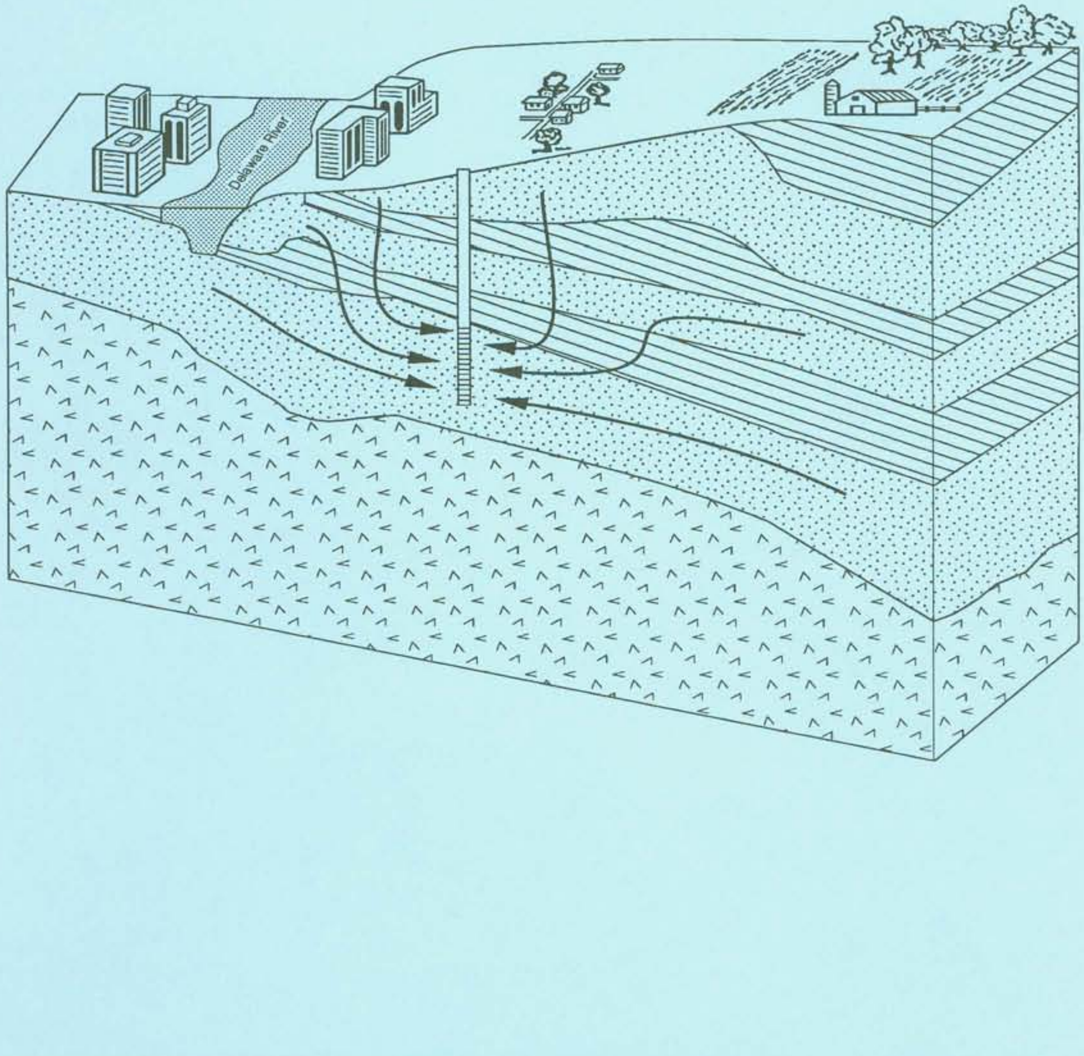
New Jersey Geological Survey
Geological Survey Report GSR 38

GROUND-WATER FLOW AND FUTURE CONDITIONS IN THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, CAMDEN AREA, NEW JERSEY



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Cover illustration: Idealized cross section through the hydrogeologic units of the Potomac-Raritan-Magothy Aquifer system, Camden Area, New Jersey, showing water movement toward a pumping well. Not to scale.

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GROUND-WATER FLOW AND FUTURE CONDITIONS IN THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, CAMDEN AREA, NEW JERSEY

by
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Prepared by the U.S. Geological Survey
in cooperation with the
New Jersey Department of Environmental Protection
Division of Science and Research
Geological Survey

New Jersey Department of Environmental Protection
Division of Science and Research
Geological Survey
CN 427
Trenton, NJ 08625
1995
Printed on recycled paper

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CONVERSION FACTORS, ABBREVIATED WATER-QUALITY UNIT, AND VERTICAL DATUM

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
foot (ft)	0.3048	meter
foot per day (ft/d)	0.3048	meter per day
foot per second (ft/s)	0.3048	meter per second
foot squared per day (ft^2/d)	0.0929	meter squared per day
foot per day per foot ((ft/d)/ft)	1.00	meter per day per meter
gallon per day	0.003785	cubic meter per day
inch (in.)	2.54	centimeter
inch per year (in/yr)	2.54	centimeter per year
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
million gallons per day (Mgal/d)	3785.	cubic meter per day

Abbreviated water-quality unit:	mg/L	(milligram per liter)

Sea level--In this report "sea level" refers to the 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 Sea Level Datum of 1929.

GROUND-WATER FLOW AND FUTURE CONDITIONS IN THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, CAMDEN AREA, NEW JERSEY

By Anthony S. Navoy and Glen B. Carleton

ABSTRACT

The Potomac-Raritan-Magothy aquifer system, locally referred to as "the PRM," is composed of Cretaceous clastic deposits that are present at the base of the Coastal Plain sediments. These deposits extend southeast from the Fall Line and underlie southern New Jersey. The Delaware River flows across the outcrop of the aquifer system in the vicinity of Camden, New Jersey, and Philadelphia, Pennsylvania, and is, therefore, hydraulically connected to the aquifer system. The river is affected by tides throughout this reach, but is fresh most of the time.

The aquifer system provides most of the potable water supply for the Camden area. Ground-water withdrawals (pumpage), which began about 1900, currently (1987) total about 125 million gallons per day. The high rate of withdrawal has created a regional cone of depression in the aquifer system's potentiometric surface that extends more than 100 ft below sea level, reversing the natural hydraulic gradient between the aquifer system and the river. Under predevelopment conditions, ground water discharged to the Delaware River. Now, the cone of depression provides the gradient to induce water to flow from the river into the aquifer system in many places. A significant amount of the recharge originates as precipitation on the local outcrop of the aquifer system. Ground water also flows into the cone of depression from other parts of the aquifer system both laterally and vertically from overlying aquifers. The magnitude of the ground-water withdrawal has resulted in several potentially deleterious circumstances or threats to the potable supply from the aquifer: (1) deep cones of depression and continuing water-level decline, (2) movement of saline water from the downdip parts of the aquifer toward public supply wells, (3) induced infiltration of saltwater from the Delaware River, and (4) induced infiltration of water containing contaminants from human-related activities on the aquifer system's outcrop area.

A finite-difference model was developed to simulate ground-water flow in the three aquifers of the Potomac-Raritan-Magothy aquifer system in the Camden area and adjacent parts of Pennsylvania. Results of the simulations were used to evaluate (1) the ground-water-flow system; (2) the sensitivity of the system to potential threats to ground-water potability; and (3) the effects of withdrawals, sea-level rise, and channel dredging on ground-water levels and on the flow budget of the aquifer system. The initial model input data and boundary flows between the modeled area and the parts of the aquifers outside the modeled area were derived from the New Jersey Coastal Plain Regional Aquifer System Analysis (RASA) model. Simulated results obtained with the calibrated model indicate that the most significant sources of water to the Potomac-Raritan-Magothy aquifer system are recharge from precipitation on the outcrop and flow from overlying aquifers. Induced flow from the Delaware River and related tributaries is simulated to be currently (1987) about 29 million gallons per day, which is about 25 percent of total withdrawals. Results of a particle-tracking analysis of the simulation show that about one-third of the water-supply withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area are within the area influenced by induced recharge from the Delaware River and its tributaries. Lateral flow from outside the areas where water is withdrawn is about 12 million gallons per day. About 8 million gallons per day flows into the study area from the southeast (downdip). The induced movement of saline water from this direction could threaten the potability of the water supply.

The effects of future water-supply withdrawals on the Potomac-Raritan-Magothy aquifer system in the Camden area were evaluated by simulating three withdrawal scenarios with the ground-water flow model: withdrawals continued in an unconstrained manner (Scenario A), withdrawals maintained at current (1987) rates (Scenario B), and withdrawals reduced to 65 percent of 1983 rates (Scenario C). The distribution of withdrawals in each of the scenarios is identical. Withdrawals are simulated for the 30-year period from 1990 to 2020.

The rate of withdrawals in Scenario A was increased to 27 percent more than the current (1987) rate by the year 2020, when the regional cones of depression are predicted to extend to a maximum depth of about 140 ft below sea level. This is a decline of about 40 ft from present (1987) levels. Because the simulated increase in withdrawals was distributed linearly through time, the rate of decline was constant. Locally available recharge to the Potomac-Raritan-Magothy aquifer system would account for about 59 percent of the water withdrawn. Inflow, possibly containing saline water, from southeast (downdip) of the Camden area would account for about 6 percent of the water withdrawn.

The rate of withdrawals in Scenario B was the same as the current rate through the year 2020. The depths of the regional cones of depression are predicted to remain essentially at present (1987) levels because the withdrawals remained fixed. The simulated water-level stabilization would occur within a 5-year period. Locally available recharge to the Potomac-Raritan-Magothy aquifer system would account for about 63 percent of the water withdrawn. Inflow derived from downdip, possibly saline water from southeast of the Camden area would account for about 7 percent of the water withdrawn.

The rate of withdrawals in Scenario C was 35 percent less than the 1983 rate and was fixed at that rate until the year 2020. The regional cones of depression are predicted to extend to a maximum depth of about 60 ft below sea level. These levels, which are similar to those observed in the mid-1960's, represent a recovery of about 40 ft from present levels. The simulation results indicate that the majority of the recovery would take place over the initial 5-year period. With withdrawals fixed, water levels would remain essentially constant thereafter. Locally available recharge to the Potomac-Raritan-Magothy aquifer system would account for about 76 percent of the water withdrawn. Inflow derived from downdip, possibly saline water from southeast of the Camden area would account for about 9 percent of the water withdrawn. Although the inflow derived from saline water, when considered as a percentage, would be 6 percent in Scenario A and 9 percent in Scenario C, the actual volume of the flow decreased from Scenario A to Scenario C, as would be expected as a result of the lower withdrawal rates.

The significant difference among the three scenarios is the proportion of water derived from locally available recharge to water derived from distant sources when considered as components of the total amount of water withdrawn for public supply in the study area. As withdrawals increased from Scenario C rates to Scenario A rates, the proportion of water leaking from overlying aquifers and flowing from the Potomac-Raritan-Magothy aquifer system in areas distant from the Camden area increased from about 60 percent of the total water withdrawn to about 75 percent. The flow of water from the distant sources has contributed to the problems in this area. The minimization of dependency on the flow of water from distant sources may constitute a viable water-management objective for the Potomac-Raritan-Magothy aquifer system in the Camden area.

INTRODUCTION

The Potomac-Raritan-Magothy aquifer system, locally referred to as "the PRM," is the primary source of water supply in the Camden area of southwestern New Jersey. Currently (1987), about 125 million gallons per day is withdrawn (pumped) from the aquifer system to supply the needs of communities in Burlington, Camden, and Gloucester Counties that are part of the study area. This volume of withdrawal has resulted in a large, regional-scale cone of depression in the potentiometric surface of the aquifer system. Water levels extend to depths of greater than 100 ft below sea level. Because of the proximity of withdrawals to its outcrop and a hydraulic connection to the Delaware River, a substantial amount of recharge is available to the aquifer system.

In spite of the availability of recharge, however, problems have arisen that could threaten the sustainability of the aquifer system as a primary source of water supply as a result of the withdrawals. These problems are (1) continued water-level decline, (2) contamination by infiltration of water containing materials derived from human activities on the outcrop, (3) potential contamination by the intrusion of saltwater from the Delaware River during droughts, and (4) potential contamination by the lateral and vertical intrusion of saline water from downdip parts of the aquifer system.

Optimal management of the aquifer system's water resources is a primary concern. The efficient use of the resource will be aided by the results of a quantitative evaluation of ground-water flow in the Potomac-Raritan-Magothy aquifer system, including an assessment of the relative importances of various flow-system components, and on the effects of future water use.

The U.S. Geological Survey (USGS), in cooperation with the New Jersey Department of Environmental Protection (NJDEP), conducted an investigation to evaluate the sensitivity of the aquifer system in the Camden area to possible changes in ground-water withdrawal rates and to evaluate the significance of various threats to the water supply. These evaluations make it necessary to quantitatively understand and measure the functional components of the flow system and to develop a predictive capability for the effects of various development alternatives on the aquifer system.

Purpose and Scope

This report (1) describes the hydrogeology and ground-water flow system of the Potomac-Raritan-Magothy aquifer system in the Camden area, including the interaction between the aquifer system and the Delaware River; (2) compiles and presents hydrogeologic data relevant to the investigation of ground-water flow in the Camden area; (3) identifies and documents the problems that threaten the sustainability of the aquifer system as a primary source of water supply for the Camden area; (4) describes a ground-water flow model of the aquifer system designed to simulate ground-water flow, interaction with the Delaware River, and the function of significant features of the flow system; and (5) describes the use of the flow model to evaluate the effects of future ground-water withdrawal scenarios.

Location and Extent of Study Area

The report focuses on the Potomac-Raritan-Magothy aquifer system in the Camden area of the New Jersey Coastal Plain, shown in figure 1. The Fall Line, on the Pennsylvania side of the Delaware River, forms a hydrologic boundary on the northwestern side of the study area. The Camden area includes Camden County, most of Gloucester County, and the western part of Burlington County. Parts of Salem, Cumberland, and Atlantic Counties are included within the study area to facilitate study of the aquifer system, which is laterally continuous through these areas. Because withdrawals from the aquifer system in these three

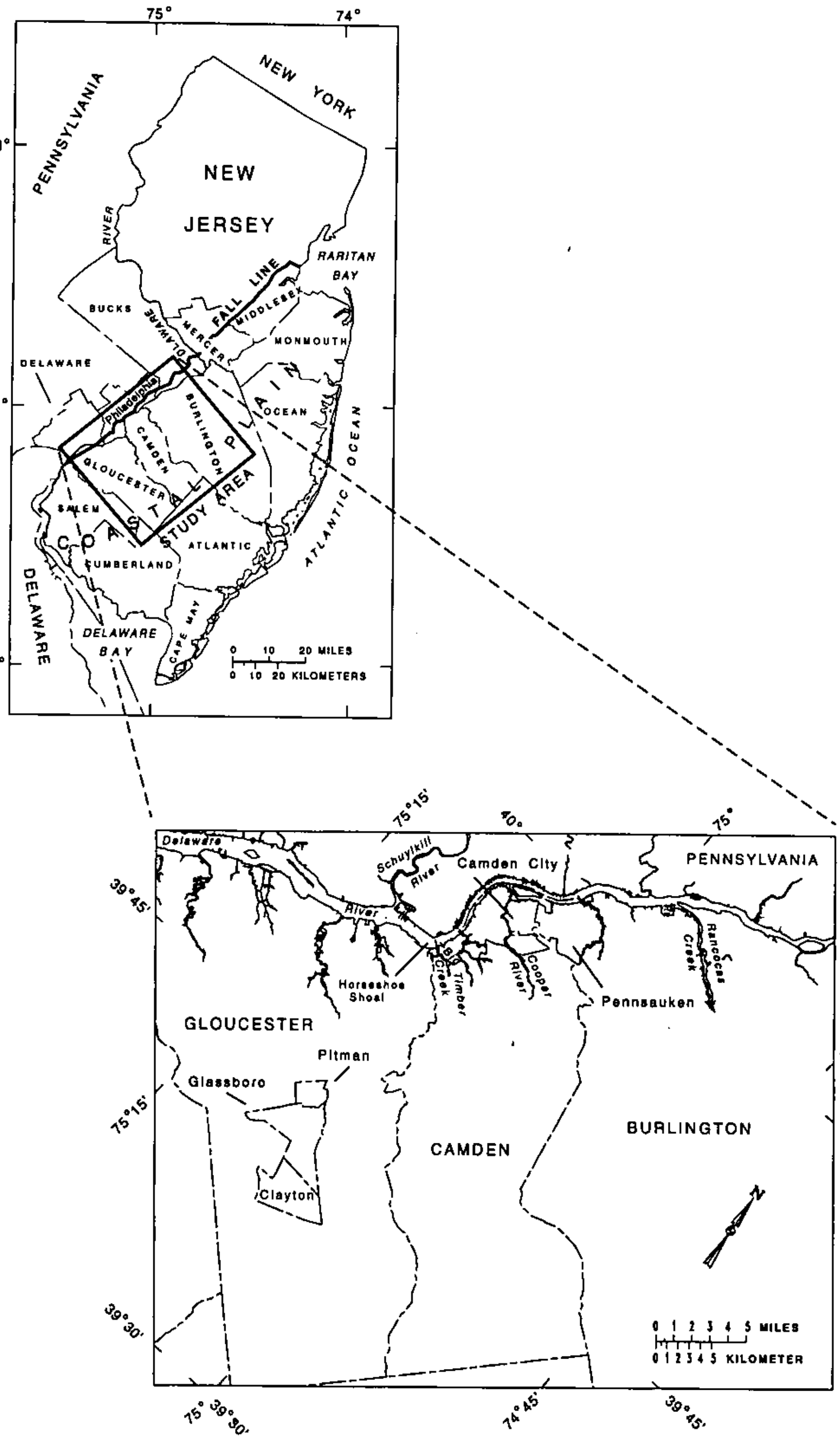


Figure 1. Location of study area.

counties are not used significantly, they are considered only peripherally and are not part of the focus of this report. The study area also extends into the Coastal Plain of southeastern Pennsylvania, including parts of Philadelphia. This area is geographically adjacent to the Camden area and constitutes a hydrogeologically significant part of the flow system;. therefore, it is considered part of the focus of this report.

Well-Numbering System

Several numbering systems for identifying wells and boreholes have been used in previous hydrogeologic investigations of the study area. The system used by the USGS, New Jersey District Office, is generally followed in this report. It consists of a two-digit county code followed by a three- or four-digit sequential number. Several wells located in Pennsylvania that are used in this report are part of the data base maintained by the USGS Pennsylvania Subdistrict Office in Malvern, Pennsylvania. Accordingly, their two-letter county code with a three-digit sequence number is used in this report. The county codes are as follows:

Atlantic County, N.J.	01
Burlington County, N.J.	05
Camden County, N.J.	07
Cumberland County, N.J.	11
Gloucester County, N.J.	15
Salem County, N.J.	33
Bucks County, Pa.	Bk or 51
Delaware County, Pa.	De or 45
Philadelphia County, Pa.	Ph or 101

Logs of test boreholes were reported by Greenman and others (1961) by using the single letter "B" and a two- or three-digit sequence number as an identifier. In order to maintain a correspondence to that source of information, that system also is used.

Previous Investigations

Many investigations of the Potomac-Raritan-Magothy aquifer system in the Camden area have been conducted. Thompson (1932) investigated the aquifer system in the City of Camden. He recognized the significance of the interconnection between the Delaware River and the aquifer system. Barksdale and others (1958) summarized the available ground-water resources of the lower Delaware River valley. They documented the deepening cones of depression in the aquifer system in the Camden area. Greenman and others (1961) focused on the Coastal Plain deposits in southeastern Pennsylvania. They amassed a significant collection of well logs, developed hydrostratigraphic correlations and fence diagrams across the area, and attempted to relate the hydrostratigraphy in the Philadelphia area to that devised by other workers in the Raritan Bay area of the northern New Jersey Coastal Plain. However, their use of Raritan Bay subdivisional nomenclature has not persisted in the Philadelphia and Camden areas. Hardt and Hilton (1969), Rush (1968), and Farlekas and others (1976) published results of ground-water investigations of Gloucester, Burlington, and Camden Counties, respectively. Their work represents a significant source of quantitative data on the aquifer system, including hydrostratigraphy, water levels, and water quality. Luzier (1980) and Harbaugh and others (1980) used a single-layer ground-water-flow model of the aquifer system across the New Jersey Coastal Plain to determine flow paths and evaluate effects of potential management strategies. Their analysis was limited by coarse horizontal discretization and the two-dimensional perspective of flow. They attempted to quantify the flow between the aquifer system and Delaware River, and to test the effectiveness of several barrier-well strategies to reduce the updip movement of deep saline water within the aquifer system. Camp Dresser and McKee, Inc. (1984a, 1984b, 1987), investigated the water-supply potential of the aquifer system in the Camden area on behalf of the NJDEP. They determined future demand, investigated the availability of production facilities, and assessed the long-term productivity of the aquifer system. As a result of their work, NJDEP declared Water-Supply Critical Area #2 and recommended a reduction of withdrawals from the aquifer system in the Camden area to minimize potential deleterious consequences resulting from deepening cones of depression. Their method of analysis did not take advantage of numerical ground-water flow modeling techniques and was constrained by their treatment of the aquifer system as a single layer throughout the Camden area. Sloto (1988) developed a ground-water flow model of the lower aquifer of the Potomac-Raritan-Magothy aquifer system in Philadelphia and nearby parts of New Jersey to determine the results of various management strategies. This model did not incorporate a detailed study of the interconnection with the Delaware River by focusing on the deepest aquifer. The USGS Regional Aquifer System Analysis (RASA) of the North Atlantic Coastal Plain project included a detailed definition of the hydrostratigraphy of the New Jersey Coastal Plain (Zapecza, 1989) and an assessment of ground-water flow obtained by using an 11-layer flow model (Martin, 1990). These two investigations represent benchmark studies of the hydrogeology of the New Jersey Coastal Plain. They provide a regional perspective that will facilitate further study at a finer resolution.

Acknowledgments

Thanks are given to the many individuals of Burlington, Camden, and Gloucester Counties who provided assistance by sharing their well logs, water-quality data, and withdrawal data, or by providing access to their facilities for data collection. The authors particularly acknowledge the invaluable assistance of Richard Westergaard of the Planning Department of Gloucester County and Frederick H. Martin, Jr., of the Department of Utilities of the City of Camden.

HYDROGEOLOGY, GROUND-WATER FLOW, AND WATER-SUPPLY ISSUES

Hydrogeology

Understanding the hydrogeology of the Camden area requires the investigation of the nature of the Coastal Plain deposits and the hydrologic forces that act upon them. These can be viewed in terms of basic hydrogeologic elements-- namely, the framework of the aquifers, precipitation and recharge, ground-water withdrawals, ground-water levels, and ground-water quality. These elements are the foundation of the ground-water-flow system and are described below.

Geologic Setting

The Atlantic Coastal Plain physiographic province extends from Florida to New York and is separated along its western edge from the Piedmont physiographic province by the Fall Line. In New Jersey and Pennsylvania, the Fall Line extends from Raritan Bay to the Delaware Bay, shown in figure 1, defining the northwestern edge of the Coastal Plain. The sedimentary deposits of the New Jersey and Pennsylvania Coastal Plain, to the southeast of the Fall Line, are composed of a three-part sediment sequence that lies unconformably on a pre-Cretaceous bedrock basement. From the basement rocks upward, the sediment sequence consists of lower Cretaceous nonmarine sand and clay, with some gravel; Cretaceous to Eocene glauconitic marine sand, silt, and clay; and upper Oligocene to Holocene nonmarine to marine shallow continental shelf sand and silt (Owens and Sohl, 1969; Olsson, 1978). This sediment sequence strikes roughly northeast to southwest, and dips gently and thickens seaward. The Potomac-Raritan-Magothy aquifer system comprises the lowest part of the sequence. A more comprehensive treatment of the regional geology can be found in Owens and Sohl (1977), Maher (1971), Brown and others (1972), and Zapecza (1989).

Characteristics of Hydrogeologic Units

The Potomac-Raritan-Magothy aquifer system contains upper, middle, and lower aquifers separated by intervening confining units. It is bounded above by the Merchantville-Woodbury confining unit and below by the bedrock surface. The relations among the geologic and hydrogeologic units of the New Jersey Coastal Plain are shown in table 1. The upper aquifer generally corresponds to the sands of the Magothy Formation, and the middle and lower aquifers generally correspond to the sand deposits within the undifferentiated Potomac Group and Raritan Formation. Further discussion of the aquifer system and other hydrogeologic units of the New Jersey Coastal Plain is given in Zapecza (1989).

The aquifer system is confined by the Merchantville-Woodbury confining unit. The approximate thickness of the Merchantville-Woodbury confining unit, which ranges from 0 to more than 200 ft in the study area is shown in figure 2. The unit thickens downdip at a rate of about 4 ft/mi.

The altitude of the top of the upper aquifer and its outcrop area are shown in figure 3. This unit is present across the study area, in nearly uniform thickness, as shown in figure 4. The upper aquifer, unlike the middle or lower aquifer, can be distinguished in the downdip part of the study area, however, differentiation of the upper and middle aquifers is difficult locally, where the intervening confining unit thins as a result of the complex depositional nature of deltaic deposits.

The altitude of the top of the middle aquifer and its outcrop area is shown in figure 5. The thickness of this unit is illustrated in figure 6. The unit has not been differentiated from the lower aquifer in downdip areas. In the Philadelphia area, the outcrop of the middle aquifer is overlain by a thin veneer of upper Cenozoic clay deposits (Owens and Minard, 1979).

The altitude of the top of the lower aquifer and its outcrop area are shown in figure 7. The thickness of the lower aquifer is shown in figure 8. The unit thickens downdip at a rate of about 20 ft/mi. Beginning about 10 to 12 miles downdip from the outcrop area, the middle aquifer is indistinguishable from the lower aquifer as a result of an increase in the thickness and number of interfingering clay and silt beds (Zapecza, 1989). In the northeastern corner of the study area, in the vicinity of Mount Holly, the lower aquifer pinches out in the subsurface as a result of the presence of a local bedrock high (Zapecza, 1989).

Locally, in the updip part of the study area, the confining unit between the upper and middle aquifers is lenticular and discontinuous. This is particularly evident in the northwestern corner of Gloucester County where the upper and middle aquifers are not easily differentiable as a result of the lenticular habit of the intervening confining unit (Lewis and others, 1991; Barton and Kozinski, 1991). The thickness of the confining unit between the middle and lower aquifers varies, particularly in the updip part of the study area, as a result of the lenticular nature of the unit.

The crystalline bedrock underlying the Coastal Plain sediments, a mica schist, is largely impermeable. A weathered zone of clay and loose mica overlies the hard bedrock and varies in thickness, with a maximum of 15 ft. This zone can function as an aquifer or aquitard depending on the degree of weathering. Available information is insufficient to delineate the weathered zone from unweathered bedrock on a regional basis. The top of bedrock surface is shown in figure 9. The surface is irregular in the updip part of the study area as a result of the presence of erosional troughs, which were mapped by Greenman and others (1961). These troughs are situated transverse to the present Delaware River channel and may represent incised channels of a pre-Cretaceous drainage system. Although the bedrock surface appears more uniform downdip, this results from a decrease in data-point density.

Table 1. --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			
Tertiary	Miocene	Pennsauken Formation	Sand, quartz, light-colored, heterogeneous, clayey, pebbly.		
		Bridgeton 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.
		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	Sand, quartz and glauconite, fine- to coarse-grained.	Piney Point aquifer	Yields moderate quantities of water.
	Eocene	Shark River Formation			
		Manasquan Formation	Clay, silty and sandy, glauconitic, green gray, and brown, contains fine-grained quartz.	Composite confining unit	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.	Composite confining unit	Poorly permeable sediments.
Cretaceous	Upper Cretaceous	Tinton Sand	Sand, quartz, glauconitic, brown and gray, fine- to coarse-grained, clayey, micaceous.		
		Red Bank Sand		Red Bank Sand	Yields small quantities of water in and near its outcrop area.
		Navesink Formation	Sand, clayey, silty, glauconitic, green and black, medium- to coarse-grained.	Composite confining unit	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.
				Confining unit	
		Raritan Formation	Sand, quartz, light-gray, fine- to coarse-grained, poorly arkosic; contains red, white, and variegated clay. Includes Farrington Sand Member.	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.

