTS NECK TWP[3]	1963	122	212- 232	68	10/17	61	10/26	-7
*25- 47	401803	740814	DORBROOK PARK	ROSENBERG 1	1957	80	322- 342	33	10/20	27	10/27	-6
*25- 64	401155	741011	FARMINGDALE WD	FARMINGDALE 4	1970	85	410- 470	-72	10/24	-73	10/26	-1
*25- 79	401331	741944	CLAYTON, WM D	CLAYTON 2	1955	170	303- 333	119	11/01	107	12/14	-12
*25- 80	401415	741501	WORTHINGTON BIO	1-1967	1967	120	294- 334	78	10/27	73	10/28	-5
*25- 90	401513	741528	BROCKWAY GLASS	BROCKWAY 1	1955	140	240- 260	83	10/24	83	10/25	0
*25- 96	401624	741502	FREEHOLD TWP WD	5-OLD SO.GULF1	1964	200	327- 356	88	10/25	81	10/24	-7
*25-105	[3]401654	741736	FREEHOLD TWP WD	FREEHOLD TWP 3	1967	112	150- 212	100	10/25	69	10/24	-31
*25-107	401701	741417	MUELLER, R W DR	DURAND,E. 1960	1960	163	249- 257	81	10/28	73	10/21	-8
*25-132	402202	741002	BELL TELE COMP	BELL LAB 2	1960	120	191- 221	64	10/17	63	10/26	-1
*25-144	402158	740956	BELL TELE COMP	BELL LAB 3	1965	120	[4]154	NM	NM	75	10/26	NA
*25-150	402432	740848	LILY TULIP CUP	LILY TULIP 2	1962	65	97- 122	36	10/20	38	10/18	2
25-151	402439	740849	LILY TULIP CUP	LILY TULIP 1	1962	60	101- 126	33	10/20	33	10/18	0
*25-161	400743	741337	HOWELL TWP BD ED	SOUTHARD SCH	1955	110	558- 582	-107	10/27	-97	10/26	10
*25-162	400815	741043	NJ NATURAL GAS	1-1973	1973	69	500- 560	-120	10/20	-125	10/25	-5
*25-165	400844	741324	HOWELL TWP MUA	ALDRICH W CO 4	1967	135	363- 550	NM	NM	-94	10/25	NA
*25-184	401429	741254	DIXON FARMS	HOWELL TWP[3]	1963	140	360- 380	69	11/01	65	10/24	-4
*25-213	401253	742122	BLUE STAR STABLES	1969	1969	165	275- 285	116	11/01	114	10/25	-2
*25-239	401838	741324	AIR CRYO INC	1	1963	128	201- 231	107	10/25	100	10/28	-7
*25-250	401918	741529	GORDONS CORNER WC	VILLAGE 215 OBS	1964	139	185- 215	99	09/30	95	10/20	-4
*25-256	401937	741428	MARLBORO ST HOSP	STATE HOSP 4	--	125	[4]124	87	10/18	83	10/25	-4
*25-263	402103	741351	MARLBORO ST HOSP	STATE HOSP 13	1953	140	142- 168	85	10/18	84	10/25	-1
*25-374	400804	740227	SEA GIRT WD	SGWD 5	1963	20	660- 710	-218	10/26	-216	10/26	2
25-384	400845	740210	SPRING LAKE WD	SLWD 2	1941	15	640- 700	-214	10/25	-225	10/25	-11
*25-385	400915	740146	SPRING LAKE WD	SLWD 3	1941	20	640- 705	-208	10/25	-210	10/25	-2
25-386	400952	740149	SPRING LAKE WD	SLWD 4	1965	15	600- 670	-199	10/25	-209	10/25	-10
25-388	400845	740312	SPRING LAKE HT WD	SPRING LK HGT3	1966	25	630- 680	-230	10/26	-256	10/25	-26
*25-389	400859	740308	SPRING LAKE HT WD	SPRING LK HGT2	1953	60	660- 711	-232	10/26	-230	10/25	2
*25-408	401007	743201	R CLAYTON CONCRETE	D T ASSOC 1	1969	105	96- 119	100	11/02	100	11/04	0
*25-429	400834	740834	USGS	ALLAIRE SPC OBS	1963	98	623- 633	-149	09/29	-149	10/31	0
*25-441	401028	740638	WALL TWP WD	RT 34 WELL	1968	120	549- 649	-163	10/27	-170	10/27	-7
25-461	402432	740848	COMDATA	TEST FOR 2	1962	65	[4]130	37	10/20	36	10/18	-1
*25-638	401105	741202	USGS	HOWELL TWP4 OBS	1987	112	483- 493	NM	NM	-53	10/20	NA
*25-692	401813	741818	WEINGARTEN-SIEGEL	JUSTIN CORP CTR	1985	110	120- 150	NM	NM	90	10/26	NA
*25-697	401950	740446	BOWERS, P J & COMP	PJ BOWERS & CO	1984	50	247- 277	NM	NM	-2	12/20	NA

Footnotes at end of table

Table 8. Water-level data for wells screened in the Englishtown aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
25-706	401552	742015	BATTLEGROUND CC	BATTLEGRD 1-J63	1963	140	170- 176	NM	NM	82	10/27	NA
*25-710	400555	740850	PARKWAY WC	PARKWAY 1 A	1986	45	594- 644	NM	NM	-164	10/25	NA
*25-713	401656	740803	BAILEY, R E	NEW 2 DOM	1988	80	300 320	NM	NM	19	[5]01/04	NA
*29- 05	400405	740242	NJ AMER WC	BAY HEAD 5	1947	10	750- 834	-219	10/24	-202	10/08	17
29- 06	400405	740244	NJ AMER WC	BAY HEAD 6	1950	10	778- 818	-206	10/24	-207	12/08	-1
*29-138	400414	742702	USGS	COLL MLLS 1 OBS	1964	137	417- 427	64	09/29	60	10/27	-4
*29-229	400712	741512	JACKSON TWP MUA	JACKSON 1	1961	110	511- 557	NM	NM	-92	10/24	NA
*29-233	400742	741639	JACKSON TWP MUA	JACKSON 4	1965	100	448- 500	-36	10/27	-36	10/24	0
*29-236	[3]400823	741533	JACKSON TWP MUA	JACKSON 2	1962	170	541- 577	-43	10/27	-53	10/24	-10
*29-237	400800	742543	GREAT ADVENTURE	GA 1	1974	140	358- 388	NM	NM	122	10/25	NA
*29-430	400220	741154	LAKEWOOD TWP MUA	S LAKEWOOD 1	1969	90	752- 817	-196	10/25	-190	10/25	6
29-431	400253	741043	LAKEWOOD TWP MUA	S LAKEWOOD 2	1963	40	680- 762	-222	10/25	-180	10/25	42
*29-433	400309	741120	LAKEWOOD TWP MUA	S LAKEWOOD 3	1966	45	673- 741	-202	10/25	-184	10/25	18
*29-438	400443	741352	NJ AMER WC	LAKEWOOD 8	1965	78	600- 758	-170	10/27	-161	10/24	9
*29-441	400505	741114	NJ AMER WC	LAKEWOOD OBS	1966	30	726- 736	-141	10/27	-140	10/26	1
*29-443	400515	741251	NJ AMER WC	LAKEWOOD 5	1957	[3]36	547- 604	[3]-151	[6]03/07	-154	10/24	-3
*29-449	400614	741157	NJ AMER WC	LAKEWOOD 9	1968	55	569- 698	-178	[6]03/07	-189	10/24	-11
*29-450	400622	741349	NJ AMER WC	LAKEWOOD 6	1960	70	520- 582	-153	10/27	-133	10/24	20
*29-451	400636	741515	LAKEWOOD T PINE PK	ST GABRIELS 1	1957	60	510- 530	-108	10/31	-103	11/01	5
*29-452	395741	740437	LAVALLETTE WD	LWD 3	1948	7	1,120-1,180	-119	10/20	-108	11/22	11
*29-454	395808	740421	LAVALLETTE WD	LWD 2	1931	5	1,009-1,136	-118	10/20	-107	11/22	11
*29-503	400210	740310	NJ WC	MANTOLKNG 6 OBS	1955	5	845- 906	-194	10/28	-194	10/28	0
*29-518	400401	743200	NEW EGYPT WC	2-1903	1903	75	218- 238	NM	NM	61	11/01	NA
29-519	400401	743200	NEW EGYPT WC	1	1907	65	214- 239	59	10/26	57	11/01	-2
*29-530	400454	740413	PT PLEASANT WD	PPWD 6 OBS	1965	20	730- 790	-211	10/25	-202	11/29	9
29-532	400459	740359	PT PLEASANT WD	PPWD 3	1946	10	748- 798	-259	10/25	-216	11/29	43
*29-534	395609	741240	USGS	TOMS RIV 2 OBS	1965	18	1,080-1,146	-86	10/02	-86	10/21	0
*29-938	400404	742137	JACKSON ESTATES	1988 WELL	1988	130	487- 527	NM	NM	-8	11/02	NA
*33-581	393846	752300	COWTOWN AUCT INC	COWTOWN AUCT 2	1975	35	95- 115	NM	NM	29	11/21	NA

[1] Datum is sea level.

[2] Depth below land surface.

[3] Revised from Eckel and Walker, 1986.

[4] Well depth.

[5] Water level measured in 1989.

[6] Water level measured in 1984.

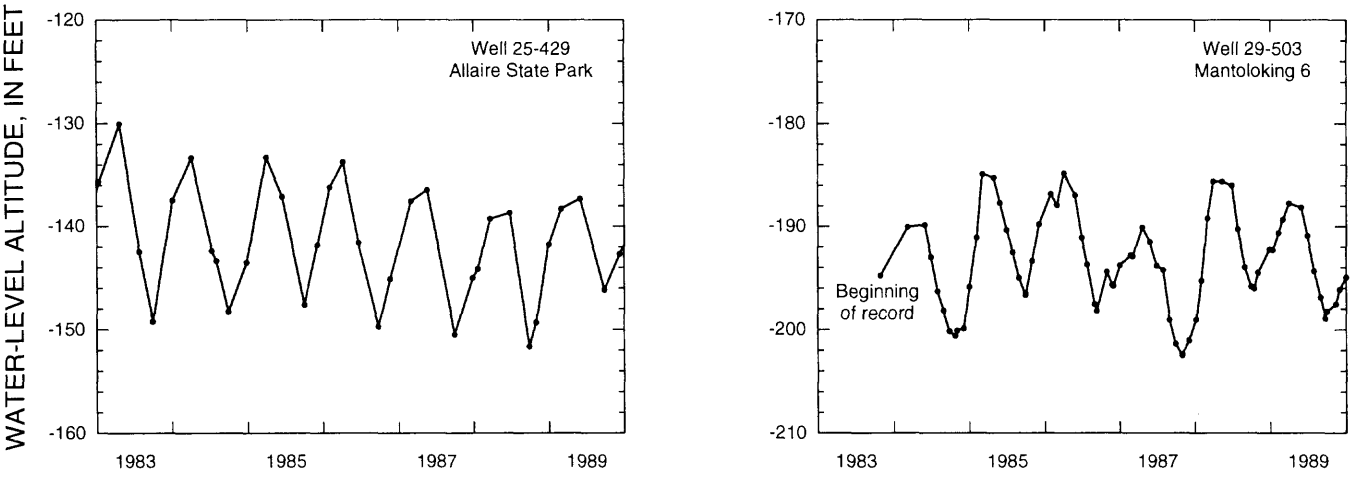


Figure 10. Water-level hydrographs for observation wells screened in the Englishtown aquifer system near centers of large ground-water withdrawals, 1983-89.

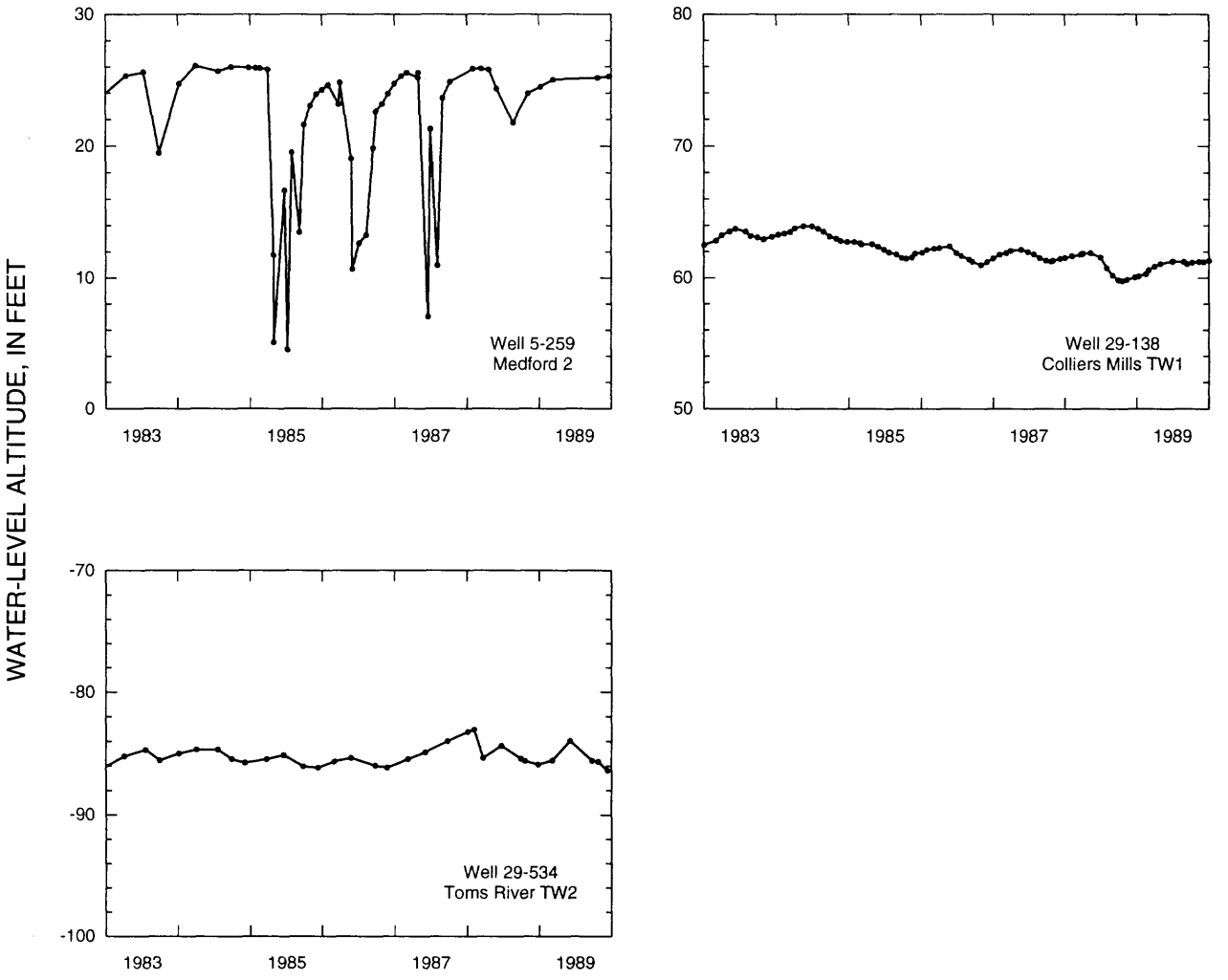


Figure 11. Water-level hydrographs for observation wells screened in the Englishtown aquifer system distant from centers of large ground-water withdrawals, 1983-89.

Upper Aquifer of the Potomac-Raritan-Magothy Aquifer System

Water Levels

Water-level measurements for 340 wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system are listed in table 9. The number of wells in New Jersey in which water levels were measured, by county, is as follows: Burlington, 42; Camden, 46; Gloucester, 60; Mercer, 8; Middlesex, 71; Monmouth, 78; Ocean, 9; and Salem, 21. In Philadelphia County, Pennsylvania, water levels were measured in two wells, and in New Castle County, Delaware, water levels were measured in three wells. The water levels in these wells were used to define the potentiometric surface shown on plate 6, though only 176 wells are plotted.

Water levels define a large, areally extensive cone of depression in the upper aquifer of the Potomac-Raritan-Magothy aquifer system (pl. 6). The cone is centered in Camden and western Burlington Counties and extends throughout most of Gloucester County. Within the cone, water levels were as low as 107 ft below sea level. The highest water levels in the upper aquifer were 69 ft above sea level in well 21-19 and 87 ft above sea level in well 23-400; these wells are located in the outcrop areas of Mercer and Middlesex Counties, respectively.

Ground-water withdrawals that cause smaller cones of depression in the middle aquifer of the Potomac-Raritan-Magothy aquifer system in Burlington, Gloucester, and Salem Counties do not appear to affect water levels in the upper aquifer, indicating a lack of hydraulic connection between the upper and middle aquifers in these areas (Walker, 1983 p. 24).

The two cones of depression in Monmouth County that were mapped in 1983 (Eckel and Walker, 1986, pl. 7) have been replaced by a regional cone that encompasses two local cones representing local centers of pumping. These local centers of pumping are in the Freehold-Marlboro Quadrangle and the greater Asbury Park Quadrangle. Water levels near the centers of these cones ranged from 40 to 45 ft below sea level.

Water-Level Fluctuations

Water-level changes in 253 wells were calculated for the 5-year period. Water levels rose in 64 wells, declined in 158 wells, and were unchanged in 31 wells. Regionally, the largest water level decline is as much as 18 ft. In Camden County, water levels declined 17 ft near the center of the cone of depression. In Burlington County, water levels declined as much as 18 ft. Water levels in Gloucester County declined about 5 to 7 ft in areas not subject to large ground-water withdrawals, and declines of 12 ft were recorded in and adjacent to local pumping centers. Water levels in wells in Mercer and Middlesex Counties that are located in and adjacent to the outcrop area declined 1 to 3 ft; however, in a few isolated wells in

Middlesex County static heads rose 10 ft. In Ocean County, water levels in wells along the Atlantic Coast rose 2 to 4 ft. Wells located inland that are affected by the major withdrawal centers showed a slight decline in water levels. Static heads in the western part of Salem County declined 4 to 5 ft over the 5-year period, and heads in the northern areas of Salem County near the Gloucester County border declined only a few feet.

Hydrographs for six wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system are shown in figures 12, 13, and 14; the locations of the wells are shown on plate 6. The hydrographs for the 6 wells show a 5-ft decline in water levels over the 5-year period.

Observation wells 5-258, 7-117, and 7-477 (fig. 12) are located near the major cone of depression in central Camden County and western Burlington County. Variations in pumping schedules at nearby public supply wells produce similar seasonal trends in water levels at the three sites. Water levels declined as much as 27 ft in observation well 7-117.

Observation wells 23-228 and 25-206 (fig. 13), in Middlesex and Monmouth Counties, respectively, are located near an area of large ground-water withdrawals. Seasonal pumping cycles caused water levels to fluctuate 6 to 7 ft. As a general trend, 2- to 3-ft declines occurred over the 5-year period. Long-term water-level trends in observation well 23-228 could be caused by natural recharge conditions and the location of the well adjacent to the outcrop area.

Similar hydrograph patterns for well 23-228, screened in the upper aquifer, and well 23-229, screened in the middle aquifer at the same location (fig. 15B), together with a head that is 6 ft lower in the middle aquifer than in the upper aquifer, indicate the presence of a downward vertical gradient from the upper to the middle aquifer at this site.

Observation well 7-477 (fig. 12), screened in the upper aquifer, and well 7-476 (fig. 15B), screened in the middle aquifer, also show similar hydrograph patterns. Although no ground water was withdrawn nearby, static heads were 20 ft lower in the upper aquifer than in the middle aquifer, indicating an upward vertical gradient from the middle aquifer to the upper aquifer. The hydrograph for observation well 33-253 (fig. 14), located far from areas of ground-water withdrawal, shows a 3-ft decline in water levels over the 5-year period with little or no seasonal variation.

Middle Aquifer and Undifferentiated Part of the Potomac-Raritan-Magothy Aquifer System

Water Levels

Water-level measurements for 378 wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system are listed in table 10. The number of wells in New Jersey in which water levels were measured, by county, is as follows: Burlington, 83; Camden, 21; Cumberland, 1; Gloucester, 64; Mercer, 18; Middlesex, 95; Monmouth, 20; Ocean, 16; Salem, 50. In Philadelphia County, Pennsylvania, water levels were measured in one well. In New Castle County, Delaware, water levels were measured in nine wells. The water levels in these wells were used to define the potentiometric surface shown on plate 7, though only 139 wells are plotted.

Table 9. Water-level data for wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988

[AMER, America; AUTH, Authority; BD ED, Board of Education; CL, Club; CONST, Construction; CO, Company; CORP, Corporation; CC, Country Club; DEPT, Department; DEV, Development; ft, feet; DEL, Delaware; HGTS, Heights; INT, International; MCHVIL PNSK WCM, Merchantville-Pennsauken Water Commission; MON BCH CLD STR, Monmouth Beach Cold Storage; mo, month; MUA, Municipal Utility Authority; NJ, New Jersey; PK, Park; POLYP, Polypropylene; PUB, Publishing; NAT, Natural; RCN, Recontouring; REFRIG, Refrigerator; SEW, Sewage; ST, State; TWP, Township; US EPA, U.S. Environmental Protection Agency; USGS, U.S. Geological Survey; WC, Water Company; HS, High School; WA, Waste Management; WD, Water Department; WSC, Water Supply Company; --, missing data, NM, not measured; NA, not applicable; wells marked with an asterisk are shown on plate 6]

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983-88) (ft)
5- 45	400716	744228	SANDMAN MOTEL	SANDMAN 1	--	85	-- --	NM	NM	8	10/31	NA
5- 60	400538	745053	BURLINGTON CWD	BCWD 2	1952	21	33- 49	NM	NM	4	11/02	NA
*5- 76	400324	745152	HEAL, CHARLES JR	HEAL	1955	50	59- 80	-4	10/31	-6	11/03	-2
*5- 77	400326	744942	BURLINGTON TWP WD	1-1973	1973	60	123- 165	NM	NM	-13	10/31	NA
*5- 116	400708	743836	CHESTERFIELD SCH	1	1957	102	247- 253	6	10/27	3	11/04	-3
*5- 165	395233	745418	EVESHAM MUA	EMUA 4	1970	110	464- 500	-81	11/07	-89	11/28	-8
*5- 167	395247	745157	EVESHAM MUA	EMUA 5	1973	50	478- 548	-79	11/07	-84	11/02	-5
*5- 169	395322	745300	EVESHAM MUA	TEST 12 -1972	1972	50	455- 475	-83	11/07	-87	11/02	-4
*5- 207	400356	744039	VAN MATER, CH	CRESANT FARMS	--	95	[3]325	-16	10/28	-20	11/03	-4
*5- 209	400412	744323	COLUMBUS WC	CWC 2(OLD 3)	1969	73	259- 274	-18	10/28	-22	11/01	-4
5- 211	400438	744519	LISEHORA,MARY	S J GROVE 1	1970	80	[3]220	-5	10/27	-9	11/04	-4
*5- 212	400515	744109	N BURL COUNTY HIGH	1	1959	83	290- 310	-15	11/10	-18	11/10	-3
*5- 218	400718	744453	RIVER FRONT MOTEL	MOTEL	--	60	[3]100	-4	10/26	-4	11/02	0
*5- 229	395630	745855	MAPLE SHADE WD	MSWD 9	1975	40	160- 200	-57	11/03	-56	11/04	1
*5- 249	395209	745043	MEDFORD TWP WD	MTWD 3	1968	55	523- 541	-75	11/03	-84	11/07	-9
*5- 251	395316	744946	MEDFORD WC	MWC 4(1968)	1968	49	506- 536	-71	11/02	-77	12/12	-6
5- 252	395413	744922	MEDFORD WC	MWC 1(3)	1957	48	506- 536	-73	11/02	-69	10/26	4
*5- 253	395422	744858	MEDFORD LEASE CO	1-1972	1972	[4]32	447- 471	-72	11/02	-68	10/26	4
*5- 258	395524	745025	USGS	MEDFORD 1 OBS	1963	[4]71	400- 410	-65	[4]01/09	-66	11/07	-1
*5- 285	395924	744702	MOUNT HOLLY WC	MHWC 4	1964	16	307- 342	-37	11/01	-42	12/05	-5
5- 289	395935	744651	MOUNT HOLLY WC	MHWC 3	1953	19	316- 346	-34	11/01	-41	12/05	-7
*5- 310	395728	745504	NJ TURNPIKE AUTH	MAINT 2	1952	40	120- 160	-48	10/26	-50	12/19	-2
*5- 315	395845	745240	LARCHLMONT FARMS	FARM WELL 1	1958	55	200- 238	-45	11/04	-49	11/04	-4
5- 317	395850	745318	NJ TURNPIKE AUTH	4N-1	1951	45	192- 222	NM	NM	-45	12/01	NA
5- 318	395850	745318	NJ TURNPIKE AUTH	4N-2	1954	45	[3]230	NM	NM	-43	12/01	NA
*5- 383	395839	744249	SYBRON CHEMICAL	IONAC CHEM 2	1960	30	490- 521	-20	11/03	-38	11/08	-18
*5- 446	400328	744636	INTERSTATE S-P	INTERSTATE 1	1960	75	220- 245	-15	10/27	-18	11/02	-3
5- 707	395315	745503	EVESHAM MUA	EMUA 7	1979	100	405- 441	-86	11/07	-94	11/03	-8
*5- 728	395819	744341	MOBILE ESTATES	FIELD PUMP	1972	55	485- 500	-31	10/31	-37	10/31	-6
*5- 729	395725	745914	MAPLE SHADE WD	MSWD 2	--	30	91- 121	NM	NM	-26	12/12	NA
5- 730	400741	744300	INTERSTATE WASTE	MONITOR 9	1978	75	[3]135	4	10/25	3	10/24	-1
*5- 731	400739	744228	INTERSTATE WASTE	MONITOR 8	1978	[4]93	118- 128	[4]4	10/25	2	10/24	-2
*5- 745	400157	744819	BURLINGTON COUNTY CC	CLUB 1R	1974	102	260- 290	-17	10/31	-21	11/07	-4
5- 747	395921	745243	DITTMAR		1949	80	[3]257	-46	10/31	-53	11/01	-7
*5- 748	395848	745407	RADIO CORP OF AMER	RANCOCAS 1	--	80	[3]170	-39	11/08	-45	11/09	-6
*5- 755	395049	745338	KING'S GRANT WC	KGWC 1	1973	90	547- 593	-79	11/04	-91	10/31	-12
5- 757	395326	745223	EVESHAM MUA	EMUA 6	--	50	458- 550	NM	NM	-87	11/02	NA
5- 795	395239	745308	MT LAUREL MUA	MLWC 5	1976	60	416- 463	-96	11/07	-97	11/02	-1
5- 820	395049	745334	KING'S GRANT WC	KGWC 2	1973	90	545- 591	-78	11/04	-80	11/14	-2
*5- 821	400033	745131	FEDERAL LAND BANK	1	1983	65	214- 218	-21	11/02	-25	11/02	-4
*5-1077	400426	744621	BURL COUNTY-OFS OF WA	GM - 38	1981	30	78- 98	NM	NM	-11	11/02	NA
5-1078	400402	744612	BURL COUNTY-OFS OF WA	GM - 40	1981	20	75- 115	NM	NM	-17	11/02	NA
7- 03	395146	750254	OWENS CORNING	CORNING 1	1956	60	285- 315	-102	11/09	-96	11/17	6
*7- 13	395221	750636	BELLMAWR BORO WD	BBWD 1	1942	31	111- 160	-46	11/09	-44	11/09	2
*7- 15	394648	745622	BERLIN WD	BWD 11	1972	150	675- 745	-89	11/07	-97	11/17	-8
*7- 18	394738	745614	BERLIN WD	BWD 9	1955	145	650- 713	NM	NM	-95	11/15	NA
7- 19	394738	745614	BERLIN WD	BWD 10	1967	145	645- 713	[5]-83	02/14	-97	11/15	-14
*7- 115	395149	745909	WOODCREST CC	CLUB 1	1949	70	400- 420	-84	11/09	-101	10/31	-17
*7- 117	395229	745712	NJ AMER WC	HUTTON HL 1 OBS	1965	[4]158	552- 562	[4]-79	12/09	-84	11/19	-5
7- 120	395237	750031	HUSSMAN REFRIG	HUSSMAN	1957	67	276- 306	-90	11/10	-84	11/09	6
*7- 131	395353	745708	NJ AMER WC	OLD ORCHARD B	1967	71	[3]342	-79	11/16	-83	11/03	-4
7- 133	395353	745708	NJ AMER WC	OLD ORCHARD 36	1968	80	299- 349	NM	NM	-75	11/08	NA
*7- 143	395441	750104	NJ AMER WC	ELLISBURG 16	1957	40	187- 220	-65	11/16	-67	11/09	-2
*7- 148	395455	745929	NJ AMER WC	KINGSTON 28	1964	44	175- 207	-66	11/10	-66	11/08	0
*7- 149	395503	750221	NJ NATIONAL GUARD	1	1956	15	96- 111	-54	11/16	-59	11/08	-5
7- 151	395514	750213	GARDEN ST RACE TRACK	RACE TRACK	1944	30	[3]158	-54	11/09	-54	11/18	0
*7- 162	395608	750025	NJ AMER WC	COLUMBIA 24	1961	34	112- 167	-50	11/10	-52	11/03	-2
*7- 193	395256	750633	CRESCENT TRAILOR PK	TRAILER PK 1	1952	20	59- 71	-40	11/14	-37	11/08	3
*7- 242	394712	750220	SOCIETY DIVINE	SAVIOR	1951	107	492- 512	-76	12/20	-82	11/16	-6

Footnotes at end of table

Table 9. Water-level data for wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Lati-tude	Location: Longi-tude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Alti-tude[1] (ft)	1983: Date (mo/day)	Water level 1988: Alti-tude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
7-244	394715	750419	CAMDEN COUNTY	LAKELAND 3	--	50	[3]490	-74	11/02	-79	11/10	-5
*7-249	394754	750343	GARDEN ST WC	BLACKWOD DIV 3	1956	65	426- 447	NM	NM	-86	11/09	NA
*7-250	394718	750336	GARDEN ST WC	BLACKWOD DIV 7	1974	60	437- 479	NM	NM	-89	11/09	NA
*7-252	394759	750158	GARDEN ST WC	BLACKWOD DIV 6	1971	75	407- 477	-84	11/15	-81	11/09	3
7-272	395028	750344	NJ AMER WC	OTTERBROOK 34	1967	60	[3]377		NM	-80	11/07	NA
*7-274	395030	750347	NJ AMER WC	OTTERBROOK 39	1968	60	269- 349	-87	11/07	-81	11/07	6
*7-275	395231	750312	NJ AMER WC	HADDON 20	1958	60	236- 267	-78	11/07	-79	11/14	-1
7-279	395238	750317	NJ AMER WC	HADDON 30	1965	65	224- 275	-72	11/07	-77	11/14	-5
7-282	395243	750320	NJ AMER WC	HADDON 11	1945	84	212- 272	-75	11/07	-77	11/10	-2
*7-285	395248	750433	NJ AMER WC	EGGBERT 18	1958	24	144- 191	-64	11/07	-64	11/08	0
*7-293	395416	750336	HADDON TWP BD ED	HADDON TWP HS1	1966	15	142- 162	-57	11/10	-57	11/10	0
*7-297	395317	750141	HADDONFIELD WD	HWD 4	1943	18	186- 240	NM	NM	-79	12/12	NA
*7-299	395322	750158	HADDONFIELD WD	LAYNE 2	1956	65	206- 246	-85	11/04	-85	11/10	0
7-310	394928	750024	NJ AMER WC	LAUREL 13	1954	77	394- 456	-83	11/16	-85	11/14	-2
*7-311	394928	750027	NJ AMER WC	LAUREL 15	1964	75	395- 473	-86	11/16	-91	11/10	-5
7-316	395134	750230	NJ AMER WC	MAGNOLIA 33	1967	75	271- 348	-87	11/09	-83	11/07	4
*7-318	395135	750246	OWENS CORNING	CORNING 2	1956	67	290- 320	-92	11/09	-87	11/17	5
*7-322	395359	750445	NJ AMER WC	OAKLYN TEST	1961	[4]33	101- 112	-53	11/07	-50	11/04	3
*7-392	394641	745909	PINE HILL MUA	PHMUA 1	1962	150	627- 669	-88	11/01	-96	11/14	-8
7-398	394726	745911	PINE HILL MUA	PHMUA 2-1972	1972	200	668- 698	-96	11/01	-97	11/14	-1
*7-404	395055	750420	NJ AMER WC	RUNNEMEDE 19	1958	67	297- 339	-83	11/07	-82	11/15	1
*7-410	395041	750056	NJ AMER WC	SOMERDALE 14	1956	95	[3]441	-95	11/09	-94	11/14	1
*7-411	395238	750121	TAVISTOCK CLUB	COUNTRY CLUB 1	1968	30	219- 247	-81	11/09	-84	11/09	-3
*7-422	395124	745952	NJ AMER WC	ASHLAND 17	1957	68	379- 421	-91	11/09	-107	11/02	-16
7-426	395129	745906	NJ AMER WC	VOORHEES 21	1959	129	422- 482	-87	11/09	-92	11/10	-5
*7-477	394215	745617	USGS	NEW BKLYN 2 OBS	1961	111	829- 839	-73	11/08	-77	11/18	-4
*7-521	394742	745931	CLEMENTON WD	CWD 10	1978	180	600- 629	NM	NM	-103	11/10	NA
*7-573	395355	750738	USGS	COAST GUARD 2	1966	11	[3]89	-9	12/02	-9	11/18	0
7-600	394658	750421	LAKELAND HOSPITAL	LAKELAND H 4	1975	45	405- 453	-75	11/02	-82	11/10	-7
*15- 01	393913	750517	CLAYTON WD	CWD 3	1956	133	746- 800	-69	11/14	-77	11/15	-8
*15- 03	394015	750559	CLAYTON WD	4-1973	1973	140	670- 740	NM	NM	-71	11/15	NA
15- 06	394627	750813	WOODBURY WD	SEWELL 1A	1967	20	263- 308	-56	11/08	-59	11/10	-3
15- 08	394628	750813	WOODBURY WD	SEWELL 2A	1973	21	244- 307	-53	11/08	-61	11/10	-8
15- 09	394746	750511	DEPTFORD TWP MUA	DTMUA 5	1971	78	414- 447	-64	11/03	-68	10/02	-4
15- 11	394811	750914	DEPTFORD TWP MUA	DTMUA 2	1958	58	255- 281	-53	11/03	-49	11/10	4
*15- 28	394755	751327	EAST GREENWICH WD	EGWD 2	1956	70	191- 216	-23	11/01	-23	11/07	0
*15- 60	394206	750758	GLASSBORO WD	GWD 3	1955	150	562- 612	-70	11/09	-66	11/10	4
15- 62	394241	750642	GLASSBORO WD	GWD 2	1947	145	562- 602	-72	11/09	-79	11/28	-7
*15- 63	394308	750702	GLASSBORO WD	GWD 4	1961	150	549- 599	-65	11/09	-64	11/28	1
*15-127	394346	750959	LEONARD, W	5	1958	140	[3]524	-49	11/14	-50	11/10	-1
*15-129	394409	751330	SOUTH JERSEY WC	SJWC 1	1950	35	[3]263	-30	11/14	-31	11/10	-1
15-147	394706	751951	SHOEMAKER, R A	1	1954	18	33- 39	5	11/18	3	11/03	-2
*15-187	394543	750746	INVERSAND CO	#2	1956	45	325- 355	NM	NM	-69	11/08	NA
15-191	394629	750859	MANTUA TWP MUA	MTMUA 2	1965	[4]72	336- 368	[4]-51	11/08	-58	11/09	-7
*15-192	[4]394635	751116	MANTUA TWP MUA	MTMUA 5	1957	[4]80	315- 337	[4]-43	11/07	-38	11/09	5
*15-194	394732	751037	MANTUA TWP MUA	MTMUA 4	1969	10	230- 265	-53	11/07	-51	11/09	2
15-226	394411	750745	PITMAN WD	PWD P2	1947	130	475- 515	-70	11/14	-82	11/14	-12
*15-227	394426	750747	PITMAN WD	PWD P3	1960	99	447- 487	-64	11/14	-71	11/14	-7
*15-240	394510	751838	DEL MONTE CORP	9	1963	32	190- 231	-19	11/18	-21	11/01	-2
*15-248	394339	750433	WASHINGTON TWP MUA	WTMUA 5	1973	125	559- 618	-68	11/08	-80	11/08	-12
*15-253	394437	750249	WASHINGTON TWP MUA	6(FRIES MLS 1)	1964	152	584- 652	-76	11/08	-81	11/08	-5
15-260	394517	750300	WASHINGTON TWP MUA	8(BELS LK WC2)	1968	130	544- 620	-75	11/08	-82	11/08	-7
*15-261	394520	750218	WASHINGTON TWP MUA	WTMUA 1	1959	100	581- 612	-81	11/08	-85	11/17	-4
15-268	394732	750447	WASHINGTON TWP MUA	WTMUA 4	1972	77	369- 417	-79	11/08	-78	11/08	1
15-275	394751	750912	WENONAH WD	WWD 2	1951	50	268- 310	-53	11/03	-62	11/14	-9
*15-276	394821	751026	W DEPTFORD TWP WD	WDTWD 4	1963	60	242- 289	-44	11/03	-46	11/14	-2
*15-281	394912	751026	W DEPTFORD TWP WD	WDTWD 3	1957	61	227- 243	-40	11/03	-37	11/14	3
*15-297	394942	751317	HUNTSMAN POLYP CO	SHELL 6 OBS	1962	21	113- 118	-11	10/31	-11	11/15	0
*15-303	395030	751236	PENNWALT CORP	TEST WELL 1	1969	10	84- 114	-8	11/04	-9	11/10	-1
*15-330	394858	750845	WOODBURY HGTS BORO	1 HELEN AVE	1972	40	190- 235	-50	11/07	-49	11/08	1
*15-332	395009	750922	WOODBURY WD	PARKING LOT 3	1946	50	148- 188	-45	10/31	-38	11/10	7
*15-339	394350	751910	GRASSO, J S	1	1969	90	247- 267	-19	11/17	-20	11/09	-1

Footnotes at end of table

Table 9. Water-level data for wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
15- 342	394438	751914	DEL MONTE CORP	10	1967	60	192- 279	-21	11/18	-21	11/02	0
15- 345	394642	751823	MUSUMECI, PETER	1	1954	62	94- 100	-12	11/14	-12	11/03	0
*15- 346	394529	751340	TOMARCHIO, ALFRED	1	1977	80	267- 343	-24	11/08	-29	11/14	-5
15- 355	394822	751247	EAST GREENWICH WD	EGWD 3	[4]1977	42	205- 245	-30	11/01	-28	11/07	2
*15- 361	394155	750704	GLASSBORO WD	GWD 5	1973	149	610- 657	NM	NM	-83	11/15	NA
*15- 378	394523	751610	NJ TURNPIKE AUTH	MAINT 1	--	100	[3]98	NM	NM	-26	12/01	NA
*15- 379	394601	751005	MANTUA TWP MUA	MTMUA 6	1973	145	368- 398	NM	NM	-40	11/09	NA
*15- 433	394631	750517	WASHINGTON TWP MUA	WTMUA 9	1981	135	512- 552	-69	11/15	-78	11/08	-9
15- 511	394828	751656	FEHLAUER, ALBERT	2	1977	10	40- 47	NM	NM	1	11/02	NA
15- 546	394759	751948	CHEMICAL LEAMAN	CL2	1981	10	20- 30	3	11/16	3	11/23	0
15- 554	394808	751914	US EPA REGION II	S-2A	1983	9	4- 14	2	11/16	1	11/21	-1
15- 560	394800	751913	US EPA REGION II	S-11A	1983	11	5- 14	8	11/16	6	11/21	-2
15- 564	394802	751933	US EPA-GAVENTA	S-9	1983	7	42- 52	NM	NM	3	11/15	NA
*15- 617	394637	751916	USGS	SHIVELER UPPER	1985	31	60- 70	NM	NM	-7	11/14	NA
15- 674	395053	751346	ESSEX CHEM C	OBS 1	1977	9	21- 40	NM	NM	4	11/07	NA
*15- 702	395053	751346	ESSEX CHEM C	OBS 3	1977	7	8- 18	NM	NM	0	11/07	NA
15- 707	394800	751936	USGS	GAVENTA W TAB	1985	7	6- 7	NM	NM	2	11/15	NA
*15- 728	394808	751724	USGS	STEFKA-4 OBS	1987	5	46- 56	NM	NM	-7	11/15	NA
*15- 741	394652	751004	USGS	MANTUA SHAL OBS	1986	82	293- 313	NM	NM	-46	11/16	NA
15- 773	395206	751118	USGS	NATIONAL PARK 5	1987	10	30- 50	NM	NM	-7	11/15	NA
15- 777	395202	751127	USGS	NATIONAL PARK 8	1987	15	57- 77	NM	NM	0	11/15	NA
15- 779	395223	751117	USGS	NATIONAL PK 11	1987	5	25- 35	NM	NM	-5	11/15	NA
15- 843	395055	751415	BP OIL CO	P-13	1980	20	38- 40	NM	NM	1	11/08	NA
*15-1000	394646	750631	RAY ANGELINI INC	ANGELINI 1	1984	75	354- 359	NM	NM	-71	11/16	NA
15-1012	394710	751158	PHILLIPS, NELSON O	MILLSTREAM FH	1984	40	250- 260	NM	NM	-43	11/14	NA
*15-1013	394351	750611	SCHULTES, RICHARD J	SCHULTES 1	1985	105	483- 493	NM	NM	-65	11/18	NA
*15-1031	394553	751920	MATLACK TRUCKING	MTLCK TRK MW-1B	1984	47	95- 105	NM	NM	-9	11/17	NA
*21- 18	401558	743003	CAPAZELLO FARMS	1-IRR	1941	110	[3]250	47	10/27	44	10/17	-3
*21- 19	401608	743354	E WINDSOR MUA	EWMUA 5	1966	90	133- 181	68	10/21	69	10/18	1
21- 21	401631	743246	MCGRAW HILL PUB	MCGRAW HILL 1	1958	97	153- 173	53	10/20	52	10/17	-1
21- 46	401119	743810	SANTOSUSSO, JA	1-1957	1957	60	138- 141	NM	NM	-70	11/15	NA
21- 81	401621	743130	HIGHTSTOWN WD	HIGHTSTOWN 1	1946	84	181- 205	53	10/20	51	10/17	-2
*21- 84	401622	743129	HIGHTSTOWN WD	HIGHTSTOWN 2	1947	84	181- 205	54	10/20	51	10/17	-3
21- 102	401240	743741	MERCER MOBLE HOME	1973 WELL	1973	110	145- 155	34	10/24	38	10/25	4
*21- 103	401309	743702	SUBURBAN NATURAL GAS	SUBURBAN 1	1953	110	183- 186	59	10/07	58	10/28	-1
23- 15	401842	743055	CRANBURY TWP WD	CTWD 2	1917	[4]95	[3]110	65	12/19	64	10/26	-1
23- 18	401841	742905	CARTER WALLACE	CW 2	1957	98	161- 201	56	10/30	53	10/23	-3
23- 19	401844	742905	CARTER WALLACE	CW 4	1958	120	161- [3]201	NM	NM	78	10/23	NA
*23- 22	401857	742908	CARTER WALLACE	CW 9	1951	120	[3]209	52	10/30	53	10/23	1
23- 24	401858	743015	DANSER, CLENDON	IRRIGATION 1	1959	115	[3]152	54	10/27	57	10/25	3
23- 32	401918	743048	BARCLAY FARMS	1 (C.DANSER)	1954	120	[3]152	62	10/27	61	10/25	-1
23- 35	402010	742838	GENERAL FOODS	1	1956	138	167- 197	58	10/21	61	10/21	3
23- 51	402432	742212	ANHEUSER BUSCH	BUSCH 6	1973	37	51- 71	NM	NM	6	10/24	NA
*23- 96	402236	742535	HELMETTA WC	6(4-R)	1972	40	32- 42	37	10/18	36	10/20	-1
*23- 98	402051	742604	NJ AMER WC	JAMESBURG 6	1954	50	99- 120	44	10/20	41	10/27	-3
23- 100	402053	742603	NJ AMER WC	JAMESBURG 7	1955	45	118- 129	43	10/20	45	10/27	2
*23- 101	402030	742115	MOLDER FISH	1973	1973	50	211- 223	NM	NM	11	10/26	NA
*23- 109	402302	742256	DUHERNAL WC	DUHERNL OBS 26	1942	[4]24	[3]101	-1	11/01	-2	10/17	-1
23- 131	402334	742231	DUHERNAL WC	DUHERNAL 8	1938	24	65- 80	NM	NM	7	12/07	NA
*23- 142	402346	741832	OLD BRIDGE MUA	BROWNTOWN 1	1965	90	199- 249	4	10/17	9	10/19	5
23- 143	402347	742038	DUHERNAL WC	DUHERNL OBS 2	1938	30	81- 91	5	10/31	5	10/17	0
23- 145	402348	742050	OLD BRIDGE MUA	11-1972	1972	30	80- 120	6	10/19	12	12/15	6
23- 151	402352	742224	DUHERNAL WC	DUHERNAL OBS 4	1938	[4]25	64- 75	7	[5]03/29	3	10/18	-4
23- 155	402355	742226	DUHERNAL WC	DUHERNAL 4	1938	21	52- 74	4	10/31	4	12/07	0
23- 156	402353	742056	OLD BRIDGE MUA	10-1972	1972	30	90- 120	NM	NM	11	10/19	NA
23- 159	402353	742152	DUHERNAL WC	DUHERNAL OBS 5	1938	20	55- 63	8	10/31	8	10/17	0
23- 161	402358	742211	DUHERNAL WC	DUHERNAL 2	1938	18	62- 73	2	10/31	-6	10/18	-8
23- 172	402404	742205	DUHERNAL WC	DUHERNAL 1	1938	13	55- 75	-9	10/31	-18	10/18	-9
*23- 173	402406	741620	OLD BRIDGE BD ED	IRA-71	1971	60	173- 193	-7	10/17	-8	10/20	-1
23- 174	402407	741924	OLD BRIDGE MUA	BROWTOWN OBS	1961	45	[3]150	6	10/17	9	10/19	3
*23- 180	402438	742129	DUHERNAL WC	DUHERNAL OBS 1	1938	19	57- 67	4	10/31	4	10/18	0
*23- 182	402449	741819	BOWNE, CLYDE	BROWNTOWN	1932	31	66- 71	15	10/19	13	10/20	-2