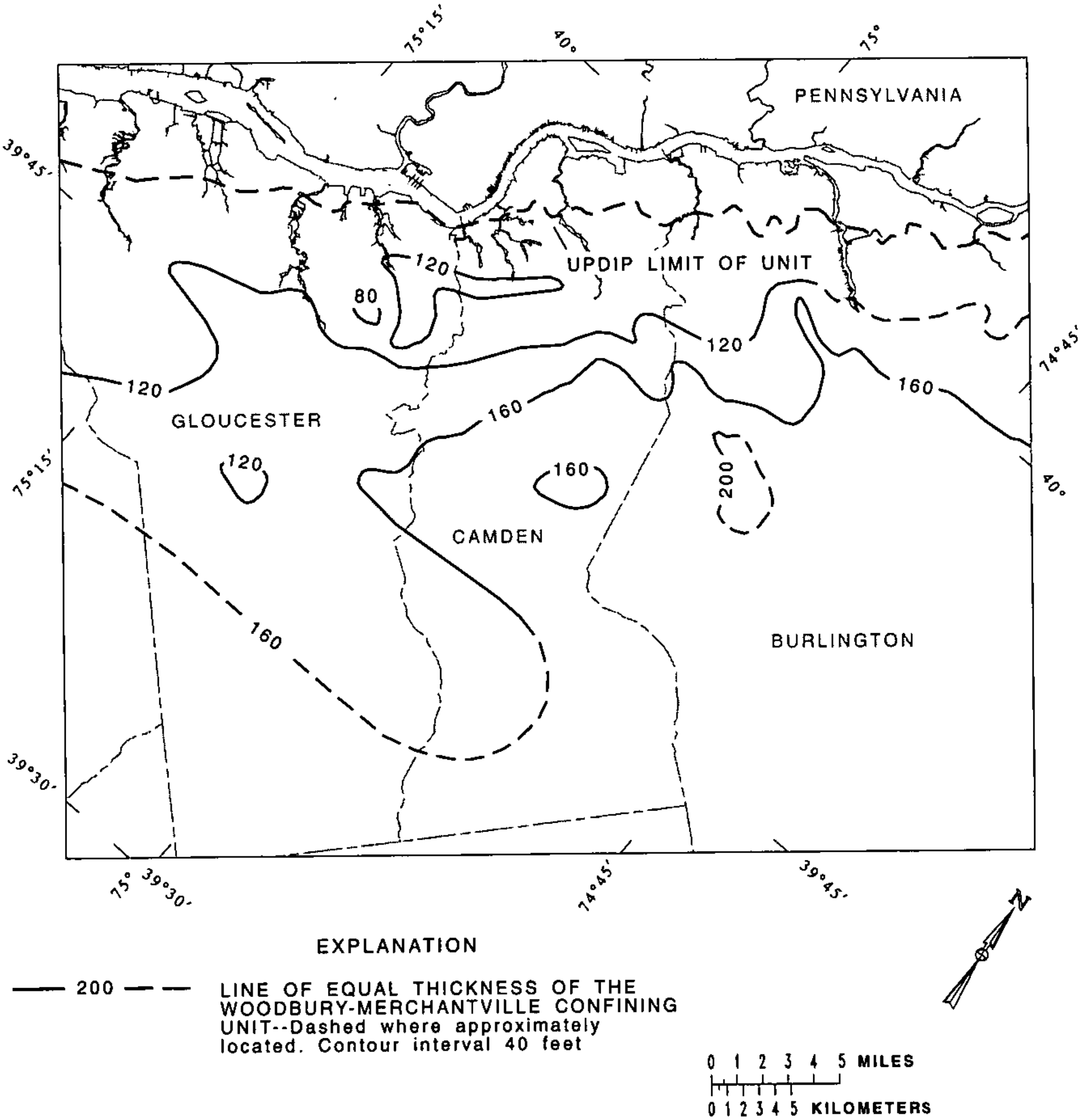


Figure 2. Thickness of the Merchantville-Woodbury confining unit, Camden area, New Jersey (modified from E.C. Regan, U.S. Geological Survey written commun., 1986).

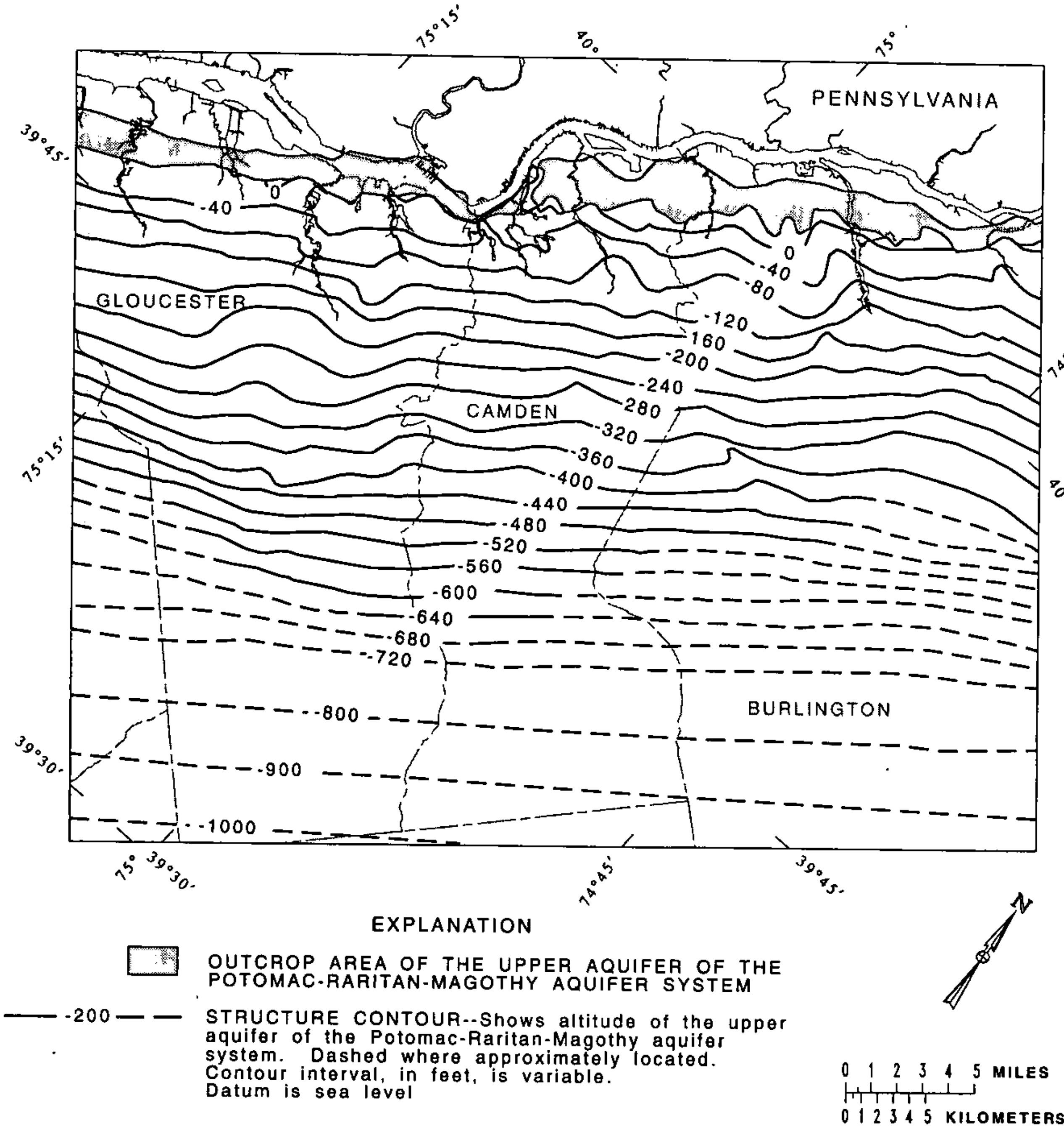


Figure 3. Altitude of the top of the upper aquifer of the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey (modified from E.C. Regan, U.S. Geological Survey, written commun., 1986).

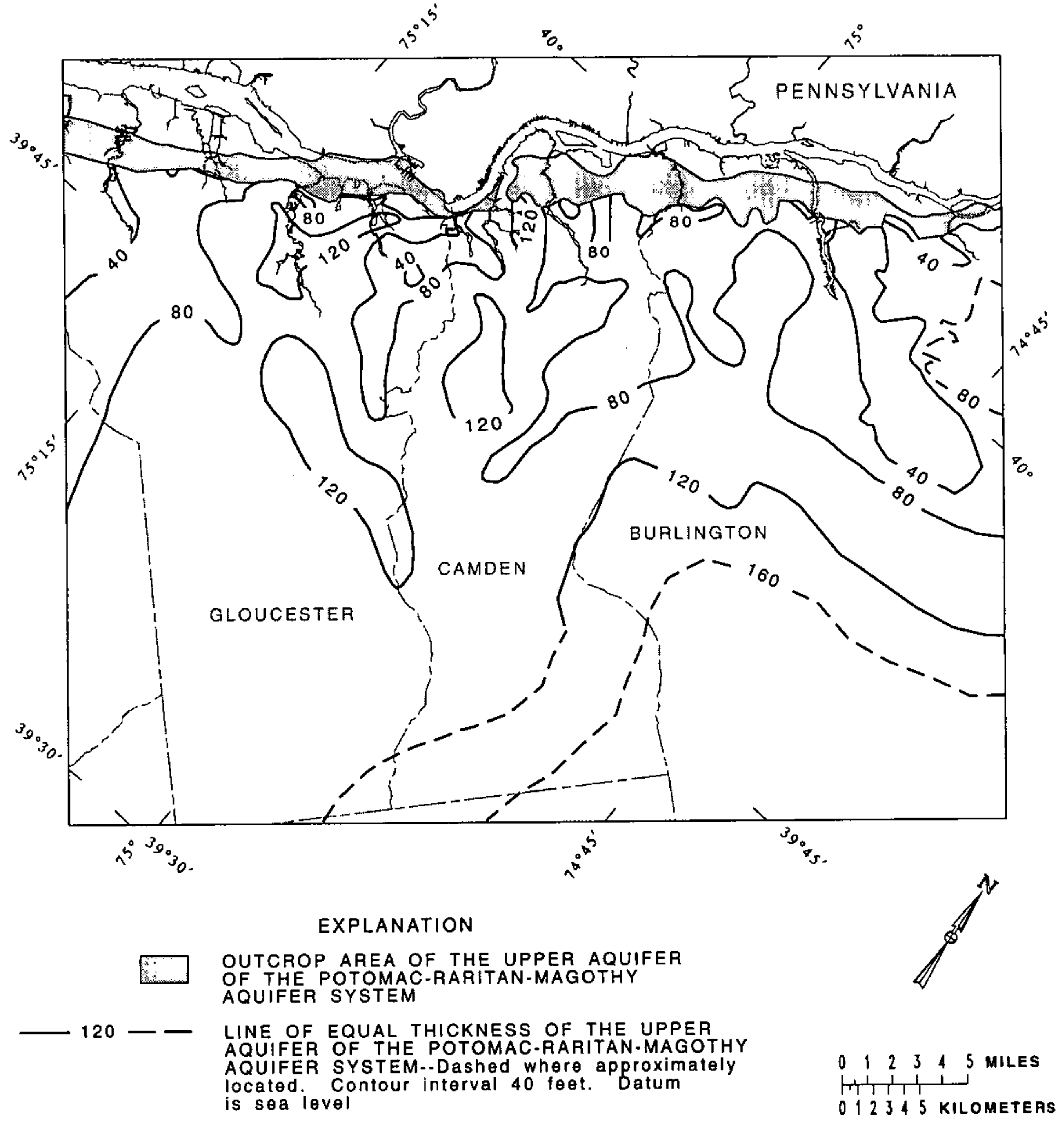


Figure 4. Thickness of the upper aquifer of the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey (modified from E.C. Regan, U.S. Geological Survey, written commun., 1986).

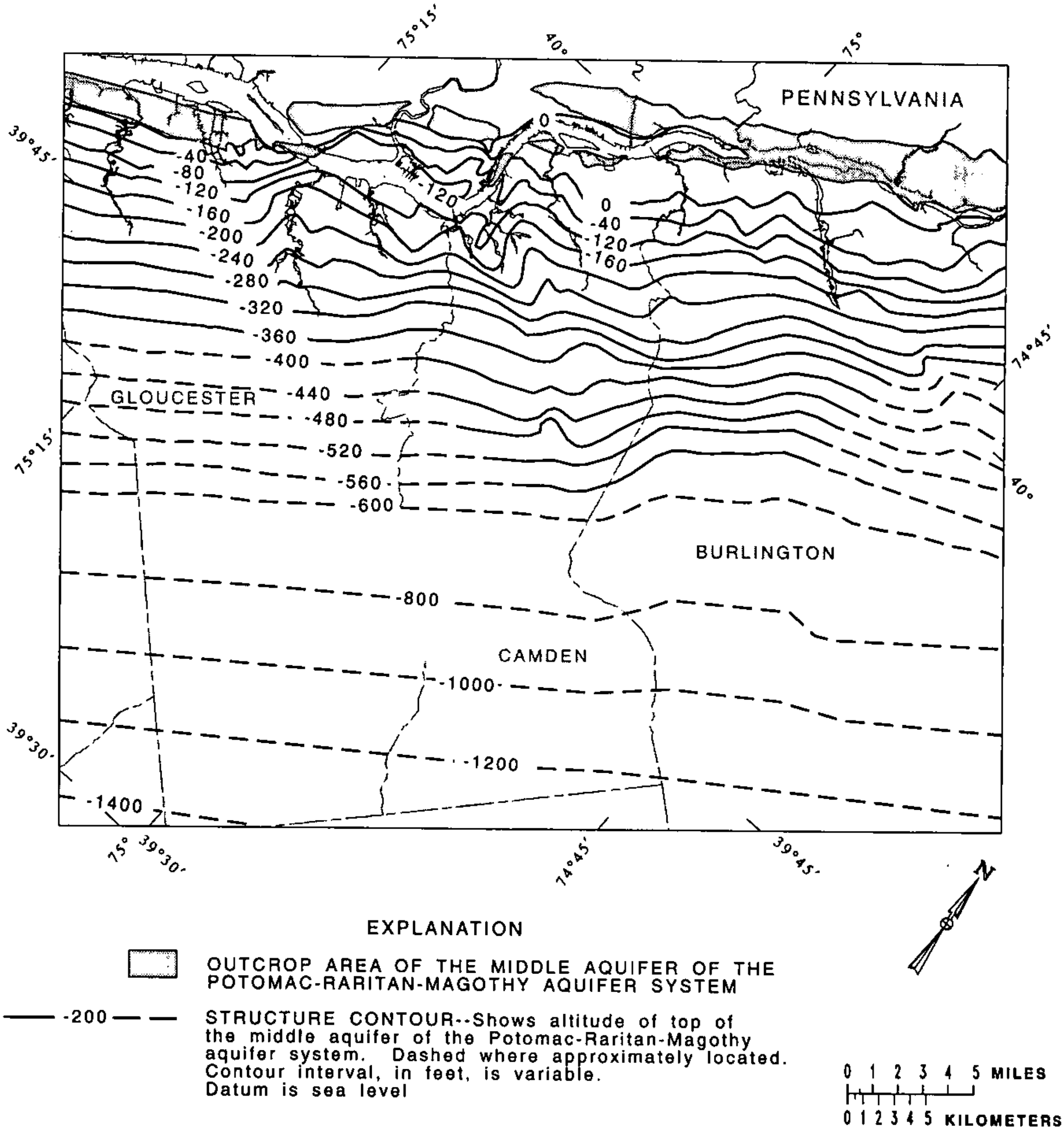


Figure 5. Altitude of the top of the middle aquifer of the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey (modified from E.C. Regan, U.S. Geological Survey, written commun., 1986).

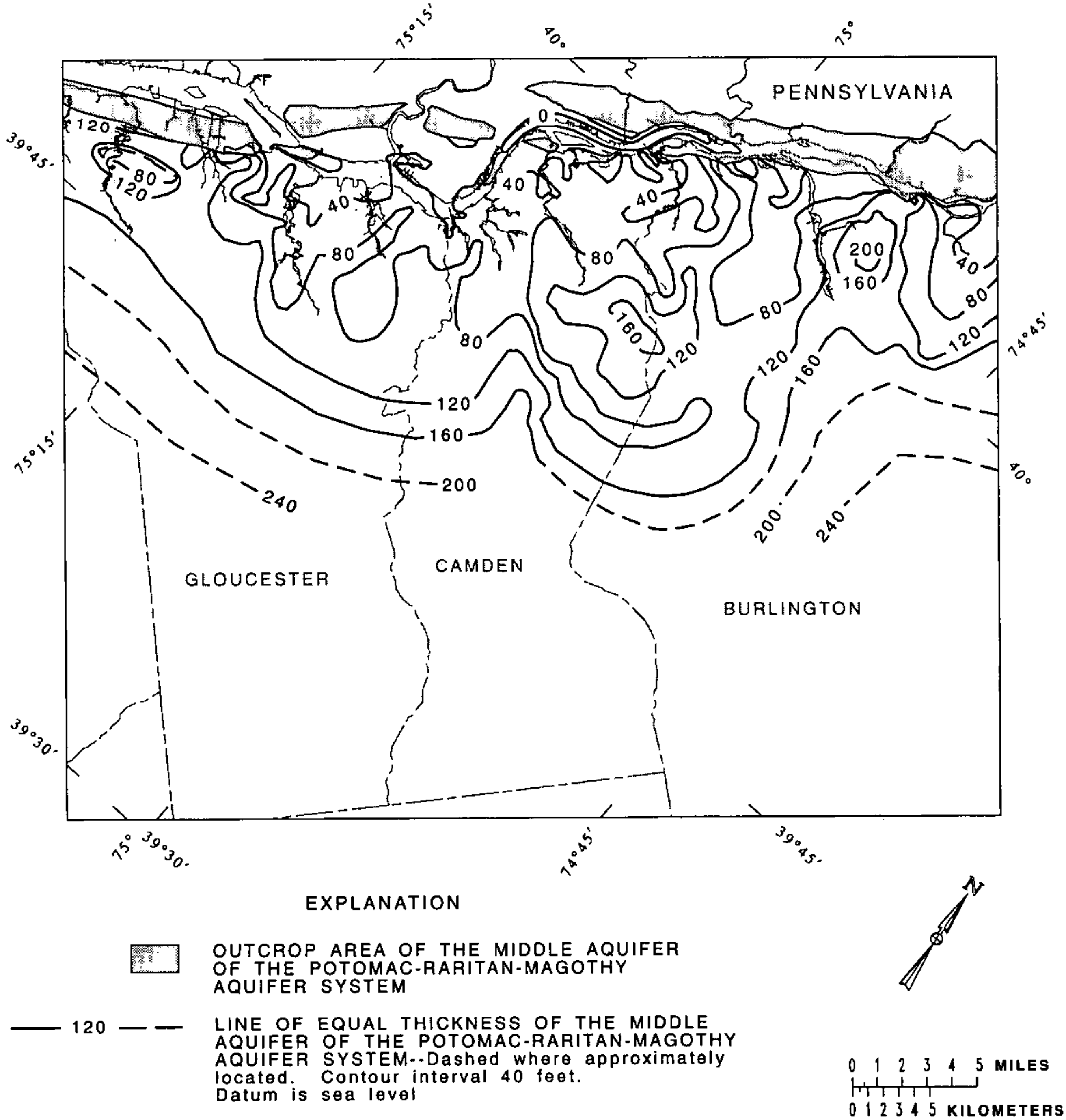
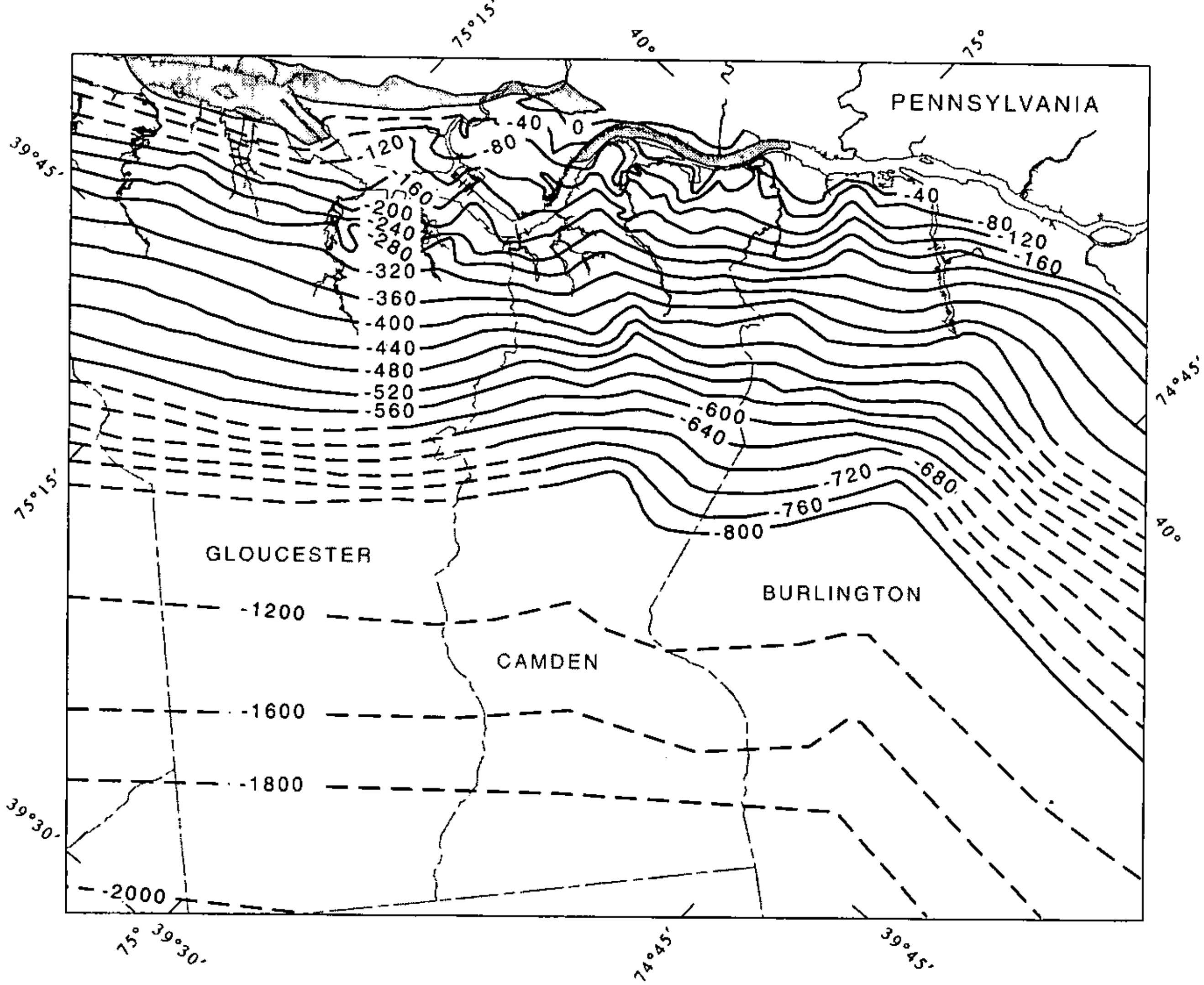


Figure 6. Thickness of the middle aquifer of the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey (modified from E.C. Regan, U.S. Geological Survey, written commun., 1986).



EXPLANATION

OUTCROP AREA OF THE LOWER AQUIFER OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM

—— -200 — — STRUCTURE CONTOUR--Shows altitude of top of the lower aquifer of the Potomac-Raritan-Magothy aquifer system. Dashed where approximately located. Contour interval, in feet, is variable. Datum is sea level

0 1 2 3 4 5 MILES

0 1 2 3 4 5 KILOMETERS

Figure 7. Altitude of the top of the lower aquifer of the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey (modified from E.C. Regan, U.S. Geological Survey, written commun., 1986).

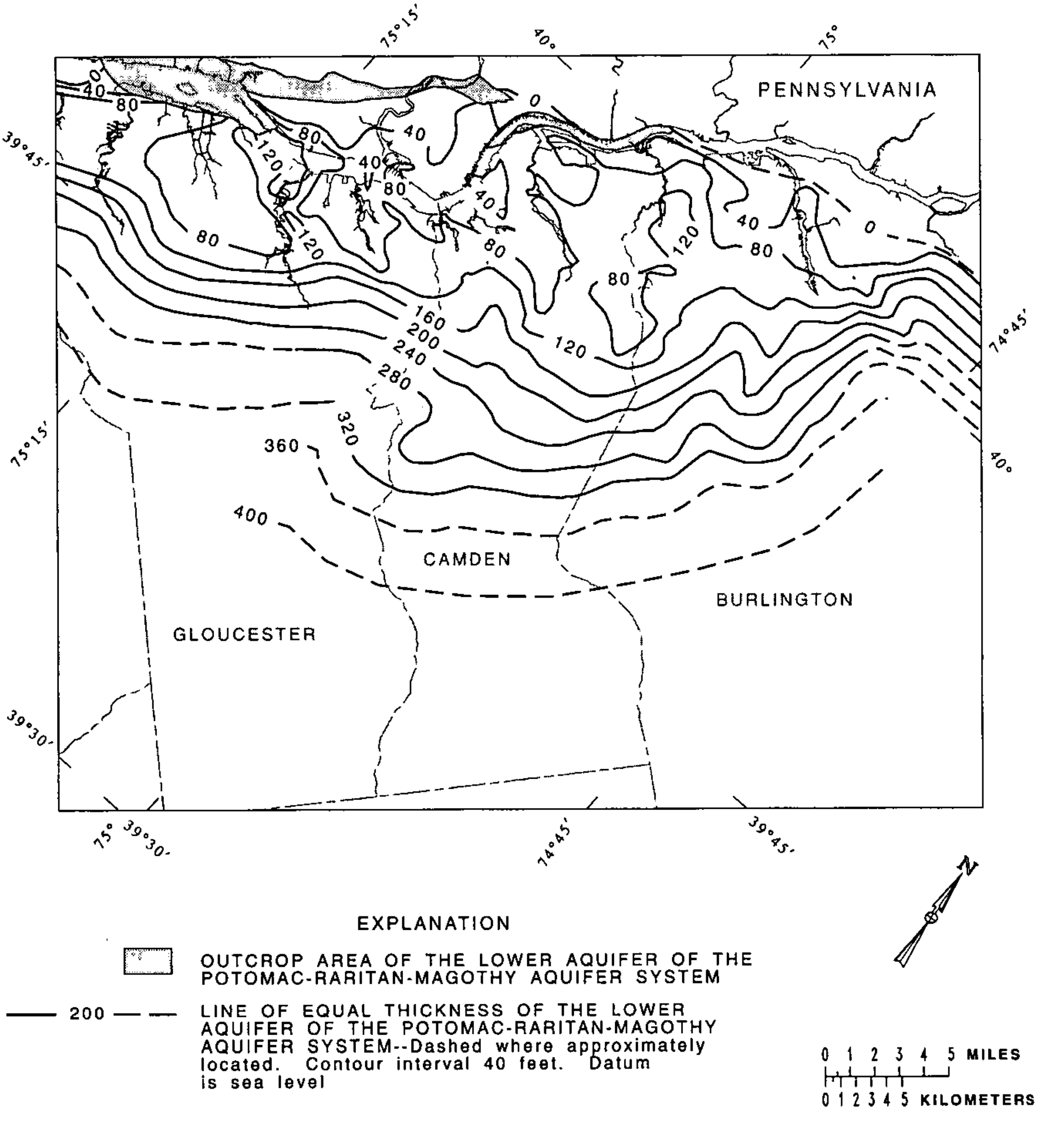
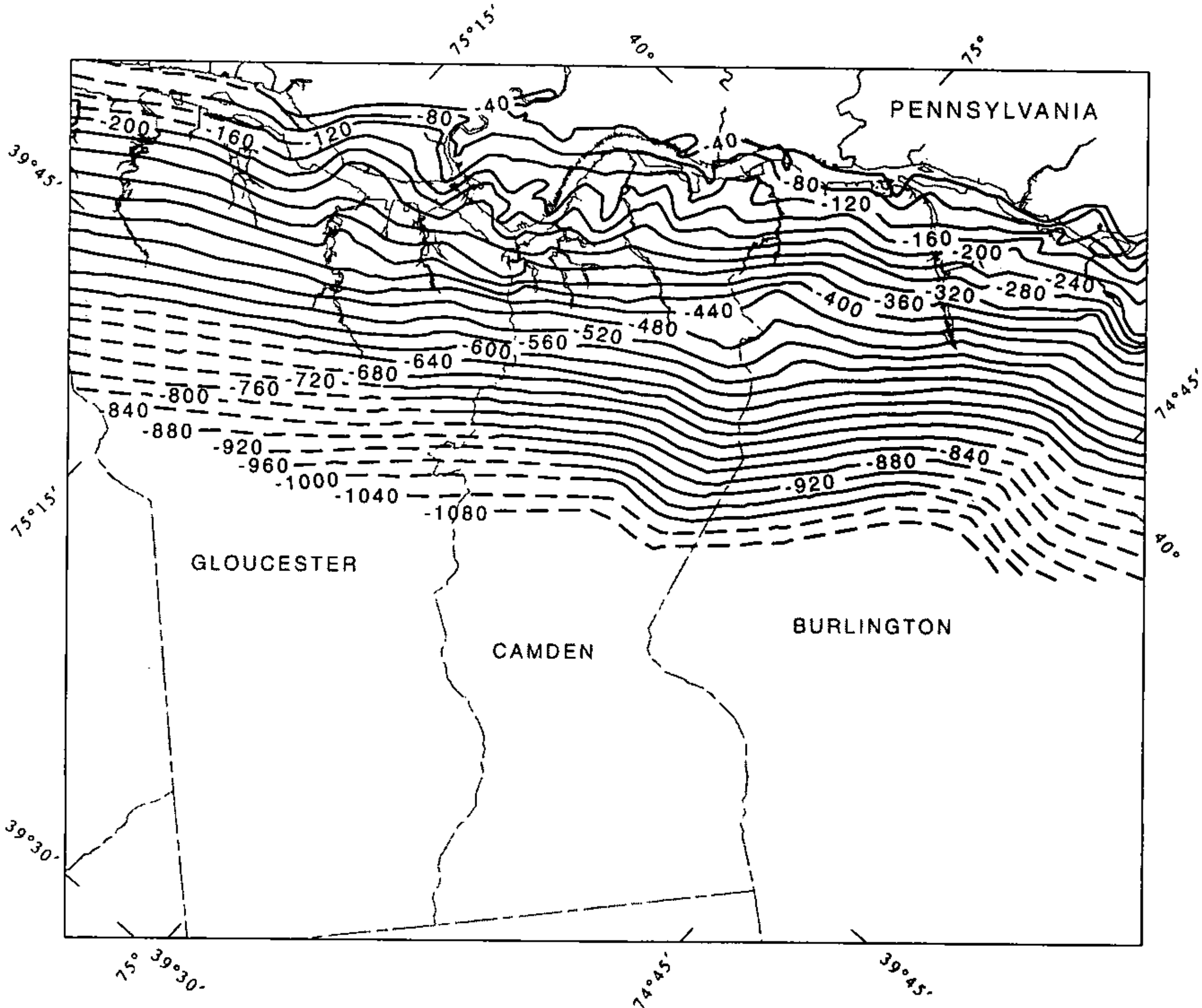


Figure 8. Thickness of the lower aquifer of the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey (modified from E.C. Regan, U.S. Geological Survey, written commun., 1986).



EXPLANATION

—— -200 — — STRUCTURE CONTOUR--Shows altitude of top of the bedrock (Wissahickon Schist). Dashed where approximately located. Contour interval 40 feet. Datum is sea level

N

0 1 2 3 4 5 MILES

0 1 2 3 4 5 KILOMETERS

Figure 9. Altitude of the top of bedrock surface, Camden area, New Jersey (modified from E.C. Regan, U.S. Geological Survey, written commun., 1986).