Footnotes at end of table

Table 9. Water-level data for wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983-88) (ft)
23- 185	402502	742127	NJ WATER POLICY	PERTH AMBOY 1	1968	14	27- 30	NM	NM	2	10/21	NA
23- 190	402526	741603	NAPPI TRUCK CO	2-1965	1965	140	[3]253	3	10/25	2	10/17	-1
23- 195	[4]402537	742001	PERTH AMBOY WD	PERTH AMBOY 5	1965	15	50- 80	-5	10/20	5	10/17	10
*23- 205	402700	741454	OLD BRIDGE MUA	LAWRENCE HAR 8	1948	60	193- 213	-4	10/17	-5	10/19	-1
23- 208	402712	741806	OLD BRIDGE MUA	1-HOPE PK	1956	140	167- 181	20	10/19	18	10/19	-2
23- 222	401952	742805	MONROE TWP MUA	FORSGATE 5	1954	130	182- 202	NM	NM	29	10/20	NA
23- 227	[4]402012	742833	GENERAL FOODS	SERVICE 3	1967	132	168- 198	60	10/21	60	10/21	0
*23- 228	402015	742757	MONROE TWP MUA	FORSGATE 3 OBS	1961	147	128- 138	58	10/20	55	10/17	-3
*23- 244	402131	742245	REESE, AUGUST	1971	1971	60	152- 158	-7	10/19	-3	10/24	4
23- 250	402252	742301	DUHERNAL WC	DUHERNL OBS 10	1938	22	83- 93	5	11/01	5	10/17	0
*23- 292	402109	743012	MONROE TWP MUA	FORSGATE 2 OBS	1961	107	93- 104	71	10/27	71	10/20	0
23- 294	402124	742824	KORLESKI	KORLESKI 1	--	140	[3]104	68	10/25	73	10/19	5
*23- 344	402558	742013	SAYREVILLE WD	SWD 2 OBS	1957	22	31- 37	13	10/19	14	10/18	1
23- 346	402604	742004	SAYREVILLE WD	SWD B	1958	27	71- 81	NM	NM	16	10/18	NA
23- 351	402605	741959	SAYREVILLE WD	SWD 1 OBS	--	35	76- 82	17	10/19	17	10/18	0
23- 356	402614	741955	SAYREVILLE WD	SWD F	1959	28	53- 74	NM	NM	17	10/19	NA
23- 359	402618	741952	SAYREVILLE WD	SWD D	1958	29	64- 75	20	10/19	16	10/18	-4
23- 361	402619	741958	SAYREVILLE WD	SWD E	1958	28	39- 62	NM	NM	21	10/18	NA
23- 367	402624	741944	SAYREVILLE WD	SWD G	1960	46	56- 87	NM	NM	29	10/18	NA
23- 369	402630	741949	SAYREVILLE WD	SWD H	1960	45	67- 83	34	10/19	32	10/18	-2
*23- 400	402745	741645	SAYREVILLE WD	R-1973	1973	100	57- 82	NM	NM	4	10/18	NA
23- 403	402745	741631	SAYREVILLE WD	SWD Q-1973	1973	40	78- 136	5	10/18	2	10/18	-3
23- 414	402825	741632	SOUTH AMBOY WD	SAWD 10	1967	10	38- 48	5	10/18	5	10/18	0
23- 433	402555	742133	NJ WATER POLICY	SO RIVER 4	1968	20	30- 33	10	10/17	8	10/21	-2
23- 442	402252	742432	SPOTSWOOD WD	SWWD 3	1973	30	64- 78	19	10/27	18	10/19	-1
23- 460	402421	742230	SCHWEITZER, P J	9	1961	25	53- 63	NM	NM	11	10/18	NA
23- 461	402421	742233	SCHWEITZER, P J	4R	1961	35	49- 59	NM	NM	20	10/18	NA
*23- 490	401925	742620	MONROE TWP MUA	8-R	1974	167	287- 325	43	10/20	48	10/20	5
23- 494	402329	742331	SPOTSWOOD WD	SWWD 5	1978	23	83- 97	14	10/27	14	10/19	0
23- 497	402109	742747	FORSGATE	HWH WELL	1975	130	109- 114	NM	NM	27	10/26	NA
23- 505	[4]401855	743229	DYAL, LEROY	DYAL2-1967	1967	90	20- 80	65	10/24	63	10/26	-2
23- 507	401801	743154	DANSER, FRANK	UNUSED DOM	--	105	[3]130	65	10/19	63	10/24	-2
*23- 508	401801	743154	DANSER, FRANK	DOMEST-73	1973	105	[3]90	65	10/19	63	10/24	-2
23- 534	402536	742018	PERTH AMBOY WD	OLD DEEP 8	--	10		NM	NM	-8	10/19	NA
23- 557	[4]402820	741629	SOUTH AMBOY WD	SAWD 9A	1979	20	48- 58	14	10/18	14	10/18	0
23- 565	401958	742819	MONROE TWP MUA	ROSSMORE GC 17	1980	130	165- 197	42	10/20	52	10/20	10
23- 567	401950	742750	MONROE TWP MUA	MTMUA 16A	1983	137	163- 244	51	10/20	54	10/20	3
23- 571	402531	741932	PERTH AMBOY WD	PERTH AMBOY 7	1983	15	67- 82	NM	NM	-6	10/18	NA
23- 581	402734	742037	PARLIN SUPPLY CO	1	1974	80	24- 44	NM	NM	60	10/17	NA
23- 595	402153	741915	OLD BRIDGE DEV CORP	SS4	1981	105	285- 290	NM	NM	5	10/21	NA
23-1156	402225	741820	JOCAMA CONSTRUCT CORP	JOCAMA BLDG 3	1982	60	230- 238	NM	NM	-4	10/26	NA
23-1157	402424	742519	RAAB, GEORGE	RAAB HAND DUG	1930	109	[3]36	NM	NM	74	10/19	NA
23-1159	402720	741950	E I DUPONT	PM8D	1987	86	95- 105	NM	NM	42	10/25	NA
23-1172	402746	741916	E I DUPONT	PM-1D PARLIN PT	1987	103	68- 78	NM	NM	40	10/25	NA
25- 04	401047	743527	ALLENTOWN WD	AWD 2	1975	77	212- 262	30	10/21	0	11/05	-30
*25- 13	401137	740121	AVON WD	AWD 4	1974	29	1,105-1,165	-27	10/25	-29	10/21	-2
25- 33	401556	740915	NAD EARLE	NAD EARLE 1	1944	126	775- 810	NM	NM	-32	11/01	NA
*25- 34	401558	740908	NAD EARLE	NAD EARLE 2(B)	1944	135	810- 836	-33	10/20	-34	10/24	-1
*25- 37	401607	741209	HOMINY HILLS GOLF CL	GLF CLB 2-1963	1963	137	686- 706	-35	10/19	-30	01/03	5
*25- 45	401810	740957	FLOCK AND SONS	1	1963	66	649- 677	-39	10/19	-40	10/26	-1
*25- 56	401744	742135	ENGLISHTOWN BORO WD	ENGLISHTOWN 2	1965	70	363- 384	1	10/19	18	10/26	17
*25- 62	401134	741014	ROKEACH & SONS	4-DEEP	1961	80	831- 885	-31	11/02	- 29	10/28	2
25- 81	401412	741605	FREEHOLD TWP WD	KOENIG LANE 4	1972	130	633- 673	NM	NM	-37	10/24	NA
25- 85	401436	741525	3M COMPANY	1	1957	120	653- 700	-43	10/19	-42	10/28	1
*25- 91	401516	741530	BROCKWAY GLASS	BROCKWAY 2	1969	140	632- 685	-47	10/24	-34	10/25	13
*25- 97	401625	741501	FREEHOLD TWP WD	6-OLD SO.GULF2	1966	195	596- 656	-47	10/25	-38	10/24	9
25- 98	401633	741726	FREEHOLD BORO WD	FREEHOLD 4	1969	110	529- 583	NM	NM	-30	10/24	NA
*25- 101	401635	741721	FREEHOLD BORO WD	FREEHOLD 5	1970	123	520- 619	-26	10/26	-33	10/24	-7
25- 103	401646	741737	FREEHOLD TWP WD	7-74	1974	107	478- 575	-36	10/26	-39	10/24	-3
25- 111	402532	740932	SHORELANDS WC[4]	W KEANSBURG 1	1958	59	326- 366	-38	10/17	-40	10/18	-2
*25- 112	402537	740933	SHORELANDS WC[4]	W KEANSBURG 2	1960	44	312- 352	-35	10/17	-39	10/18	-4
25- 116	402400	735912	HIGHLANDS WD	HWD 2 NEW	1961	10	600- 660	-18	11/03	-16	10/27	2
*25- 117	402401	735920	HIGHLANDS WD	HWD 4	1973	20	630- 680	NM	NM	-11	10/27	NA
25- 118	402401	735934	HIGHLANDS WD	HWD 1	1949	15	649- 709	-21	11/03	-20	10/27	1

Footnotes at end of table

Table 9. Water-level data for wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983-88) (ft)
25-119	402403	735923	HIGHLANDS WD	HWD 3	1973	15	719- 779	-19	11/03	-17	10/27	2
*25-121	402023	741100	PENNWALT CORP	1 (PENNWALT)	1960	80	560- 590	-33	10/19	-35	10/27	-2
*25-146	402327	741114	BELL TELEPHONE CO	CRAWFRD HILL 1	1962	280	555- 585	-35	10/17	-36	10/26	-1
*25-154	402445	741019	SHORELANDS WC[4]	W KEANSBURG 3	1964	73	400- 430	-35	10/17	-38	10/18	-3
*25-175	401246	741516	ADELPHIA WC	1(HOVBILT CO)	1969	100	681- 762	-34	10/28	-40	10/26	-6
*25-177	401255	741147	SCHROTH, EMIL A	SCHROTH	1969	95	781- 801	-18	10/25	-28	10/26	-10
*25-195	402621	740743	KEANSBURG MUA	KWD 5A	1954	[4]15	290- 350	[4]-35	10/21	-32	10/20	3
25-196	402628	740744	KEANSBURG MUA	KWD 3	1942	12	308- 348	-33	10/21	-30	10/20	3
*25-197	402535	741214	KEYPORT BORO WD	KEYPORT 7	1976	35	304- 354	-26	10/18	-25	10/19	1
*25-206	402625	741145	KEYPORT BORO WD	KEYPORT 4 OBS	1939	14	225- 249	-15	10/19	-17	10/19	-2
25-207	402626	741144	KEYPORT BORO WD	KEYPORT 6	1970	11	247- 277	-14	10/19	-27	10/19	-13
25-218	401557	742318	BOY SCOUTS AMER	QUAIL HILL 2	1967	250	510- 527	13	10/24	12	10/20	-1
*25-220	401537	742012	BATTLEGROUND CC	IRRIGATION	1967	120	539- 569	-29	10/21	-29	10/25	0
25-244	[4]401848	[4]741704	GORDONS CORNER WC	GORDONS 7	1969	160	524- 594	-43	10/19	-48	10/20	-5
*25-251	401908	741510	GORDONS CORNER WC	GORDONS 9	1971	128	478- 528	-39	10/19	-43	10/20	-4
*25-259	402035	741423	MARLBORO ST HOSP	STATE HOSP 12	1950	155	508- 593	-26	10/18	-27	10/25	-1
*25-282	402507	741344	BAYSHORE SEW AUTH	BAYSHORE 1	1976	10	245- 260	-13	10/18	-13	10/17	0
25-284	402515	741450	MATAWAN BORO WD	MATAWAN BORO 3	1956	90	231- 271	-7	10/19	-11	10/17	-4
25-288	402349	741232	ABERDEEN TWP MUA	MATAWAN MUA 3	1967	83	345- 425	-33	10/19	-36	10/17	-3
25-292	402359	741233	ABERDEEN TWP MUA	MATAWAN MUA 1	1962	87	341- 414	-33	10/19	-34	10/18	-1
25-293	402403	741245	ABERDEEN TWP MUA	MATAWAN MUA 2	1962	73	316- 354	-28	10/19	-29	10/17	-1
*25-294	402428	741345	MATAWAN BORO WD	MATAWAN BORO 1	1944	20	222- 252	-22	10/19	-24	10/17	-2
25-295	402427	741348	MATAWAN BORO WD	MATAWAN BORO 2	1943	20	228- 258	-21	10/19	-23	10/17	-2
25-303	402106	740810	BAMM HOLLOW CC	BHCC 1	1966	70	527- 600	NM	NM	-61	10/27	NA
*25-316	402536	735905	STATE OF NJ	SANDY HOOK SP1	1965	11	371- 397	-4	10/24	-9	10/19	-5
*25-321	402706	735952	NATIONAL PK SERV	FT HANCOCK 4	1941	5	332- 486	-3	10/24	-3	10/19	0
*25-322	401157	742418	RESTINE, P J	RESTINE 1	1956	210	667- 697	-2	10/31	-4	10/27	-2
*25-332	401930	735841	MON BCH CLD STR	MBCS 1971 DEEP	1971	10	817- 850	-18	10/20	-17	09/07	1
*25-333	401214	740355	NJ AMER WC	JUMPING BR 5	1956	35	1,000-1,072	-33	10/25	-41	10/28	-8
25-334	401214	740355	NJ AMER WC	JUMPING BR 4	1951	23	1,013-1,065	-37	10/25	-37	10/28	0
25-344	401232	740102	NJ AMER WC	LAYNE 2	1939	20	1,090-1,130	NM	NM	-27	10/28	NA
*25-345	401233	740100	NJ AMER WC	LAYNE 3-1958	1958	20	1,085-[3]1,125	-24	10/25	-27	10/28	-3
*25-351	401323	740156	NJ AMER WC	WHITESVILLE	--	18	[3]777	-38	10/26	-40	10/28	-2
*25-358	402047	740420	RED BANK WD	1B-1950	1950	40	637- 687	-33	10/24	-37	10/27	-4
25-360	402054	740320	RED BANK WD	4-75	1975	146	668- 759	-34	10/24	-34	10/27	0
*25-362	401312	742802	ROOSEVELT WD	ROOSEVELT 3	1956	198	442- 472	30	10/31	28	10/27	-2
25-419	402632	741049	UNION BEACH WD	UBWD 1 1962	1962	10	235- 285	-23	10/18	-21	10/18	2
25-420	402634	741051	UNION BEACH WD	UBWD 2 1969	1969	10	262- 289	-13	10/18	-19	10/18	-6
*25-434	400926	740749	STATE OF NJ	ALLAIRE S P 3	1967	40	1,004-1,029	-42	10/20	-45	10/26	-3
25-436	400952	740725	BRISBANE C T C	1 (OLD 3-1971)	1971	60	990-1033	-41	10/28	-43	10/26	-2
25-456	402640	740904	INT FLAVOR FRAGRANCE	IFF-3R	1976	[4]17	277- 316	[4]-26	10/30	-26	10/21	0
*25-457	401551	742212	KNOB HILL CC	KNOB 1-74	1974	108	465- 495	6	10/20	4	10/25	-2
*25-459	402219	740337	NAVESINK, CC	1-78	1978	80	551- 612	-24	10/26	-25	10/27	-1
*25-462	402717	740816	KEANSBURG AMUSE	1-69	1969	10	200- 250	-16	10/21	-15	10/20	1
25-493	401231	741127	HOWELL TWP	1-1975/YELBRK[4]	1975	[4]115	[3]860	[4]-35	11/01	-38	10/25	-3
*25-496	402441	740233	ATLANTIC HIGHLANDS WD	AHWD 4	1980	15	510- 543	-18	10/21	-19	10/24	-1
*25-500	400849	743403	COLLINS	1	1981	88	270- 305	4	10/20	0	10/28	-4
25-501	401215	740358	NJ AMER WC	JUMPING BR 6	1981	30	1,000-1,075	NM	NM	-48	10/28	NA
25-502	401411	741608	FREEHOLD TWP WD	8	1981	125	616- 671	-51	10/25	-43	10/24	8
25-514	402641	740911	INT FLAVOR FRAGRANCE	IFF-2R	1983	[4]14	266- 312	[4]-26	10/30	-27	10/21	-1
*25-550	401258	741629	FREEHOLD TWP WD	OBS 9	1984	105	636- 656	NM	NM	-39	10/24	NA
25-551	401258	741627	FREEHOLD TWP WD	9	1984	105	617- 676	NM	NM	-42	10/24	NA
25-564	401918	741530	GORDONS CORNER WC	11	1984	138	479- 576	NM	NM	-35	10/20	NA
25-565	402704	741051	USGS	CONASCONK PT.	1985	10	201- 211	NM	NM	-15	10/17	NA
25-567	402630	741029	USGS	UB WATER TOWER	1986	10	250- 270	NM	NM	-23	10/18	NA
25-568	402652	741100	USGS	JCP&L	1986	10	245- 265	NM	NM	-12	10/20	NA
*25-639	401105	741202	USGS	HOWLL TWP 5 OBS	1988	112	891- 901	NM	NM	-35	10/20	NA
25-705	401518	742227	MANALAPAN TWP WD	MANALAPAN 2	1984	120	505- 636	NM	NM	-76	10/24	NA
*29- 70	395905	740359	NJ AMER WC	MONTEREY 1	1967	5	1,375-1,495	-28	10/19	-26	11/29	2
*29-100	395956	740344	NJ AMER WC	NORMANDY 3	1954	8	1,428-1,479	-27	10/19	-24	11/29	3
*29-134	400329	741947	JACKSON TWP MUA	SCM 1	1961	95	846- 962	-28	11/17	-31	10/24	-3
*29-238	[4]400824	742630	JACKSON TWP MUA	JACKSON 7	1974	130	584- 648	-4	10/28	-8	10/25	-4
29-453	395808	740416	LAVALLETTE WD	LWD 4	1960	5	1,358-1,515	-28	10/20	-26	11/22	2
*29-504	400210	740310	NJ AMER WC	MANTOLOKING 7	1960	5	1,263-1,368	-27	10/28	-25	11/29	2

Footnotes at end of table

Table 9. Water-level data for wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
*29-524	400409	740406	PT PLEASANT WD	PPWD 7	1967	8	1,183-1,260	-33	10/25	-30	11/30	3
*29-531	400454	740414	PT PLEASANT WD	PPWD 5	1960	18	1,256-1,342	-33	10/25	-29	11/30	4
*29-577	395741	740437	LAVALLETTE WD	LWD 5	1978	7	1,394-1,498	-22	10/20	-20	11/22	2
*33- 74	394241	752201	OLDMANS TWP WD	1 (AUBURN W C)	1968	80	185- 206	NM	NM	-13	11/09	NA
33- 75	394258	752200	MACKANNAN, C	CM1 AUBURN HI	1941	[4]16	129- 134	[4]-12	11/17	-14	11/14	-1
*33- 76	394328	752446	DAWSON, H W	DAWSON 1	1957	27	118-[3]123	0	11/10	2	11/22	2
*33-105	393458	752945	LOVELAND, SC	DILWORTH	1950	10	[3]263	-22	11/07	-26	11/18	-4
33-109	393734	753149	SIEGFRIED CHEM	1973-1	1973	5	116- 131	-1	12/08	-2	12/22	-1
*33-111	393746	752955	PENNSVILLE TWP WD	HOOK RD OBS	1971	10	190- 235	-15	11/09	-17	11/21	-2
33-112	393754	753147	PENNSVILLE TWP WD	PTWD 4	1965	10	117- 137	NM	NM	-10	11/21	NA
33-126	394057	752950	E I DUPONT	RANNEY 7	1966	15	52- 140	2	11/16	-2	11/21	-4
33-128	394102	752946	E I DUPONT	RANNEY 6	1966	15	50- 60	1	11/16	-4	11/21	-5
*33-253	393348	752755	USGS	SALEM 3 OBS	1965	3	335- 340	-23	09/29	-27	11/22	-4
33-316	394121	752921	E I DUPONT	102	1970	5	[3]85	NM	NM	-7	11/22	NA
*33-325	394149	752918	E I DUPONT	CARNEY PT 3	1933	5	[3]102	-8	11/14	-10	11/21	-2
33-326	394153	752928	E I DUPONT	CARNEY PT 4	1955	5	[3]86	NM	NM	-4	11/22	NA
33-333	394208	752859	E I DUPONT	CARNEY PT 5	1957	5	[3]81	-3	11/14	-3	11/22	0
*33-342	394236	752724	NJ WATER POLICY	PENNS GROVE 24	1941	18	46- 51	1	11/10	-1	11/22	-2
*33-355	393914	751930	WOODSTOWN ICE COMP	C1	1927	58	[3]360	-22	11/18	-24	11/09	-2
*33-360	393750	753131	PENNSVILLE TWP WD	PTWD 5	1979	10	101- 117	-8	12/08	-11	11/21	-3
*33-361	394205	752700	PENNS GROVE WSC	SCHULTES 4	1978	13	44- 54	-8	11/10	-9	11/22	-1
33-408	[4]394450	752410	PEDRICKTOWN SWIM	SWIM 1	1960	15	26- 36	1	11/15	1	11/16	0
33-439	394449	752351	BOND, WILLARD K	1	1982	25	49- 59	NM	NM	5	11/22	NA
*33-671	393954	753013	PENNSVILLE TWP WD	PTWD 3A	1988	7	87- 102	NM	NM	-5	11/21	NA
*PH-751	395444	750831	SAF AMERICA INC	#2 SAF	1979	10	62- 77	NM	NM	-6	11/08	NA
PH-752	395443	750832	SAF AMERICA INC	#3 SAF	1979	9	60- 75	NM	NM	-7	11/08	NA
*Jd25-09	393450	753842	TEXACO	OBS 3A	--	57	114- 156	NM	NM	-7	11/14	NA
*Eb23-23	393316	754216	USGS (DEL)	LUMS POND B	--	60	288- 292	NM	NM	35	11/15	NA
*Gd33-05	392212	753243	USGS (DEL)	DEAKYNEVILLE 5	--	18	627- 660	NM	NM	-8	11/14	NA

[1] Datum is sea level.