Aquifer and Confining-Unit Hydraulic Properties

The aquifers of the Potomac-Raritan-Magothy aquifer system are among the most permeable of the New Jersey Coastal Plain. Selected data on transmissivity, hydraulic conductivity, storage coefficients, and vertical hydraulic conductivity for the aquifer system and related units in the Camden area are summarized in table 2. The data in table 2 are not internally consistent because they originate from different sources and types of analyses and may not represent actual hydraulic characteristics as a result of the method of collection or analysis (Martin, 1990, p. 9). The data from Martin (1990) are the calibrated hydraulic properties from the RASA model in the Camden area. These data probably are the best estimates of hydraulic properties available at a regional scale.

Precipitation and Recharge

Precipitation in the Coastal Plain of New Jersey is about 45 in/yr. Rhodehamel (1970, p. 6-7) estimated evapotranspiration to be about 22.5 in/yr, surface-water runoff to be about 2.5 in/yr, and recharge to the ground-water system to be about 20 in/yr. Of the 20 in/yr that recharges the ground-water system, about 17 in/yr is discharged as base flow to streams; the remainder flows into deeper aquifers. Rhodehamel's estimates are based on the flow system of the entire Coastal Plain. In the Camden area, the amount of recharge to the ground-water system may be less than 20 in/yr as a result of urbanization. Much of the water that has entered the ground may be intercepted by public-supply wells in the Camden area, reducing the ground-water contribution to base flow. The direct measurement of recharge in the urbanized Camden area was not attempted. Measurement of stream base flow as a method of approximating recharge was not possible either, as a result of tidal effects. Therefore, the only feasible quantitative approach to the estimation of recharge is to check or modify values derived from similar areas elsewhere in the Coastal Plain during calibration of water levels obtained by using a ground-water-flow model.

Ground-Water Withdrawals

Ground water is the major source of potable water in the Camden area. In 1980, 95 percent of ground-water withdrawals in Burlington, Camden, and Gloucester Counties were from either the upper, middle, or lower aquifer (Vowinkel, 1984, p. 19). Although early withdrawals from the aquifer system were concentrated in the City of Camden, development in the suburbs has led to increased use over much of the study area.

Annual withdrawals

Significant development of the aquifer system began in 1898, when the first withdrawals from wells in the City of Camden's Morris well field were made (Farlekas and others, 1976, p. 26). Annual withdrawals from each of the upper, middle, and lower aquifers and the combined total are shown in figure 10. The increase in withdrawals from the 1930's to the 1970's is readily apparent. Use of the lower aquifer has been, and continues to be, the highest among the three aquifers. Use of the upper and middle aquifers currently (1987) is similar. Current (1987) withdrawals from the aquifer system in the Camden area are about 125 Mgal/d. Positive correlation between population and withdrawals was strong from the turn of the century until the 1970's. Population increased more slowly in the 1970's (Camp Dresser and McKee, Inc., 1984a, p. 3-9), while withdrawals slightly decreased. Economic conditions also affect withdrawals directly by increasing or decreasing industrial withdrawals and indirectly by affecting population. The decrease in withdrawals from 1980 to 1981, shown in figure 10, may have been caused, in part, by the statewide restriction on water use imposed in 1981 as a result of drought conditions that year (Camp Dresser and McKee, Inc., 1984a, p. 3-22).

Table 2.--Selected data on hydraulic characteristics of the Potomac-Raritan-Magothy aquifer system and related units in the vicinity of the Camden area, New Jersey

[Modified from Martin, 1990; ft/d, feet per day; ft^2/d, feet squared per day; Co., County; Twp., Township; --, no information]

Transmissivity (ft^2/d)	Hydraulic conductivity (ft/d)	Storage coefficient (dimensionless)	Source of data	Location	Reference
		ENGLISHTOWN AQUIFER SYSTEM			
2,100	--	2.7×10^{-4}	Aquifer test	Clementon, Camden Co.	Farlekas and others (1976, p. 61)
500	--	1.0×10^{-4}	Simulation results	Camden area	Martin (1990, p. 104)
		UPPER AQUIFER OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM			
500-3,000	--	1.0×10^{-4}	Aquifer test	Delmarva Peninsula	Cushing and others (1973, p. 41)
16,600	240	1.0×10^{-3}	Aquifer test	Haddon Heights, Camden Co.	Barksdale and others (1958, p. 97)
2,300-9,000		5.8×10^{-4}-2.4×10^{-3}	Aquifer test	Old Bridge, Middlesex Co.	Barksdale and others (1958, p. 47)
6,000-35,000	--	8.0×10^{-5}-8.0×10^{-3}	Simulation results	N.J. Coastal Plain	Luzier (1980, p. 44)
2,000-10,000	--	1.0×10^{-4}	Simulation results	Camden area	Martin (1990, p. 103)
		MIDDLE AQUIFER OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM			
6,200-12,000	130-270	2.1×10^{-4}	Aquifer test	Burlington Twp., Burlington Co.	Rush (1968, p. 33)
22,000	200	6.0×10^{-2}	Aquifer test	Burlington Twp., Burlington Co.	Rush (1968, p. 33)
28,200-68,600	--	1.1×10^{-4}-5.8×10^{-4}	Aquifer test	Palmyra, Burlington Co.	Rush (1968, p. 33)
13,100-17,400	217-290	1.0×10^{-4}-2.4×10^{-4}	Aquifer test	Beverly, Burlington Co.	Rush (1968, p. 33)
20,000	200	1.5×10^{-4}	Aquifer test	Riverton, Gloucester Co.	Barksdale and others (1958, p. 97)
6,300	200	1.5×10^{-4}	Aquifer test	Gibbstown, Gloucester Co.	Barksdale and others (1958, p. 97)
8,300	350	1.2×10^{-3}	Aquifer test	Camden, Camden Co.	Barksdale and others (1958, p. 97)
6,000-35,000	--	8.0×10^{-5}-8.0×10^{-3}	Simulation results	N.J. Coastal Plain	Luzier (1980, p. 44)
4,000-10,000	--	1.0×10^{-4}	Simulation results	Camden area	Martin (1990, p. 102)
		LOWER AQUIFER OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM			
2,300-6,700	--	1.0×10^{-4}-3.5×10^{-4}	Aquifer test	Camden, Camden Co.	Farlekas and others (1976, p. 38)
3,200-3,700	--	3.3×10^{-5}-1.5×10^{-3}	Aquifer test	Camden, Camden Co.	Farlekas and others (1976, p. 38)
8,300	350	1.2×10^{-3}	Aquifer test	Camden, Camden Co.	Barksdale and others (1958, p. 97)
16,600	240	1.0×10^{-3}	Aquifer test	Haddon Heights, Camden Co.	Barksdale and others (1958, p. 97)
6,800-9,100	140-190	9.0×10^{-5}-1.7×10^{-4}	Aquifer test	Westville, Gloucester Co.	Barksdale and others (1958, p. 97)
6,000-35,000	--	8.0×10^{-5}-8.0×10^{-3}	Simulation results	N.J. Coastal Plain	Luzier (1980, p. 44)
4,000-10,000	--	1.0×10^{-4}	Simulation results	Camden area	Martin (1990, p. 101)

Geologic unit	Vertical hydraulic conductivity (ft/d)	Source of data	Location	Reference
Englishtown Formation (clayey-silt lithofacies)	1.9×10^{-6}	Laboratory test	Lakewood, Ocean Co.	Nichols (1977a, p. 58)
Merchantville Formation	1.0×10^{-4}-4.0×10^{-4}	Laboratory test	Winslow Township, Camden Co.	Farlekas and others (1976, p. 133-134)
Merchantville Formation and Woodbury Clay	3.7×10^{-6}-6.0×10^{-5}	Laboratory test	Fort Dix, Burlington Co.	Nichols (1977b, p. 58)
Merchantville Formation and Woodbury Clay	3.6×10^{-6}-1.4×10^{-5}	Laboratory test	Lakewood, Ocean Co.	Nichols (1977b, p. 58)
Merchantville Formation and Woodbury Clay	4.3×10^{-6}	Simulation results	Northern N.J. Coastal Plain	Nichols (1977a, p. 76)
Merchantville Formation and Woodbury Clay	8.6×10^{-7}-1.7×10^{-3}	Simulation results	N.J. Coastal Plain	Luzier (1980, p. 29)
Woodbury Clay	1.0×10^{-4}-3.0×10^{-2}	Laboratory test	Winslow Township, Camden Co.	Farlekas and others (1976, p. 133-134)

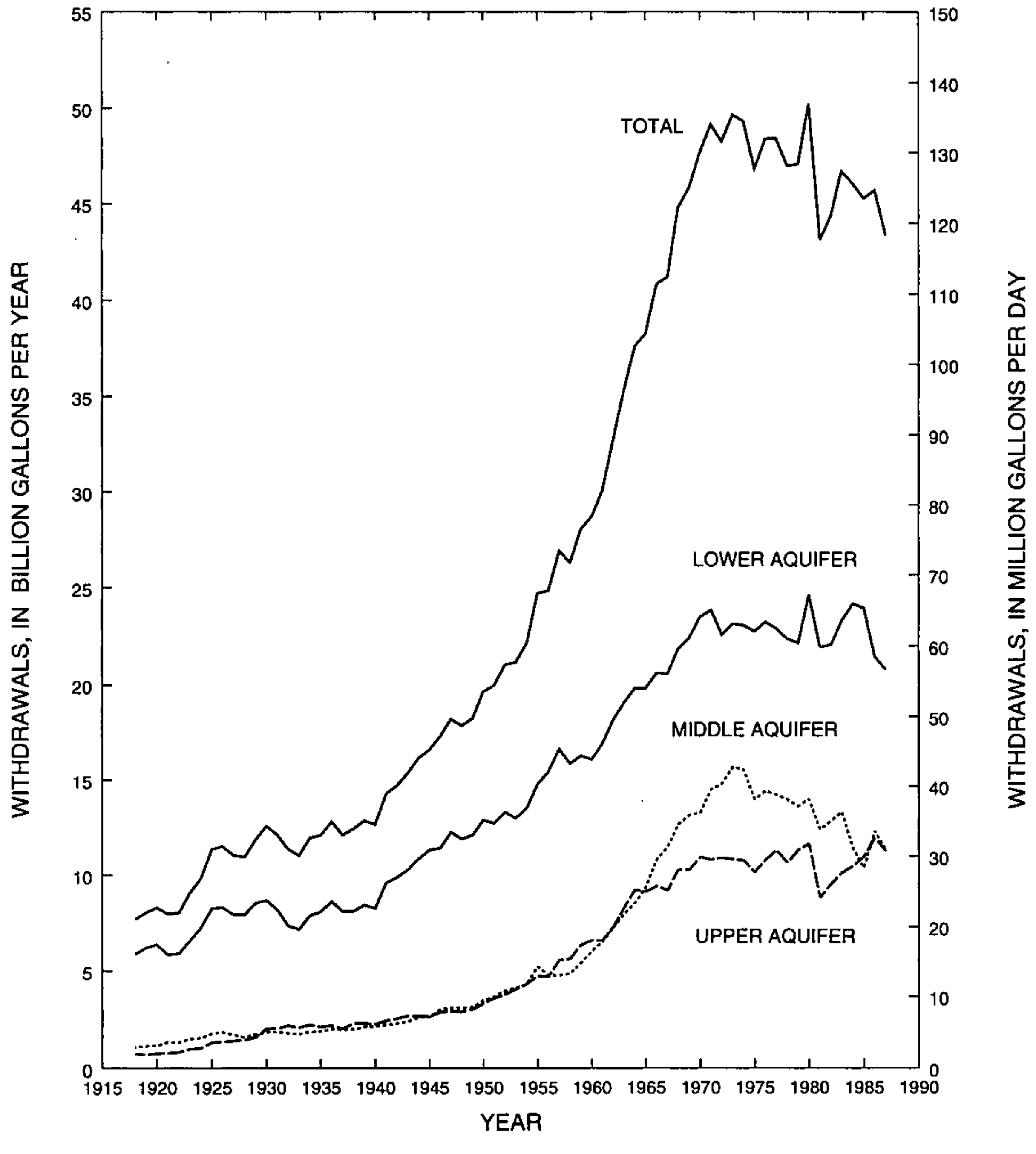


Figure 10. Historical annual withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey, 1918-87.

Seasonal variations in withdrawals change from year to year, depending on the amount and temporal distribution of precipitation, and on temperature. Agricultural withdrawals are most affected by climatic fluctuations. Domestic and industrial use increase significantly during the summer and are affected by climatic changes from year to year. For the purposes of this report, however, where multiannual effects are the focus of investigation, only the annual rates are used in the analyses.

Both overall use (fig. 10) and concentration of use of the lower aquifer are highest among the three aquifers. In 1983, the City of Camden and other major users pumped 8.67 billion gallons (23.8 Mgal/d) from the lower aquifer in Pennsauken Township. The next highest withdrawal was from wells within the City of Camden, through which 2.08 billion gallons (5.70 Mgal/d) was withdrawn in 1983, also from the lower aquifer. Withdrawals from the middle aquifer were smaller, whereas the upper aquifer was the least stressed of the three. Withdrawals from the aquifer system in the southernmost part and southeastern corner of the study area were not significant.

The sources of water-use data used in this report are Zapecza and others (1987) and the NJDEP, Bureau of Water Allocation. The source, character, and limitations of the data are described briefly below. A more complete presentation can be found in Zapecza and others (1987, p. 7-9).

Water-use data used in this report cover three periods: 1918-55, 1956-80, and 1981-87. Data for the most recent period are presented in table 3 (at end of report). These data were retrieved from the State Water Use Data System (SWUDS), a computerized data base of the New Jersey District of the USGS. SWUDS contains statewide well-owner and site information and monthly withdrawal data, which are reported quarterly to the NJDEP, Bureau of Water Allocation. Although a single water-allocation permit may cover multiple ground- and surface-water sources, all withdrawals presented in this report are for the aquifer system only. In most cases, the owner reported withdrawals, either metered or estimated by multiplying hours of pump operation by pump capacity, by well. In cases where data were unreported or withdrawals from multiple wells were aggregated, the amount or distribution of withdrawal was estimated.

Data for the periods before 1981 were taken from Zapecza and others (1987, tables 2 and 3). Like the data for 1981-87, those for 1956-80 were compiled from quarterly reports and, where possible, were recorded as monthly withdrawal by well; however, some data were aggregated. The data for 1918-55 were compiled only as annual totals for each user. Public suppliers have been required to report total annual withdrawals since 1917, whereas private users who own wells with pumps having a capacity of 100,000 gal/d or greater have been required to obtain permits and report withdrawals since 1947. Owners of private wells drilled before 1947 were "grandfathered" and were not required to report until 1980 (Vowinkel, 1984, p. 5). Therefore, most of the data for 1918-55 are for public suppliers who reported only annual totals. Withdrawals from individual aquifers were estimated from the proportion of wells in each aquifer that were in operation in each year. In addition to the public-supply data, industrial-withdrawal data were estimated by identifying wells that were in service prior to 1956. The estimates are based on the installation dates and the percentage of water withdrawn through these wells in relation to the overall total diversion by the company in 1956 (Zapecza and others, 1987, p. 8).

Vowinkel (1984, p.7) divided withdrawals into three categories: public-supply, industrial and commercial, and agricultural. These categories accounted for 86, 13, and 1 percent, respectively, of aquifer-system withdrawals in the study area in 1980. Industrial use includes only withdrawals made directly by industrial or commercial users, not water supplied by a public supplier to such a user. Many agricultural users have "grandfather" rights and did not begin to report their use until 1980; however, because agricultural use represented about 1 percent of reported withdrawals from the Camden area in 1983, the effect of any missing data from previous years is thought to be minor. Self-supplied domestic users were not considered because the data are unavailable and the quantity of use is small. Camp Dresser and McKee, Inc.

(1984a, p. 3- 19), estimate that less than 4 percent of the population in the Camden area is self-supplied. Of these users, some have wells that are screened in shallow aquifers above the Potomac-Raritan-Magothy aquifer system.

Future water use

Camp Dresser & McKee, Inc. (1984a, p. 3-46), projects that future average-day water demand for public purveyors and self-supplied users in the Camden area will be 123.1 Mgal/d in the year 2000, and 136.0 Mgal/d in 2020. On the basis of 1980 withdrawals of 110.1 Mgal/d, these values represent increases of 13.0 Mgal/d (12 percent) and 25.9 Mgal/d (24 percent), respectively. Because the increase in demand by self-supplied users is expected to be minimal, this projected increase in total demand is due primarily to an increase in demand by public purveyors of 14 percent by the year 2000 and 27 percent by 2020. Currently (1987), the NJDEP is not issuing permanent permits for new withdrawals from the aquifer system in the Camden area because of perceived overdraft conditions. Future demand for water in the Camden area is likely to be satisfied, at least in part, from sources other than the Potomac-Raritan-Magothy aquifer system.

Ground-Water Levels

Before development, the potentiometric surface of the aquifer system stood above sea level in the Camden area. The approximate altitude of this surface is shown in figure 11. About 1900, few wells were present in the area; consequently, few recorded water-level measurements are available. Therefore, this potentiometric surface is an approximation. Furthermore, it is an integration of the potentiometric surface of the three component aquifers, because data are insufficient to construct separate surfaces.

Once water-supply pumping was initiated on a large scale, water levels declined. Several patterns of decline are evident in the Camden area, as exhibited by the hydrographs of water levels in the observation wells whose locations are shown in figure 12. The hydrograph in figure 13 of water levels in well 07-108 (Camden DIV 10), which is open to the lower aquifer in Pennsauken near the Delaware River and in which measurements were initiated in the 1930's, shows a seasonal variation, probably resulting from changes in nearby pumping rates and climatic conditions that affect recharge. From a long-term perspective, the water level declined steadily from the 1930's to about 1970; stabilized for about 10 years, from 1970 to 1980; and recovered about 15 ft from 1980 to 1987.

The nested observation wells 05-258 (Medford #1), open to the upper aquifer; 05-261 (Medford #5), open to the middle aquifer; and 05-262 (Medford #4), open to the lower aquifer, are located in Burlington County. The nested observation wells 07-413 (Elm Tree #3), open to the middle aquifer, and 07-412 (Elm Tree #2), open to the lower aquifer, are located in central Camden County. The hydrographs of both sets of wells (figs. 14 and 15, respectively) exhibit a different water-level history than that shown by 07-108 (Camden DIV 10) (fig. 13). Water levels in these wells, monitored since the mid-1960's, declined consistently. Although the rate of decline has slowed since about 1980, the trend has continued to the present (1990). The declines are evident in all three aquifers.

The nested observation wells 15-297 (Shell #6), open to the upper aquifer and 15-296 (Shell #5), open to the lower aquifer, are located in Gloucester County near the Delaware River. These wells also have been monitored since the mid-1960's, and show a third, different water-level history than the others. The water levels, shown in figure 16, have declined less and more slowly than those in the Medford or Elm Tree wells, and have remained fairly stable since the 1970's.

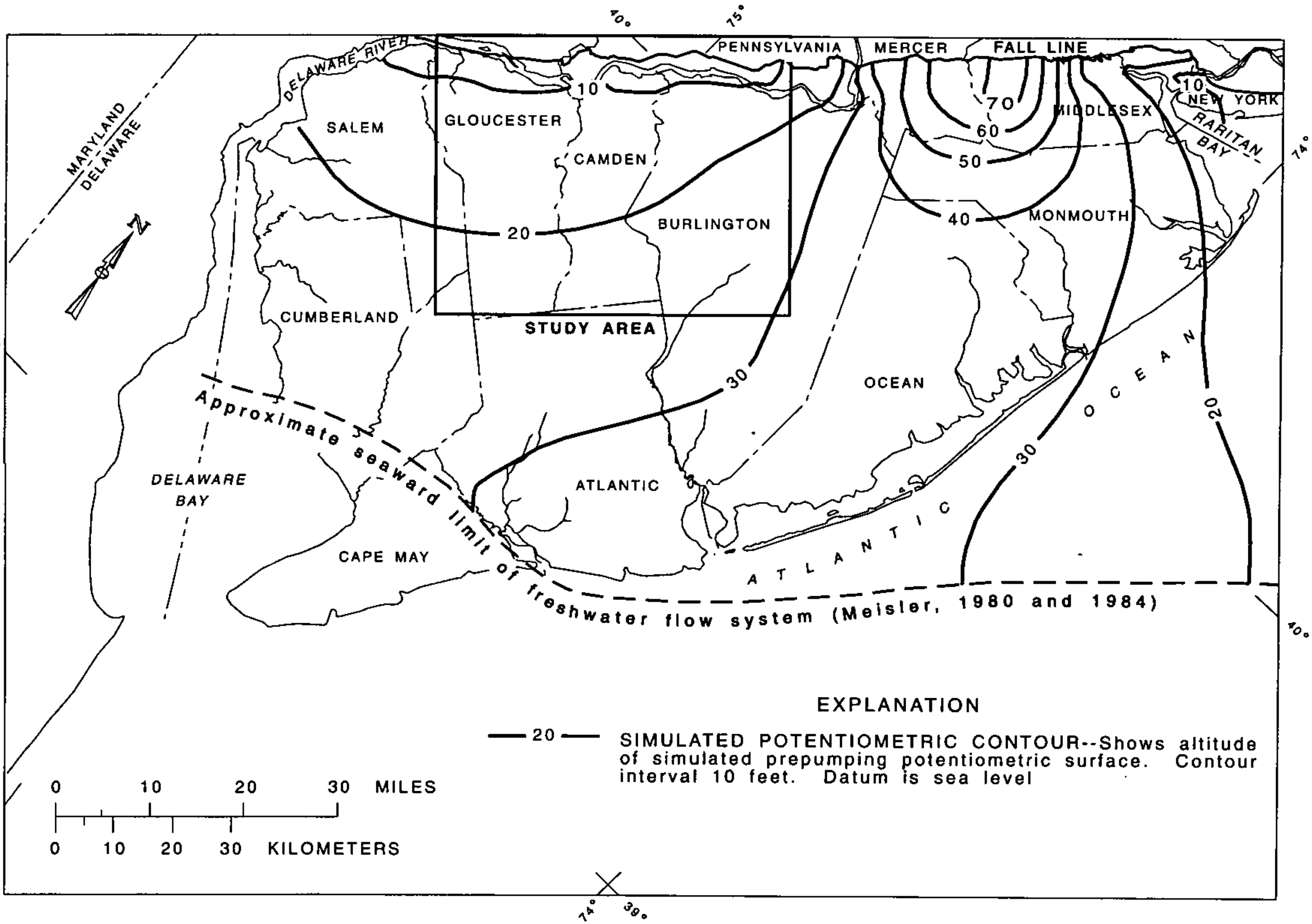


Figure 11. Approximate potentiometric surface of the middle aquifer of the Potomac-Raritan-Magothy aquifer system in southern New Jersey, prior to 1900 (modified from Martin, 1990, fig. 31).

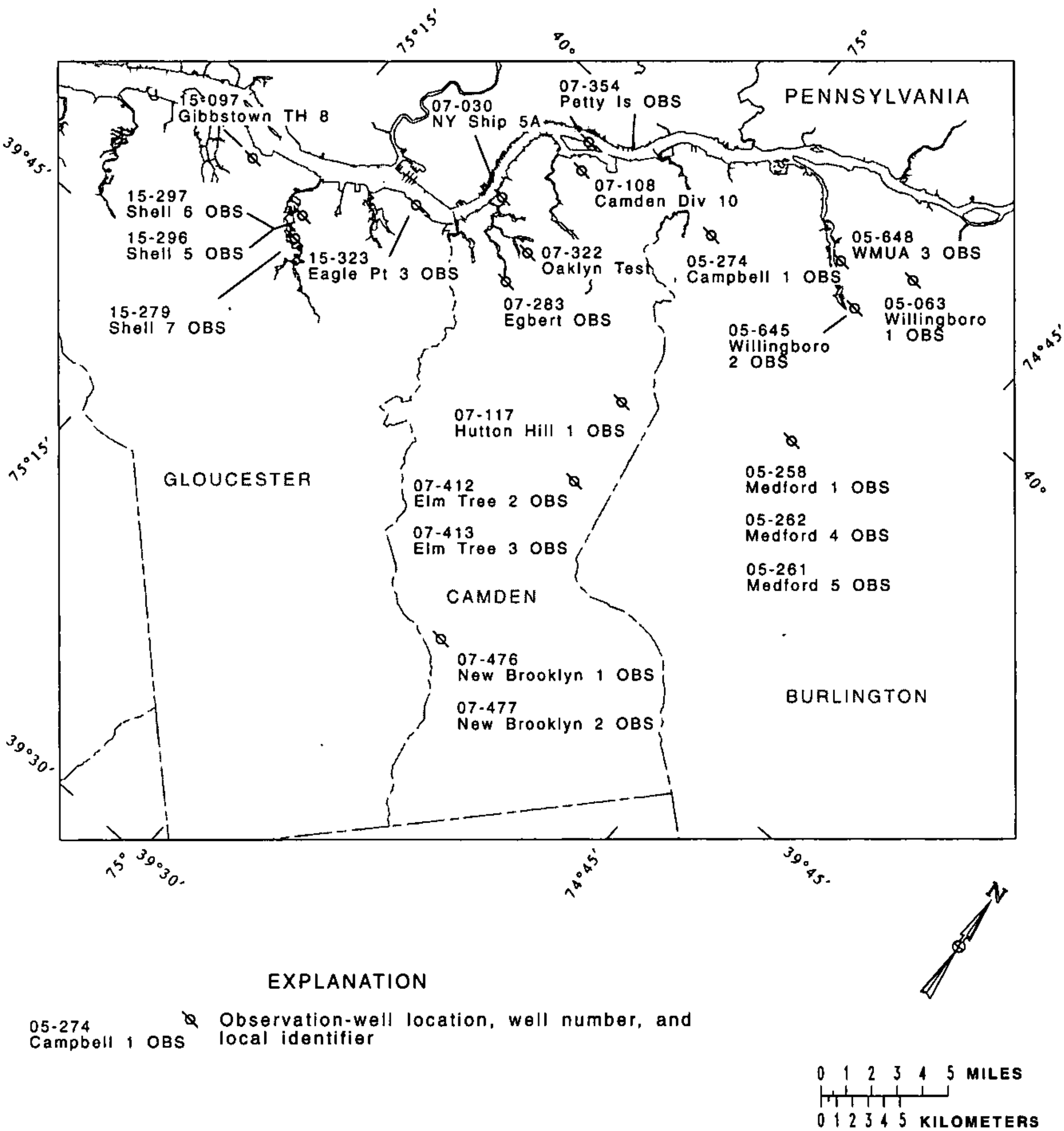


Figure 12. Location of selected long-term observation wells in the Camden area, New Jersey.

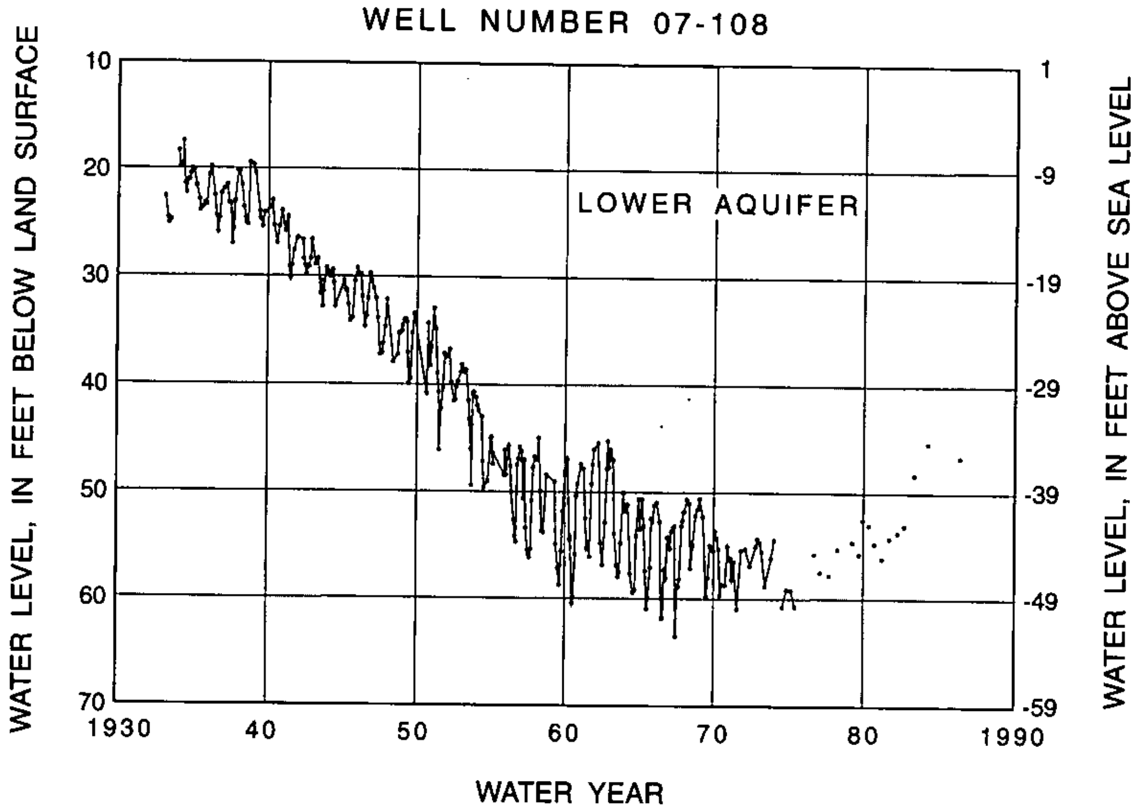


Figure 13. Water levels in well 07-108. (Camden DIV 10), 1933 -87.

Although these hydrographs indicate the general rate and magnitude of water-level decline in the area, the number of long-term observation wells is too small to clearly determine the areal variation in the potentiometric surface. A map of the potentiometric surface can only be developed from synoptic measurements of water levels in many wells. Previously published potentiometric-surface maps include those drawn by Barksdale and others (1958) for the early 1950's; Gill and Farlekas (1976) for 1900, 1956, and 1968; Luzier (1980) for 1973; Walker (1983) for 1978; and Eckel and Walker (1986) for 1983.