[2] Depth below land surface.

[3] Well depth.

[4] Revised from Eckel and Walker, 1986

[5] Water level measured in 1984.

[6] Water level measured in 1989.

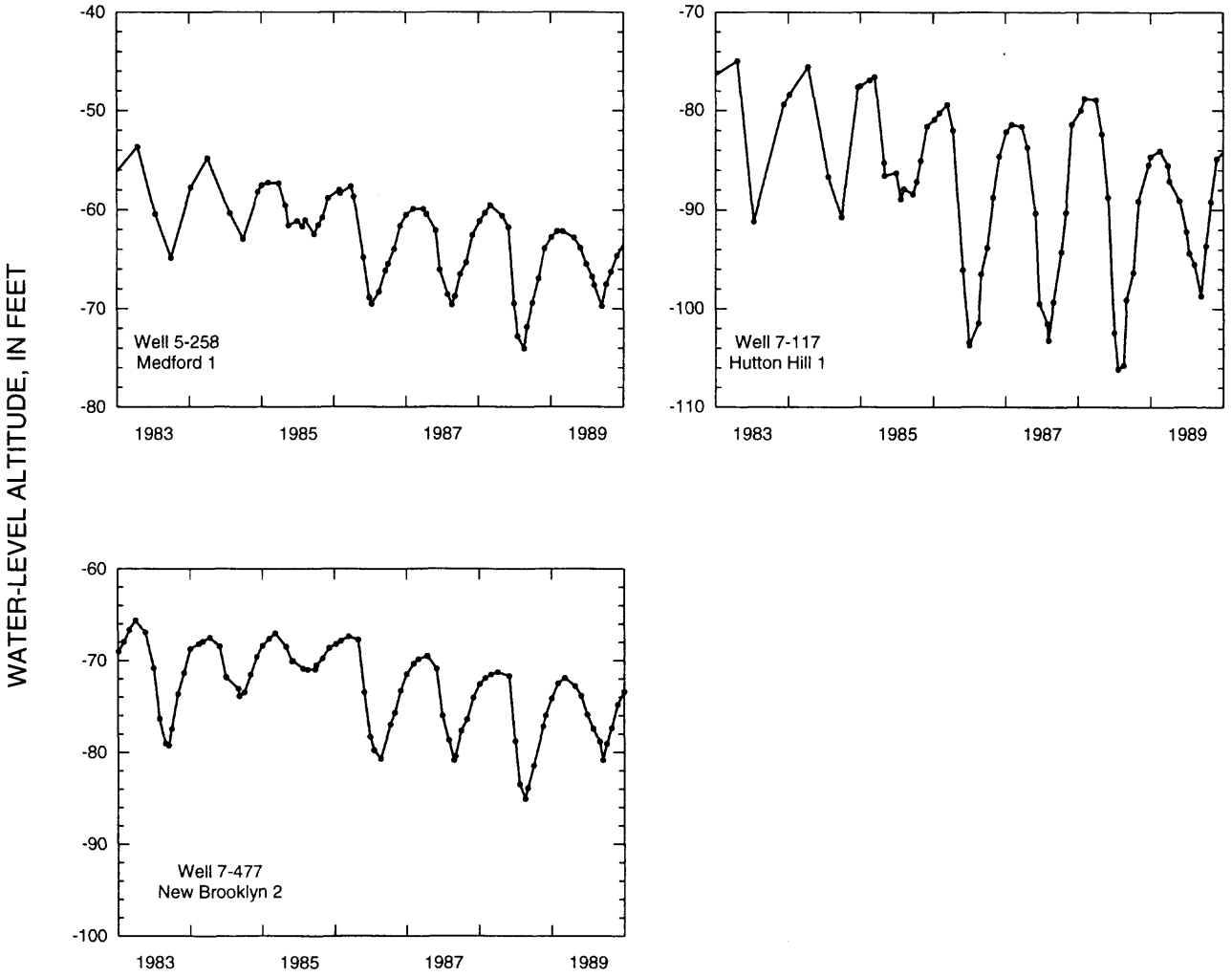


Figure 12. Water-level hydrographs for observation wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system near centers of large ground-water withdrawals, 1983-89.

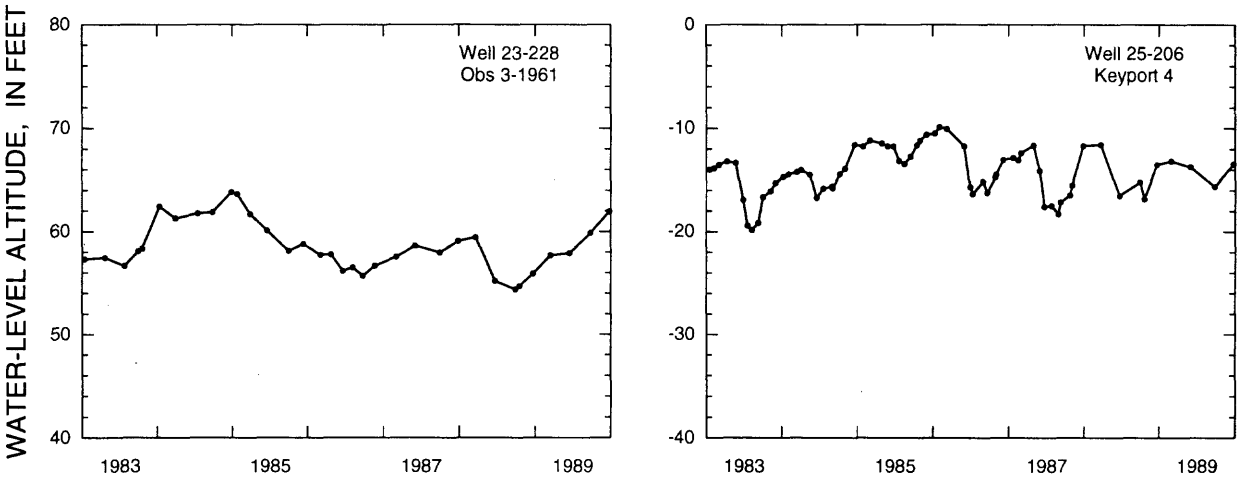


Figure 13. Water-level hydrographs for observation wells screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system near areas of local ground-water withdrawals, 1983-89.

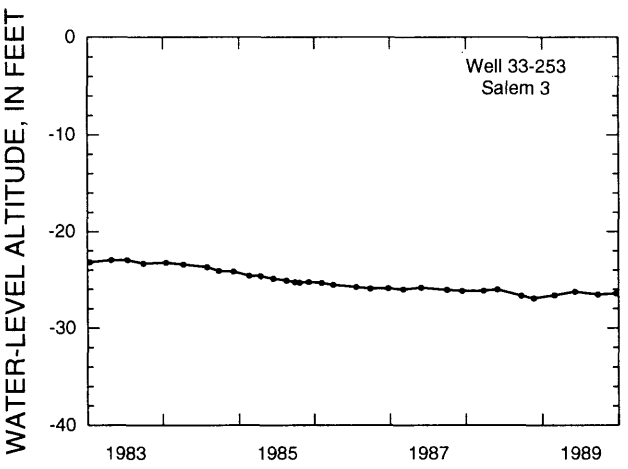


Figure 14. Water-level hydrograph for an observation well screened in the upper aquifer of the Potomac-Raritan-Magothy aquifer system, distant from centers of ground-water withdrawals, 1983-89.

Water levels in the middle aquifer define three major cones of depression, which were identified in 1983 (pl. 7). A fourth cone of depression has developed since 1983 in Ocean County. In northern Monmouth and eastern Middlesex Counties, water levels were as low as 116 ft below sea level. The second major cone of depression, where water levels were as low as 92 ft below sea level, is located in central Camden and western Burlington Counties. The third major cone is located in southern Salem County; water levels were as low as 68 ft below sea level. The fourth cone of depression, in which water levels were as low as 70 ft below sea level, has developed in the middle aquifer in eastern Ocean County. Water-level data from two wells at Brick Township Municipal Utility Authority in Ocean County, wells 29-46 and 29-779, indicate the formation of an areally small but deep cone of depression centered in the Lakewood area. The potentiometric surface of the middle aquifer is similar to that of the lower aquifer in many areas. This similarity could be coincidental and related to ground-water withdrawals from both aquifers in these areas, or could be the result of a lateral or vertical hydraulic connection between these aquifers in some areas (Walker, 1983, p. 11). Regionally, the highest water levels, as much as 78 ft above sea level, were measured in wells near the outcrop in central Mercer and Middlesex Counties.

Water levels in well 11-137, screened in the saltwater zone in the undifferentiated part of the aquifer system in Cumberland County, were adjusted from 49 ft below sea level to an equivalent freshwater head of 27 ft below sea level on the basis of density, at the time of measurement (Walker, 1983, p. 13). The conversion of observed saltwater head to freshwater head in a given well is accomplished by use of the equation

$$p=\rho g l,$$

where p is the pressure at the bottom of the casing, ρ is the density of the water in the casing, g is the acceleration due to gravity, and l is the measured length of water column above the casing terminus. By equating the right term of the above equation for freshwater and saltwater columns,

$$\rho_f g l_f = \rho_s g l_s \quad , \text{ and}$$

$$l_f = (\rho_s/\rho_f) l_s$$

where the subscripts f and s refer to freshwater and saltwater, respectively. The density of freshwater is assumed to be 1,000 grams per cubic decimeter (Cooper and others, 1964). The adjusted head measurement was used to contour the potentiometric surface; however, the unadjusted heads are shown in table 10. This is the only well in the aquifer system where an adjustment was required.

Water-Level Fluctuations

Water-level changes in 285 wells were calculated for the 5-year period. Water levels rose in 57 wells, declined in 200 wells, and were unchanged in 29 wells. The decline in water levels in about two-thirds of the wells located in the middle aquifer over the 5-year period indicates a regional decline in the potentiometric head in most areas. The greatest declines in head were at the center of the cone of depression in northern Monmouth County, where ground-water withdrawals caused water levels to fall from 70

to 116 ft below sea level. Water-level recoveries in two wells, 25-153 and 25-467 (West Keansburg Water Company #4 and #5, respectively), did not return to static conditions following short-term withdrawals (Glen Carleton, U.S. Geological Survey, written commun., 1989). Withdrawals from well 25-153 increased from 255.7 Mgal/yr in 1987 to 287.5 Mgal/yr in 1988 and decreased to 225.5 Mgal/yr in 1989. Withdrawals from well 25-467 increased from 218 Mgal/yr in 1987 to 245.8 Mgal/yr in 1988 and decreased to 199 Mgal/yr in 1989 (R.M. Clawges, U.S. Geological Survey, written commun., 1991).

In Monmouth County, water levels declined an average of 14 ft; declines ranged from 2 to 17 ft in areas distant from pumping centers. Water levels declined 15 ft in a localized cone of depression in northeastern Burlington County. In areas minimally affected by ground-water withdrawals, water-level changes ranged from recoveries of 9 ft to declines of 6 ft. In central Camden County, water levels declined as much as 8 ft, whereas in the northern part of the outcrop area, water levels recovered as much as 35 ft. Water levels in Gloucester County, in general, were unchanged throughout the period; however, water levels declined 9 ft in well 15-395 and rose 17 ft in well 15-94.

Water levels in Middlesex County declined as much as 18 ft. Small, deep, localized cones of depression formed in the northern and central parts of the county. Water levels in Ocean County declined more than 20 ft during 1983-88, particularly in the areas of Brick Township, Jackson Township, and Lakewood. Water levels in observation well 29-47, located in Brick Township, declined from 41 to 65 ft below sea level (table 10). An increase in withdrawals from the undifferentiated part of the Potomac-Raritan-Magothy aquifer system probably caused a reshaping of the potentiometric surface in the county (pl. 7). Water levels in Salem County declined as much as 11 ft in areas of local ground-water withdrawals; average declines in Salem County ranged from 2 to 4 ft.

Hydrographs of water levels in 12 observation wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system are shown in figure 15; well locations are shown on plate 7. The hydrographs indicate that water levels declined 3 to 4 ft at wells in Salem, Camden, Burlington, and Middlesex Counties. Water levels in observation well 5-683, located in southeastern Burlington, declined 8 ft. This large decline is the effect of the lateral expansion of the cone of depression in northern Ocean County on water levels in the well.

In Ocean County observation well 29-85, located near an area of large ground-water withdrawals, water levels declined 11 ft during the 5-year period. In well 29-19, located near the southeastern coast of Ocean County far from pumping centers in northern Ocean County, heads declined only 5 ft. Water levels in wells in the outcrop area were unchanged, as exemplified by well 23-70. Seasonal water-level fluctuations were greatest (as much as 36 ft) in well 25-272 in northeastern Monmouth county.

Table 10. Water-level data for wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988

[AMER, American; ATL, Atlantic; AUTH, Authority; C, Company; CHEM, Chemical; CONSERV, Conservation; CORP, Corporation; CC, Country Club; CO, County; DEL, Delaware; DEL VAL DIST, Delaware Valley District; DEPT, Department; ELEC, Electric; E-G, Electric and Gas; ENV, Environmental; ft, feet; FC, Field Club; GST, Garden State; GEOL, Geological; HS, High School; INC, Incorporated; INDUS, Industries; INT, International; MEM, Memorial; MCHVIL PNSK WCM, Merchantville Pennsauken Water Commission; mo, month; MUA, Municipal Utility Authority; NJ, New Jersey; NJS, New Jersey State; OBS, Observation well; POLYP, Polypropylene; PL, Power and Light; PROD, Products; RF, Refinery; RUB, Rubber; SERV, Service; TK, Track; TWP, Township; TSA, Township Sewage Authority; USGS, U.S. Geological Survey; W+L, Water and Light; WC, Water Company; WD, Water Department; WSC, Water Supply Company; --, missing data; NM, not measured; NA, not applicable; wells marked with an asterick are shown on plate 8]

Well number	Location: Lati-tude	Location: Longi-tude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Alti-tude[1] (ft)	1983: Date (mo/day)	Water level 1988: Alti-tude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
5- 40	400405	745517	NJ AMER WC	DVWC 16	1910	18	39- 51	8	10/26	6	11/03	-2
*5- 48	400800	744309	NJ DEPT DEFENSE	NAT GUARD 1	1952	83	[3]230	4	10/25	0	11/25	-4
5- 52	400455	745121	BURLINGTON CO WD	BCWD 1 1943	1943	10	57- 78	NM	NM	8	11/02	NA
*5- 63	400213	745108	WILLINGBORO MUA	WMUA 1-OBS[4]	1965	[4]45	284- 294	-16	[5]01/16	-21	11/02	-5
*5- 70	400313	745004	BURLINGTON TWP WD	TEST 1	1970	60	140- 200	-11	11/01	-16	10/31	-5
5- 80	400331	745316	HEISLER, ALBERT	1	1950	46	212- 252	NM	NM	-12	11/01	NA
5- 84	400342	744948	MASONIC HOME	MASONIC 1	1921	60	174- 194	-10	11/01	-16	10/31	-6
5- 86	400404	745301	TENNECO CHEM	TENNECO 5	1964	18	102- 132	NM	NM	-3	10/31	NA
5- 87	400407	745246	TENNECO CHEM	TENNECO 5-OBS	1961	14	50- 60	-9	12/29	-14	10/31	-5
5- 90	400409	745309	TENNECO CHEM	TENNECO 6-OBS	1961	15	55- 65	-3	12/29	-9	10/31	-6
5- 98	400525	744938	HERCULES POWDER	HERCULES 3	1961	27	111- 136	1	11/04	0	11/03	-1
5-101	400543	744948	HERCULES POWDER	HERCULES 3 OBS	1945	19	94- 104	2	11/04	2	11/03	0
5-106	400617	744920	OXIDENTAL CHEM C	HOOKER 2R	1970	20	126- 146	-4	11/04	-22	11/04	-18
*5-109	400632	744904	NATIONAL GYPSUM	NAT GYP 2	1955	22	113- 123	-3	11/04	-5	11/03	-2
*5-114	400606	743923	DEMARCO, RALPH	DEMARCO	1958	85	388- 392	-8	11/08	-12	11/03	-4
5-121	400934	744019	NJS REFORMATORY	NJSR 4	1951	97	357- 387	-5	10/28	-8	10/24	-3
*5-122	[4]400941	744017	NJS REFORMATORY	NJSR 5	1964	75	337- 367	0	10/28	-1	10/25	-1
5-126	395929	745922	NJ AMER WC[4]	DVWC 12-POMONA	1961	73	157- 196	-17	10/27	-16	11/03	1
*5-127	395938	745810	NJ AMER WC[4]	RIVERTON 14	1964	35	179- 229	-17	10/27	-20	11/03	-3
5-136	400146	745932	TAYLOR, H G	TAYLOR 3	1963	16	[3]25	13	10/21	11	11/03	-2
5-137	400147	745934	TAYLOR, H G	TAYLOR 2	1963	14	[3]25	11	10/21	11	11/03	0
5-138	400148	745936	TAYLOR, H G	TAYLOR 1	1963	15	[3]25	12	10/21	11	11/03	-1
5-140	[4]400244	745607	CHANT, HARRY R	CHANT 1	1965	[4]25	140- 155	[4]6	10/28	4	11/01	-2
*5-145	400110	745713	HOLY CROSS HS	HIGH SCHOOL	1958	70	154- 174	1	10/27	-3	11/01	-4
5-147	400126	745647	NJ AMER WC	FAIRVIEW ST	1970	83	180- 235	1	10/26	-2	11/03	-3
*5-150	400207	745831	AMICO SAND	AMICO	1957	15	27- 37	5	10/28	4	10/31	-1
5-160	400315	745408	NJ AMER WC	DVWC 22	1963	45	102- 123	17	10/26	4	11/03	-13
5-161	400318	745438	NJ AMER WC[4]	DVWC 32	1971	40	135- 167	5	10/26	-2	11/03	-7
5-180	400532	744833	WORKMAN, JAMES	WORKMAN 1	1951	41	170- 194	9	12/29	8	11/08	-1
5-181	400722	744918	GRIFFIN PIPE C	GRIFFIN B	1964	28	98- 119	NM	NM	-7	11/06	NA
5-182	400722	744918	GRIFFIN PIPE C	GRIFFIN A	1964	26	92- 113	NM	NM	-7	11/06	NA
5-188	400704	744838	FLORENCE TWP WD	FTWD 3	1948	30	123- 138	0	11/04	-3	11/04	-3
5-189	400706	744930	FLORENCE TWP WD	FTWD 2	1931	15	105- 120	NM	NM	-14	11/04	NA
5-190	400712	744842	FLORENCE TWP WD	FTWD 1	1931	30	99- 119	3	11/04	3	11/04	0
*5-206	400325	744456	CARTY, RONALD	RALPH PARKER	1959	62	370- 380	-25	11/08	-23	10/28	2
*5-214	400531	744430	WALDER, THOMAS	1	--	60	[3]319	NM	NM	-13	11/02	NA
5-232	395727	745915	MAPLE SHADE WD	MSWD 8	1972	20	210- 270	-35	11/03	-33	11/04	2
*5-261	395525	745025	USGS	MEDFORD 5 OBS	1967	[4]73	740- 750	-58	9/30	-61	11/07	-3
5-264	395704	745812	MOORESTOWN TWP WD	MTWD 5	1963	38	248- 288	-50	11/01	-48	11/03	2
5-265	395702	745808	MOORESTOWN TWP WD	MTWD 6	1963	42	248- 288	-47	11/01	-47	11/03	0
*5-266	395703	745811	MOORESTOWN TWP WD	MTWD 3	1942	40	269- 299	-52	11/01	-52	11/03	0
*5-268	395751	745832	MARLAC ELECTRONICS	LAYNE 1	1960	70	[3]288	-35	11/03	-39	11/01	-4
*5-273	395835	745643	MOORESTOWN FC	FIELD CLUB 1	1964	70	274- 302	-29	12/20	-32	11/01	-3
5-274	395841	745905	CAMPBELL SOUP	CAMPBELL 1	1958	40	241- 262	-26	11/01	-29	12/06	-3
5-276	395840	745903	CAMPBELL SOUP	CAMPBELL 2	1958	41	232- 263	NM	NM	-30	12/06	NA
*5-283	395933	745456	MOORESTOWN TWP WD	MTWD 8	1969	65	282- 332	-35	11/01	-34	12/19	1
5-284	395936	745452	MOORESTOWN TWP WD	MTWD 4	1959	59	298- 338	-32	11/01	-31	12/19	1
*5-290	395936	744655	MOUNT HOLLY WC	MHWC 6	1973	15	545- 615	-57	11/01	-63	12/05	-6
*5-297	395525	745416	RUDDEROW, J E	SPRING VALLEY	1954	48	441- 457	NM	NM	-71	11/01	NA
*5-304	395608	745644	MOUNT LAUREL MUA	MLWC 2	1965	20	362- 399	-63	11/02	-64	11/02	-1
[6]5-330	395949	743655	US ARMY	FORT DIX 4	1943	140	1,056-1,086	-51	11/01	-65	11/09	-14
*[6]5-331	400034	743621	US ARMY	FORT DIX 1	1941	138	916- 960	-38	11/01	-47	12/29	-9
*[6]5-332	400106	743720	US ARMY	FORT DIX 5	1969	150	1,064-1,104	-42	11/01	-52	12/29	-10
[6]5-333	400129	743656	US ARMY	FORT DIX 2	1941	131	1,030-1,051	-48	11/01	-61	11/07	-13
[6]5-335	400141	743525	US AIR FORCE	MCGUIRE D	1953	110	1,012-1,075	-66	11/02	-65	11/19	1
*5-336	400150	743428	US AIR FORCE	MCGUIRE C	1953	102	1,036-1,089	NM	NM	-58	11/19	NA
*[6]5-337	400216	743607	US AIR FORCE	MCGUIRE A	1953	122	992-1,055	-66	11/02	-67	11/19	-1
*5-340	400300	743514	US AIR FORCE	MCGUIRE B	1960	130	780- 835	-30	11/02	-34	11/19	-4
*[6]5-344	400546	743446	HOFFMAN-LAROCHE	1974 WELL	1974	136	783- 814	-18	11/01	-9	10/27	9
5-382	395839	744242	SYBRON CHEM	IONIC CHEM 4	1976	30	773- 824	-52	11/03	-63	11/08	-11
*5-385	395839	744249	SYBRON CHEM	IONAC CHEM 5	1977	30	747- 823	-52	11/03	-61	11/08	-9