The potentiometric surfaces for the upper, middle, and lower aquifers in the fall of 1988 are shown in figures 17, 18, and 19, respectively. The effects of withdrawals are evident in each of the aquifers as regional cones of depression. The resolution of the maps is insufficient to show the cones of depression surrounding individual pumped wells. The regional cones of depression, which are generally centered in north-central Camden County, extend to depths in excess of 90 ft below sea level. Given that the predevelopment potentiometric surface was above sea level (fig. 11), the magnitude of water-level decline due to withdrawals exceeds 100 ft in the centers of the cones.

The water-level data used to construct the three potentiometric-surface maps in figures 17, 18, and 19 are listed in table 4 (at end of report). Water-level measurements made in 1978, 1983, 1984, 1986, and 1988 are also presented in table 4. The owners and construction characteristics of the wells used for water-level measurements and those used for other purposes in this report are compiled in table 5 (at end of report).

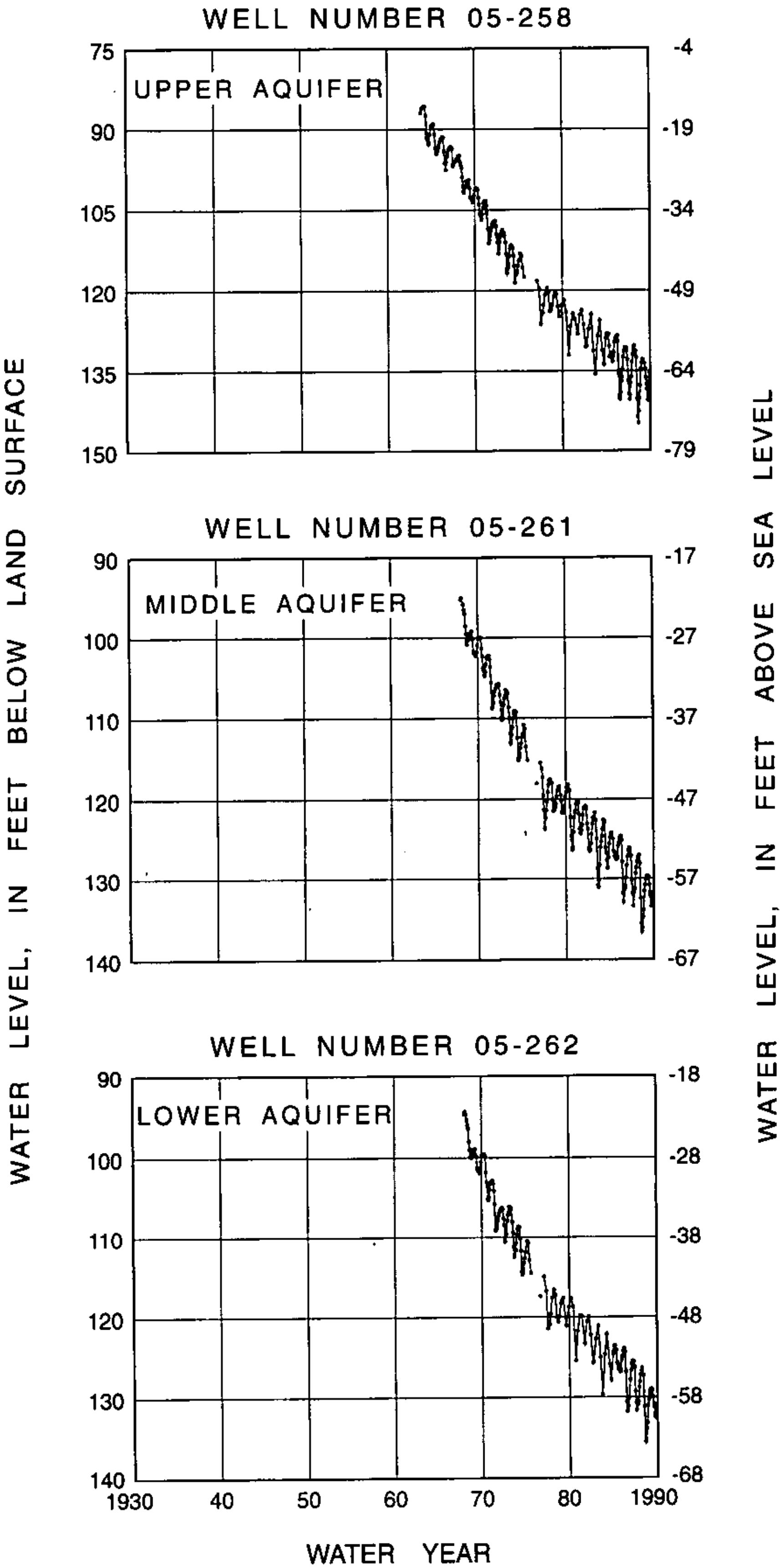


Figure 14. Water levels in wells 05-258 (1963-91), 05-262 (1968-91), and 05-261 (1968-91) (Medford 1,4, and 5).

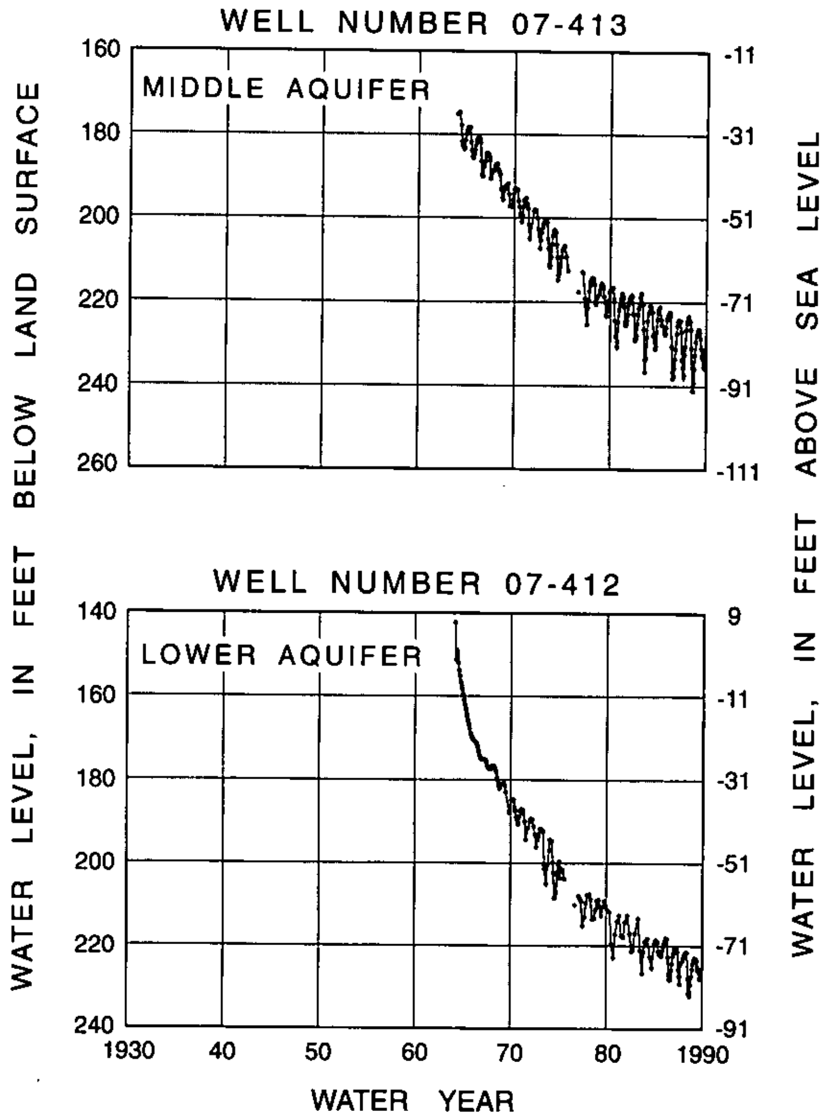


Figure 15. Water levels in wells 07-412 (1963-91)and 07-413 (1964-91) (Elm Tree 2 and 3).

Ground-Water Quality

The quality of water in the Potomac-Raritan-Magothy aquifer system in the Camden area is affected by natural processes and by the introduction of contaminants from anthropogenic sources. Five distinct water-quality zones, or "hydrochemical facies," in the aquifer system have been delineated by Back (1966) on the basis of concentrations of inorganic, naturally occurring water constituents. The locations of these zones are related to the regional ground-water flow patterns in the aquifer system. The regional flow pattern determines the source, pathway residence time, and ultimate destination of the water. These factors, in turn, affect the composition of the water and the reactions of the water with aquifer matrix material. Additional discussion of these processes can be found in Back (1966) and Ervin and others (1994).

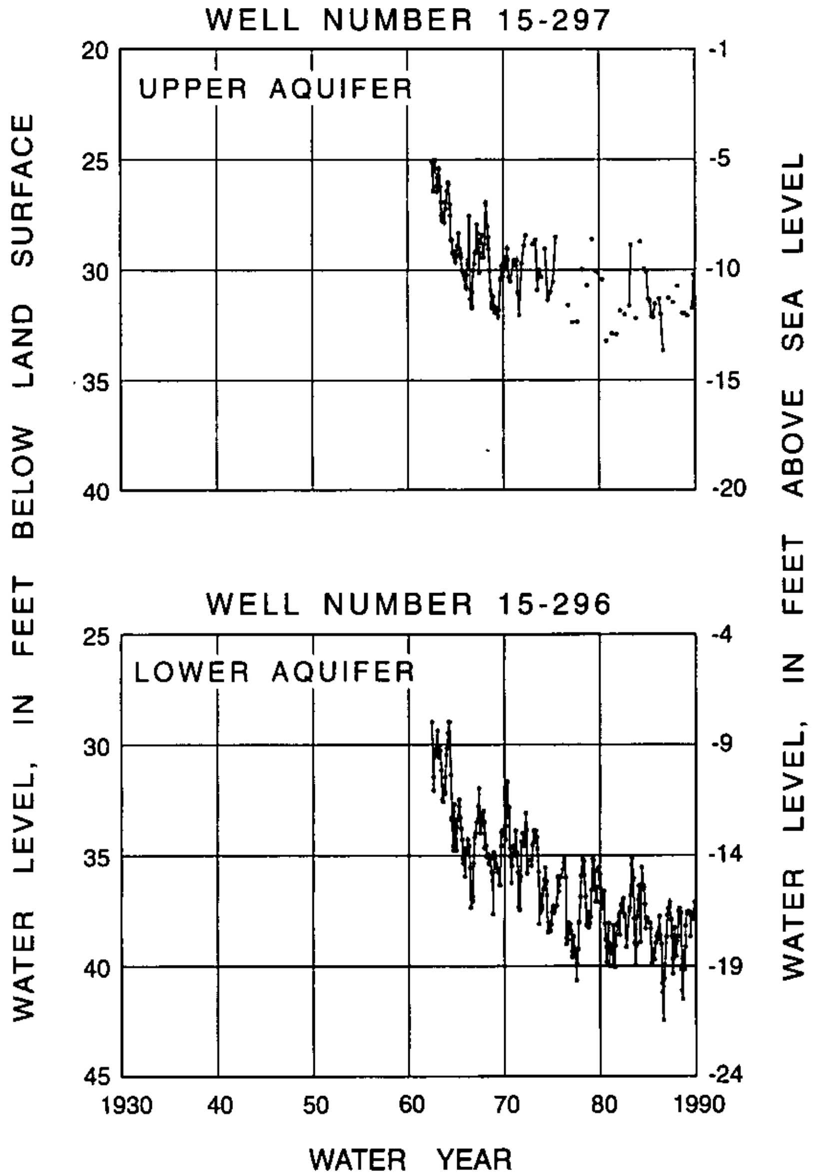


Figure 16. Water levels in wells 15-296 and15-297 (Shell 5 and 6), 1962-91.

From a simplified geochemical standpoint, the five zones of aquifer-system water can be reduced to two -- potable and nonpotable -- with respect to water supply in the Camden area. Nonpotable water is found in the deep, downdip parts of the aquifer system. In the study area it is found in the southeastern part of Gloucester County and may be found in the extreme southeastern part of Camden County. Concentrations of dissolved solids in the nonpotable water range from the threshold of potability at its updip extent to slightly higher than those found in seawater (Knobel, 1985, p. 31, "Ragovin" well samples) at the farthest downdip sampling site in Cumberland County (outside the study area). The composition of the nonpotable water is indicative of ion-exchange reactions and possible mixing of freshwater with seawater. Additional information on these processes can be found in Ervin and others (1994).

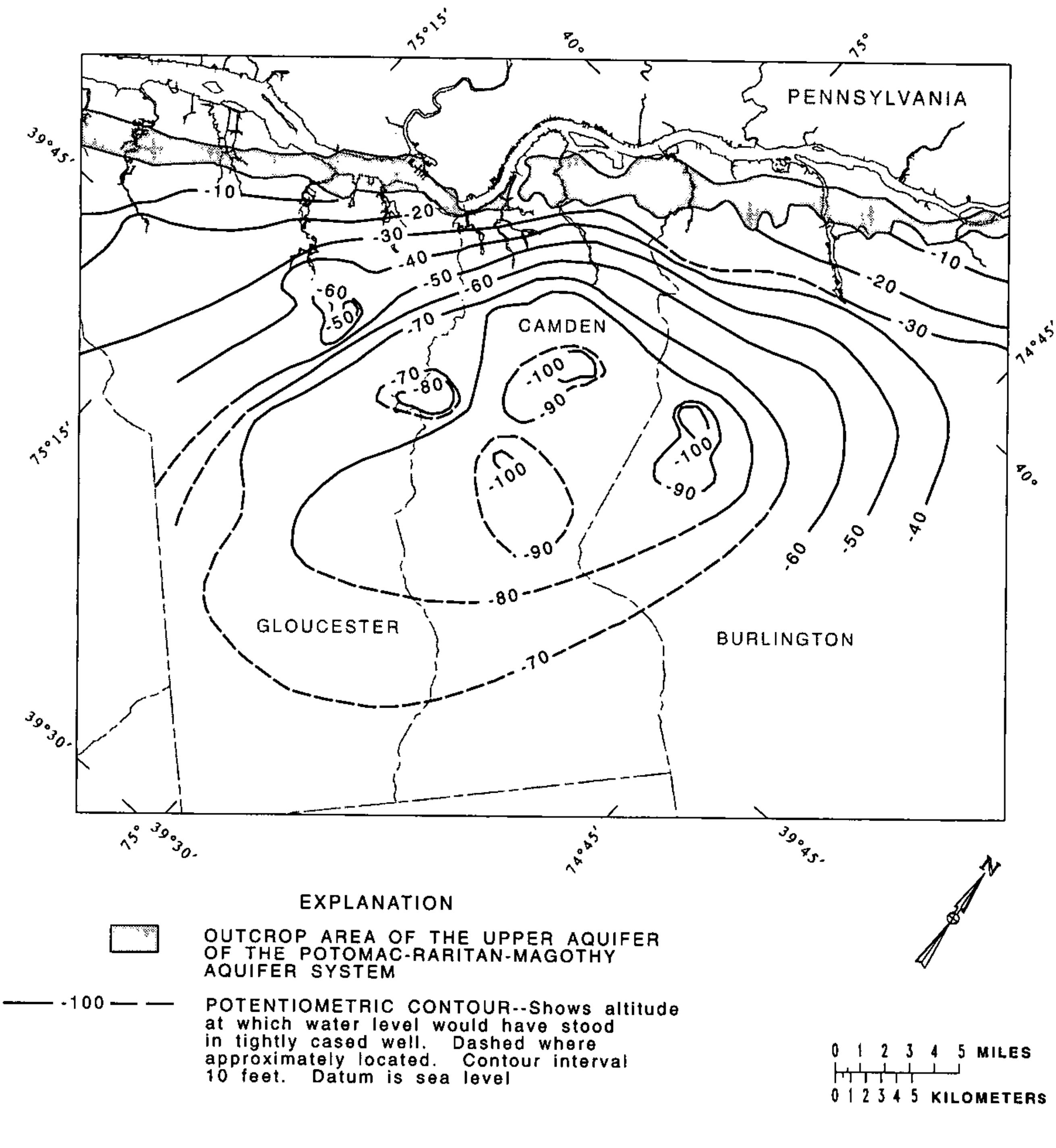


Figure 17. Potentiometric surface of the upper aquifer of the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey, fall 1988 (modified from Rosman and Storck, 1995).

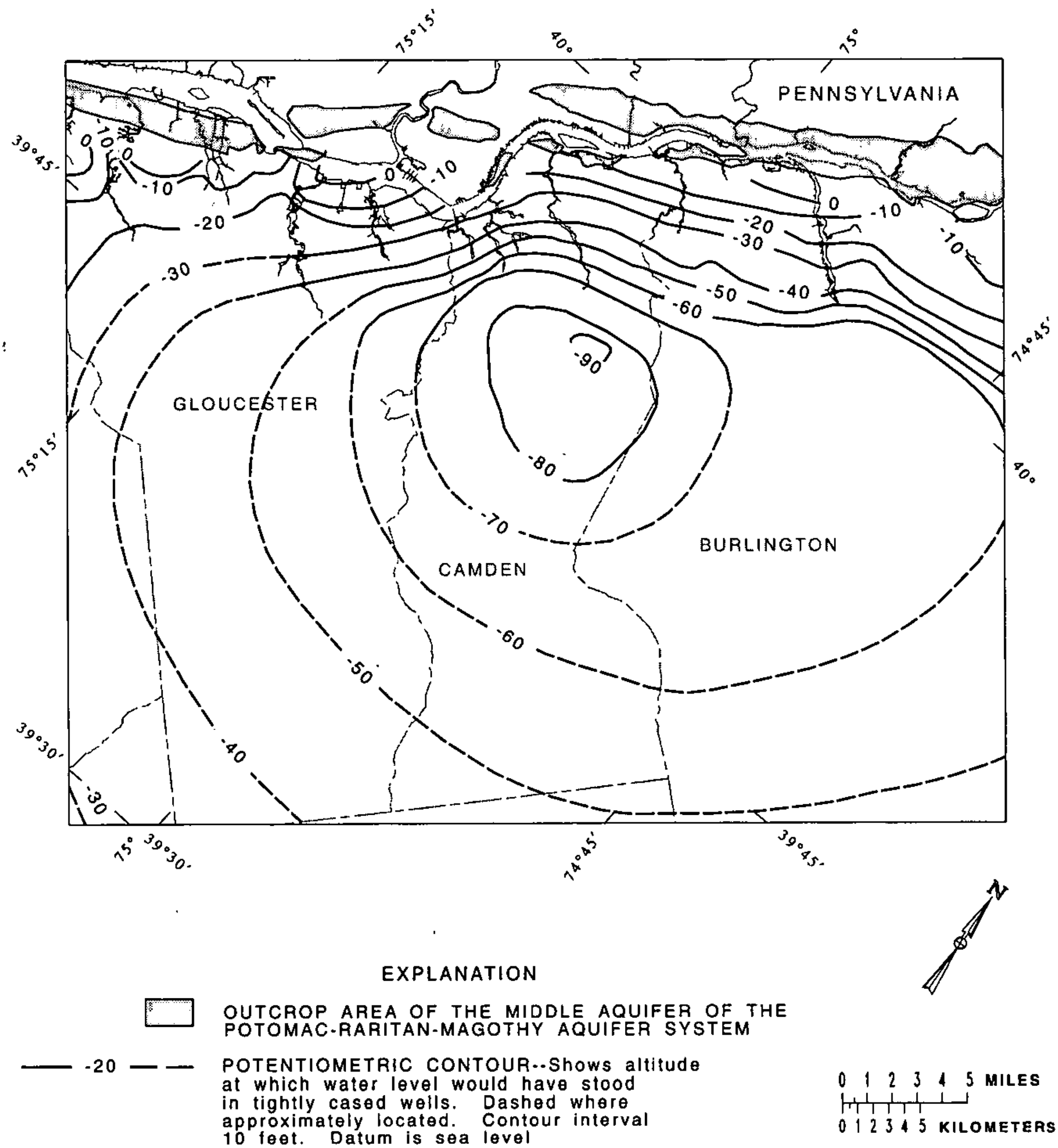


Figure 18. Potentiometric surface of the middle aquifer of the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey, fall 1988 (modified from Rosman and Storck, 1995).

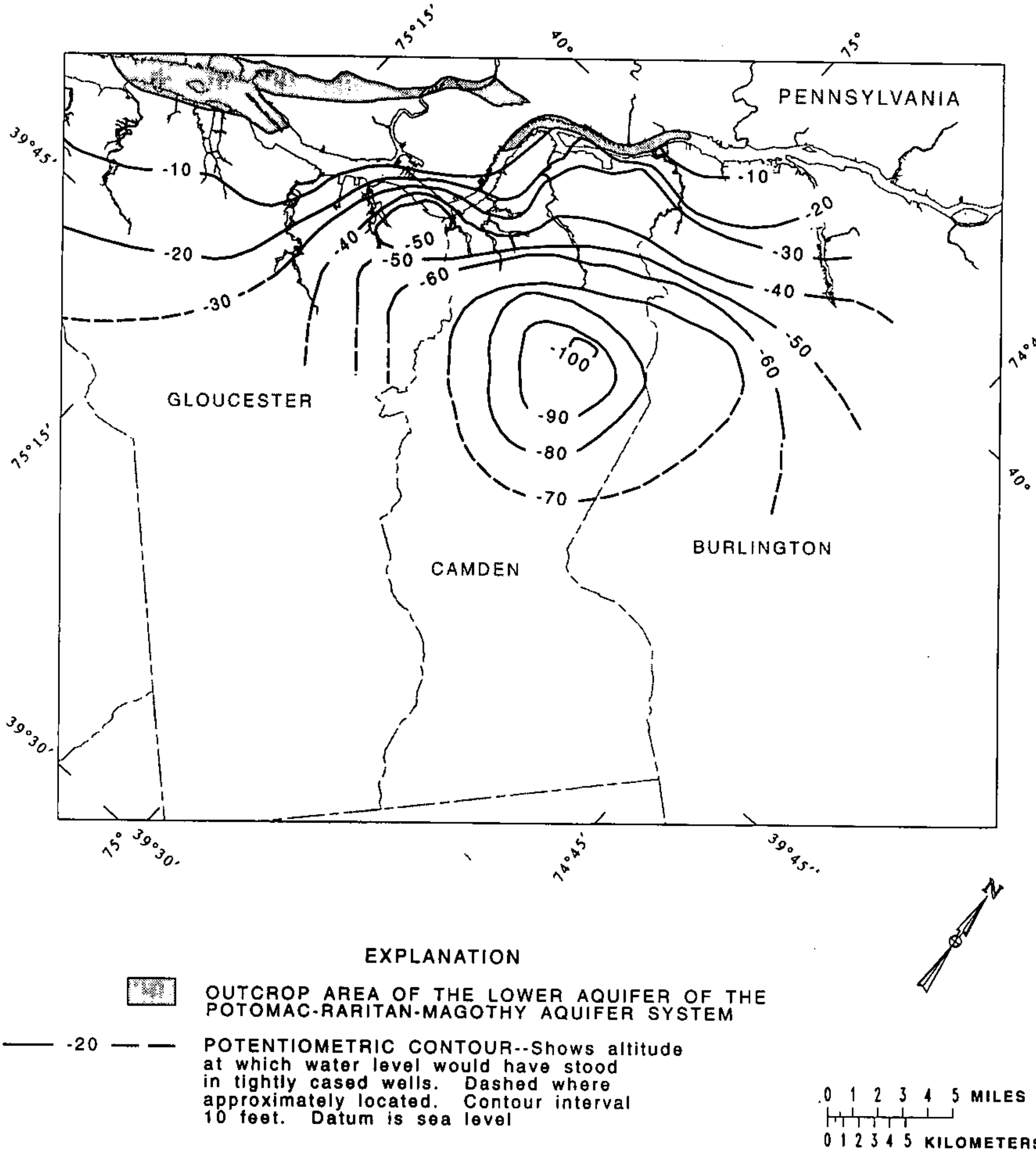


Figure 19. Potentiometric surface of the lower aquifer of the Potomac-Raritan-Magothy aquifer system, Camden area, New Jersey, fall 1988 (modified from Rosman and Storck, 1995).

The approximate downdip limit of freshwater (less than 250 mg/L dissolved chloride) in the lower aquifer is shown in figure 20 (Gill and Farlekas, 1976). The saline water probably is found farthest updip in the lower aquifer and farther downdip (and therefore deeper) in each successive aquifer overlying the lower aquifer. This configuration is supported by Meisler (1980). Generally, as the depth to the top of the aquifer system increases as one proceeds in a downdip direction, the cost of installing a well also increases. The number of wells completed in the aquifer system decreases significantly in favor of production from overlying units, such as the Wenonah-Mount Laurel and Cohansey aquifers in the areas that require increased well depth and that are near saline water. Thus, water-quality data are sparse and the location and concentration gradient of the interface between freshwater and downdip saline water must be inferred. Therefore, the updip limit of freshwater shown in figure 20 is only an approximation of the position of the interface in the lower aquifer. The interface position in the upper and middle aquifers probably is present farther to the southeast.

The presence of dissolved iron and contaminants related to human activities in the water of the aquifer system along its outcrop and, to some extent, in the confined parts of the aquifer system near the outcrop areas, has significantly affected the potability of the water supply in many parts of the Camden area. These topics are discussed in more detail in Ervin and others (1994) and Langmuir (1969).

Ground-Water Flow

Ground water enters the Potomac-Raritan-Magothy aquifer system in its recharge area, flows toward parts of the aquifer with lower head potential, and eventually discharges to the surface, such as through discharge to the Delaware River or flow to a well. The flow-system components must be understood and quantified in order to predict the effects of external and internal stresses on them.

Predevelopment Flow System

The ground-water flow regime of the aquifer system in the study area is affected by the properties of the aquifers and confining units, and by stresses located outside the Camden area. Because the aquifer system in the Camden area is an integral part of the Coastal Plain, the local flow system must be evaluated within the context of the larger scale system. The direction of flow and locations of recharge and discharge areas in southern New Jersey before development can be inferred from the potentiometric-surface map of the aquifer system prior to 1900 (fig. 11). These features are indicated in figure 20. Recharge entered the regional flow system through the aquifer-system outcrop at relatively higher elevations in Mercer and Middlesex Counties. Ground water in the Camden area traveled along an arcuate path to discharge into the Delaware River and adjacent low-lying tributary reaches that stand at or near sea level in the aquifer-system outcrop. This resulted in a U-shaped (in map view) flow system with recharge and discharge occurring on the same linear outcrop area. In the upgradient areas, nearer to the recharge area, ground water generally flowed downward from the shallower units toward the deeper units. In the downgradient areas, nearer to the discharge area, ground water generally flowed upward from the deeper units toward the shallower units and subsequently discharged to low-lying surface-water bodies. Flow across the Merchantville-Woodbury confining unit was impeded by low vertical hydraulic conductivity. Flow to and from the crystalline bedrock was insignificant.

Flow paths between the recharge and discharge areas were essentially concentric. The flow rate decreased in the downdip direction as path length increased. Ervin and others (1994) and Gill and Farlekas (1976) observed a transition from fresh to saline water in the downdip part of the aquifer system, parallel to the flow lines. The saline water was characterized by dissolved-chemical concentrations indicative of ion-

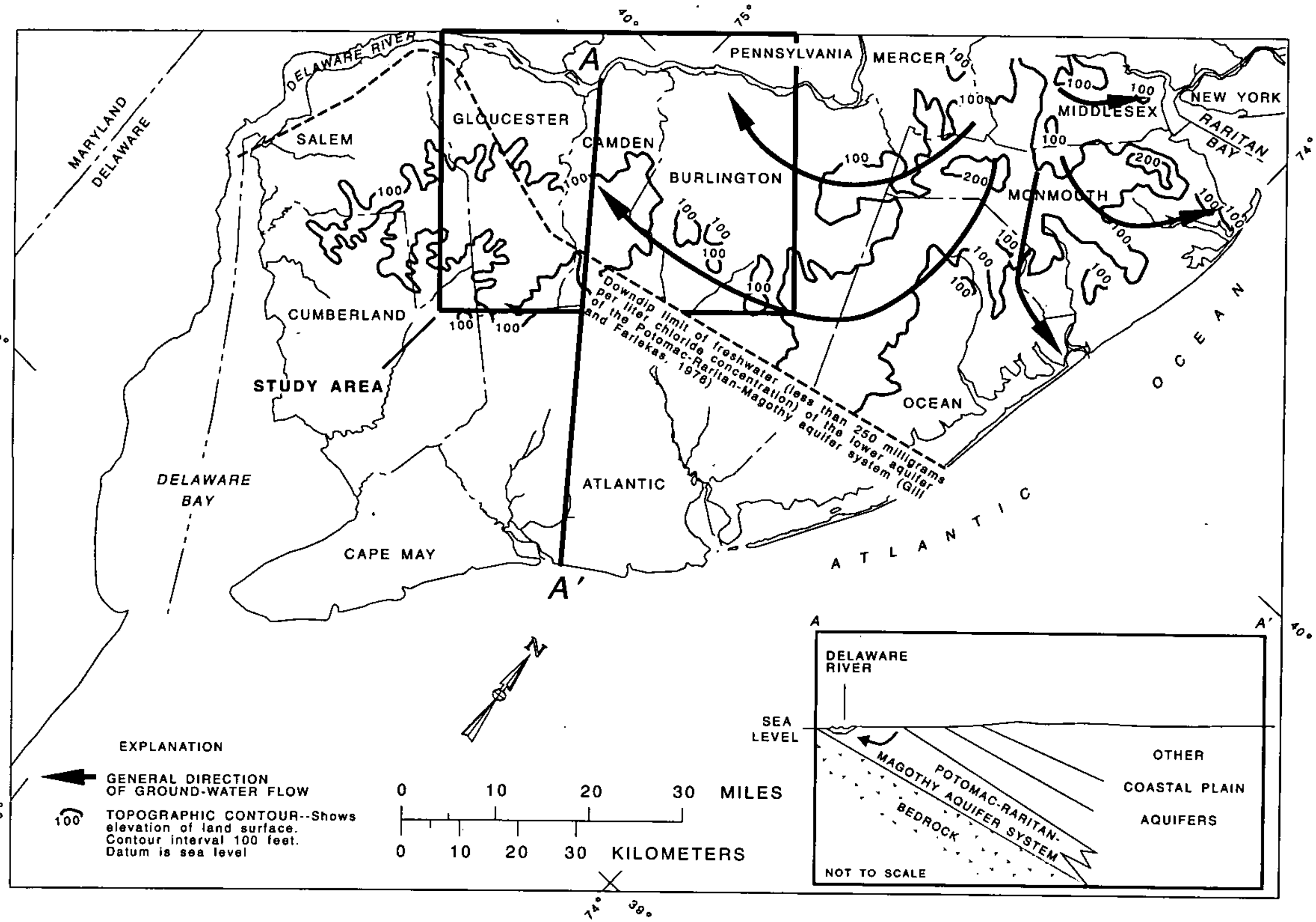


Figure 20. Generalized pattern of prepumping ground-water flow in the Potomac-Raritan-Magothy aquifer system and approximate location of the downdip limit of freshwater in southern New Jersey (modified from Martin, 1990, fig. 21).

exchange processes. This transition marked the effective limit of fresh ground-water flow in the aquifer system. Ground-water flow seaward of the transition was effectively stagnant. The elevated chloride concentration resulted from past mixing with sea water and from ion-exchange reactions with geologic material.