Table 10. Water-level data for wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
*[6]5- 388	395939	743742	US ARMY	FORT DIX 6	1970	160	1,090-1,140	-47	11/01	-62	12/29	-15
5- 393	400212	745748	RIVERSIDE INDUS	FTC 39	1952	15	54- 67	2	10/28	1	10/31	-1
*5- 436	400118	744010	HELIS, W G	STOCK FARM 1	1928	96	757- 800	NM	NM	-51	[7]01/25	NA
*5- 440	400242	744223	RHODIA CORP	RHODIA 1 OBS	1964	[4]72	603- 613	-29	[5]1/06	-36	10/27	-7
*5- 448	[4]400355	744809	STATE OF NJ	1-REST AREA	1972	36	200- 220	-5	10/27	-10	11/07	-5
*5- 634	400041	744809	MOUNT HOLLY WC	MHWC 5	1965	55	[3]516	-58	11/03	-60	12/05	-2
*5- 649	400122	745308	WILLINGBORO MUA	WMUA 6	1959	39	[3]363	-16	10/27	-26	11/02	-10
5- 651	400139	745325	WILLINGBORO MUA	WMUA 9(OLD 3)	1959	28	203- 304	-19	10/27	-29	11/02	-10
5- 661	400225	745402	WILLINGBORO MUA	WMUA 1	1955	10	147- 199	-16	10/27	-22	11/02	-6
*5- 667	400250	745321	WILLINGBORO MUA	WMUA 5	1958	39	230- 256	-16	10/27	-17	11/02	-1
5- 668	400308	745325	WILLINGBORO MUA	WMUA DCB 28	1955	43	222- 242	-9	10/27	-11	11/02	-2
*[6]5- 683	395122	743017	USGS	BUTLER PL 1 OBS	1964	[6]141	2,102-2,117	-34	10/19	-42	10/21	-8
5- 732	400327	744934	BURLINGTON T WD	4	1979	80	315- 366	NM	NM	-14	10/31	NA
5- 749	395508	745539	RAMBLEWOOD CC	3 TEE	1972	75	[3]425	-69	11/02	-75	10/31	-6
5- 751	395546	745622	RAMBLEWOOD CC	2 TEE	--	20	[3]325	-64	11/02	-69	10/31	-5
5- 782	400224	745815	RIVERSIDE TWP	SEWERAGE 1	1954	10	35- 47	NM	NM	0	11/01	NA
5- 801	400020	750114	TEXACO CORP	OW 10	1980	20	5- 25	0	10/26	-1	10/31	-1
5- 805	400100	750035	CINNAMINSON TSA	1	1983	[4]11	[3]44	2	10/21	-1	10/31	-3
5- 807	400110	745947	HOEGANAES IRON	L1	1982	[4]12	5- 25	4	10/24	3	10/31	-1
5- 812	400123	750004	HOEGANAES IRON	L6	1982	[6]8	3- 23	5	10/24	4	10/31	-1
5- 814	[4]400121	745923	HOEGANAES IRON	I2	1982	18	5- 25	8	10/24	10	10/31	2
*5-1091	400151	745432	WILLINGBORO MUA	WMUA 11	1988	28	197- 243	NM	NM	-16	11/02	NA
7- 39	395457	750640	CAMDEN CITY WD	CITY 7N	1966	21	123- 163	NM	NM	-28	11/04	NA
7- 46	395512	750640	CAMDEN CITY WD	CITY 11	1942	13	124- 154	-27	11/21	8	11/15	35
*7- 48	395527	750646	CAMDEN CITY WD	CITY 6N	1948	14	111- 135	-26	11/23	-20	11/03	6
7- 61	395541	750622	CAMDEN CITY WD	CITY 4	1950	41	131- 156	-33	11/21	-29	11/04	4
*7- 124	395252	745943	NJ AMER WC	BROWNING 45	1973	77	483- 626	-84	11/10	-92	11/04	-8
7- 132	395353	745708	NJ AMER WC	OLD ORCHARD C	1967	71	[3]500	-81	11/16	-81	11/03	0
7- 134	395353	745708	NJ AMER WC	OLD ORCHARD 37	1968	68	454- 488	NM	NM	-73	11/08	NA
*7- 135	395353	745708	NJ AMER WC	OLD ORCHARD 38	1968	72	443- 493	NM	NM	-73	11/08	NA
*7- 142	395438	750107	NJ AMER WC	ELLISBURG 23	1960	32	321- 378	NM	NM	-66	11/09	NA
*7- 146	395455	745924	NJ AMER WC	KINGSTON 27	1963	40	366- 417	-70	11/10	-70	11/08	0
7- 147	395455	745929	NJ AMER WC	KINGSTON 25	1961	44	309- 367	-68	11/10	-67	11/08	1
*7- 186	394950	745855	NJ AMER WC	GIBBSBORO OB 3	1969	70	[3]680	-84	11/10	-88	11/02	-4
*7- 284	395247	750432	NJ AMER WC	EGGBERT 35	1967	22	[3]484	NM	NM	-74	11/08	NA
*7- 304	395404	750202	HADDONFIELD WD	LAKE ST WELL	1967	50	307- 372	NM	NM	-72	11/10	NA
*7- 315	395134	750229	NJ AMER WC	MAGNOLIA 16	1964	78	428- 510	-89	11/16	-87	11/07	2
*7- 329	395628	750406	MCHVIL PNSK WCM	BROWNING 2A	1965	16	110- 140	-31	11/03	-34	11/09	-3
7- 338	395737	750626	USGS	PETTY I EAST 3	1966	5	[3]55	-19	11/03	-19	11/08	0
*7- 413	394922	745630	NJ AMER WC	ELM TREE 3 OBS	1963	[4]149	706- 717	-78	11/09	-82	11/18	-4
*[6]7- 476	394215	745617	USGS	NEW BKLYN 1 OBS	1960	[4]111	1,485-1,495	-53	11/08	-57	11/18	-4
*7- 534	395553	750207	GST RACE TK	2	--	40	--	-48	11/14	-49	11/18	-1
*7- 564	395712	750612	NJ DEP	HARRISON 4	1980	15	15- 35	-12	12/02	-12	11/04	0
*[6]11- 137	392514	745217	DE ROSA, SAM	RAGOVN 2100 OBS	1964	85	2,083-2,093	-43	11/09	-49	12/02	-6
*15- 24	395115	750706	DEPTFORD TWP MUA	DTMUA 4	1971	40	282- 345	-50	11/03	-46	11/10	4
15- 69	394920	751619	GREENWICH TWP WD	GTWD 3(NEW 4)	1959	10	108- 168	-9	11/15	-10	11/01	-1
15- 76	394939	751704	HERCULES CHEM	4 1970	1970	15	90- 120	0	11/15	-1	11/01	-1
15- 84	394948	751639	HERCULES CHEM	GIBBSTOWN 2	1954	12	121- 146	NM	NM	-9	11/01	NA
15- 96	394959	751650	HERCULES CHEM	GIBBSTOWN OB 2	1953	[4]14	129- 134	[4]-2	11/15	-3	11/01	-1
15- 97	395000	751636	HERCULES CHEM	GIBBSTOWN TH 8	1954	[4]6	102- 107	-1	11/15	-1	11/01	0
15- 133	394510	752244	PURELAND WC	TEST WELL 1	1970	20	317- 367	NM	NM	-2	11/08	NA
*15- 135	394516	752241	SHELL OIL C	OBS WELL 8A	1972	[4]7	130- 180	-1	11/16	-2	11/07	-1
*15- 137	394535	752054	PURELAND WC	PURE 2(3-1973)	1973	[4]29	158- 208	[4]-6	11/16	-8	11/09	-2
*15- 140	394608	752135	PURELAND WC	TEST WELL 4	1970	[4]6	132- 184	[4]-1	11/16	-2	11/09	-1
15- 143	394551	752313	PURELAND WC	LANDTECT TW-6C	1972	[4]19	102- 152	2	11/16	1	11/07	-1
15- 144	394613	752129	PURELAND WC	1-1973	1973	[4]8	81- 136	-2	11/17	-3	11/09	-1
15- 146	394648	752318	PURELAND WC	LANDTECT TW-9	1970	[4]5	82- 101	-2	11/16	-3	11/08	-1
15- 158	394733	752351	MONSANTO CHEM	BRIDGEPORT W2	1961	12	57- 82	NM	NM	-14	11/08	NA
15- 159	394736	752344	MONSANTO CHEM	BRIDGEPORT E1	1961	11	56- 81	NM	NM	-17	11/08	NA
15- 161	394739	752232	MONSANTO CHEM	OB1(TW5-OBC)	1960	[4]8	70- 90	-6	11/15	-4	11/08	2
15- 163	[4]394747	752410	MONSANTO CHEM	OB3(TW1-OBA)	1961	[4]10	95- 100	-9	11/15	-8	11/08	1
15- 166	394755	752108	PENNS GROVE WSC	BRIDGEPORT 2	1955	5	65- 85	1	11/17	2	11/01	1
15- 167	394726	752319	MONSANTO CHEM	MONSANTO 1	1969	10	64- 94	NM	NM	-12	11/08	NA
15- 170	394854	751906	VINE CONCRETE C	REPAUP 1	1970	11	85- 106	NM	NM	4	11/16	NA
15- 212	394929	751447	PAULSBORO WD	PWD 4	1951	25	192- 220	-12	11/02	-12	11/07	0

Footnotes at end of table

Table 10. Water-level data for wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location Latitude	Location Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983 Altitude[1] (ft)	1983 Date (mo/day)	Water level 1988 Altitude[1] (ft)	1988 Date (mo/day)	Change in water level (1983-88) (ft)
*15- 213	394947	751416	PAULSBORO WD	PWD 5	1957	10	135- 175	-10	11/02	-10	11/07	0
15- 236	394434	751843	SWEDESBORO B WD	SBWD 3	1969	75	241- 312	-20	11/08	-22	11/10	-2
15- 238	394438	751833	SWEDESBORO B WD	SBWD 2	1940	30	217- 240	-21	11/08	-24	11/10	-3
*15- 242	394512	751830	DEL MONTE CORP	6	1944	25	267- 298	-21	11/18	-21	11/01	0
*15- 279	394857	751250	HUNTSMAN POLYP C	SHELL OBS 7	1962	17	315- 320	-24	11/04	-26	11/10	-2
15- 347	394932	751722	GREENWICH TWP WD	GTWD 5 (2-A)	1977	20	82- 117	-2	11/15	-2	11/01	0
*15- 348	394910	751541	GREENWICH TWP WD	GTWD 6	1978	20	105- 135	-10	11/16	-11	11/01	-1
15- 354	394716	752112	ROLLINS ENV SERV	DP 2	1975	[4]13	81-[3] 91	7	11/17	6	11/02	-1
15- 359	395015	751727	E I DUPONT	C POWER 22	--	5	[3]103	2	11/15	0	11/02	-2
*15- 374	394843	750728	DEPTFORD TWP MUA	DTMUA 6	1979	50	430- 486	-65	11/03	-63	11/10	2
15- 380	[4]394757	752346	MONSANTO CHEM	OBS 2	1961	[4]18	71- 76	-9	11/15	-9	11/08	0
15- 387	394713	752121	ROLLINS ENV SERV	DP 1	1975	[4]10	80- 90	6	11/17	9	11/01	3
15- 395	394801	751759	REPAUPO FIRE C	30-1972	1979	[4]20	93- 113	[4]-5	11/18	-14	11/01	-9
*15- 415	394834	751044	W DEPTFORD TWP WD	TEST 8-79	1979	40	287- 307	-42	11/03	-39	11/14	3
15- 435	394836	751046	W DEPTFORD TWP WD	WDTWD 8	1981	40	252- 312	-43	11/03	-38	11/14	5
15- 490	394716	752103	ROLLINS ENV SERV	MA-3I	1981	[4]3	30- 40	[4]0	11/17	-1	11/02	-1
15- 492	394716	752103	ROLLINS ENV SERV	MA-3D	1981	[4]3	45- 60	[4]3	11/17	-1	11/02	-4
15- 494	394716	752103	ROLLINS ENV SERV	MA-3S	1981	[4]3	5- 10	[4]1	11/17	-1	11/02	-2
15- 540	394800	751936	US EPA	EPA 108	1982	7	87- 97	NM	NM	2	11/15	NA
15- 549	394757	751945	CHEM LEAMAN	DW1	1981	[4]7	95- 97	5	11/16	4	11/01	-1
15- 550	[4]394759	751949	CHEM LEAMAN	DW2	1981	[4]10	100- 102	3	11/16	2	11/23	-1
15- 555	394808	751914	US EPA REGION II	S-2B	1983	[4]11	40- 50	2	11/16	3	11/21	1
15- 556	394808	751914	US EPA REGION II	S-2C	1983	[4]11	98- 108	1	11/16	1	11/21	0
15- 561	394800	751913	US EPA REGION II	S-11B	1983	11	79- 89	6	11/16	6	11/21	0
15- 562	394800	751913	US EPA REGION II	S-11C	1983	11	105- 115	NM	NM	5	11/21	NA
15- 569	394529	752045	PURELAND WC	PWC 3	1981	32	161- 201	NM	NM	-12	11/09	NA
*15- 585	394704	752058	ROLLINS ENV SERV	DP5	1981	8	79- 89	NM	NM	-1	11/02	NA
15- 586	394720	752052	ROLLINS ENV SERV	DP4	1981	12	95- 125	NM	NM	2	11/02	NA
*15- 616	394637	751916	USGS	SHIVELER MIDDLE	1985	31	230- 240	NM	NM	-8	11/14	NA
15- 620	394804	751933	USGS	GAVENTA MID 1	1985	7	131- 141	NM	NM	2	11/14	NA
15- 679	394946	751612	MOBIL OIL C	W-5D	1985	10	118- 128	NM	NM	-3	11/03	NA
*15- 681	395038	751605	MOBIL OIL CO	MW-7D	1985	9	60- 70	NM	NM	1	11/03	NA
15- 682	395048	751518	MOBIL OIL C	W-8D	1985	11	105- 115	NM	NM	-3	11/03	NA
15- 685	395046	751446	EXXON CORP	MW 7	1984	30	8- 28	NM	NM	6	11/08	NA
15- 689	395018	751650	E I DUPONT	DUPONT 93	1985	10	7- 17	NM	NM	2	11/02	NA
15- 697	394755	752108	PENNS GROVE WC	BRDGEPRT BKUP 2	1984	8	69- 84	NM	NM	4	11/01	NA
*15- 713	394808	751724	USGS	STEFKA-2 OBS	1986	6	125- 155	NM	NM	-8	11/15	NA
15- 727	394808	751724	USGS	STEFKA-3 OBS	1987	5	206- 216	NM	NM	-8	11/15	NA
15- 771	395202	751115	USGS	NAT PK 2-PW-M	1987	10	92- 123	NM	NM	-6	11/15	NA
15- 774	395206	751118	USGS	NAT PK 4-OW-AM	1987	10	93- 113	NM	NM	-1	11/15	NA
*15- 776	395202	751127	USGS	NAT PK 7-OW-CM	1987	15	125- 135	NM	NM	-4	11/15	NA
15- 780	395223	751117	USGS	NAT PK 10-OW-BM	1987	5	75- 85	NM	NM	-2	11/15	NA
15- 1039	394958	751512	MOBIL OIL C	MOBIL 48 DWTA	1988	7	100- 153	NM	NM	-11	11/03	NA
21- 12	401536	742920	EAST WINDSOR MUA	6 TWIN RIVERS	1971	115	520- 560	27	10/21	23	10/18	-4
21- 22	401702	743106	EAST WINDSOR MUA	EWMUA 3	1965	100	337- 367	42	10/19	32	10/18	-10
*21- 25	401717	743352	CARTER WALLACE	KENTILE 1	1954	100	206- 215	64	10/20	67	10/23	3
*21- 26	401725	743159	EAST WINDSOR MUA	EWMUA 2	1964	100	260- 290	72	10/19	65	10/18	-7
21- 27	401730	743202	EAST WINDSOR MUA	EWMUA 1	1964	98	279- 295	70	10/19	65	10/18	-5
*21- 39	401048	744036	KALEX CHEM PROD	1 (KEYE TEX)	1964	55	179- 199	14	11/07	14	12/22	0
*21- 43	401103	744155	BORDENTOWN WD	WHITE HORSE 2	1965	10	118- 138	6	10/28	8	10/30	2
*21- 54	401305	743921	GST WC	ROBRT FROST 10	1962	85	194- 243	NM	NM	38	10/12	NA
21- 62	401353	743951	GST WC	PARK AVENUE 11	1969	100	162- 207	40	10/07	39	10/12	-1
21- 73	401419	744007	GST WC	PAXSON AVE 9	1958	80	128- 144	NM	NM	42	10/12	NA
*21- 80	401558	743200	COCA-COLA CORP	COCA-COLA 1972	1972	125	150- 180	NM	NM	53	10/24	NA
21- 89	401654	744038	SHELL CHEM C	1972 WELL	1972	70	23- 33	NM	NM	64	10/31	NA
21- 92	401152	744528	CHAMPALE	YARD WELL	1961	27	70- 80	2	11/01	3	10/24	1
*21- 101	401238	743448	PRINCETON MEM PARK	MEMORIAL PK 1	1966	135	366- 421	36	10/20	35	10/25	-1
21- 106	401349	743552	PATER MOTORS	1-1949	1949	110	220- 230	NM	NM	106	10/28	NA
21- 120	401555	743704	ELIZABETHTOWN WD	JEFFERSON PK 1	1965	80	96- 121	75	10/27	63	10/24	-12
21- 127	401712	743640	REED SOD FARM	1953-HOLMAN	1953	100	18- 68	NM	NM	80	10/26	NA
21- 145	401717	743352	CARTER WALLACE	EAST WINDSOR T	1954	100	205- 226	64	10/20	66	10/23	2
23- 9	401800	743206	DANSER, FRANK	IRR-1950	1950	100	250- 280	67	10/19	64	10/24	-3
*23- 11	401818	742932	CARTER WALLACE	[4]CW 1	1956	115	255- 285	48	10/25	53	10/23	5
23- 13	401841	743355	STULTZ, STANLEY	1-1954(CLIFRD)	1954	100	133- 163	72	10/24	70	10/21	-2
*23- 16	401842	743055	CRANBURY TWP WD	CTWD 1A	1972	95	230- 260	61	10/25	58	10/26	-3