Stressed Flow System

Over the past ninety years, the development of ground-water supplies from the aquifer system in the Camden area has resulted in declining water levels caused by the stress of pumping. Declines of as much as 120 ft have been observed. This has affected the ground-water flow regime by reversing the hydraulic gradients in the area, but many of the features of the predevelopment flow system, discussed above, are still evident. The withdrawals in the Camden area have lowered the aquifer system's potentiometric surface to below sea level, inducing recharge from the Delaware River and its tributaries into the aquifer system. Thus, many places along the Delaware River are no longer discharge areas, but have become recharge areas. Figure 21 shows generalized ground-water flow paths under stressed conditions: the long-distance, arcuate, and long-travel-time path from Mercer and Middlesex Counties; the intermediate-distance paths from downdip areas; and the short-distance, short-travel-time path from the Delaware River.

Concurrent development of the aquifer system across the Delaware River in Philadelphia also induced recharge from the Delaware River to satisfy Philadelphia's withdrawals. As contamination with iron and manganese, probably occurring naturally, and other constituents related to human activities became intolerable, the major ground-water users gradually switched to municipal surface-water supply. By the mid-1960's, withdrawals on the Pennsylvania side of the river had been curtailed substantially and water levels recovered, facilitating the flow of water under the Delaware River from Philadelphia into the Camden area. Results of analyses of ground-water samples have provided evidence of this under-river flow (Greenman and others, 1961; Ervin and others, 1994), indicating that the Pennsylvania side of the Delaware River probably also has become a recharge area for the aquifer system in the Camden area.

The hydrographs of water levels in wells 05-258 in the upper aquifer, 05-261 in the middle aquifer, and 05-262 in the lower aquifer (Medford wells #1, #5, and #4, respectively; fig. 14) and wells 07-413 in the middle aquifer and 07-412 in the lower aquifer (Elm Tree wells #3 and #2, respectively; fig. 15) show continuing, unabated declines. These observation wells are not located near local recharge areas, such as the river or the aquifer-system outcrop. Although the rate of withdrawals has stabilized, the water-level declines continue. This behavior may indicate that the ground-water flow system in the downdip parts of the study area is not under equilibrium conditions.

Water levels in well 07-108 in the lower aquifer (Camden DIV 10 well, fig. 13) and wells 15-297 in the upper aquifer and 15-296 in the lower aquifer (Shell observation wells #6 and #5, respectively; fig. 16) declined but subsequently stabilized or recovered. Because areas near the river can receive induced recharge from it, water levels tend to be stable. Although withdrawals are largest near the Delaware River, the reduced magnitude of drawdown and apparent stability of water levels indicate that the hydraulic connection of the river and outcrop with the aquifer system is highly effective. Furthermore, the locations of the deepest cones of depression observed in the aquifer system are not near the river and do not coincide with the locations of the largest withdrawals.

Because the study area is urbanized, the characteristics of the unconfined part of the aquifer system are difficult to investigate and remain largely unknown. Most public water-supply wells in the area are screened in the confined part of the aquifer system to maximize protection from surficial contamination. Because water-supply wells are a primary source of hydrologic data, information about the water table is scarce. Available data (for example, Barton and Krebs (1990)), indicate that vertical flows are significant

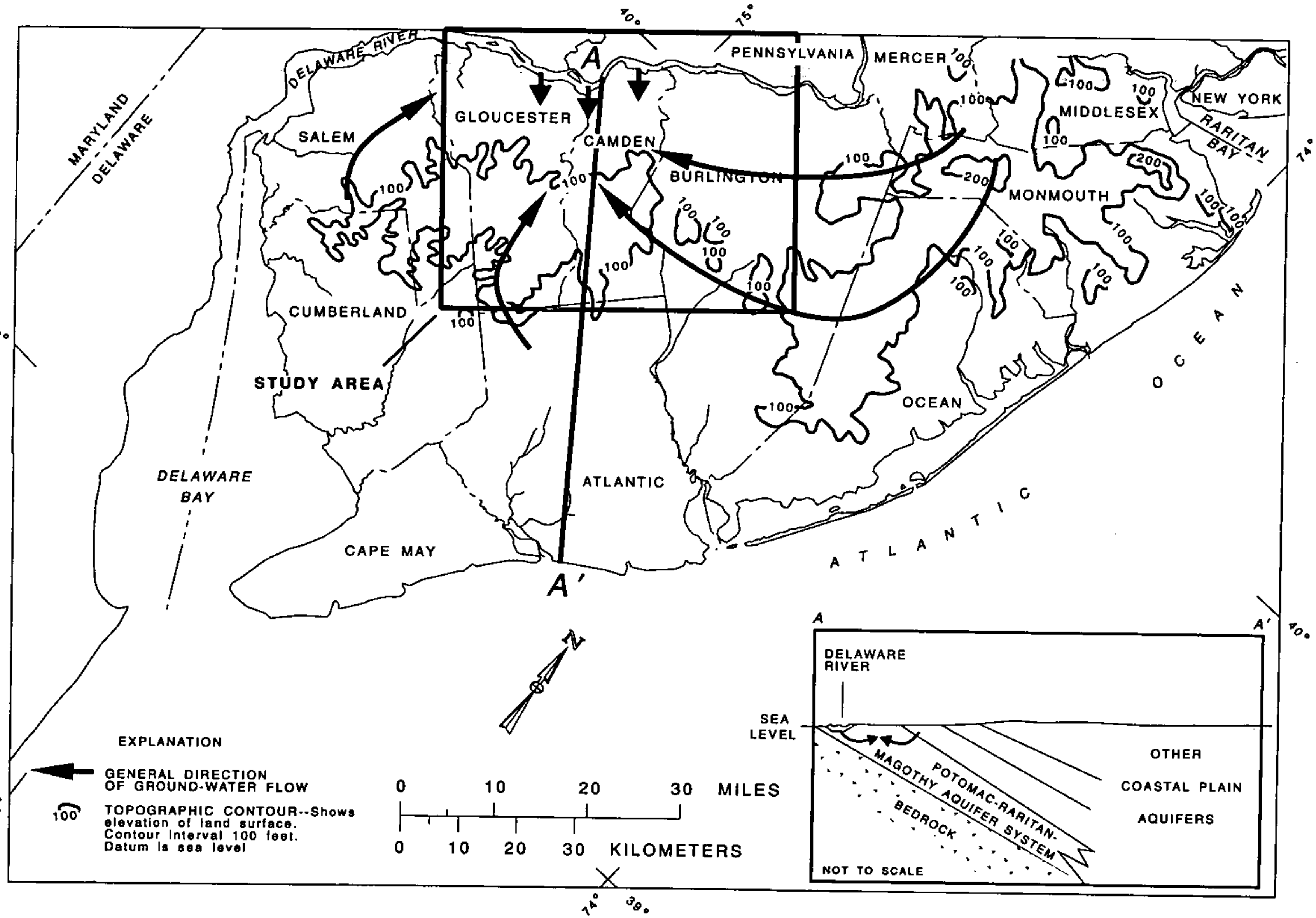


Figure 21. Generalized pattern of ground-water flow under stressed conditions in the Potomac-Raritan-Magothy aquifer system in southern New Jersey.

as a result of withdrawals from the underlying, confined parts of the aquifer system, that induce downward flow from the unconfined part of the aquifer system into the confined part. This vertical flow is indicated by the presence of depressions in the water table that extend below sea level. In Pennsauken, the municipality with the largest withdrawals, the water table is drawn down by leakage to the confined part of the aquifer system to below sea level within a mile of the Delaware River (Barton and Krebs, 1990).

Delaware River/Aquifer-System Interaction

The interaction between the Delaware River and the aquifer system is the most significant feature of the ground-water flow system in the Camden area. This interaction depends on two major factors: (1) the physical orientation of the geologic material beneath the river and (2) the hydraulic conditions controlling flow. The aquifer system and related confining units are laterally extensive and lie under or are adjacent to the river. The riverbed material, which is superimposed over these regional units, is composed of river deposits or reworked formation material, all modified by dredging operations. The riverbed material does not have a hydraulically significant contact with laterally adjacent regional geologic units, but it does have a significant vertical connection to the river. Given the aquifer system's physical contact with the river, the rate and magnitude of flow are controlled by the relative hydraulic potential across the connection and by the aquifer-system and riverbed hydraulic conductivities.

Aquifer geometry near river

Within the Camden area, the aquifer system extends from the New Jersey Coastal Plain across the Delaware River into southeastern Pennsylvania. Where the course of the Delaware River crosses troughs in the bedrock surface, a significant thickness of aquifer-system and hydraulically associated Cenozoic deposits fills these troughs and provides an avenue for the exchange of water with the river and with the flow system on the Pennsylvania side. Where bedrock highs exist under the riverbed, under-river flow is impeded and interaction between the river and the aquifers on the New Jersey side is limited to lateral infiltration along the banks rather than across the entire river perimeter. Therefore, the hydrogeologic framework of the deposits within these troughs controls the interaction between river and aquifer system, and under-river flow.

Figure 22 shows the outcrops of the upper, middle, and lower aquifers in the vicinity of the river. Where an aquifer crops out beneath the river, direct river-aquifer interaction may occur. Plate 1 shows hydrostratigraphic sections across the river at selected locations, which are indicated on figure 22. Plate 2 shows the hydrostratigraphic section along the course of the Delaware River, also indicated on figure 22, from the perspective of looking toward New Jersey from Pennsylvania. The approximate position of the river bottom is indicated so that the units in contact with the sides or river bottom can be differentiated. The map of aquifer outcrops and the hydrostratigraphic sections were constructed from the well logs compiled in table 6 (at end of report) and results of a surface-geophysical survey conducted by using marine-seismic and electromagnetic-conductance (EM) methods. A part of the survey conducted along the course of the river is documented in Duran (1986); the methods used for the survey are described in Duran (1987). The original data are stored at the USGS, New Jersey District, office. The resolution of this investigation obscures the local-scale variability, therefore, the delineated regional aquifer contact may not be exactly consistent with a sand-clay boundary in a particular log. In the preparation of plates 1 and 2, the "average" position of the contact, with respect to the regional geologic trend of the unit, was determined when nearby well logs contained contradictory information.

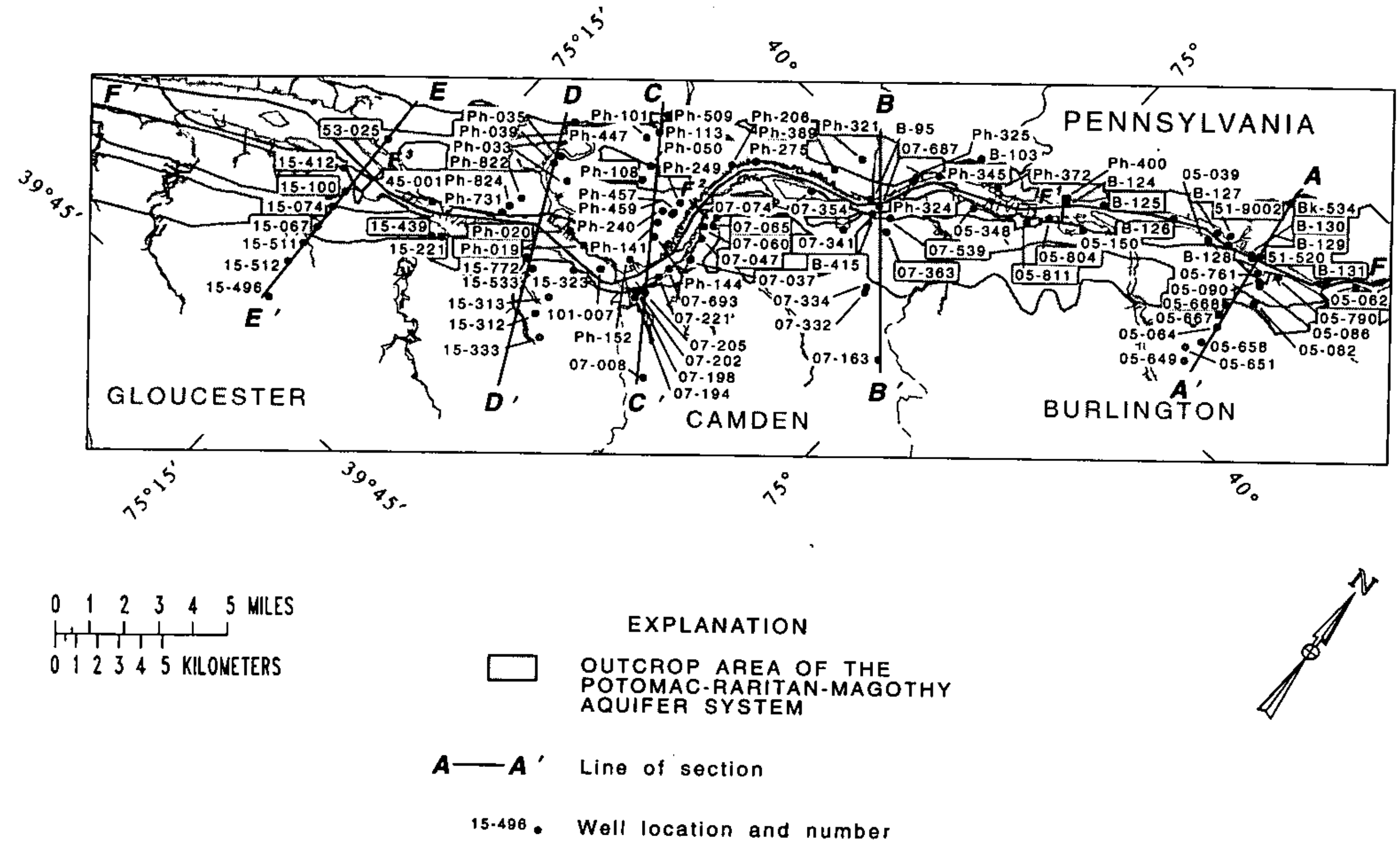


Figure 22. Locations of hydrostratigraphic sections, reference wells, and outcrops of the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system in the vicinity of the Delaware River, Camden area, New Jersey.

Riverbed materials and permeability

The riverbed materials are evident in the results of the shallow-focus EM survey. Figure 23 shows the distribution of shallow riverbed material classified as sand, silt, or clay on the basis of the survey results. In some areas of the riverbed, the particle size of the materials seems to be directly related to that of the underlying regional geologic material; for example, the riverbed materials are sandy where an aquifer underlies the river. In other areas, they seem to bear no relation to underlying regional geologic units. Near-bank material generally appears to be less permeable than material in central-channel areas, perhaps as a result of the former presence of wetlands.

Nature of the interaction

In the upstream part of the study area, in Burlington County, the river's primary contact is with the middle aquifer, although tributaries to the Delaware River cross the outcrop of the upper aquifer. Along the course of the river in Camden County, the river's primary contact is with the lower aquifer; however, tributaries cross the middle and upper aquifers. In Gloucester County, the river is connected with the upper and lower aquifers; the only contact with the middle aquifer occurs along the tributaries.

The contact between the aquifer system and the tributaries of the Delaware River, such as Rancocas River, Cooper River, and Big Timber Creek, could play an important role in river-aquifer interaction. The tributaries can be a source of induced recharge. Because the parts of the tributaries that are in contact with the aquifer system in the study area are tidally affected, they are subject to the same problems, such as saltwater encroachment, as the main channel of the Delaware River. The tributaries generally have not been dredged, so the riverbed may contain more organic matter than the Delaware River and, therefore, the permeability of the riverbed may be lower.

The elevation of the Delaware River within the study area averages 0.5 ft above sea level. The river is tidal throughout the study area and upstream to Trenton, N.J. The tidal range is about 5.5 ft. Before the aquifer system was developed as a significant water-supply source aquifer heads were above sea level. Because the river level was at about sea level, ground water discharged to the Delaware River and the low-lying parts of its tributaries. When the aquifer system was developed, heads declined to below sea level. By the 1980's, heads beneath the river were as much as 60 ft below sea level, as estimated from potentiometric levels on the banks and in adjacent land areas (figs. 17, 18, and 19). The water levels that were estimated to be considerably below sea level were verified by installing temporary well points into the aquifer system at a location in the middle of the river. Wells were installed at Horseshoe Shoal into the middle (101-008) and lower (101-007) aquifers. The heads were measured to be about 5 ft below sea level in the middle aquifer and about 27 ft below sea level in the lower aquifer. Because the accuracy of vertical elevation control for these measurements was not ideal, these measurements are approximate. The direct measurement did, however, verify the existence of a considerable head difference between the river and the aquifer system.

Luzier (1980, p. 66) determined that a significant part of the aquifer-system withdrawals in the Camden area is derived from induced recharge from the river. He estimated that 42 percent of the ground-water flow into the Camden area due to withdrawals in the early 1970's came from the river. This conclusion had been reached qualitatively by most earlier workers, such as Barksdale and others (1958) and Thompson (1932). The locations of the highest intensity withdrawals do not coincide with the deepest points of the regional cone of depression in any of the three aquifers. The regional cones are centered in the vicinity of Cherry Hill, N.J., about 8 miles east of the river, but the largest withdrawals are in Pennsauken, N.J., and elsewhere in close proximity to the river. At these locations, recharge is induced from the river or from the outcrop area to satisfy the intense, adjacent withdrawals. The withdrawals farther from the river, such as

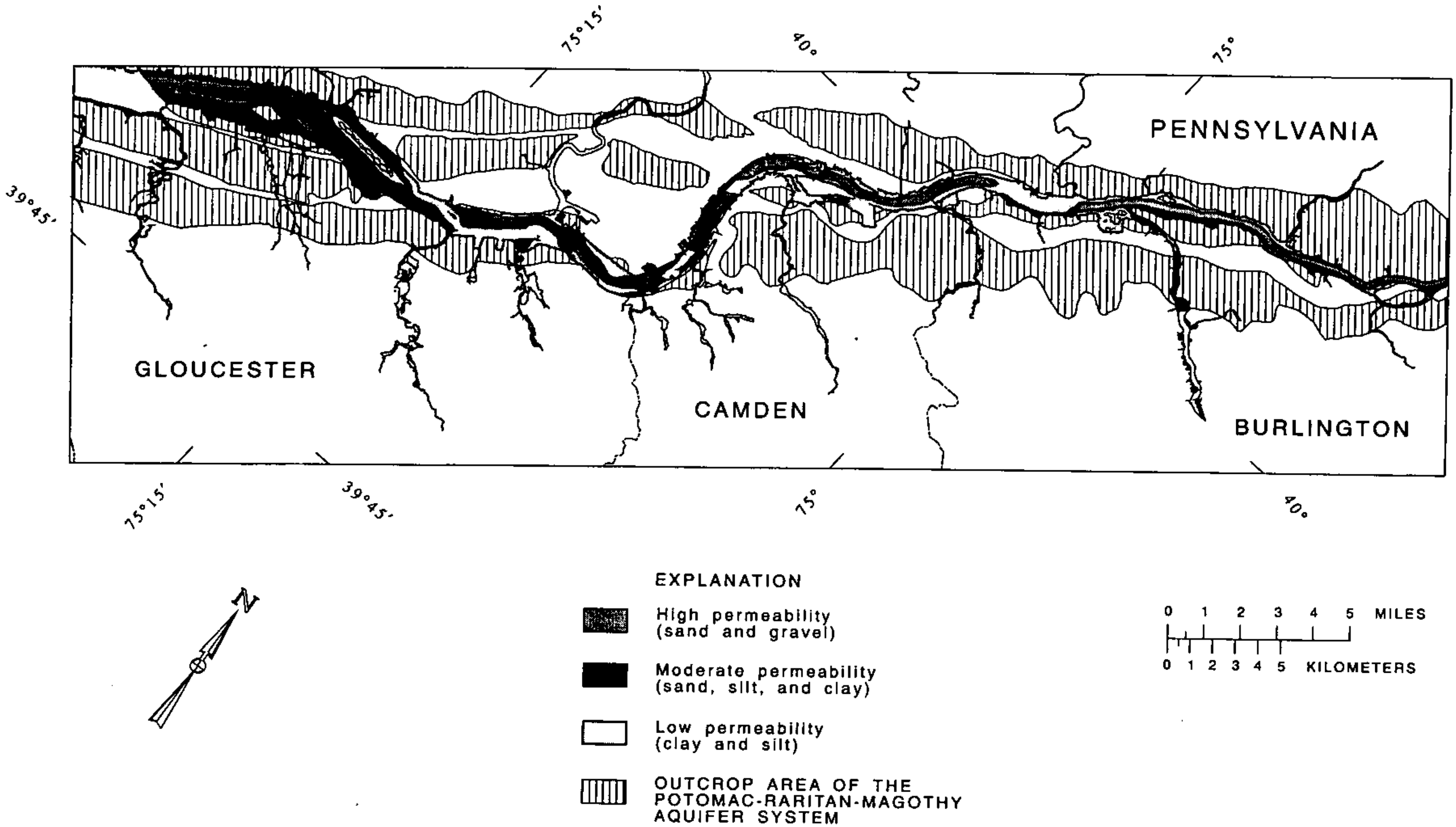


Figure 23. Relative permeability of shallow Delaware River bed material, Camden area, New Jersey.

near Cherry Hill, are cut off from the induced-recharge sources that are directly available to the aquifer system by the river-proximal withdrawals, causing the deepest regional cones of depression to form as water flows through confining units from overlying aquifers or flows laterally from distant recharge locations to satisfy the withdrawals.

Duran (1986) shows that downstream from the study area the riverbed is composed primarily of clayey material. This indicates that the river-to-aquifer flow is impeded farther downstream and is less significant than it is in the study area.

Water-Supply Issues

The sustainability of water supply from the aquifer system in the Camden area is threatened by several existing or potential regional-scale problems. Ground-water levels in some areas continue to decline as a result of pumping. Contaminants, namely organic compounds and metals, have entered the aquifer system from environmentally hazardous sites and land-use areas on the aquifer system's outcrop (recharge) area. Contamination of the aquifer system by saltwater intruding from the Delaware River during drought conditions is a potential problem, as is contamination of parts of the aquifer system from intrusion of saline water from areas farther downdip. Each of these threats is a manifestation of withdrawals.

Cones of Depression

Concern about the presence of deep cones of depression in the potentiometric surfaces of the aquifer system is focused on two aspects: the depth of the depressions and the rate of water-level decline. The lowered water levels result in higher energy costs to pump water. An ultimate concern of water managers in the area is the possibility that withdrawals could become so intense as to dewater significant parts of the aquifer system.

Dependence on the aquifer system as a source of water supply in the Camden area increased with the population. A decline in water levels in the aquifer system caused by water-supply withdrawals began at the turn of the century, when ground water was first used for public supply, and continued into the 1980's, when regional population and industrial growth slowed significantly. Consequently, the rate of increase of water-supply withdrawals also slowed substantially, but, in some areas, as indicated earlier in this report, water levels have continued to decline at a consistent rate, which may indicate a lag time for the stabilization of water levels that could be an important consideration with regard to future management decisions.

Recharge Containing Surficial Contaminants

A substantial amount of water enters the aquifer system as recharge because water-supply withdrawals in the Camden area are significant. The source of this water is precipitation that passes through an urban area in which industrial and commercial activities are common. Runoff from urban areas typically contains a variety of contaminants that can adversely affect the potability of the water supply.Because mitigation of contamination is difficult, the presence of these compounds in water from the aquifer system could lead to the need for treatment prior to use.

Intrusion of Downdip Saline Water

Saline water occurs naturally in the downdip parts of the aquifer system in the southern part of the study area and may move toward water-supply withdrawal locations in response to the low and declining water levels. A potentiometric gradient has been established (figs. 17-19) that could allow ground water to flow from this area toward the water-supply wells. In addition to this lateral flow, saline water potentially could flow vertically through a confining unit (referred to as upconing). Both modes of saline-water intrusion could occur in combination along a particular flow path.

The distinction between modes of intrusion is not solely for the sake of categorization, however. The ability to detect and abate contamination resulting from saline-water intrusion can differ substantially depending on the mode. A regional freshwater-saltwater interface moving laterally through an aquifer may advance slowly. If a warning network of monitor wells is in place, the movement is predictable, allowing for the timely development of abatement strategies. An upconing situation, however, may not allow for the same degree of warning. Saline water in an aquifer underlying a pumped aquifer flows vertically through the confining unit. Although the movement is slow, it is directed toward individual production wells. Therefore, when saline water reaches the pumped aquifer, the production wells are affected first, and monitor wells that are not virtually adjacent to the production wells may not be useful for the detection of the upconing saline water.

The location in the Camden area most likely to be affected by saline-water intrusion is Gloucester County, especially in the upper aquifer. The interface between saline water and freshwater in the upper aquifer is southeast of the production wells. Although the location of the interface is not well-established, it may be as much as several miles from the nearest water-supply wells. Borehole geophysical logs from the vicinity of the communities of Clayton, Pitman, and Glassboro in Gloucester County indicate that in some locations saline water may occur as little as several tens of ft beneath the pumped aquifer. Even though potable water is separated from nonpotable water by confining units, vertical movement can be expected. Therefore, the upconing mode of intrusion may be the most likely mechanism by which deep saline water can be expected to enter the aquifer, moving vertically over a short distance through low-permeability material rather than laterally over several miles through high-permeability material.

Vulnerability to Contamination From Delaware River

Two types of contaminants potentially can enter the aquifer system from the river: contaminants related to human activities, such as pesticides, industrial waste, and sewage; and contaminants related to saltwater from downstream in the Delaware Estuary. Since the 1970's, dumping of hazardous compounds into the river has been substantially controlled and curtailed. Because of the transient nature of dumping and the slow rates of ground-water flow and recharge, the vulnerability to contamination from these compounds is low. The potential for the encroachment of saltwater up the Delaware Estuary into a position where it would recharge the aquifer system, however, is more likely, and could result from a reduction in the freshwater flow of the river (drought), a rise in sea level, or both. The term "saltwater encroachment" is used herein to describe the movement of saltwater in the Delaware River. In order to minimize confusion, the term "saltwater intrusion" is used herein to describe the movement of saltwater in the ground-water system.

Drought-Related Saltwater Encroachment

Within the Delaware Estuary, the freshwater of the river mixes with sea water, forming a salinity transition zone. Cohen and McCarthy (1962, p. B14) report that the transition zone was in excess of 40 miles long during August of 1955. The length of the transition zone can be determined by measuring the distance between freshwater and water in which the concentration of dissolved chloride is 6,000 mg/L, a concentration about one-half that of dissolved chloride in sea water. Under normal conditions, the midpoint of the transition zone, with respect to dissolved-chloride concentration, is found near the Delaware Memorial Bridges, near Wilmington, Del. (Hull and others, 1986, p. 26). Freshwater and saltwater in this part of the estuary are generally well-mixed; therefore, the front exhibits consistent salinity with depth, rather than being a wedge-shaped front (C.H.J. Hull, Delaware River Basin Commission, oral commun., 1985). The 250-mg/L chloride-concentration line is commonly used to indicate the location of the interface between potable and nonpotable water. The use of the term "freshwater-saltwater interface" in this report indicates the interface between saltwater and freshwater where the concentration of chloride is 250 mg/L.

The freshwater-saltwater interface in the Delaware River moves daily in response to tides and seasonally in response to variations in rainfall. The fluctuation of the interface location in response to tides is about 6 miles. The normal interface position can be considered to be in the vicinity of the Delaware Memorial Bridges, shown in figure 24. During average summer low freshwater flow of the river, the interface moves to the Chester, Pa., area. During a severe drought, the interface could be expected to move farther upstream. The maximum observed upstream encroachment occurred in November 1964, when the interface moved into the Philadelphia and Camden area to a position at about the Benjamin Franklin Bridge, shown on figure 24.

When the freshwater-saltwater interface in the Delaware River reached the Camden area in November and December 1964 water-supply withdrawals were intense and may have drawn saltwater into the aquifer system. The specific conductance of water samples collected from the Delaware River, shown in figure 25, is evidence of the encroachment of saltwater in November and December 1964 in this area. Presumably, a slug of water having higher-than-normal chloride concentration recharged the aquifer. After that occurrence, higher-than-normal chloride values were observed in the aquifer system in the Camden area. Dissolved-chloride concentrations of water from selected water-supply wells near the Delaware River are shown in figure 26. The concentrations generally peaked in 1965 or later, probably indicating the passing of the slug of water that was recharged during the drought event. The highest concentration measured was approximately 80 mg/L, whereas the background chloride concentration of water in the aquifer system in that area is about 10 to 20 mg/L, shown as the concentrations prior to the peaks on figure 26. Because the sampling frequency was low, the peak concentration and timing cannot be clearly established. Ultimately, the data show that this drought-related intrusion event did not threaten potability, but it does prove that an encroachment event can adversely affect the water supply.

Saltwater Encroachment Related to Global Climate Change and Sea-Level Rise

The northeastern United States has experienced climatic variation, from continental glaciation to temperate climates, in recent geologic history. Earth's average temperature during the last ice age (18,000 years b.p.) averaged 5°C lower than today (Donn and others, 1962). The reasons for the climatic change in the geologic past could possibly relate to variations in the Earth's orbital eccentricity or to changes in the latitude of land masses resulting from plate tectonics.

Recently, climatic researchers have observed an increase in the atmospheric concentration of gases that are attributed to industrial and related activities (Smagorinsky, 1982). These products of industrialization, such as carbon dioxide, methane, and water vapor, are termed "greenhouse gases." Greenhouse gases are transparent to visible light, but are relatively opaque to heat radiation. The trapping of additional heat by the increasing concentration of greenhouse gases, causing a global warming trend, is considered feasible (Smagorinsky, 1982). A projected manifestation of a global warming trend is sea-level rise as a result of increased melting of mountain glaciers and polar ice caps, and the volumetric expansion of sea water due to the higher temperature.

Other climatic effects, such as increased cloud cover or decreased global reflectivity, could affect the magnitude and rate of global warming and related sea-level rise. Hoffman and others (1983) suggest that many such uncertainties are associated with predictions of warming and sea-level rise. They compiled

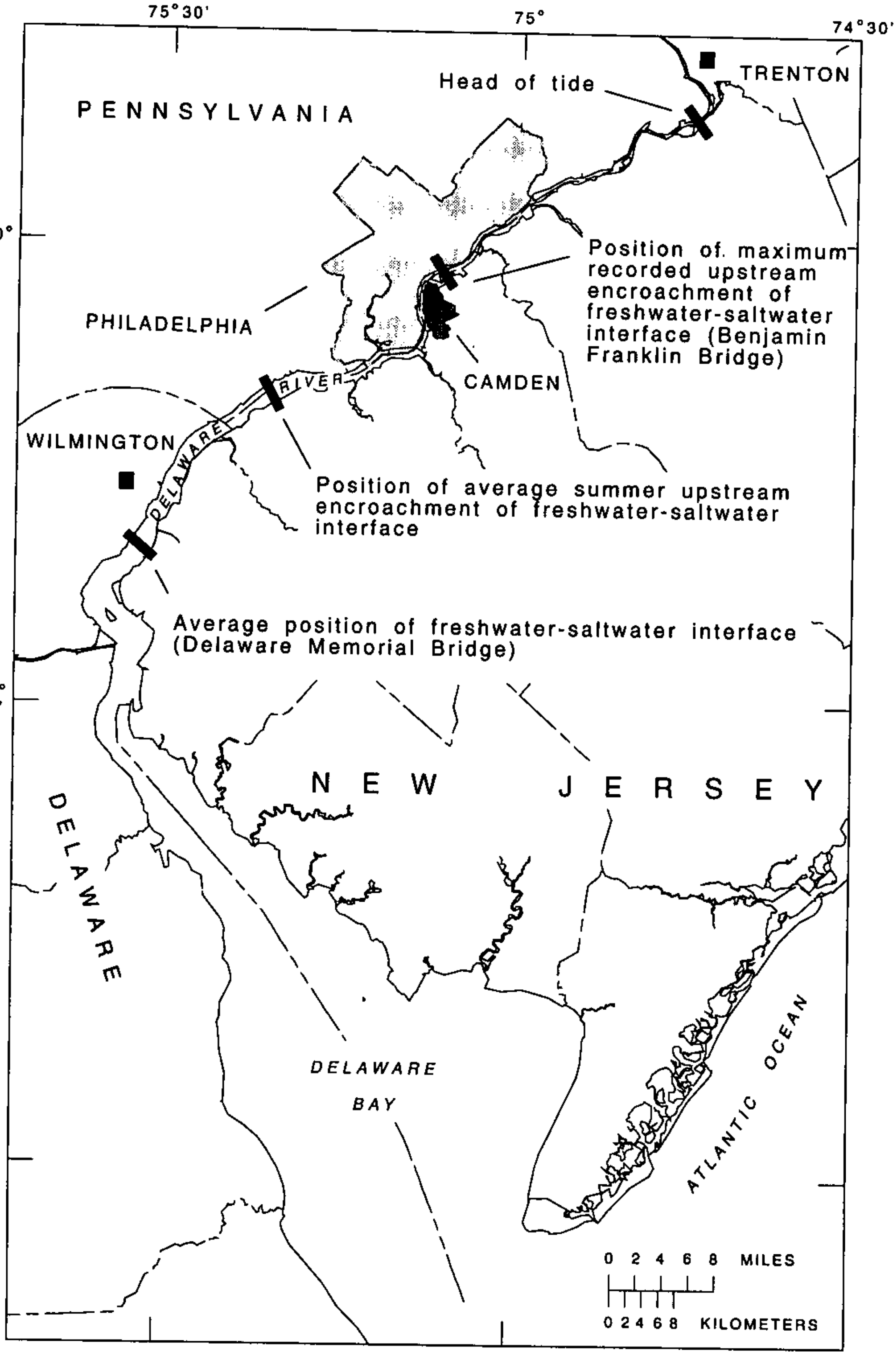


Figure 24. Location of various freshwater-saltwater-interface positions in the Delaware River and Estuary (Ayers and Leavesley, 1989, fig. 9).

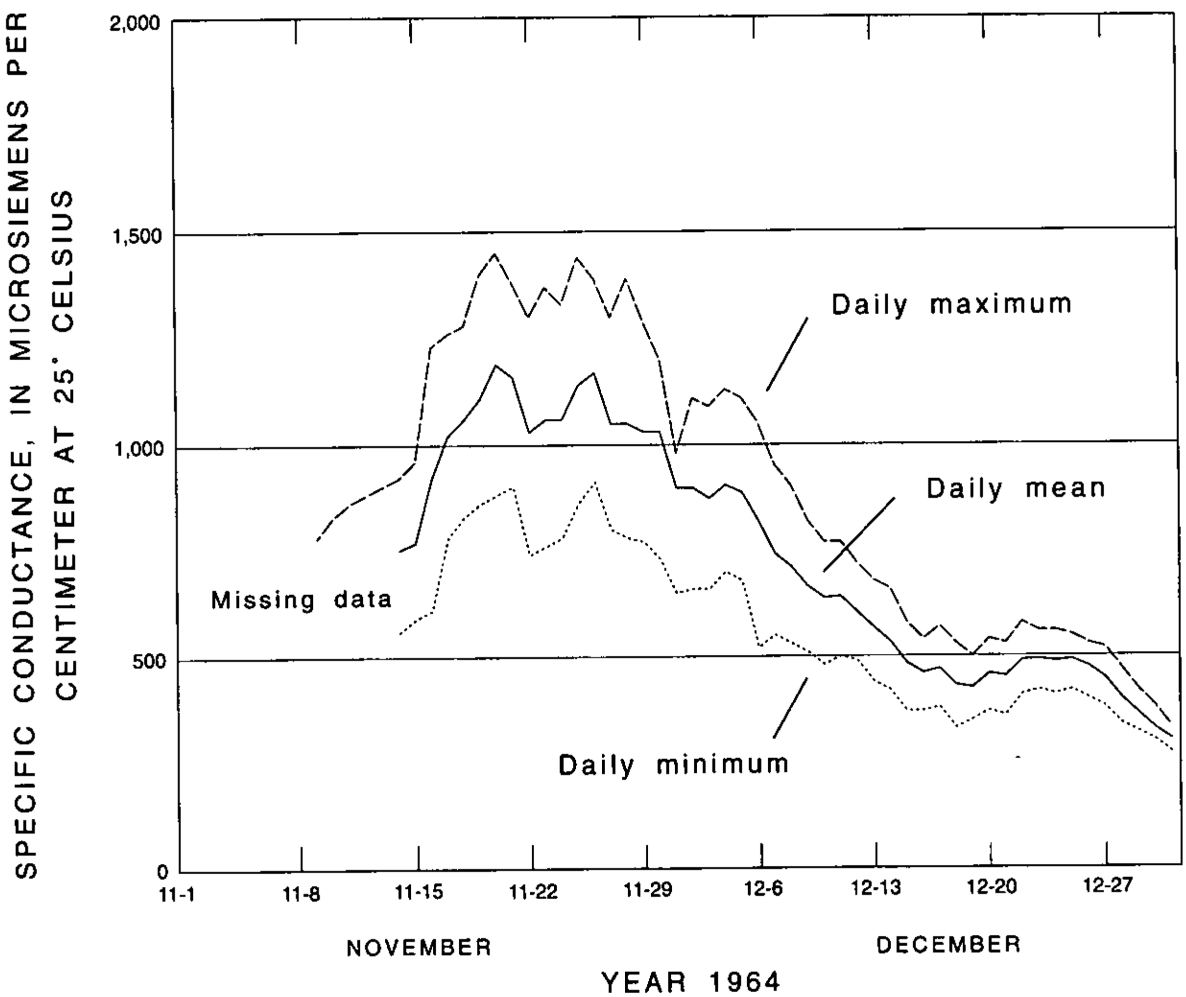


Figure 25. Specific conductance of water samples collected from the Delaware River at the Benjamin Franklin Bridge, Philadelphia, Pennsylvania, November and December, 1964.

published sea-level-rise estimates and categorized them as conservative or liberal, on the basis of the uncertainties in the effects of controlling factors. The compiled rises are 0.4 and 2.0 ft by the year 2025, for conservative and liberal estimates, respectively, and 1.25 and 7 ft by 2075, for conservative and liberal estimates, respectively.

These values were derived by considering the effects of a global temperature rise due to greenhouse gases, but other factors also can affect sea level, which has varied substantially over geologic time. Changes in the size and shape of ocean basins can affect sea level (Hays and Pitman, 1973), as can the weight and subsequent removal of continental glaciers. On a regional or local scale, many processes can affect relative sea level. About 1 ft of apparent sea-level rise has been measured at Philadelphia over the last century (Hicks and others, 1983) that pre-dates any of the greenhouse affects. This change in apparent mean sea level from 1923-80 is shown in figure 27. Any rise due to global warming would be superimposed on this continuing local rise.

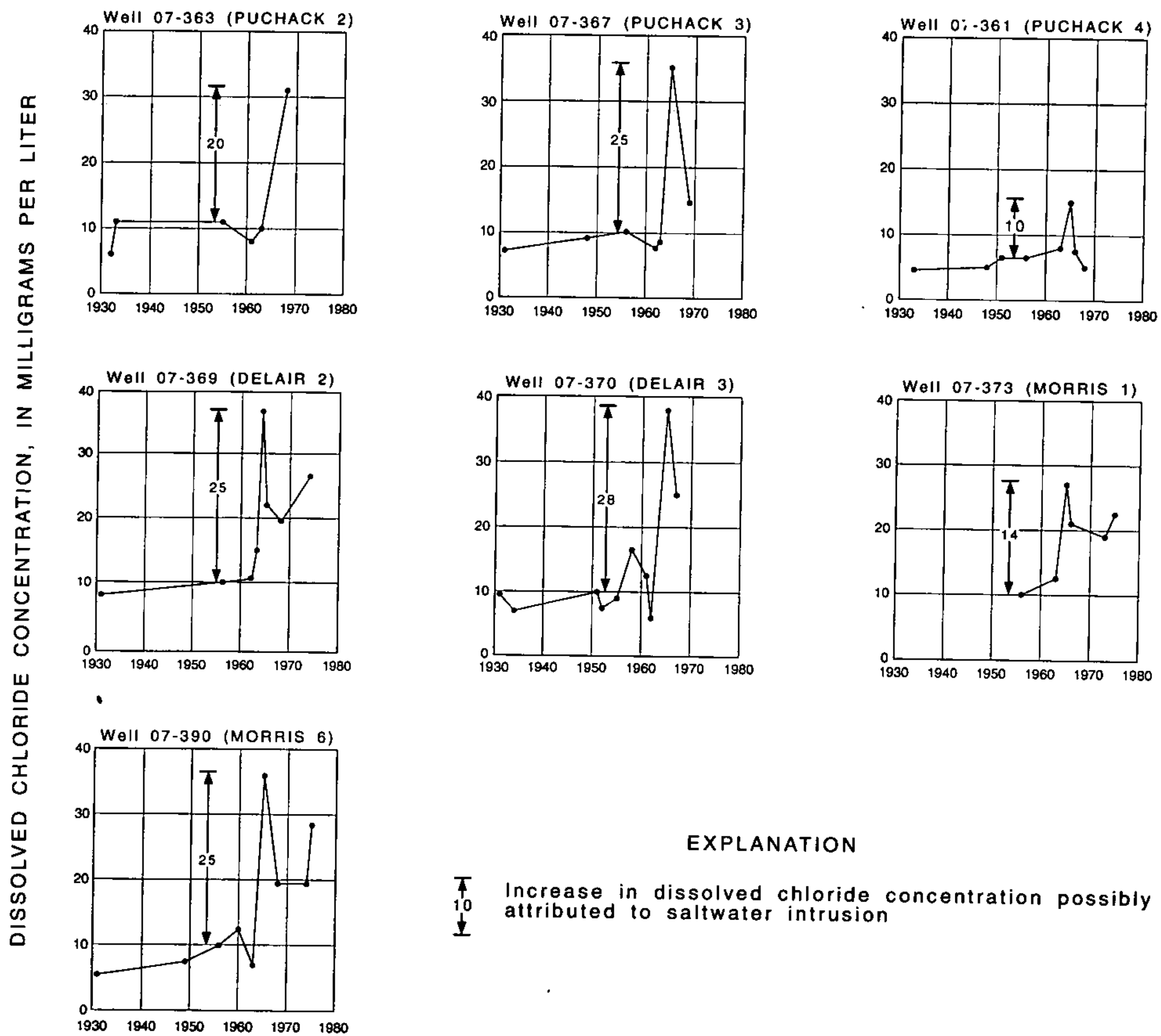


Figure 26. Dissolved chloride concentration of water from selected water-supply wells near the Delaware River in Camden, New Jersey (modified from Lennon and others, 1986, fig. 15).

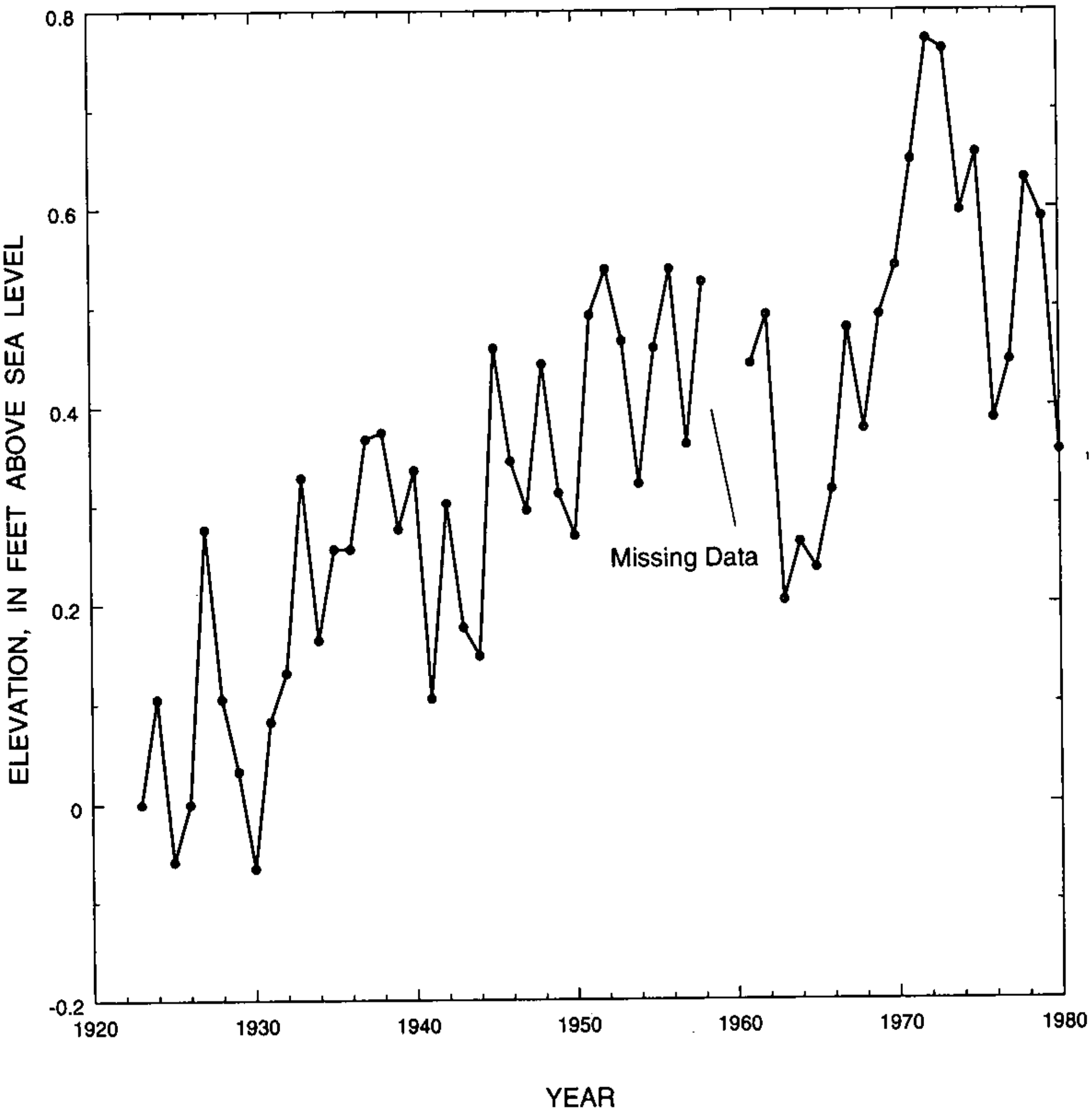


Figure 27. Apparent sea level at Philadelphia, Pennsylvania, 1923 to 1980 (Hull, Thatcher, and Tortoriello, 1986, fig. 7).

A change in sea level is only one side of the potential driving force on the position of the freshwater-saltwater interface in an estuary. Higher temperatures caused by a global climatic change could change the freshwater flow of the Delaware River. Any change that would reduce the discharge, such as a reduction in rainfall or increase in evapotranspiration (caused by a lengthening of the growing season), would enable the interface to move upstream. Two of three general-circulation-model (GCM) investigations reported by McCabe and Ayers (1989) predict decreases in total annual runoff of 7 to 39 percent from the Delaware River Basin as a result of increased atmospheric carbon dioxide, whereas results of the other investigation indicated a slight increase (2 to 9 percent) in total annual runoff. Because of the uncertainties involved in the GCM's and their coarse scale compared to the size of the Delaware River Basin, these findings are not conclusive.

The historical trend of sea-level rise is documented. Furthermore, the potential exists for an acceleration of the rise as a result of the global warming, although the actual rate may be arguable. Nevertheless, the likelihood of a future rise in sea level in the Delaware River and Estuary is high.

GROUND-WATER FLOW UNDER CURRENT AND FUTURE CONDITIONS

Simulation of Ground-Water Flow

Evaluation of the effects of ground-water withdrawal on the aquifer system in the Camden area requires a detailed understanding of the ground-water system, including the interaction between the Delaware River and the aquifer system, directions of ground-water flow, and ground-water flow budgets. A ground-water-flow model of the Potomac-Raritan-Magothy aquifer system with a quantitative predictive capability was developed to evaluate the potential effects of alternative future ground-water-withdrawal scenarios.

Construction of the flow model and simulation of withdrawal scenarios was accomplished in several stages. A conceptual model of the flow system was developed on the basis of the hydrogeologic data described earlier in this report. The objectives of this study require a quantitative, numerical model that can simulate ground-water flow in the aquifer system in the Camden area, the interaction with the Delaware River and its tributaries, and the hydrologic effects of the Coastal Plain deposits outside the immediate study area. The density of the simulated ground water was assumed to be invariant and characteristic of freshwater. The "Modular Model" computer program of McDonald and Harbaugh (1988) meets these requirements and was used to perform the simulations. The conceptual model of the flow system expresses, in general terms, the boundary and initial conditions, and hydrologic parameters that constitute the input data for the numerical model. The numerical model was then calibrated to assure that it adequately represents measured field data, with regard to the objectives of the investigation. The model's sensitivity to the variation of important input parameters was determined to judge the accuracy of final results. Finally, the various ground-water withdrawal scenarios were simulated.

Model Discretization

The model is a quasi-three-dimensional representation of the hydrogeologic units in the study area that consists of five layers. The layers represent aquifers, where ground-water flow is assumed to be horizontal. Ground-water flow through confining units is assumed to be vertical only and is simulated as one-dimensional flow between the aquifer layers. Heads in confining units are not explicitly determined. A schematic representation of model layers is shown in figure 28. Heads in layer 1 of the model are held constant; they provide vertical leakage to the overlying Coastal Plain deposits that are not directly modeled. Layer 2 represents the Englishtown aquifer system, which overlies the Potomac-Raritan-Magothy aquifer system. The Englishtown aquifer system, although not the main focus of this investigation, is incorporated in the model to act as a buffer for the stabilization of vertical flow with the Potomac-Raritan-Magothy aquifer system. Layers 3, 4, and 5 represent the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system, respectively.

Each modeled layer was discretized horizontally into the grid shown in figure 29, consisting of 99 rows and 106 columns. The grid is variably spaced and is oriented approximately parallel to the Fall Line and to the strike of the aquifer system (42° E.). The dimensions of the smallest grid cells are 880 ft by 1,650 ft (0.05 mi^2). The smallest cells are generally near the Delaware River. The dimensions of the largest cells are 2,200 ft by 3,300 ft (0.26 mi^2). The largest cells are generally located in the downdip, southeastern part of the study area where data are sparse.

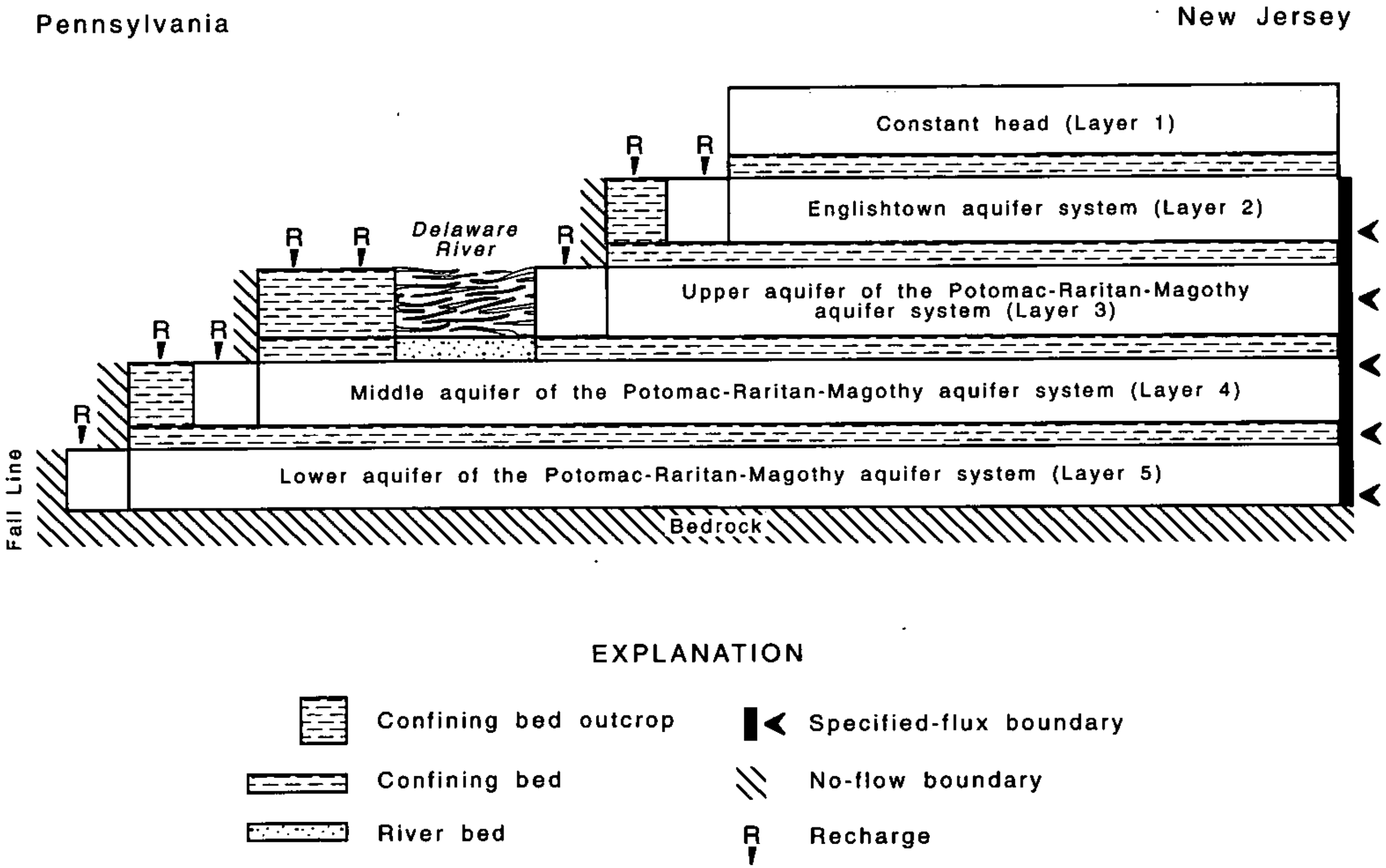


Figure 28. Schematic representation of aquifers, confining units, and boundary conditions used in the Camden area flow model.

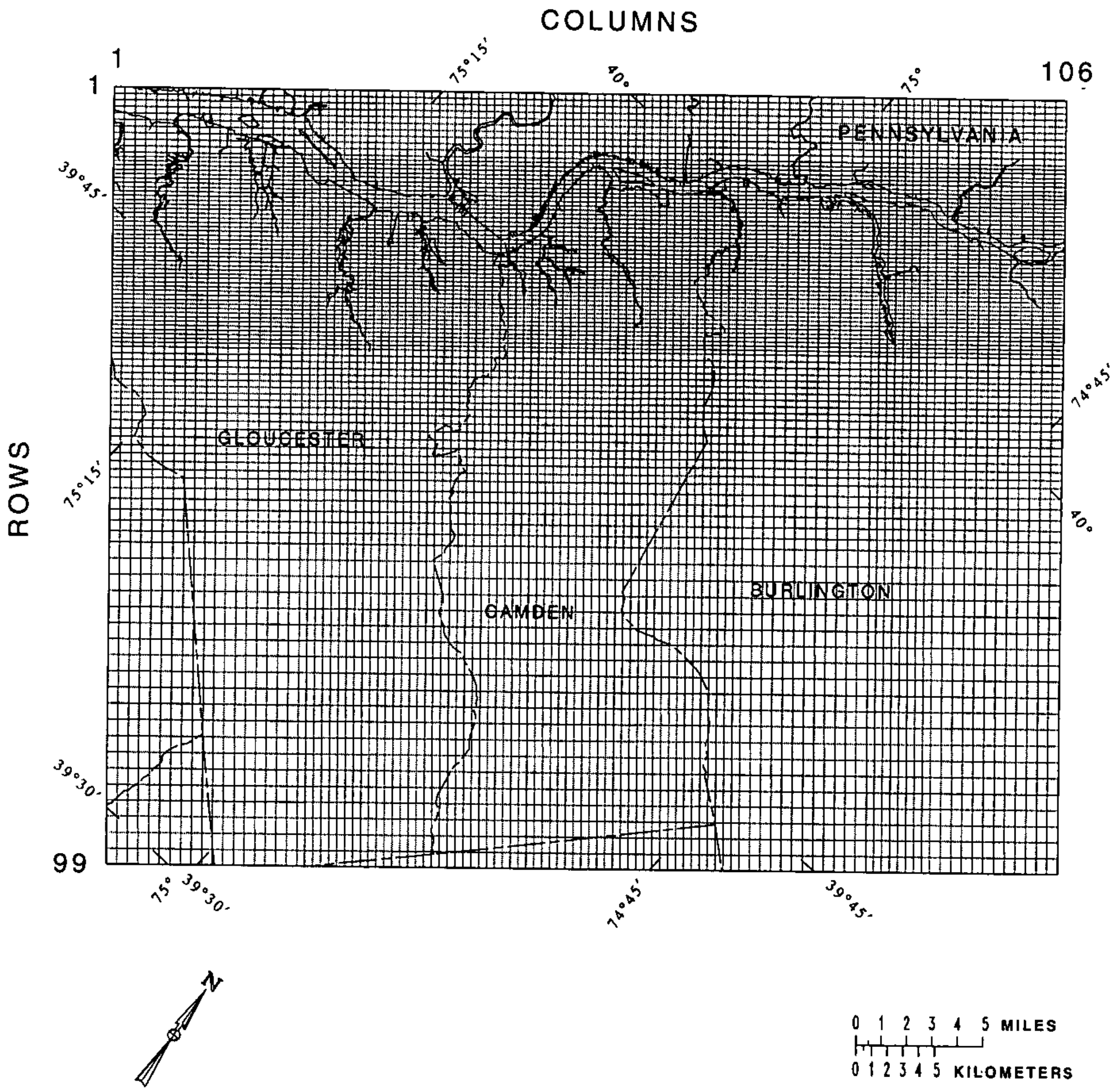


Figure 29. Finite-difference-model grid for the study area.

Boundary Conditions

The boundaries of ground-water flow models are assigned conditions that are intended to represent the sense and function of the realistic limits of the flow system. The vertical boundary beneath the lower aquifer, representing the contact with bedrock (bottom of the model) and the lateral boundary to the northwest, representing the pinchout of Coastal Plain deposits at the Fall Line, are simulated as no-flow boundaries. Ground-water flow between the Coastal Plain and bedrock units is assumed to be insignificant.