Footnotes at end of table

Table 10. Water-level data for wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
23- 17	401843	743055	CRANBURY TWP WD	CTWD 3	1963	98	268- 298	61	10/25	60	10/26	-1
23- 28	401924	742909	CARTER WALLACE	CW 5	1964	105	298- 335	55	10/30	59	10/23	4
23- 33	401923	743247	DYAL, LEROY	DYAL 1 (1951)	1951	90	170- 180	67	10/24	66	10/26	-1
*23- 39	402410	742531	KONUK, JOSEPH	KONUK 1	1956	140	225- 245	NM	NM	-3	10/21	NA
23- 45	402426	742515	POLYSAR RUB SERV	RETURN WELL	1969	110	203- 233	NM	NM	-7	10/20	NA
*23- 50	402432	742212	ANHEUSER BUSCH	BUSCH 5	1963	37	215- 265	-39	10/27	-50	10/24	-11
*23- 57	402441	742448	E BRUNSWICK TWP WD	COLONIAL OAKS	1954	122	216- 241	-21	09/30	-20	10/18	1
23- 58	402448	742700	MIDDLESEX WC	TAMARACK 1-75	1975	108	87- 107	27	10/21	32	10/18	5
23- 63	402501	742440	E BRUNSWICK TWP WD	EBTWD 1	1951	110	162- 182	-13	09/30	-11	10/18	2
23- 64	402503	742812	USGS	[4]BEECHER OBS	[4]1974	85	35- 40	64	10/17	66	10/18	2
*23- 70	402555	742719	FISCHER, ROBERT	FISCHER OBS	1936	73	0- 21	56	10/17	56	10/17	0
23- 72	402635	742402	SMITH, LAWRENCE	SMITH 2-1972	1972	80	120- 130	-14	10/17	-13	10/17	1
23- 94	402239	742530	HELMETTA WC	5-1962 (OLD#2)	1962	60	183- 193	27	10/18	20	10/20	-7
*23- 97	402247	742503	DUHERNAL WC	DUHRNL OBS 49F	1946	39	236- 301	2	10/18	6	12/07	4
*23-114	402319	742246	DUHERNAL WC	DUHRNL OBS 52F	1945	26	225- 237	-30	11/01	-30	10/17	0
23-127	402330	742258	DUHERNAL WC	DUHERNAL AF	1945	12	236- 296	-33	10/31	-29	10/24	4
*23-132	402335	742136	DUHERNAL WC	DUHRNL OBS 56F	1947	25	262- 267	-38	11/01	-36	10/18	2
*23-147	402350	741840	OLD BRIDGE MUA	BROWNTOWN 4	1966	80	425- 475	-79	10/17	-65	10/19	14
23-171	402404	742204	DUHERNAL WC	DUHERNAL BF	1946	20	240- 300	-44	11/01	-44	10/18	0
23-176	402407	741924	OLD BRIDGE MUA	OBS 1-1972	1972	45	321- 363	-53	10/17	-66	10/19	-13
*23-179	402436	742041	OLD BRIDGE MUA	OBS 2-1972	1972	10	250- 292	-50	10/17	-62	10/19	-12
*23-194	402536	742018	PERTH AMBOY WD	RUNYON 1 OBS	1930	18	201- 281	-46	10/20	-59	10/19	-13
23-197	402543	742010	PERTH AMBOY WD	PERTH AMBOY 2	1944	20	205- 260	-47	10/20	-64	10/17	-17
23-201	402614	741744	OLD BRIDGE MUA	MIDTOWN 1	1956	15	266- 306	NM	NM	-63	10/20	NA
*23-206	402700	741454	OLD BRIDGE MUA	LAWRENCE HAR 9	1953	60	360- 395	-78	10/19	-86	10/19	-8
23-226	402013	742834	GENERAL FOODS	2	1967	132	330- 364	53	10/21	60	10/21	7
*23-229	402015	742757	MONROE TWP MUA	FORSGATE 4 OBS	1961	147	319- 330	51	10/20	48	10/17	-3
23-232	402023	742858	MONROE TWP MUA	FORSGATE 11	1961	130	272- 314	61	10/21	59	10/20	-2
*23-240	402051	742746	MONROE TWP MUA	12-1961	1961	140	305- 353	46	10/20	40	10/20	-6
23-257	403052	741654	ALL STAR DAIRY	ALL STAR 1	1932	61	[3]158	-29	11/10	-31	10/19	-2
23-262	403150	741603	CHEVRON OIL C	OBS 1	1951	30	72- 82	15	10/17	17	10/18	2
23-263	403200	741620	CHEVRON OIL C	CHEVRON 2	1950	45	96- 106	6	10/17	9	10/18	3
23-264	403200	741620	CHEVRON OIL C	OBS 2	1950	45	96- 106	8	10/17	9	10/18	1
23-265	403211	741612	CHEVRON OIL C	11	--	14	11- 94	11	10/17	11	10/18	0
23-266	[4]403211	741631	CHEVRON OIL C	CHEVRON 3	1951	40	87- 96	15	10/17	17	10/18	2
23-270	403231	741616	AMER CYANAMID CORP	TEST 2	--	12	53- 57	9	10/17	9	10/18	0
23-289	402056	742937	MONROE TWP MUA	15(KIMBRY-CLK)	1956	134	227- 257	66	10/25	73	10/20	7
23-291	402109	743013	MONROE TWP MUA	FORSGATE 1 OBS	1961	107	192- 203	65	10/27	64	10/20	-1
23-295	402125	742920	INT PERMALITE	LAKES CARBON 1	1966	120	187- 233	68	10/21	68	10/21	0
23-298	402129	742901	STAUFFER CHEM	STAUFFER PW 1	1965	[4]123	217- 237	[4]71	10/21	74	10/21	3
23-302	402138	742940	SOUTH BRUNSWICK MUA	FORSGATE 14	1955	115	170- 200	76	10/21	76	10/17	0
23-306	402147	742847	PHELPS DODGE C	PHELPS DODGE 3	1968	120	201- 207	69	10/21	69	10/21	0
23-315	402204	743024	SOUTH BRUNSWICK MUA	13	1971	102	103- 138	76	10/24	73	10/17	-3
23-316	402206	743515	AEROCHEM CORP	AEROCHEM 2	1961	120	[3]100	86	10/25	85	10/24	-1
23-319	402220	742950	SOUTH BRUNSWICK MUA	SBMUA 12	1963	93	110- 135	72	10/24	75	10/17	3
23-322	402230	743040	SOUTH BRUNSWICK MUA	SBMUA 11	1963	122	95- 115	77	10/24	74	12/20	-3
*23-329	402315	742652	DEY BROTHERS	2	1955	115	215- 248	34	10/17	33	10/17	-1
23-348	402605	741957	SAYREVILLE WD	OBS WELL 101	1968	30	269- 279	-47	10/19	-59	10/18	-12
23-350	402608	741955	SAYREVILLE WD	OBS WELL 102	1968	30	267- 277	-51	10/19	-62	10/18	-11
23-353	402611	741955	SAYREVILLE WD	OBS WELL 103	1968	35	262- 273	-47	10/19	-59	10/18	-12
23-365	402633	742120	DUHERNAL WC	DUH SAY 4 OBS	1931	6	148- 160	-43	10/17	-51	10/17	-8
23-370	402631	742053	HERCULES POWDER	HERCULES 6	1946	20	164- 194	-39	10/24	-48	10/21	-9
23-371	402638	742022	HERCULES POWDER	HERCULES 5	1929	48	182- 228	NM	NM	-50	10/21	NA
23-376	402649	742025	HERCULES POWDER	HERCULES 3	1928	41	180- 220	-43	10/24	-52	10/21	-9
23-380	402659	742020	HERCULES POWDER	HERCULES 2	1927	48	184- 237	-42	10/18	-37	12/14	5
23-384	402705	742023	HERCULES POWDER	HERCULES 1REBT	1939	54	170- 225	-35	10/24	-43	10/21	-8
23-401	402744	741628	SAYREVILLE WD	MORGAN P	1967	44	254- 288	-80	10/18	-77	10/18	3
23-404	402745	741645	SAYREVILLE WD	MORGAN OBS 1	1966	23	238- 248	-78	10/19	-78	10/18	0
*23-411	402822	741630	SOUTH AMBOY WD	SAWD 8	1947	10	209- 234	-69	10/18	-69	10/18	0
23-423	402943	741808	NL INDUSTRIES	CL TEST 1	1956	30	75- 84	-46	10/18	-47	10/18	-1
23-429	402923	741648	JERSEY CENTRAL PL	WERNER STA 6	1969	18	154- 177	-39	10/18	-40	10/18	-1
23-430	402923	741651	JERSEY CENTRAL PL	7-1972	1972	12	135- 165	-41	10/18	-42	10/18	-1
*23-438	402559	742142	SOUTH RIVER WD	SRWD 5	1977	20	132- 182	-38	10/17	-46	10/21	-8
23-439	402633	742200	SOUTH RIVER WD	SRWD 2 OBS	1967	21	121- 126	-32	10/17	-38	10/21	-6
23-441	[4]402742	742309	HERBERT SAND C	HSC 3	1964	6	49- 52	1	10/18	1	10/27	0

Footnotes at end of table

Table 10. Water-level data for wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983-88) (ft)
23- 445	402328	742318	SPOTSWOOD WD	TW 4F-76	1976	[4]18	195- 264	[4]-21	10/27	-27	10/19	-6
23- 449	402352	742250	DUHERNAL WC	DUHERNAL 17	--	20	[3]60	NM	NM	2	12/07	NA
23- 452	402401	742243	SCHWEITZER, P J	8	1947	25	226- 276	-51	10/27	-69	10/18	-18
23- 456	402404	742235	SCHWEITZER, P J	1R	1956	21	235- 275	-49	10/27	-66	10/18	-17
23- 462	403043	741842	UNION CARBIDE	CARBIDE 1	1965	15	47- 57	13	10/18	12	10/17	-1
*23- 482	403242	741617	AMER CYANAMID CORP	TEST 1 OBS	--	11	44- 76	9	10/17	10	10/18	1
23- 492	402129	742823	BASF-WYANDOTTE	BASF 3	1978	130	230- 276	61	10/21	54	10/21	-7
*23- 503	[4]401938	742404	EONAITIS, PETER	EONAITIS 1	1964	140	410- 440	12	10/25	13	10/19	1
23- 504	402047	742820	FORSGATE	I-IRR	1972	141	288- 340	57	10/20	43	10/26	-14
*23- 506	402358	742612	SMITH, LAWRENCE	3-1958	1958	120	213- 223	NM	NM	9	10/17	NA
23- 510	402234	743114	IBM CORP	GW 20	1978	119	30- 65	82	10/17	78	12/15	-4
23- 511	402232	743114	IBM CORP	GW-18A	[4] 1979	118	65- 95	80	10/17	77	10/21	-3
23- 512	402531	742822	ERDMAN, W	ERDMAN 1	--	85	--	NM	NM	62	10/20	NA
23- 514	402755	742258	HERBERT SAND C	NEW 2-76	1976	5	25- 35	2	10/18	2	10/27	0
23- 543	403242	741526	SHELL OIL CORP	SHELL 5(S2)	--	25	[3]42	NM	NM	5	10/19	NA
23- 548	403257	741539	SHELL OIL CORP	SHELL 8(R7)	--	17	[3]36	NM	NM	5	10/19	NA
23- 552	402018	743021	SOUTH BRUNSWICK MUA	SBMUA 15	1979	105	116- 166	NM	NM	59	10/17	NA
23- 566	402129	742901	STAUFFER CHEM	D-2	1982	124	122- 225	NM	NM	68	10/21	NA
23- 568	402410	742231	SCHWEITZER, P J	12	1983	25	210- 280	-44	10/27	-62	10/18	-18
23- 577	403210	741520	CHEVRON OIL CORP	SB-13A	1981	7	37- 57	NM	NM	-3	10/18	NA
23- 578	403236	741543	CHEVRON OIL CORP	E15A	1981	5	44- 64	NM	NM	-4	10/18	NA
23- 585	402450	742330	CHIRLIAN, PAUL	DEEPWELL	1980	120	238- 248	NM	NM	-32	10/17	NA
23- 782	402353	742056	OLD BRIDGE MUA	OLD BRIDGE 12	1984	30	230- 337	NM	NM	-60	10/19	NA
23-1158	402350	742051	OLD BRIDGE MUA	OLD BRIDGE R6	1988	30	255- 350	NM	NM	-55	10/19	NA
*23-1160	402720	741950	E I DUPONT	FW-2	1988	86	210- 230	NM	NM	-54	10/25	NA
23-1161	402739	741938	E I DUPONT	FW-4	1988	105	214- 229	NM	NM	-53	10/25	NA
*25- 55	401744	742135	ENGLISHTOWN B WD	ENGLISHTOWN 1	1963	70	651- 671	-22	10/19	-24	10/26	-2
*25- 153	402444	741010	SHORELANDS WC	W KEANSBURG 4	1970	65	635- 690	-70	10/17	-116	10/19	-46
*25- 166	400952	741405	HOWELL TWP MUA	ALDRICH W CO 3	1964	114	336- 396	NM	NM	-40	10/25	NA
*25- 230	402004	741853	GORDONS CORNER WC	GORDONS 5	1972	125	580- 670	-36	10/19	-49	10/21	-13
*25- 247	401902	741811	GORDONS CORNER WC	GORDONS 2	1964	146	762- 832	-34	10/19	-48	10/20	-14
25- 249	401859	741809	GORDONS CORNER WC	GORDONS 4	1968	143	741- 810	NM	NM	-49	10/20	NA
*25- 268	402117	741511	MARLBORO TWP MUA	2-PROD	1972	114	632- 698	-50	10/20	-64	10/26	-14
25- 269	402122	741511	MARLBORO TWP MUA	1-PROD	1972	111	647- 716	-55	10/20	-68	10/26	-13
*25- 272	402208	741452	MARLBORO TWP MUA	MARLBORO 1 OBS	1972	117	670- 680	-55	10/20	-73	10/17	-18
*25- 297	402603	741422	ABERDEEN TWP WD	MATAWAN TWP 1	1956	80	447- 487	-78	10/20	-98	[7]10/19	-20
25- 318	402700	735958	NATIONAL PARK SERV	FT HANCOCK 2	1906	8	600- 724	-7	10/24	-14	[7]01/05	-7
*25- 320	402705	735959	NATIONAL PARK SERV	FT HANCOCK 5A	1970	14	838- 878	-8	10/24	-10	10/19	-2
25- 452	401857	741811	GORDONS CORNER WC	GORDONS 10	1980	135	740- 800	-39	10/19	-56	10/20	-17
*25- 453	402632	741051	UNION BEACH WD	UBWD 3 1977	1977	10	480- 532	-91	10/18	-107	10/18	-16
25- 466	402610	741351	ABERDEEN TWP WD	3-77	1977	56	420- 470	[4]-80	10/20	-86	10/19	-6
25- 467	402436	741013	SHORELANDS WC[4]	W KEANS 5	1978	[4]77	650- 700	[4]-75	10/27	-115	10/19	-40
*25- 495	401850	740301	DEPT OF ENERGY	DGE TC-40	--	10	[3]1,000	NM	NM	-11	10/26	NA
*25- 509	401315	742810	ROOSEVELT WD	ROOSEVELT 4	--	170	390- 430	29	10/31	27	10/27	-2
*25- 635	401105	741202	USGS	HOWEL TWP 1 OBS	1987	111	1,226-1,330	NM	NM	-38	10/20	NA
*25- 711	401743	741902	GORDONS CORNER WC	GORDONS 12	1986	90	649- 756	NM	NM	0	10/20	NA
*[6]29- 19	394829	740535	USGS	IS BEACH 3 OBS	1962	9	2,736-2,756	-6	10/02	-11	10/28	-5
29- 45	400431	740832	BRICK TWP MUA	FORG POND 9-73	1973	8	1,441-1,779	NM	NM	-89	[7]01/12	NA
29- 46	400432	740833	BRICK TWP MUA	FP 10	1975	20	1,607-1,827	NM	NM	-70	[7]01/12	NA
*[6]29- 47	400433	740833	BRICK TWP MUA	OBS 1	1973	8	1,709-1,749	-41	11/03	-65	[7]01/12	-24
*[6]29- 85	395929	741420	CIBA-GEIGY CORP	TRCHEM 84 OBS	1968	67	1,460-1,480	-29	10/26	-40	10/31	-11
*[6]29- 118	[4]400200	742110	LAKEHURST N A S	LAKE NAS 32	1964	96	1,397-1,583	-28	11/04	-42	10/26	-14
*[6]29- 132	400319	741957	JACKSON TWP MUA	SCM 3	1962	95	1,606-1,728	-37	10/26	-51	10/24	-14
[6]29- 135	400333	741942	JACKSON TWP MUA[4]	SCM 4	1962	95	1,345-1,555	-25	10/26	-47	10/24	-22
*[6]29- 440	400504	741324	NJ AMER WC	LAKEWOOD 10	1972	72	1,357-1,602	-31	10/27	-44	10/24	-13
*[6]29- 490	395901	742017	AM SMELTNG & RF	[4]2	1972	89	1,436-1,636	-29	[5]03/08	-44	10/20	-15
[6]29- 575	400659	741707	JACKSON TWP MUA	JACKSON 9	1978	134	1,276-1,430	-29	10/26	-42	10/24	-13
*[6]29- 576	400653	741717	JACKSON TWP MUA	JACKSON 8	1977	135	1,276-1,462	-35	10/26	-48	10/24	-13
*29- 581	400821	742630	JACKSON TWP MUA	[4]JACKSON TWP 10	1984	130	876- 976	-16	10/28	-26	10/25	-10
*[6]29- 588	400435	741105	LAKEWOOD TWP MUA	S LAKEWOOD 7	1978	70	1,410-1,620	-27	10/25	-56	10/25	-29
*[6]29- 626	395721	741230	TOMS RIVER WC	TRWC 30	1963	9	1,700-1,875	-23	10/25	-34	11/04	-11
29- 779	400433	740831	BRICK TWP MUA	BTMUA 12	1982	34	1,700-1,860	NM	NM	-68	01/12[7]	NA
*33- 64	393912	752436	E I DUPONT	COURSE LAND 3A	1966	30	568- 578	-15	11/16	-18	11/22	-3
33- 65	393912	752436	E I DUPONT	COURSE LAND 3B	1966	30	501- 512	-15	11/16	-18	11/22	-3
33- 66	393912	752436	E I DUPONT	COURSE LAND 3C	1966	30	375- 386	-14	11/16	-18	11/22	-4

Footnotes at end of table

Table 10. Water-level data for wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	1988: Date (mo/day)	Change in water level (1983-88) (ft)
33- 67	393936	752437	E I DUPONT	COURSE LAND P1	1966	10	445- 591	-17	11/16	-21	11/22	-4
*33- 69	394139	752349	NJ TURNPIKE AUTH	SERVICE IN-1	1953	40	313- 333	-19	10/26	-20	12/01	-1
33- 70	[4]394141	752343	NJ TURNPIKE AUTH	SERVICE 1N-2	--	40	[3]330	-21	10/26	-22	12/01	-1
33- 72	[4]394154	752351	NJ TURNPIKE AUTH	SERVICE 1S-1	1953	35	342- 368	-25	10/26	-27	12/01	-2
33- 80	394542	752510	AIR REDUCTION	AIRCO 1	1963	[4]15	112- 132	NM	NM	-3	11/08	NA
33- 82	394542	752603	BRIDGE, BRUCE H	BRIDGE	1957	[4] 6	[3]205	[4]-20	11/17	-19	11/07	1
33- 84	394549	752523	B F GOODRICH CORP	TEST 8	1967	11	97- 117	-5	11/18	-6	11/17	-1
33- 85	394556	752530	B F GOODRICH CORP	6 (PW-2)	1967	10	109- 129	-10	11/18	-14	11/17	-4
33-103	394346	752828	PENNS GROVE SA	SEWERAGE AUTH1	1955	8	50- 60	-1	11/15	0	11/22	1
*33-106	393514	752917	LINSKI, ALEX	1	1962	5	359- 365	NM	NM	-30	[7]01/05	NA
*33-107	393620	753310	NJ DEPT CONSERV	FT MOTT SP 1	1900	8	300- 320	-21	11/09	-24	11/15	-3
*33-119	394009	753043	PENNSVILLE TWD	PTWD 2	1949	7	210- 230	-39	11/14	-43	11/21	-4
33-122	394045	753018	ATLANTIC CITY ELEC	DEEPWATER 3R	1970	10	165- 235	-52	11/14	-61	11/23	-9
33-125	394051	753030	ATLANTIC CITY ELEC	DEEPWATER 5	1953	10	149- 219	-51	11/14	-55	11/23	-4
33-127	394100	753030	ATLANTIC CITY ELEC	DEEPWATER 6	1958	10	158- 188	-48	11/14	-51	11/23	-3
33-131	394109	753009	E I DUPONT	CHAMBERS OB2-1	1965	7	237- 247	-46	11/14	-57	11/21	-11
33-132	394109	753009	E I DUPONT	CHAMBERS OB2-2	1965	7	192- 200	-49	11/14	-54	11/21	-5
33-141	394131	753009	E I DUPONT	CHAMBERS OB3-3	1965	5	197- 207	-45	11/14	-53	11/21	-8
*33-158	393848	752010	ACME MARKETS	ACME 1	1960	62	562- 575	NM	NM	-25	11/16	NA
33-163	393928	752147	RICHMAN ICE CREAM	RICHMAN 1	1948	25	455- 475	NM	NM	-27	11/09	NA
*33-164	393928	752147	RICHMAN ICE CREAM	RICHMAN 2	1946	20	[3]446	-29	11/18	-30	11/09	-1
33-165	393942	752234	E I DUPONT	COURSE LAND 4A	1966	47	634- 644	-15	11/16	-18	11/22	-3
33-166	393942	752234	E I DUPONT	COURSE LAND 4B	1967	47	568- 578	-15	11/16	-18	11/22	-3
33-167	393942	752234	E I DUPONT	COURSE LAND 4C	1966	47	430- 440	-14	11/16	-16	11/22	-2
*33-198	394117	752207	DUBOICE, MAURICE	IRR 74	1974	51	337- 362	-23	11/17	-25	11/15	-2
*33-251	393348	752755	USGS	SALEM 1 OBS	1965	3	699- 709	-28	09/29	-32	11/22	-4
33-298	393952	752429	E I DUPONT	COURSE LAND P2	1966	9	385- 635	-19	11/14	-22	11/22	-3
33-299	393957	752432	E I DUPONT	COURSE LAND 1A	1966	26	604- 614	-17	11/14	-20	11/22	-3
33-300	393957	752432	E I DUPONT	COURSE LAND 1B	1966	25	507- 517	-13	11/14	-15	11/22	-2
33-301	393957	752432	E I DUPONT	COURSE LAND 1C	1966	26	404- 415	-12	11/14	-14	11/22	-2
33-302	394000	752439	E I DUPONT	COURSE LAND 2A	1966	30	583- 593	-16	11/16	-19	11/22	-3
33-303	394000	752439	E I DUPONT	COURSE LAND 2B	1966	30	533- 544	-10	11/16	-12	11/22	-2
33-304	394000	752439	E I DUPONT	COURSE LAND 2C	1966	30	435- 445	-9	11/16	-11	11/22	-2
*33-305	394013	752459	E I DUPONT	COURSE LAND P3	1966	14	381- 457	-14	11/16	-16	11/22	-2
33-328	394157	752918	E I DUPONT	CARNEY PT 1	1967	5	175- 195	-17	11/14	-23	11/22	-6
33-334	394211	752901	E I DUPONT	CARNEY PT 6	1957	5	157- 182	-16	11/14	-23	11/22	-7
[6]33-354	393904	751946	WOODSTOWN WD	WWD 2	1946	45	670- 705	-36	11/18	-27	11/10	9
[6]33-362	393926	751927	WOODSTOWN WD	WWD 3	1975	60	692- 712	-30	11/18	-34	11/10	-4
*[6]33-364	392743	753158	PUBLIC SERV E-G	PW5	1974	17	765- 840	-66	11/17	-62	11/21	4
33-442	394617	752522	US ARMY CORPS	EAB 8	1982	[4] 9	95- 100	[4] -2	11/17	-6	11/08	-4
33-443	394617	752522	US ARMY CORPS	EAB 8A	1982	[4] 9	35- 40	[4] 5	11/17	2	11/08	-3
33-444	394459	752702	US ARMY CORPS	DGB 100	1982	23	83- 88	NM	NM	12	12/01	NA
33-448	394648	752538	US ARMY CORPS	EHW-4	--	[4]13	37- 42	[4] 8	11/08	12	11/08	4
33-449	394614	752539	US ARMY CORPS	EHW-5	--	[4]10	32- 37	[4] 8	11/08	3	11/09	-5
33-450	394516	752750	US ARMY CORPS	EHW-6	--	10	28- 33	4	11/08	6	11/09	2
[6]33-452	392751	753207	PUBLIC SERV E-G	HOPE CREEK	1976	[4]10	746- 817	-66	11/17	-68	11/21	-2
33-457	392751	753207	PUBLIC SERV E-G	PSEG 6	1981	20	1,115-1,135	NM	NM	-31	12/08	NA
*PH- 12	395342	751021	US NAVY		1944	9	[5]101	NM	NM	-7	11/08	NA
*059-128	393548	753740	TEXACO	#27	--	30		NM	NM	-28	11/14	NA
Cc55-17	394006	753529	NEW CASTLE W+L	SCHOOL 2	--	40	89- 115	NM	NM	-7	11/14	NA
*Cd51-08	394006	753454	NEW CASTLE W+L	BASIN RD 1	--	22	65- 82	NM	NM	-12	11/14	NA
Dc15-16	393954	753534	NEW CASTLE W+L	FRENCHTOWN #2	--	32	99- 109	NM	NM	-13	11/14	NA
Dc22-18	393833	753814	ARTESIAN WC	FAIR WINDS 27	--	50	69- 89	NM	NM	-14	11/15	NA
*Dc25-27	393848	753532	JAMES RIVER CORP	7	--	10	129- 183	NM	NM	-16	11/14	NA
*Dc34-06	393755	753648	USGS (DEL)	DEL NAT GUARD 2	--	28	183- 188	NM	NM	-28	11/14	NA
*Eb23-24	393316	754216	USGS (DEL)	LUMS POND C	--	60	432- 436	NM	NM	-34	11/14	NA
Ec32-03	393209	750802	UNION CARBIDE	ST GEORGES 3	--	11	318- 328	NM	NM	-32	11/14	NA

1 Datum is sea level.
2 Depth below land surface.
3 Well depth.
4 Revised from Eckel and Walker (1986).
5 Water level measured in 1984.
6 Well screened in the undifferentiated part of the Potomac-Raritan-Magothy aquifer system.
7 Water level measured in 1989.