The lateral boundaries on the northeastern, southwestern, and southeastern edges of the model are simulated as specified-flow boundaries, which represent the connection between the modeled area and other parts of the Coastal Plain that are outside of the study area. The locations of these boundaries are not hydrologically significant, but they are sufficiently far from the main focus of the investigation that boundary effects are minimal. The values of the specified flows are derived from the New Jersey Coastal Plain RASA ground-water flow model (Martin, 1990). Although the discretization of the RASA model is much coarser than that of the Camden area model, the RASA model simulates the entire New Jersey Coastal Plain and consists of 10 aquifer layers. The RASA model has hydrologically valid lateral boundaries on all sides and incorporates all significant Coastal Plain aquifers. The relation of the RASA model grid to the Camden area model is shown in figure 30. During simulations, identical Camden area stresses were simulated in both the RASA and Camden area models. The flows across the Camden area model flux boundaries are derived from the RASA model and incorporated into the Camden area model by using the Modular Model code's well package. Thus, the flow system of the entire Coastal Plain is incorporated into the Camden area model, but without the burden of maintaining the same resolution of horizontal and vertical discretization, which would require prohibitively large computer resources. The discretization of the Camden area model is sufficiently fine that any inconsistency in flow at the boundary resulting from the change in scale from the RASA model is smoothed.

The upper surface of the model includes several significant boundaries, the connection with the Delaware River and its tributaries, the recharge received from precipitation on the outcrop areas, and the vertical flow to and from the overlying Coastal Plain deposits. The connection between the aquifer system and the river is simulated as a head-dependent boundary condition by using the river package of the Modular Model. A one-dimensional flow path is specified by using the aquifer heads, river stage, and riverbed hydraulic conductivity, shown schematically in figure 31. Cells that are in contact with the river were determined by intersecting the model grid (fig. 29) with the map of aquifer outcrops (fig. 22) and a map of the river geometry. Recharge is a specified flow, in which a specified rate is applied over the cells in the topmost active layer representing the outcrop area. Flow from overlying Coastal Plain deposits was simulated by adjusting the constant heads of model layer 1 to produce the required flow to model layer 2, the Englishtown aquifer system.

Model Calibration

Results of a model simulation are meaningful only if the model adequately reflects reality or, in other words, is calibrated. The Camden flow model was calibrated by using a trial-and-error approach. Parameters were adjusted, a simulation was performed, and the results were evaluated on the basis of the fit between the simulated and measured data. These data include water levels recorded at long-term observation wells and synoptic water-level measurements. The model also had to be consistent with the general concepts of flow in the aquifer system, such as magnitude and direction, before the model was considered calibrated. If the model can adequately simulate changes in head and flow (to the degree to which we know them) in response to changing stresses, such as water-supply withdrawals, it can then be used to provide realistic, detailed information on the distribution of heads and flows at a resolution that is impossible to obtain from

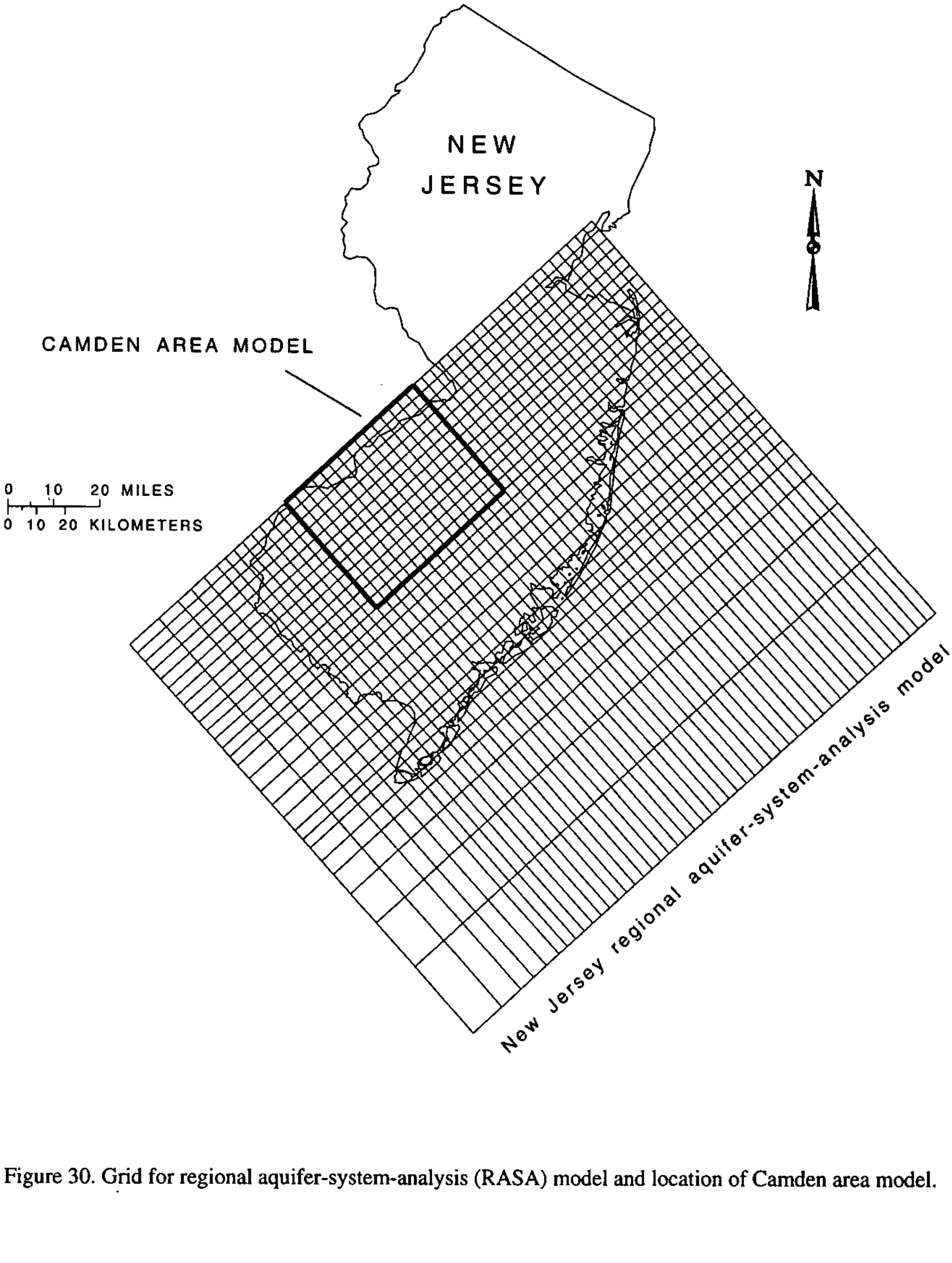


Figure 30. Grid for regional aquifer-system-analysis (RASA) model and location of Camden area model.

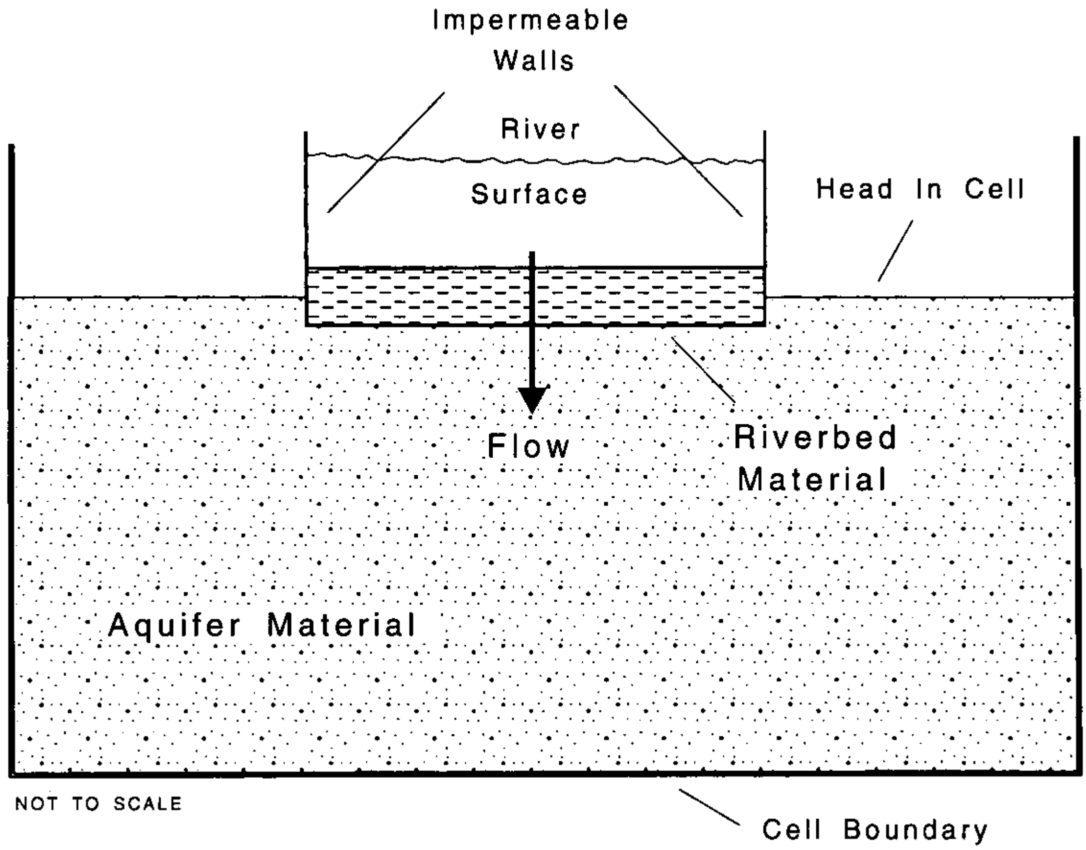


Figure 31. Schematic representation of modeled river/aquifer connection (modified from McDonald and Harbaugh, 1988, fig. 33).

available data. Furthermore, the model can be used to simulate responses to future withdrawals realistically; however, the future conditions must not be too different from historical conditions for the model to produce meaningful results.

The initial conditions for the model are the predevelopment water levels in the aquifers, considered to be in equilibrium (steady-state) (Martin, 1990). For calibration, the model simulated, in transient mode, the period from predevelopment conditions beginning about 1900 through the period when water-supply withdrawals increased and water levels declined, to 1988, the year for which the most recent synoptic water-level measurements for the study area were available. The historical withdrawal data were simplified into 10 stress periods. Withdrawal rates were fixed at an average level for the period, shown in figure 32, and were adjusted to account for pumping in Pennsylvania. The model simulates 10 time steps within each stress period to generate a continuity in water-level change.

Other input parameters, such as hydraulic conductivity, storage, and vertical leakance, were derived from the New Jersey Coastal Plain RASA model (Martin, 1990). The initial values are close approximations of actual values and distributions; however, because of the substantial difference in grid size and spacing between the two models, initial values in the Camden area model were adjusted to more accurately simulate the Delaware River and recharge along the aquifer system's outcrop. Aquifer-thickness data (figs. 4, 6, and 8), developed at a higher resolution than was available for the RASA model, were used in conjunction with

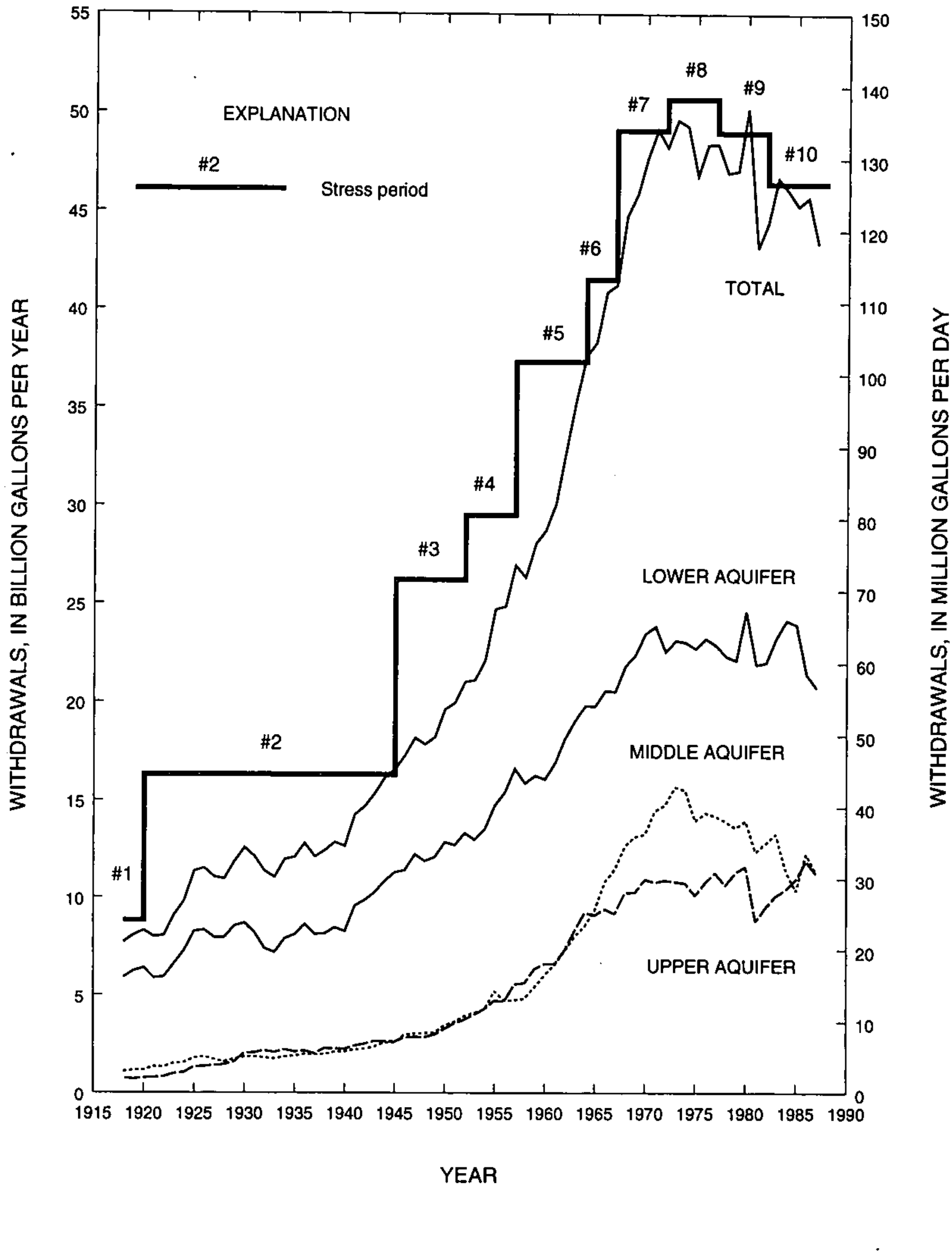


Figure 32. Annual ground-water withdrawals by aquifer, 1915-87, and model stress-period withdrawals.

hydraulic-conductivity data to generate the aquifer transmissivities. Initial values of recharge were set at a rate of 18 inches per year, on the basis of a water budget for the New Jersey Coastal Plain reported by Rhodehamel (1970). Initial values for the magnitude of streambed hydraulic conductivity were based on typical values for sand, silt, and clay as reported by Freeze and Cherry (1979, p. 29), and were distributed according to the information on figure 23.

The model was judged to be calibrated when the following criteria were met:

1. Simulated hydrographs matched the measured, long-term hydrographs to within 15 ft in most cases.
2. The interpreted 1988 potentiometric surfaces, including the depths of the cones of depression, were reproduced to within 15 ft. The locations and configurations of the simulated cones were consistent with measured data.
3. The general direction of flow and magnitudes of hydraulic-parameter values were consistent with the conceptual model of ground-water flow in the study area.

The 15-ft accuracy in water levels required for this calibration was determined on the basis of several factors. Seasonal variations in water levels in the aquifer system, caused by seasonal variations in withdrawals and climatic factors, can be in the range of 10 to 20 ft/yr, resulting in a minimum change of +/- 5 ft over several years. Because the purpose of this model is to evaluate conditions over several years, the calibration was not intended to bring the model to a seasonal time base. The potential accuracy of synoptic water-level measurements made in the field, if errors in reading measuring devices are ignored, is related to the accuracy of the measurement-site altitude. Altitudes of most water-level measurement sites from which data were used in this study were estimated from USGS topographic quadrangle maps with 10-ft contour intervals. Their accuracy therefore can be considered to be +/- 5 ft. Thus, accounting for seasonality and measurement accuracy results in a potential error of 10 ft. On a semiquantitative basis, an additional +/- 5 ft of error from other sources must be tolerated, such as errors in the areal distribution of model parameters. Together, these sources of error yield an acceptable calibration accuracy goal of +/-15 ft.

The comparison of simulated to measured hydrographs for the 22 long-term aquifer-system monitor wells, whose locations are indicated in figure 12, are shown in figures 33 to 35. In most cases, the hydrographs match to within 10 ft and, in some cases, they match to within 5 ft. These results fall within the calibration goal indicated above. The match was at or slightly worse than the tolerated limit at only 3 of the 22 sites. Attempts to bring the simulated water levels at the three sites to within the calibration criteria caused simulated water levels at other sites to violate the criteria to a larger degree. Therefore, the match at these three sites was considered tolerable, even though it did not meet the calibration criteria.

The general shape and configuration of the simulated potentiometric surfaces of the aquifer system are comparable, within the tolerable levels, to those of the measured surfaces, as shown in figures 36 to 38. The model's performance is consistent with the general concept of the flow system. The calibration criteria were satisfied, except in the case of the three sites discussed above, and the model was judged to provide a satisfactory representation of ground-water flow in the aquifer system in the Camden area.

Calibrated-Model Parameters

The major model parameters that describe the hydrologic characteristics of the aquifer system are aquifer transmissivity, aquifer storage, confining-unit vertical leakance, recharge, and hydraulic properties of streambeds.

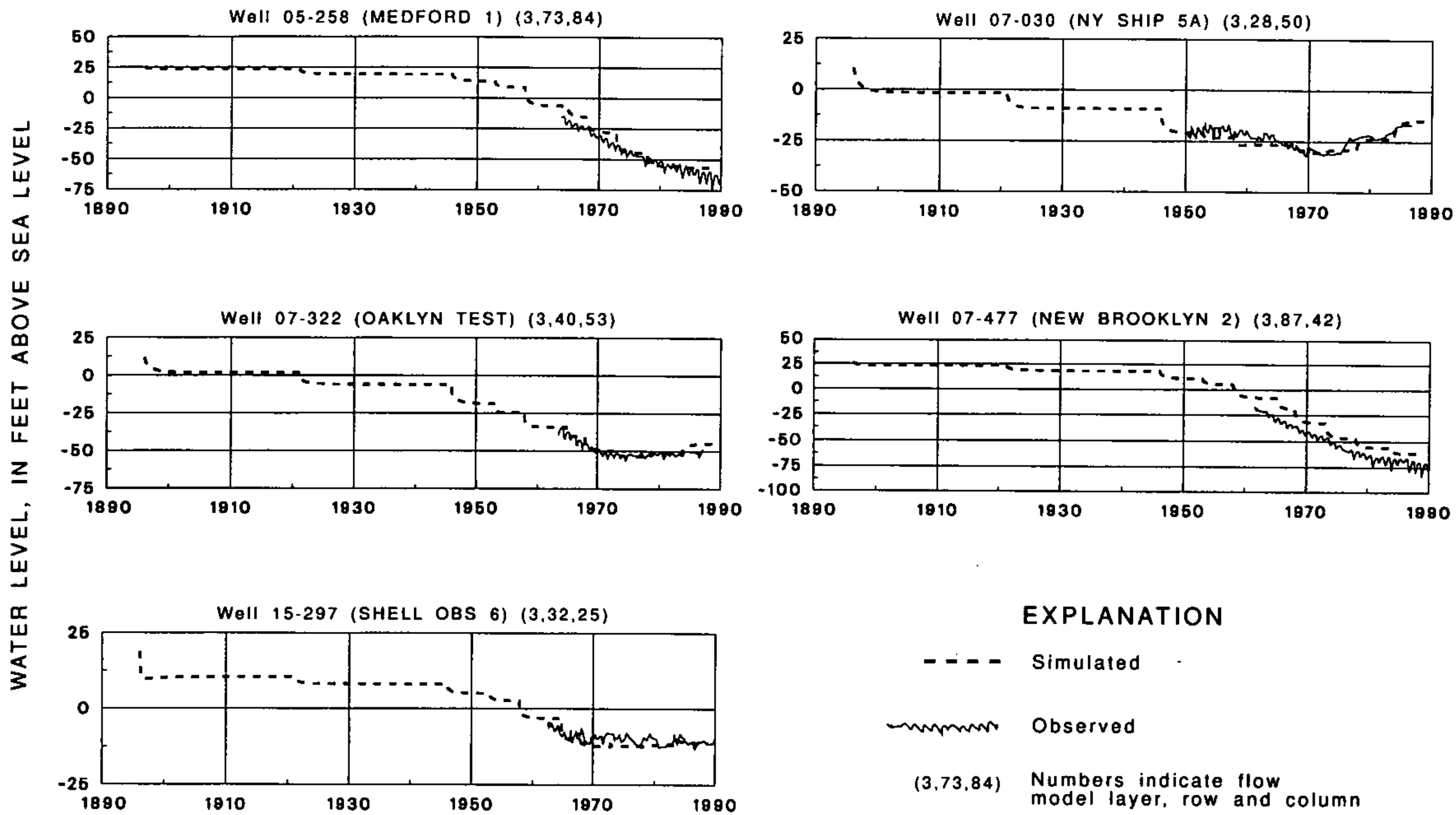


Figure 33. Simulated and measured water levels for the upper aquifer of the Potomac-Raritan-Magothy aquifer system.

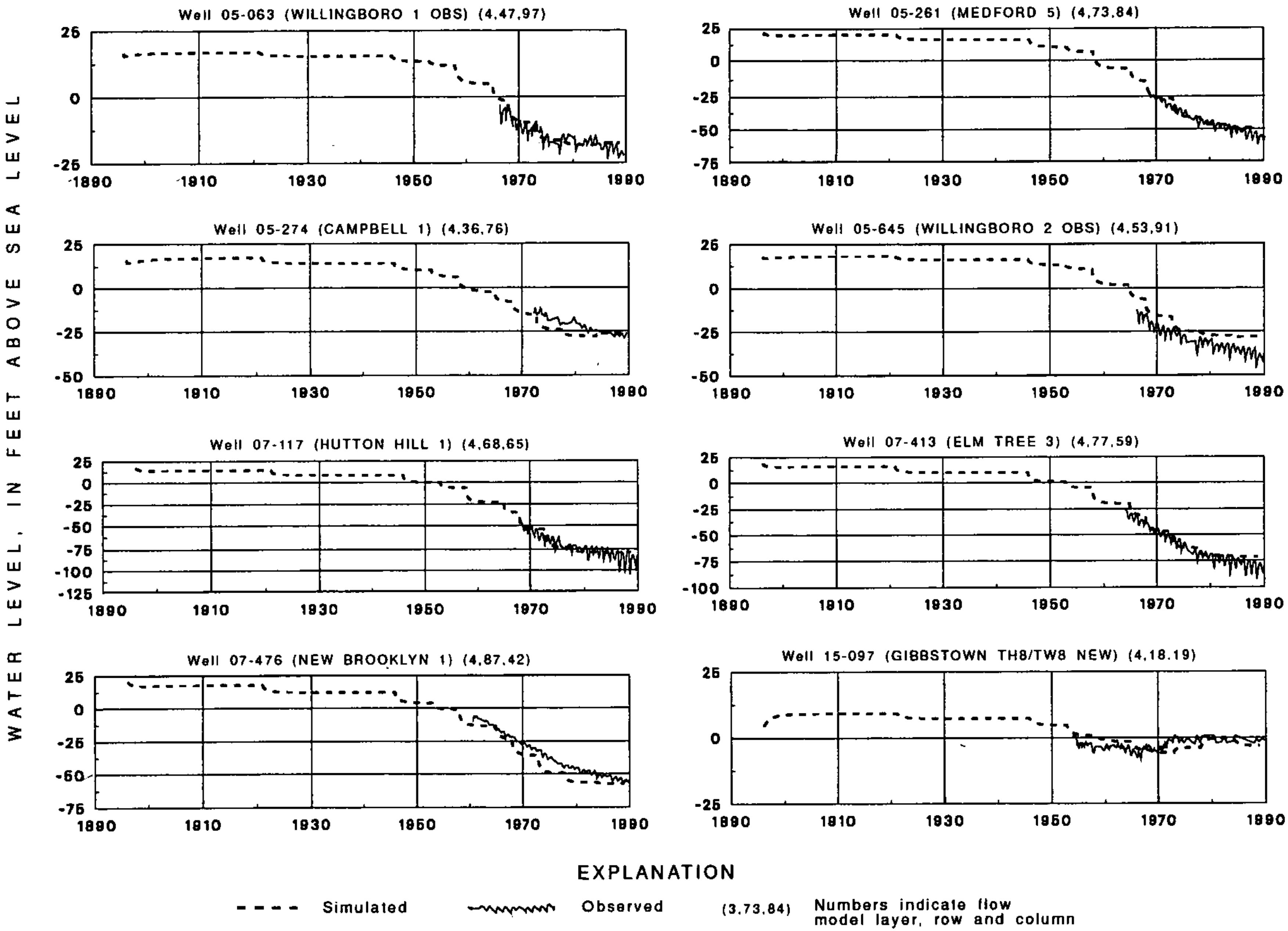


Figure 34. Simulated and measured water levels for the middle aquifer of the Potomac-Raritan-Magothy aquifer system.

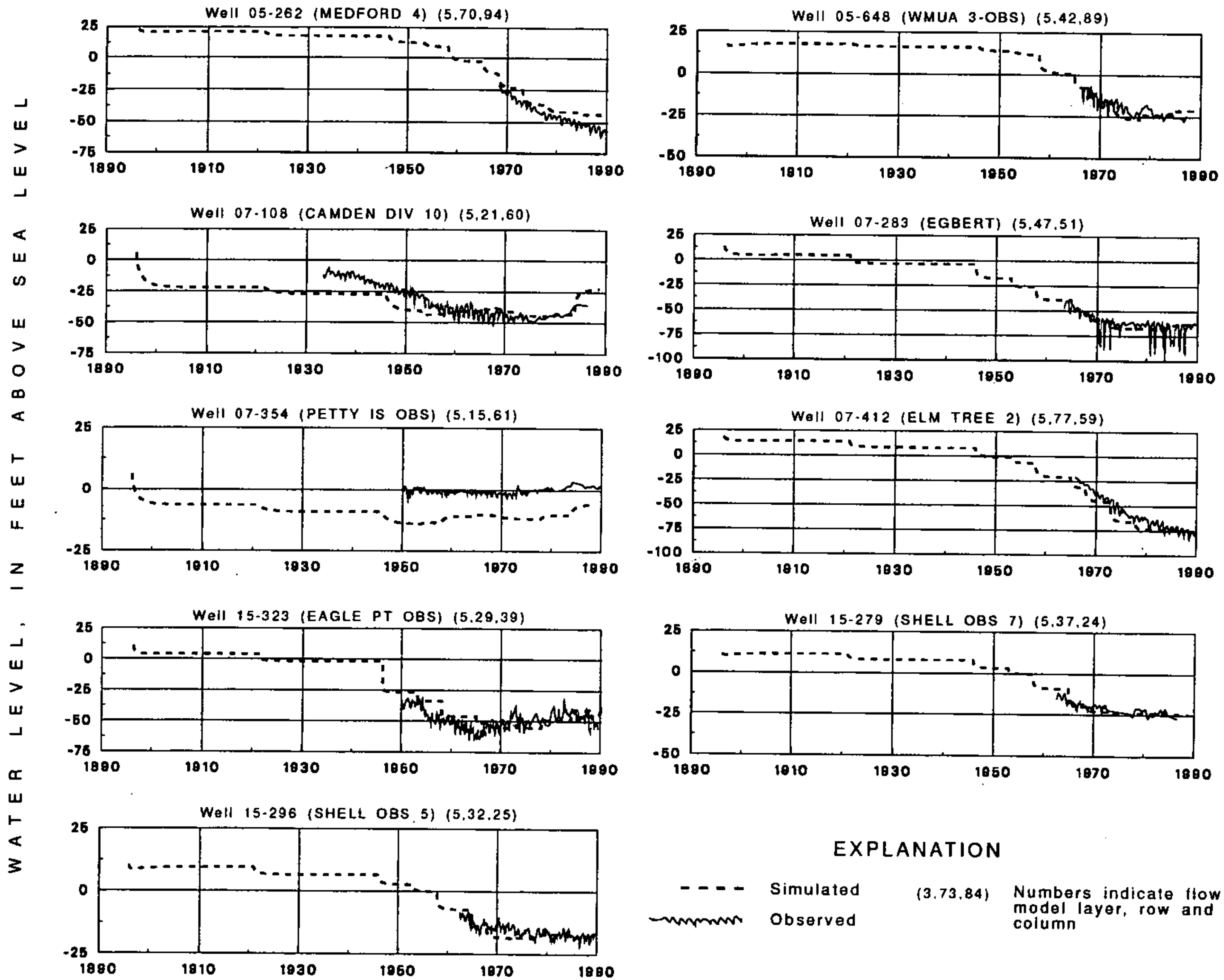
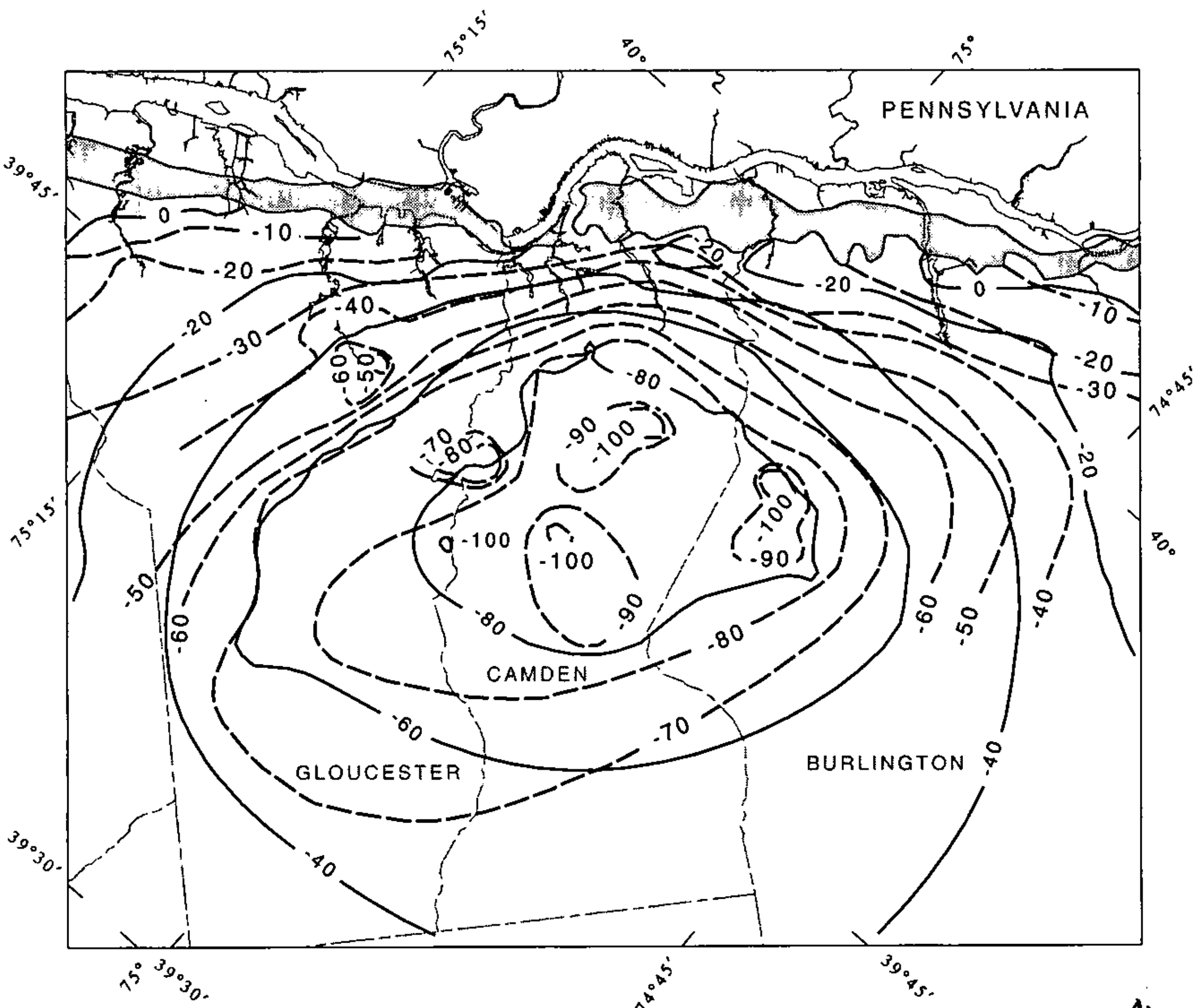


Figure 35. Simulated and measured water levels for the lower aquifer of the Potomac-Raritan-Magothy aquifer system.