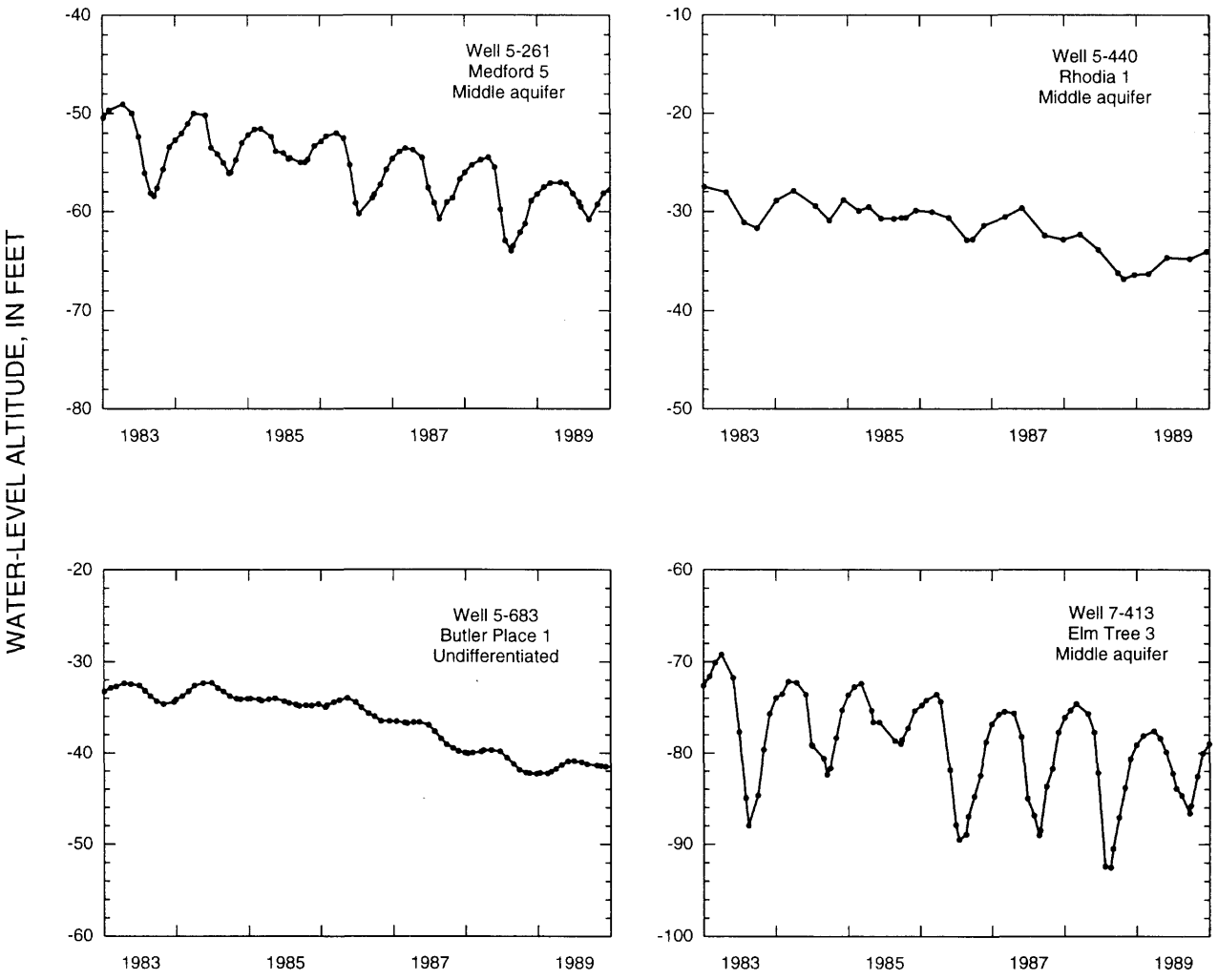


Figure 15A. Water-level hydrographs for observation wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system, 1983-89.

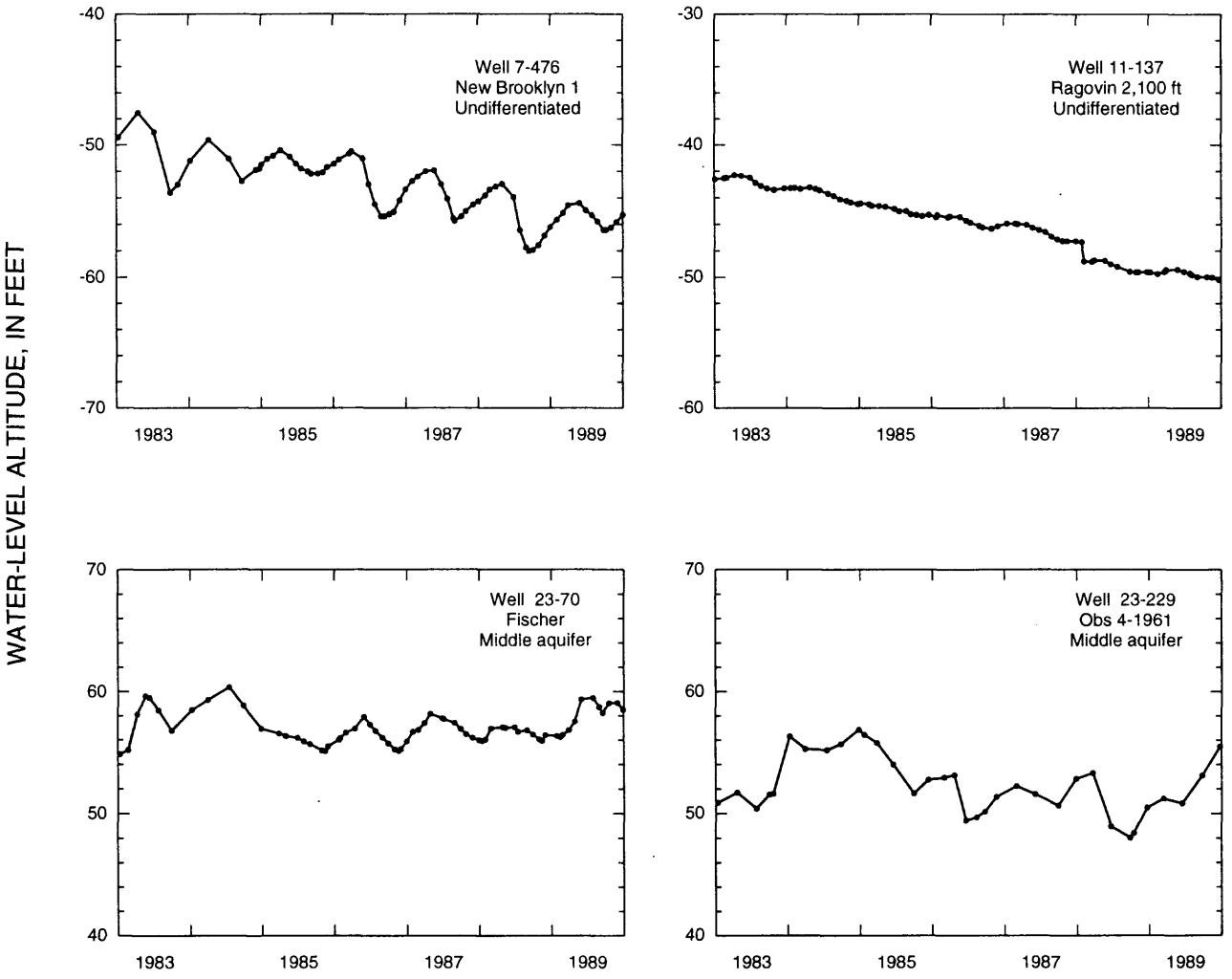


Figure 15B. Water-level hydrographs for observation wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system, 1983-89.

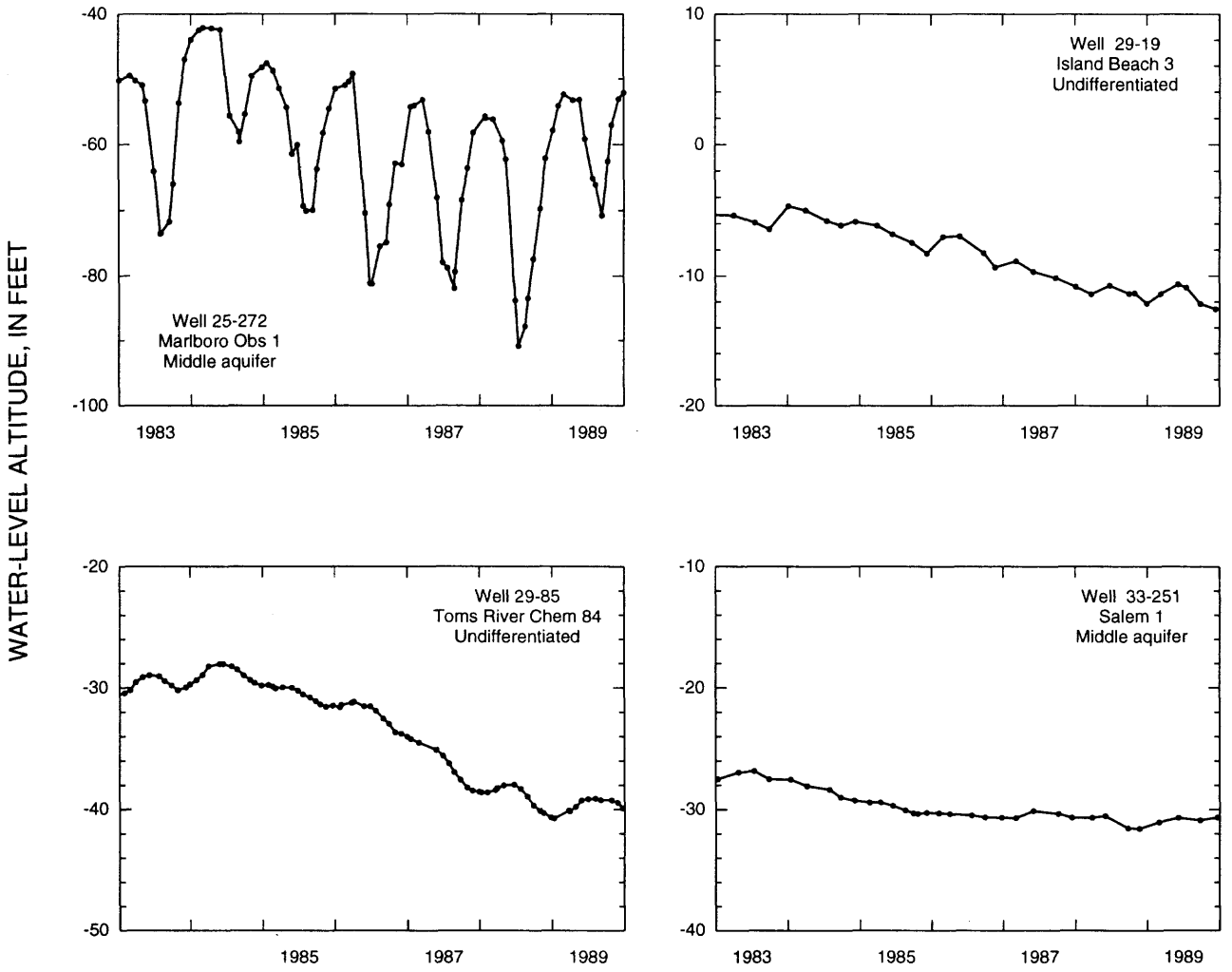


Figure 15C. Water-level hydrographs for observation wells screened in the middle aquifer and undifferentiated part of the Potomac-Raritan-Magothy aquifer system, 1983-89.

Lower Aquifer of the Potomac-Raritan-Magothy Aquifer System

Water Levels

Water-level measurements and well-construction information for 141 wells screened in the lower aquifer of the Potomac-Raritan-Magothy aquifer system are listed in table 11. The number of wells in New Jersey in which water levels were measured, by county, is as follows: Burlington, 16; Camden, 71; Gloucester, 34; and Salem, 6. In Philadelphia County, Pennsylvania, water levels were measured in four wells, and in New Castle County, Delaware, water levels were measured in nine wells. The water levels in these wells were used to define the potentiometric surface shown on plate 8, though only 50 wells are plotted.

The most extensive cone of depression in the lower aquifer of the Potomac-Raritan-Magothy aquifer system is in the north-central part of Camden County; water levels in the center of the cone reach a depth of 103 ft below sea level (pl. 8). The cone extends radially northeast into Burlington County and west into Gloucester County; water levels were more than 70 and 60 ft below sea level, respectively.

In northwestern Salem County adjacent to the Delaware River, a small cone of depression developed probably as a result of localized withdrawals from industrial and public supply wells. Water levels in the cone of depression were more than 50 ft below sea level. Regionally, the highest water levels were measured in wells near the Delaware River in Camden and Gloucester Counties; water levels ranged from 1 ft above sea level to 10 ft below sea level.

Water-Level Fluctuations

Water-level changes in 102 wells screened in the lower aquifer were calculated for the 5-year period. Water levels rose in 39 wells, declined in 56 wells, and were unchanged in 9 wells.

The largest regional declines were in the areas of Mount Laurel Township, Burlington County, and Cherry Hill Township, Camden County. Water levels in these areas declined as much as 17 ft and 9 ft, respectively, during 1983-88. In Camden County, water levels declined as much as 9 ft (from 94 ft to 103 ft below sea level) during 1983-88 where public supply wells are in operation. Along the Delaware River in Gloucester City, Camden County, water levels in wells 7-201, 7-204, and 7-221 rose as much as 17 ft (from 57 ft below sea level in 1983 to 40 ft in 1988) in about 5 years; local pumping ceased in 1984. These wells are affected by tides, and water levels vary as much as 6 ft.

Analysis of static water levels in observation wells in areas distant from ground-water-withdrawal centers indicates regional trends in the lower aquifer. Water levels in observation wells 5-262, 5-645, 5-648, 7-185, 7-221, 7-412, 7-563, and 15-296 represent unstressed conditions that exist in the aquifer distant from the cone of depression that is centered in Camden County. Water levels measured in 1983 and 1988 indicate a regional decline in head of as much as 12 ft in Burlington County, 6 ft in southeastern Camden County, and 3 ft in Gloucester County. Water levels in observation wells in and adjacent to the outcrop area in Camden County increased about 5 ft.

Hydrographs of water levels in observation wells screened in the lower aquifer of the Potomac-Raritan-Magothy aquifer system are shown in figure 16, and well locations are shown on plate 8. The hydrographs for observation well 5-262 in northwestern Burlington County and well 7-412 in north-central Camden County show declines in water levels of about 5 ft over the 5-year period. The hydrograph for observation well 33-187 in northeastern Salem County shows a 4-ft water-level decline for the same period. The hydrographs reveal seasonal variations of 5 to 10 ft; seasonal variations were greatest after spring 1986.

SUMMARY AND CONCLUSIONS

The principal sources of water in the Coastal Plain of New Jersey are the major aquifers that underlie the region. Increased ground-water withdrawals have stressed many of these aquifers, causing large regional cones of depression to develop.

Water levels were measured in nine aquifers from October 1988 through February 1989. Water levels in 1,251 wells were measured during the 1988 study and compared with 1,071 water levels measured during a previous study conducted in 1983. Water levels in 916 of the wells measured in the 1983 study were remeasured in the 1988 study. Water levels measured during the 1988 study were used to construct potentiometric-surface maps for the nine aquifers. Water-level hydrographs for observation wells screened in these aquifers were used to evaluate seasonal variations and long-term (1983-88) trends. Water levels continued to decline, although ground-water withdrawals from six of the major aquifers--Vincentown aquifer; Wenonah-Mount Laurel aquifer; Englishtown aquifer system; and the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system--stabilized or decreased.

A small cone of depression in the confined Cohansey aquifer is centered in southern Cape May County. The lowest water levels in this aquifer were 20 ft below sea level.

The potentiometric surface of the Atlantic City 800-foot sand of the Kirkwood Formation defines an elongated cone of depression that encompasses the barrier islands from Cape May City to Ocean County. The lowest water levels in this aquifer, as much as 96 ft below sea level, were measured in wells south of Atlantic City near Margate and Ventnor.

Table 11. Water-level data for wells screened in the lower aquifer of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988

[B, Boro; C, Company; CORP, Corporation; CO, County; DEL, Delaware; DEL VAL DIST, Delaware Valley District; ft, feet; MCHVIL PNSK WCM, Merchantville Pennsauken Water Commission; mo, month; MUA, Municipal Utility Authority; NJ, New Jersey; Phila, Philadelphia; Sub, Suburban; T, Township; USGS, U.S. Geological Survey; WC, Water Company; WD, Water Department; WSC, Water Supply Company; --, missing data; NM, not measured; NA, not applicable; wells marked with an asterisk are shown on plate 8]

Well number	Location		Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level				Change in water level (1983--88) (ft)
								1983		1988		
	Latitude	Longitude						Altitude[1] (ft)	Date (mo/day)	Altitude[1] (ft)	Date (mo/day)	
5-123	395904	750009	NJ AMER WC	DVWC 28	1969	25	226- 261	-12	10/27	-16	11/03	-4
*5-125	395929	745922	NJ AMER WC	DVWC 10	1959	79	239- 281	-15	10/27	-16	11/03	-1
*5-130	400002	750044	NJ AMER WC	RIVERTON 13	1963	70	167- 198	-3	10/26	-14	11/03	-11
5-131	400002	750044	NJ AMER WC	DVWC 27	1965	75	145- 176	NM	NM	-10	11/04	NA
*5-143	400105	745734	NJ AMER WC	DVWC 23	1964	36	176	NM	NM	-7	11/03	NA
5-146	400122	745807	NJ AMER WC	DVWC 19	1959	25	89- 130	2	10/26	0	11/03	-2
*5-228	395630	745855	MAPLE SHADE WD	MSWD 10	1975	40	440- 500	-51	11/03	-60	12/14	-9
*5-262	395524	745025	USGS	MEDFORD 4 OBS	1967	[3]72	1,125-1,145	-58	09/30	-60	11/07	-2
*5-272	395834	745910	MOORESTOWN T WD	MTWD 7	1969	40	335- 375	-22	11/01	-34	12/19	-12
*5-645	400010	745216	WILLINGBORO MUA	WMUA 2 OBS	1965	[3]40	431- 441	-35	11/01	-41	11/07	-6
*5-648	400103	745409	WILLINGBORO MUA	WMUA 3-OBS	1965	34	306- 316	-23	10/27	-29	11/02	-6
*5-746	395727	745915	MAPLE SHADE WD	MSWD 11	1978	20	389- 450	-34	11/03	-36	11/18	-2
*5-819	395608	[3]745649	MT LAUREL MUA	MLMUA 6	1982	20	499- 590	-59	11/02	-68	11/02	-9
5-822	395620	745529	MT LAUREL MUA	MLMUA 3	1974	35	593- 642	-57	11/02	-74	11/02	-17
*5-823	395615	745512	MT LAUREL MUA	MLMUA 4	1974	35	590- 640	-62	11/02	-75	11/02	-13
5-1075	395632	745555	MT LAUREL MUA	ELBOLANE 7	1987	40	528- 644	NM	NM	-63	11/02	NA
*7- 12	395221	750637	BELLMAWR B WD	BBWD 3	1956	35	334- 359	-56	11/07	-48	11/09	8
7- 47	395524	750729	CAMDEN SEWAGE	SEWAGE PLANT 1	1954	9	163- 193	-14	11/28	-12	11/18	2
7- 64	395546	750533	CAMDEN CITY WD	CITY 17	1954	34	230- 265	-39	11/21	-32	11/05	7
7- 68	395557	750535	CAMDEN CITY WD	CITY 13	1953	30	185- 225	-35	11/21	-28	11/05	7
7- 78	395616	750632	CAMDEN CITY WD	CITY 5N	1963	22	134- 169	-21	11/21	-19	11/04	2
7- 79	395617	750710	CAMDEN CITY WD	CITY 12	1945	23	136- 166	-13	11/21	-11	11/04	2
7- 83	395638	750622	CAMDEN CITY WD	CITY 1A	1953	10	135- 170	-25	11/21	-22	11/04	3
7- 90	395652	750607	CAMDEN CITY WD	CITY 10	1935	10	126- 158	-24	11/21	-21	11/04	3
7- 94	395706	750553	CAMDEN CITY WD	CITY 16	1954	23	149- 179	-26	11/21	-24	11/04	2
7- 98	395715	750519	NJ AMER WC	CAMDEN DIV 52	1965	18	147- 198	NM	NM	-26	11/04	NA
7-107	395720	750513	NJ AMER WC	CAMDEN DIV 51	1965	20	141- 192	-35	[4]01/10	-30	11/04	5
7-111	395726	750518	NJ AMER WC	CAMDEN DIV 50	1958	9	139- 170	NM	NM	-26	11/04	NA
7-112	395728	750520	NJ AMER WC	CAMDEN DIV 48	1954	10	122- 164	-30	[4]01/10	-34	11/04	-4
*7-121	395252	745943	NJ AMER WC	BROWNING T-1	1973	80	672- 729	-94	11/10	-103	11/04	-9
7-122	395252	745943	NJ AMER WC	BROWNING 44	1974	80	684- 741	NM	NM	-100	11/04	NA
7-123	395252	745943	NJ AMER WC	BROWNING 46	1973	[3]81	664- 735	-93	11/10	-101	11/04	-8
7-130	395353	745708	NJ AMER WC	OLD ORCHARD A	1967	71	743- 748	-75	11/10	-80	11/03	-5
7-144	395442	750103	NJ AMER WC	ELLISBURG 13	1953	39	491- 527	-64	11/16	-67	11/09	-3
7-157	395600	750031	NJ AMER WC	COLUMBIA 31	1967	45	376- 427	NM	NM	-55	11/09	NA
7-163	395609	750028	NJ AMER WC	COLUMBIA 22	1960	39	371- 453	-51	11/10	-53	11/09	-2
7-171	395426	750514	COLLINGSWOOD WD	CWD 7(B)	1965	10	224- 313	-45	11/03	-33	11/07	12
*7-172	395426	750514	COLLINGSWOOD WD	CWD 6(A)	1965	10	218- 312	-40	11/03	-37	11/07	3
7-175	395521	750439	COLLINGSWOOD WD	CWD 1R	1949	25	266- 306	-48	11/03	-47	11/07	1
7-178	395522	750432	COLLINGSWOOD WD	CWD 3	1960	15	257- 287	-41	11/03	-41	11/07	0
7-179	395526	750424	COLLINGSWOOD WD	CWD 5	1956	10	248- 278	-44	11/03	-40	11/07	4
7-184	394950	745855	NJ AMER WC	GIBBSBORO OB 1	1969	70	1,081-1,091	-92	11/10	-98	11/01	-6
*7-185	394950	745855	NJ AMER WC	GIBBSBORO OB 2	1969	70	940- 950	-84	11/10	-86	11/01	-2
7-188	395002	745851	NJ AMER WC	GIBBSBORO 42	1972	65	934- 986	NM	NM	-89	11/02	NA
7-201	395318	750755	AMSPEC CHEMICAL	AMSPEC 1 OBS	1948	5	246- 266	-57	11/08	-40	11/15	17
7-204	395322	750757	AMSPEC CHEMICAL	AMSPEC 4 OBS	1953	5	235- 260	-55	11/08	-39	11/15	16
7-205	395324	750736	HINDE AND DAUCH	3	1945	7	230- 250	-50	11/10	-37	11/18	13
7-206	395329	750732	HINDE AND DAUCH	2	1945	9	231- 251	-47	11/10	-35	11/18	12
7-207	395332	750734	HINDE AND DAUCH	JERSEY AVE 1	1945	9	230- 250	-47	11/10	-36	11/18	11
7-220	395349	750651	GLOUCESTER CO WD	GCWD 40	1961	10	221- 261	-41	[4]01/20	-49	11/23	-8
7-221	395356	750738	USGS	COAST GUARD 1	1966	[3]11	162- 170	-35	12/02	-30	11/18	5
*7-273	395030	750347	NJ AMER WC	OTTERBROOK 29	1965	60	612- 712	-71	11/07	-77	11/07	-6
7-278	395238	750316	NJ AMER WC	HADDON 15	1956	65	452- 594	-76	11/07	-82	11/09	-6
*7-281	395242	750323	NJ AMER WC	HADDON 14	1954	76	506- 598	-76	11/07	-79	11/09	-3
7-283	395246	750434	NJ AMER WC	EGBERT OBS	1962	[3]24	445- 455	-64	11/07	-64	11/02	0

Footnotes at end of table

Table 11. Water-level data for wells screened in the lower aquifer of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Lati-tude	Location: Longi-tude	Owner	Local number	Year drilled	Alti-tude of land sur-face[1] (ft)	Screened interval[2] (ft)	Water level 1983: Alti-tude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Alti-tude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983--88) (ft)
7-290	395406	750317	HADDON T WD	HTWD 1	1952	56	436- 468	-66	11/10	-74	11/18	-8
7-292	395406	750332	HADDON T WD	HTWD 4	1965	45	417- 448	-64	11/10	-67	11/18	-3
*7-302	395319	750140	HADDONFIELD WD	RULON	1956	25	523- 572	-79	11/04	-85	11/10	-6
*7-320	395652	750307	MCHVIL PNSK WCM	WOODBINE 1	1963	65	245- 285	-40	11/04	-38	11/09	2
7-332	395711	750220	MCHVIL PNSK WCM	MARION 2	1963	65	223- 258	-45	11/04	-45	11/09	0
7-335	395720	750225	MCHVIL PNSK WCM	MARION 1	1957	61	243- 278	-35	11/04	-35	11/09	0
7-337	395737	750626	USGS	PETTY ISLAND 2	1966	5	[5]129	-19	11/03	-19	12/13	0
*7-341	395800	750417	MCHVIL PNSK WCM	DELA GARDEN 2	1954	39	115- 145	-27	11/03	-25	11/09	2
7-343	395757	750640	USGS	PETTY I WEST 1	1966	5	[5]84	NM	NM	-19	11/08	NA
*7-348	395801	750119	MCHVIL PNSK WCM	PARK AVE 3	1958	25	240- 275	-35	11/03	-34	11/09	1
7-354	395811	750556	GENERAL FOODS	PETTY IS OBS	1949	12	[5]78	2	11/04	1	11/08	-1
7-359	395835	750308	CAMDEN CITY WD	PUCHACK 5	1924	30	136- 181	-26	12/06	-17	11/04	9
7-367	395840	750307	CAMDEN CITY WD	PUCHACK 3	1924	10	127- 175	-33	12/06	-30	11/04	3
7-368	395848	750347	CAMDEN CITY WD	DELAIR 1	1930	10	106- 126	-22	12/06	-17	11/05	5
7-370	395853	750348	CAMDEN CITY WD	DELAIR 3	1930	8	87- 127	-17	12/06	-13	11/05	4
7-373	395900	750318	CAMDEN CITY WD	MORRIS 6	1932	14	98- [5]133	-25	11/17	-17	11/05	8
7-375	395910	750307	CAMDEN CITY WD	MORRIS 8	1956	10	[5]124	-22	11/17	-18	11/05	4
7-379	395919	750302	CAMDEN CITY WD	MORRIS 10	1960	16	75- 115	-12	11/17	-12	11/05	0
7-382	395929	750253	CAMDEN CITY WD	MORRIS 4A	1960	8	95- 134	-11	11/17	-13	11/05	-2
*7-390	395944	750211	CAMDEN CITY WD	MORRIS 1	--	9	[5]107	-5	11/17	-8	11/05	-3
*7-412	394922	745630	NJ AMER WC	ELM TREE 2 OBS	1963	[3]149	1,082-1,092	-72	11/09	-78	11/18	-6
7-523	395152	750542	BELLMAWR B WD	BELLMAWR BORO	1977	75	458- 557	-64	11/07	-67	11/09	-3
7-527	395550	750537	CAMDEN CITY WD	PARKSIDE 18	1976	40	258- 288	-37	11/21	-31	11/05	6
*7-528	395835	750302	CAMDEN CITY WD	PUCHACK 7	1975	20	140- 180	-28	12/06	-32	11/04	-4
7-539	395902	750325	CAMDEN CITY WD	TW-6-79	1979	10	101- 142	-37	11/17	-31	11/05	6
7-541	395611	750546	CAMDEN CITY WD	TW-8-79	1979	20	215- 253	-34	11/21	-31	11/04	3
7-547	395731	750458	NJ AMER WC	54	1982	35	160- 200	-33	[4]01/10	-32	11/04	1
7-548	395802	750611	BRENAMAN, JE	1	1982	10	73- 83	-5	11/04	-21	12/13	-16
7-563	395712	750612	NJ DEP	HARRISON 3	1980	15	97- 117	-16	11/30	-15	11/04	1
7-596	[3]395239	[3]750754	BROOKLAWN B WD	BBWD 4	1982	10	263- 293	-52	11/14	-51	11/23	1
7-597	395718	750513	NJ AMER WC	55	1983	11	136- 176	-31	[4]01/10	-30	11/04	1
7-674	395403	750322	HADDON T WD	HTWD 2A	1988	60	430- 473	NM	NM	-68	11/18	NA
*15-139	394608	752135	PURELAND WC	TEST WELL 3	1970	[3]7	301- 345	[3]-10	11/16	-11	11/09	-1
15-175	394858	752225	AM DREDGING C	RACCOON IS T 1	1972	8	100- 120	1	11/17	-1	11/16	-2
15-220	395051	751349	ESSEX CHEMICAL C	OLIN 1	1954	10	234- 256	-7	11/09	-7	11/07	0
*15-282	394913	751105	W DEPTFORD T WD	5 KINGS HIWAY	1973	55	388- 450	NM	NM	-34	11/14	NA
*15-296	394942	751317	SHELL CHEMICAL C	SHELL 5 OBS	1962	[3]21	321- 326	-16	10/31	-18	11/15	-2
*15-308	395044	751242	PENNWALT CORP	TEST WELL 8	1969	10	231- 271	-15	11/04	-19	11/10	-4
15-309	395045	751255	PENNWALT CORP	TEST WELL 5	1969	10	248- 288	-13	11/04	-17	11/10	-4
15-311	395104	751244	PENNWALT CORP	TEST WELL 7	1969	10	203- 243	-10	11/04	-13	11/10	-3
*15-312	395107	750946	W DEPTFORD T WD	6 RED BANK AVE	1973	20	322- 372	-55	10/25	-56	11/14	-1
15-316	395159	750907	TEXAS OIL C	EAGLE PT OBS 1	1948	[3]32	288- 298	-54	10/25	-58	11/08	-4
15-318	395207	750930	TEXAS OIL C	EAGLE POINT 2	1948	17	259- 289	-51	10/25	-54	11/08	-3
15-320	395216	750915	TEXAS OIL C	EAGLE POINT 1	1947	20	248- 288	-52	10/25	-56	11/08	-4
15-321	395221	750856	TEXAS OIL C	EAGLE POINT 5	1948	13	237- 277	-57	10/25	-61	11/08	-4
*15-323	395235	750950	TEXAS OIL C	EAGLE PT 3 OBS	1948	[3]21	255- 275	-43	09/29	-44	11/16	-1
*15-326	395216	750739	WESTVILLE WD	WWD 5	1971	12	243- 277	-48	11/03	-48	11/15	0
15-327	395221	750737	WESTVILLE WD	WWD 4	1957	16	286- 313	-59	11/03	-51	11/15	8
*15-331	394955	750908	WOODBURY WD	RAILROAD 5	1960	35	405- 457	-47	10/31	-53	11/10	-6
15-349	394650	752316	PURELAND WC	LANDTECT 2	1973	6	170- 220	-6	11/16	-9	11/08	-3
*15-350	394550	752313	PURELAND WC	LANDTECT 1	1973	[3]20	234- 284	-9	11/16	-9	11/07	0
15-398	394935	751938	PETTIT, LOUIS	419	1979	1	50- 60	NM	NM	-2	11/03	NA
15-430	395156	750938	TEXAS OIL C	EAGLE POINT 6A	1981	15	256- 328	-49	10/25	-53	11/08	-4
15-434	395224	750734	WESTVILLE WD	WWD 6	1980	15	265- 317	-60	11/03	-49	11/15	11
15-438	395012	751333	GLOUCESTER MUA	GCMUA 1	1981	10	202- 217	NM	NM	-18	11/14	NA
15-533	395155	751051	NATIONAL PARK WD	NPWD 6	1981	22	240- 272	-33	11/07	-34	11/09	-1
*15-615	394637	751916	USGS	SHIVELER LOWER	1985	29	378- 388	NM	NM	-15	11/14	NA
*15-618	394804	751933	USGS	GAVENTA DEEP OBS	1985	7	230- 240	NM	NM	-7	11/14	NA
*15-671	394957	750530	USGS	DEPTFORD DEEP OBS	1986	35	650- 670	NM	NM	-69	11/16	NA
15-678	394946	751612	MOBIL OIL C	W-5C	1985	9	194- 204	NM	NM	-8	11/03	NA
15-680	395038	751605	MOBIL OIL C	W-7C	1985	9	186- 196	NM	NM	-5	11/03	NA
*15-711	395048	751518	MOBIL OIL C	W-8C	1985	12	153- 163	NM	NM	-5	11/03	NA
*15-712	394808	751724	USGS	STEFKA-1 OBS	1986	7	275- 290	NM	NM	-10	11/15	NA
*15-738	394948	751524	MOBIL OIL C	W-4C	1985	5	188- 198	NM	NM	-9	11/03	NA

Footnotes at end of table

Table 11. Water-level data for wells screened in the lower aquifer of the Potomac-Raritan-Magothy aquifer system, 1983 and 1988--Continued

Well number	Location: Latitude	Location: Longitude	Owner	Local number	Year drilled	Altitude of land surface[1] (ft)	Screened interval[2] (ft)	Water level 1983: Altitude[1] (ft)	Water level 1983: Date (mo/day)	Water level 1988: Altitude[1] (ft)	Water level 1988: Date (mo/day)	Change in water level (1983-88) (ft)
*15- 742	394652	751004	USGS	MANTUA DEEP OBS	1986	84	757- 777	NM	NM	-39	11/16	NA
*15- 770	395202	751115	USGS	NAT PARK 1-PW-L	1987	10	204- 224	NM	NM	-25	11/15	NA
*33- 86	394557	752523	B F GOODRICH CORP	4 (PW-3)	1967	13	169- 189	-12	11/18	-11	11/09	1
33- 137	394112	753028	E I DUPONT	DRINKWATER 8	1943	14	317- 347	NM	NM	-54	11/21	NA
*33- 187	394037	751914	USGS	POINT AIRY OBS	1958	[3]73	664- 672	-26	11/18	-28	11/16	-2
*33- 330	394205	752657	PENNS GROVE WSC	LAYTON 11	1936	16	[5]394	-15	11/10	-23	12/12	-8
33- 335	394212	752751	E I DUPONT	CARNEY PT 7	1967	11	270- 430	-32	11/16	-35	11/23	-3
33- 346	394256	[3]752718	PENNS GROVE WSC	LAYNE 1	1956	19	317- 357	-35	11/18	-47	11/23	-12
33- 402	394657	752546	US ARMY CORPS	EHW-1 TEST	1980	6	109- 114	[3] -4	11/08	-6	11/09	-2
PH- 01	395334	751009	US NAVY	1	1940	11	207- 232	NM	NM	-8	11/08	NA
PH- 05	395314	751010	US NAVY	19	1946	9	242-[5]247	NM	NM	-22	11/08	NA
*PH- 63	395408	751040	ROOSEVELT PARK	CITY POOL	1919	6	[5]185	NM	NM	-5	11/08	NA
*PH- 750	395445	750831	S.A.F. AMERICA INC	#1 SAF	1979	10	122- 167	NM	NM	-8	11/08	NA
010-450	394140	753238	USGS (DEL)	USGS 4 D 3	1956	15	48- 51	NM	NM	-17	11/14	NA
904-2997	393712	753742	ARTESIAN WC	ARTESIAN VIL 2 OBS	--	20	153- 174	NM	NM	-20	11/15	NA
Cd31- 19	394224	753405	USGS (DEL)	POLYGON 1	--	69	72- 75	NM	NM	14	11/14	NA
Cd31- 26	393739	753944	ARTESIAN WC	GLENDALE 4 OBS	--	68	261- 355	NM	NM	22	11/15	NA
*Cd52- 27	394011	753347	NEW CASTLE W+L	WATER PLANT 3	--	9	128- 141	NM	NM	-5	11/14	NA
*Db1- 55	393917	754016	WILMINGTON SUB WC	SMALLEYS DAM	--	20	215- 238	NM	NM	-10	11/15	NA
*Dc33- 08	393712	753742	ARTESIAN WC	ARTESIAN VIL 2	--	19	125- 225	NM	NM	-21	11/15	NA
Eb23- 22	393316	754216	USGS (DEL)	LUMS POND C	--	60	432- 436	NM	NM	-34	11/15	NA
*Eb23- 35	393316	754421	USGS (DEL)	LUMS POND D	--	60	540- 544	NM	NM	-49	11/15	NA

[1] Datum is sea level

[2] Depth below land surface

[3] Revised from Eckel and Walker (1986)

[4] Water level measured in 1984

[5] Well depth

[6] Water level measured in 1989

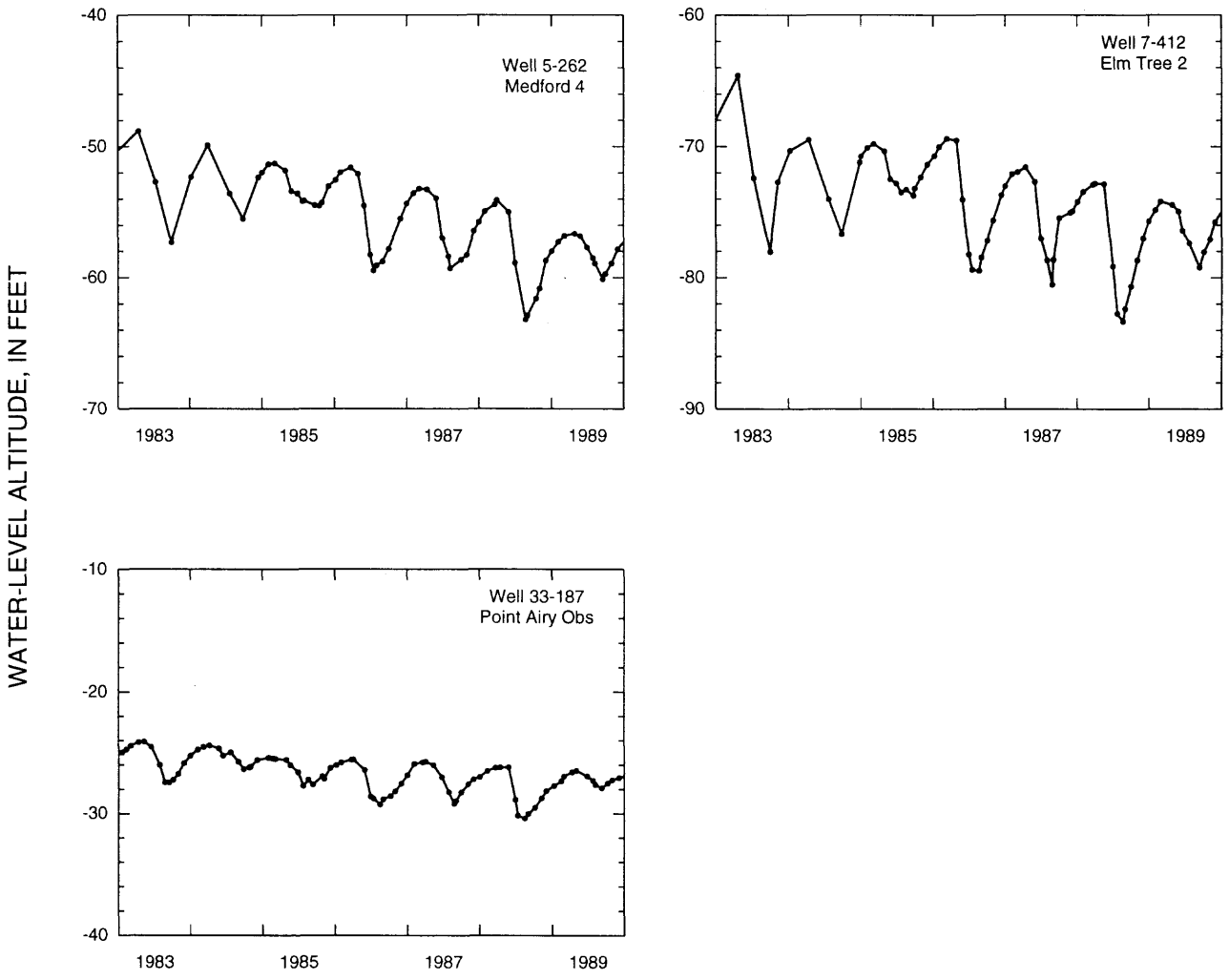


Figure 16. Water-level hydrographs for observation wells screened in the lower aquifer of the Potomac-Raritan-Magothy aquifer system, 1983-8[illegible]

In the Piney Point aquifer in New Jersey, the lowest water levels, as much as 60 ft below sea level, were measured in wells located in Ocean County. In southern Cumberland County, water levels were as much as 44 ft below sea level, probably because of large withdrawals of ground water in Kent County, Delaware.

The lowest water levels measured in the Englishtown aquifer system were 256 ft below sea level in the Spring Lake Heights area. In the overlying Wenonah-Mount Laurel aquifer, water levels as much as 218 ft below sea level were measured in coastal Monmouth and Ocean Counties. The cones of depression in the Wenonah-Mount Laurel aquifer coincide with potentiometric lows in the Englishtown aquifer system, probably as a result of withdrawals from the Englishtown aquifer system and subsequent leakage of water from the Wenonah-Mount Laurel aquifer to the Englishtown aquifer system.

The most extensive cones of depression are located in the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system. The lowest water levels were measured in cones of depression in Camden, Monmouth, and Middlesex Counties. Water levels were as low as 107 ft below sea level in the upper aquifer in Camden County and 116 ft below sea level in the undifferentiated part of the aquifer system that spans an area of Middlesex and Monmouth Counties.

In the confined Cohansey aquifer, water levels declined about 1 ft throughout most of Cape May County, but water levels in southern Cape May County rose 1 to 13 ft. Water levels in the Rio Grande water-bearing zone of the Kirkwood Formation declined 2 to 3 ft. In the Atlantic City 800-foot sand, water levels declined 21 ft in the cone of depression, whereas regional trends indicate water-level declines of 1 to 10 ft.

Water levels in the Piney Point aquifer declined 18 to 26 ft in the center of the cone of depression along the coast of Ocean County. Declines in Cumberland County ranged from 1 to 10 ft and probably resulted from withdrawals in Delaware.

Water-level data for the Vincentown aquifer are limited; however, water levels measured by an extremes recorder in an observation well in Ocean County indicated no significant change for the 5-year period.

Heads in the Wenonah-Mount Laurel aquifer declined 1 to 29 ft in Burlington, Camden, Gloucester, and Salem Counties. Heads declined as much as 52 ft in the center of the cone of depression in Monmouth County. This cone coincides with the major cone of depression in the Englishtown aquifer system. In the Englishtown aquifer system, heads declined as much as 26 ft during the 5-year period, in part, because of changes in pumping patterns of public supply companies.

In the Potomac-Raritan-Magothy aquifer system, water levels declined 8 to 16 ft in and adjacent to cones of depression in Camden County and 2 to 46 ft in Monmouth and Middlesex Counties. In Ocean County, water levels declined 10 to 29 ft.

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GLOSSARY

Artesian aquifer. An aquifer containing water under sufficient pressure to cause the water level in a well open to the aquifer to rise above the top of the aquifer. Also called confined aquifer.

Cone of depression. A low area in the potentiometric surface usually centered in the area of greatest concentration of withdrawals.

Confining layer (confining unit). A body of relatively impermeable material stratigraphically adjacent to one or more aquifers. The hydraulic conductivity may range from nearly zero to some value several orders of magnitude lower than that of the aquifer.

Head, static. The height above a standard datum of the surface of a column of water (or other liquid) that can be supported by the pressure at a given point. Head, when used alone in this report, is understood to mean static head.

Hydraulic conductivity. A measure of the ability of a material to transmit water.

Hydraulic gradient. The change in static head per unit of distance in a given direction. If not specified, the direction is understood to be that of the maximum rate of decrease in head.

Isochlor. The line on a map which shows equal chloride concentrations.

National Geodetic Vertical Datum of 1929 (NGVD of 1929). A geodetic datum derived from a general adjustment of the first order level nets of both the United States and Canada, formerly called mean sea level. NGVD of 1929 is shown on all the plates but is referred to as sea level in the text of this report.

Observation well. Any well lacking a pump.

Porosity. The property of a rock or soil for containing interstices or voids. It may be expressed quantitatively as the ratio of the volume of its interstices to its total volume. It may be expressed as a decimal fraction or as a percentage.

Potentiometric surface. A surface which represents the static head in an aquifer. The potentiometric surface is defined by the levels to which water will rise in tightly cased wells open to the aquifer. See head, static.

Production well. Any well with a pump.

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