EXPLANATION

OUTCROP AREA OF THE UPPER AQUIFER OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM

—— -100 —— SIMULATED POTENTIOMETRIC CONTOUR--Shows simulated altitude at which water level would have stood in tightly cased wells. Contour interval 20 feet. Datum is sea level

— — -100 — — OBSERVED POTENTIOMETRIC CONTOUR--Shows observed altitude at which water level would have stood in tightly cased wells. Contour interval 10 feet. Datum is sea level

0 1 2 3 4 5 MILES

0 1 2 3 4 5 KILOMETERS

Figure 36. Simulated and measured fall 1988 potentiometric surfaces for the upper aquifer of the Potomac-Raritan-Magothy aquifer system.

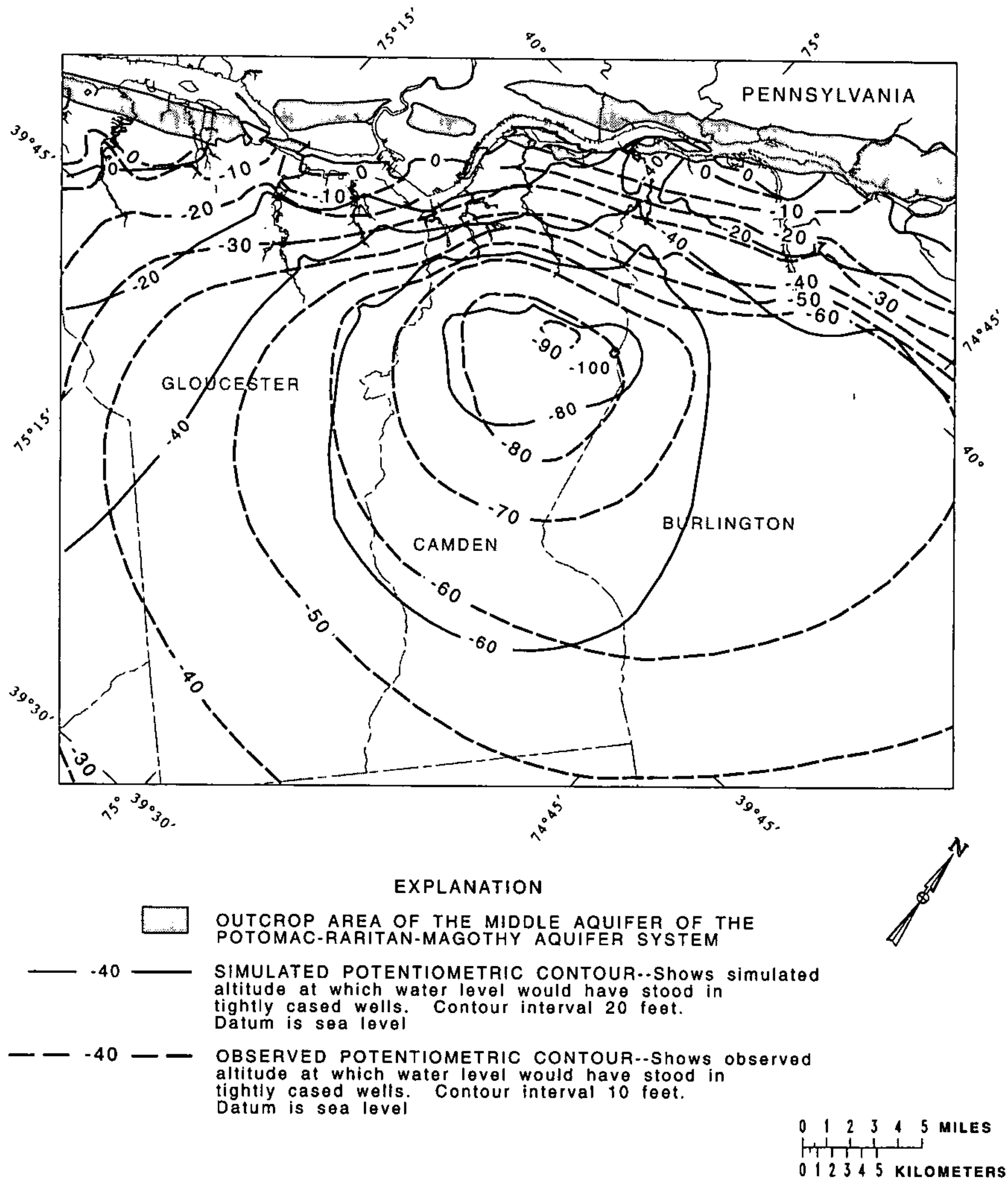


Figure 37. Simulated and measured fall 1988 potentiometric surfaces for the middle aquifer of the Potomac-Raritan-Magothy aquifer system.

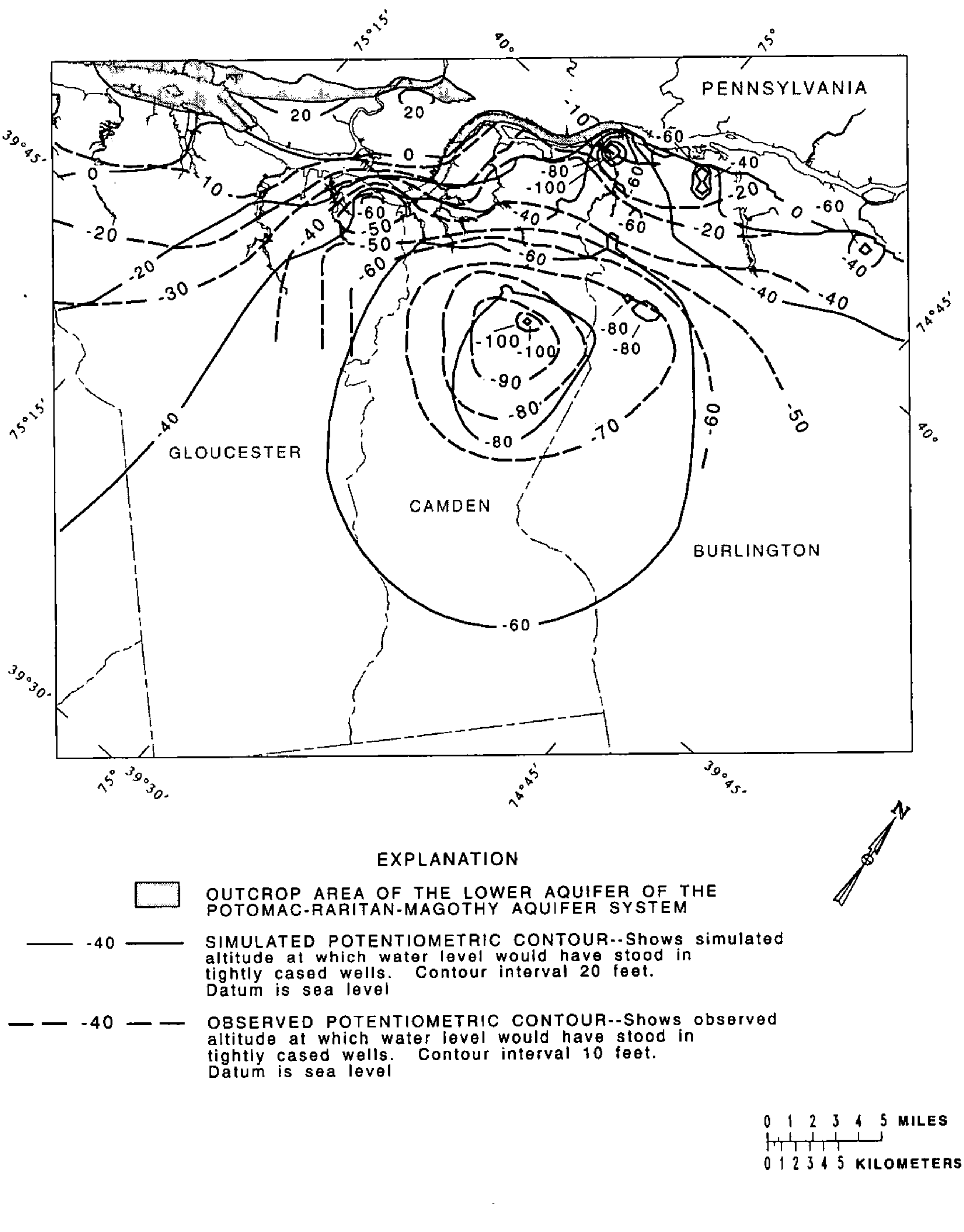


Figure 38. Simulated and measured fall 1988 potentiometric surfaces for the lower aquifer of the Potomac-Raritan-Magothy aquifer system.

The aquifer transmissivity is calculated from the horizontal hydraulic conductivity and the aquifer's saturated thickness. Thickness (figs. 5, 7, and 9) was considered to be invariant for purposes of model calibration. The calibrated hydraulic conductivities vary spatially and range from 7 to 130 ft/d. This variation is attributable to a decrease in the grain size of aquifer material in the downdip direction. The clay content increases in that same direction. The magnitude and distribution of hydraulic conductivities of the aquifer system used in the calibrated model are shown in figures 39 to 41. The transmissivities used in the calibrated model are generally similar to those in the RASA model (Martin, 1990). The minor differences that do exist are, in part, the result of the comparatively fine grid size of the Camden area model, which allows a more accurate definition of thickness in the vicinity of the boundaries with the Delaware River and Fall Line. The calibrated transmissivities of the upper aquifer average about 4,000 ft^2/d over the modeled area, ranging from near zero where the unit thins at its updip limit to a maximum of about 11,500 ft^2/d. Transmissivities of the middle aquifer average about 5,500 ft^2/d, and range from near zero to about 15,000 ft^2/d. Transmissivities of the lower aquifer average about 7,100 ft^2/d, and range from near zero to about 25,000 ft^2/d. Because the overlying Englishtown aquifer system was not a primary focus of this investigation, the RASA model transmissivity for this unit (Martin, 1990, fig. 58) was used and was not varied during calibration. A storage coefficient of 1.0×10^{-4} was used for all aquifers.

The calibrated hydraulic conductivities or transmissivities of the aquifer system from the Camden and RASA models are generally lower than those reported from results of aquifer tests, such as those listed in table 2. This is expected and can be explained in several ways.The proximity of significant recharge, such as from the Delaware River or its tributaries, affected many of the aquifer-test analyses, especially those conducted prior to the 1960's. The asymmetrical nature of a line recharge source near the pumped well during an aquifer test could result in erroneously elevated transmissivity values. Furthermore, the typical aquifer test is used to evaluate the properties of a discrete sand layer (in the case of the Coastal Plain). The simulated regional aquifer layer, however, may incorporate the tested sand with other sands and intervening clays that together are not sufficiently thick or extensive to be considered or simulated as a confining unit. The result is that the hydraulic conductivities of regional-scale aquifer layers in a calibrated flow model are expected to be lower than those determined from local-scale aquifer tests. Therefore, calibrated flow models are better suited for determining aquifer properties at a regional scale than are local-scale aquifer tests.

The confining-unit vertical leakance (vertical hydraulic conductivity divided by confining-unit thickness) for the calibrated model ranged from 1.0×10^{-6} to 1.0×10^{-12} (ft/d)/ ft. The magnitude and distribution of vertical leakance for the confining unit between the Englishtown aquifer system and the upper aquifer, between the upper and middle aquifers, and between the middle and lower aquifers, respectively, are shown in figures 42 to 44.

Water directly enters the aquifer system as recharge from precipitation only on an outcrop area. The recharge value used in the model is not the total, or gross, amount of rainfall impinging on the outcrop area, but is the net amount that enters into the saturated part of the aquifer, after evapotranspiration and direct surface runoff. The objective of this study is to evaluate withdrawal scenarios on a multi-year basis. Therefore, the recharge rates used in the model were not varied through time. The values of recharge rates to the uppermost active cells of the calibrated model range from 4 to 16 in/yr. The distribution of recharge over the upper surface of the model is shown in figure 45. The lower recharge rates, 4 to 9 in/yr, were used primarily on the Pennsylvania side of the river, where the aquifer system thins at its updip limit. During model calibration, recharge rates higher than these caused unrealistically high heads in the aquifer system. Reducing the values corrected this problem. Similarly, unrealistically high heads also resulted at cells adjacent to the Delaware River and its major tributaries. The lower recharge values were used in these locations as well.

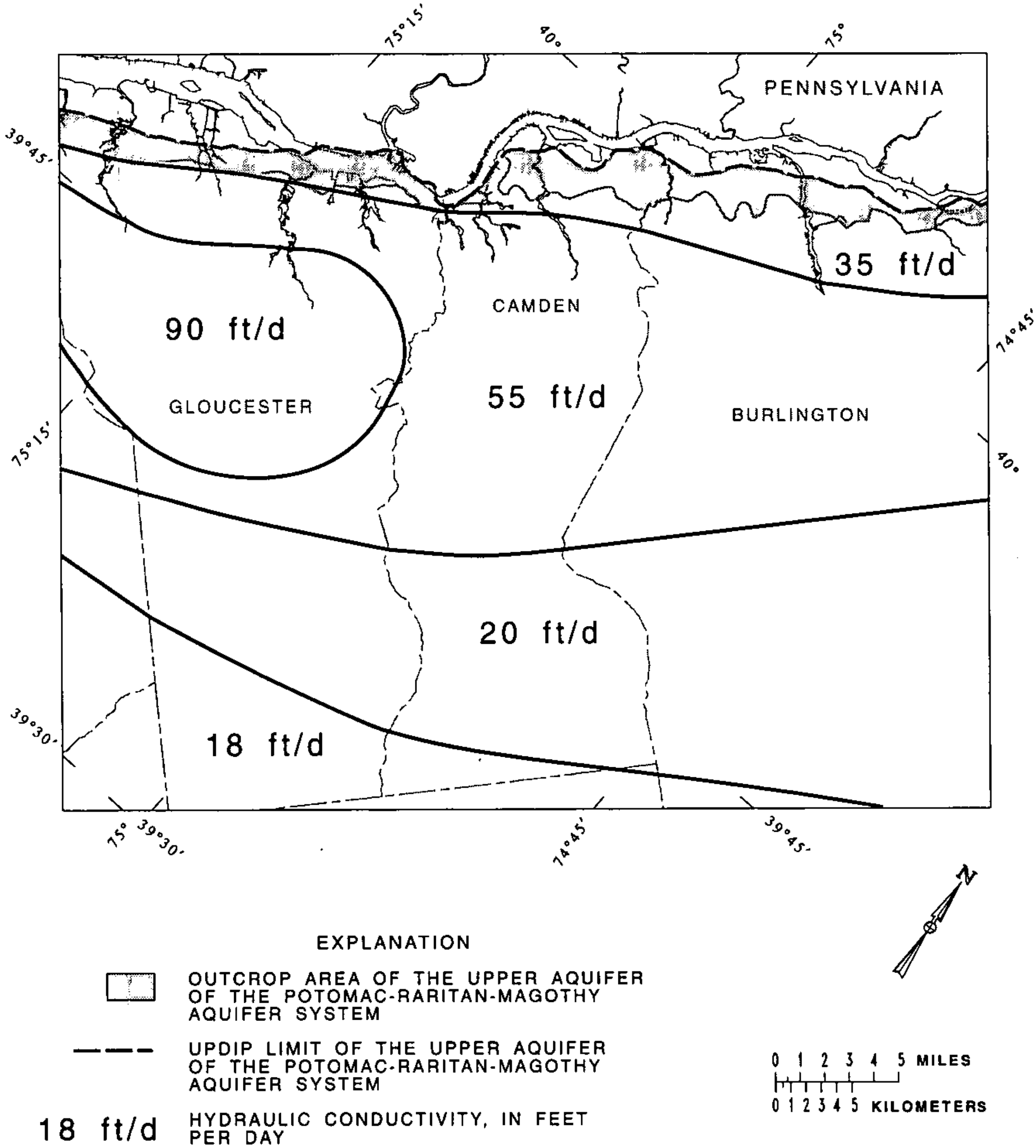


Figure 39. Hydraulic conductivity used in the model for the upper aquifer of the Potomac-Raritan-Magothy aquifer system.

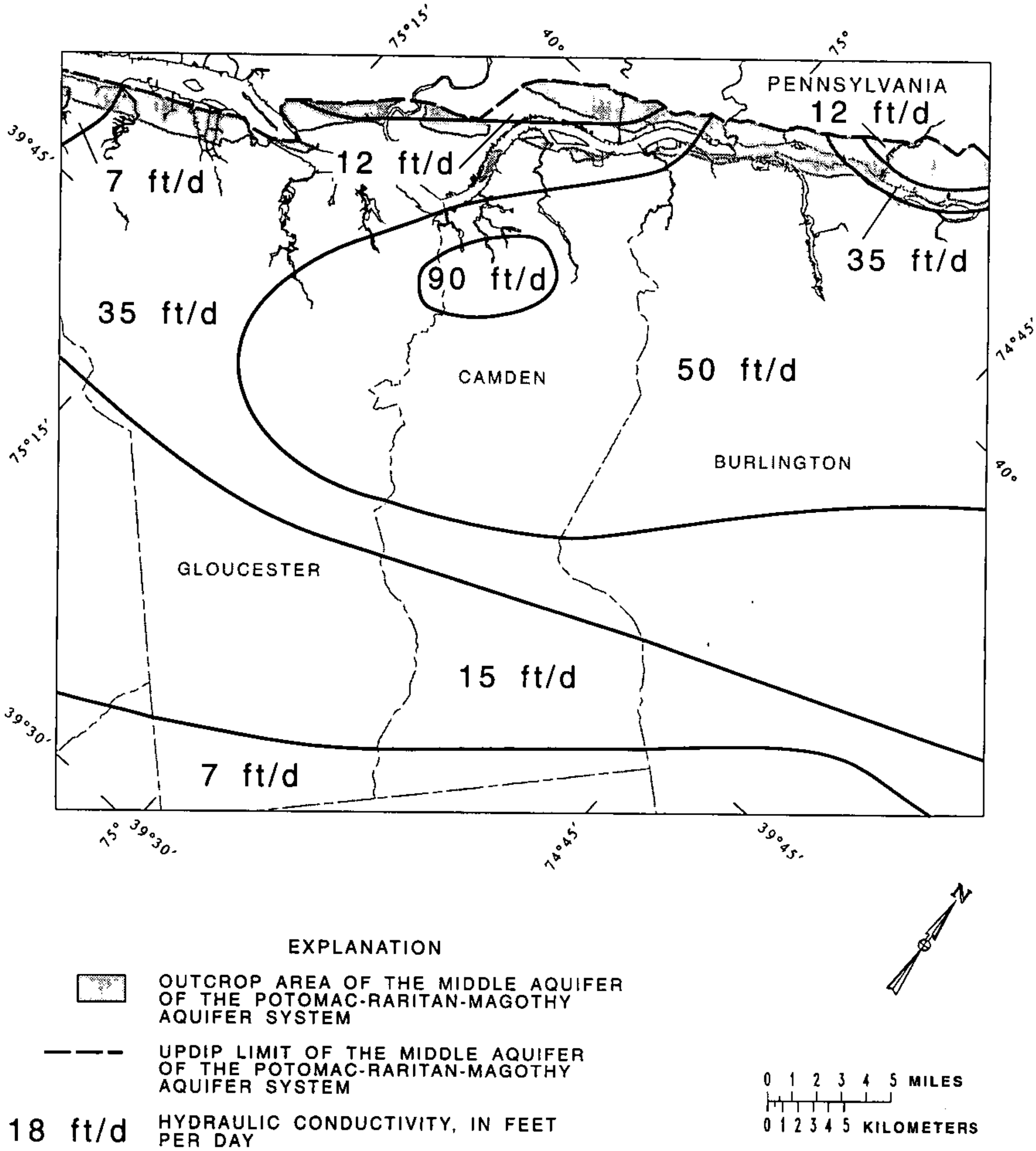


Figure 40. Hydraulic conductivity used in the model for the middle aquifer of the Potomac-Raritan-Magothy aquifer system.

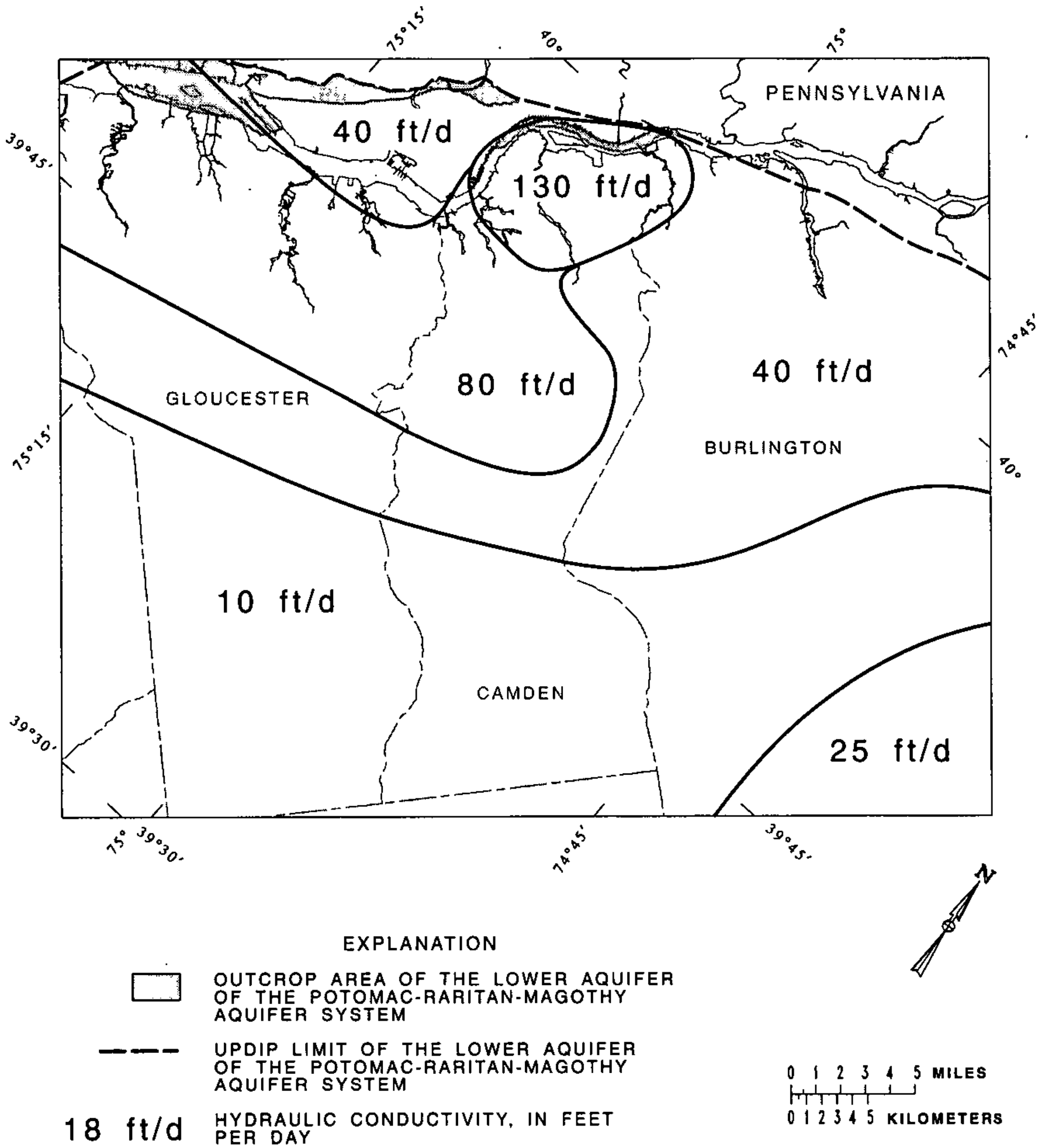


Figure 41. Hydraulic conductivity used in the model for the lower aquifer of the Potomac-Raritan-Magothy aquifer system.

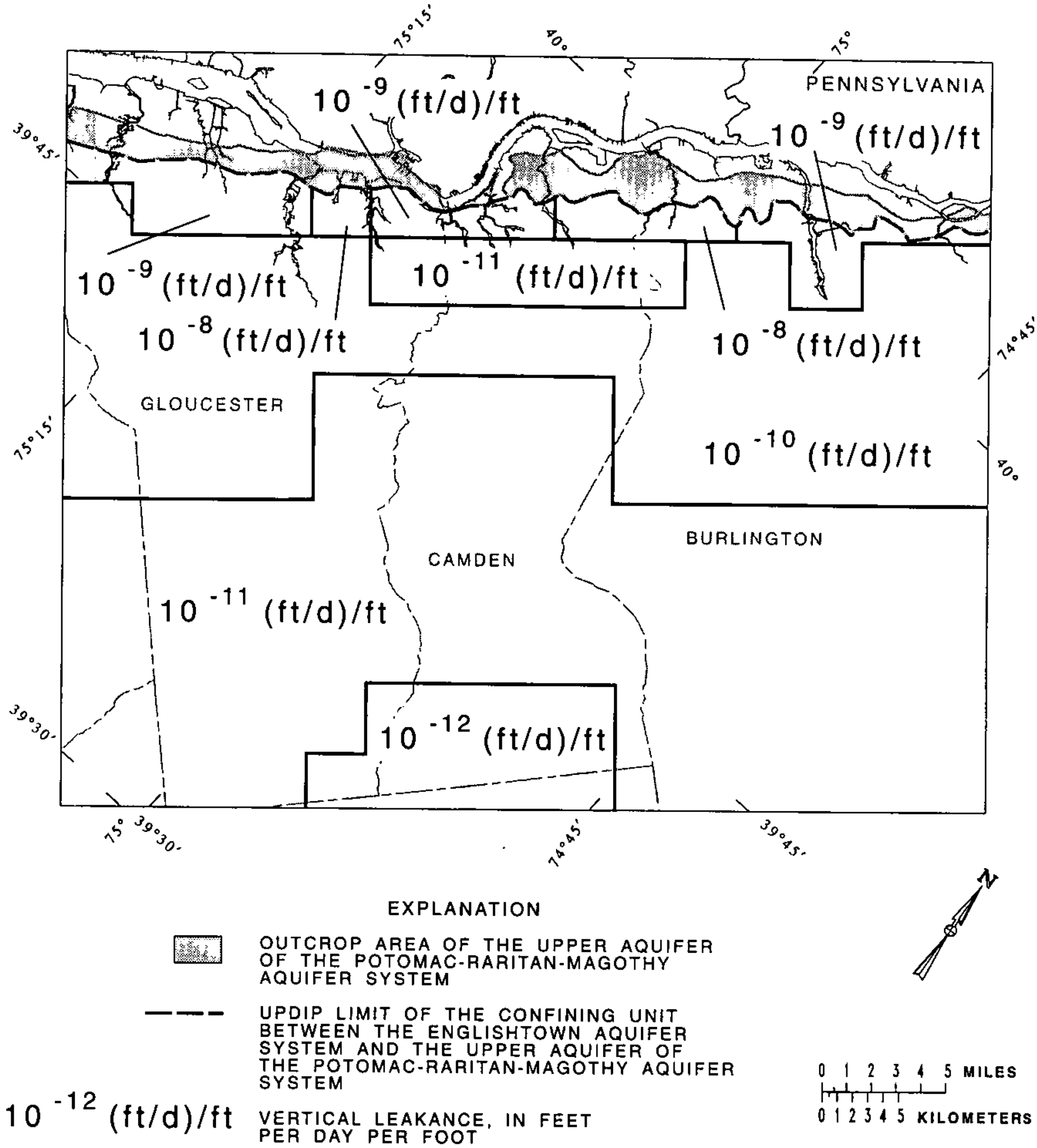


Figure 42. Vertical leakance used in the model for the confining unit between the Englishtown aquifer system and the upper aquifer of the Potomac-Raritan-Magothy aquifer system.

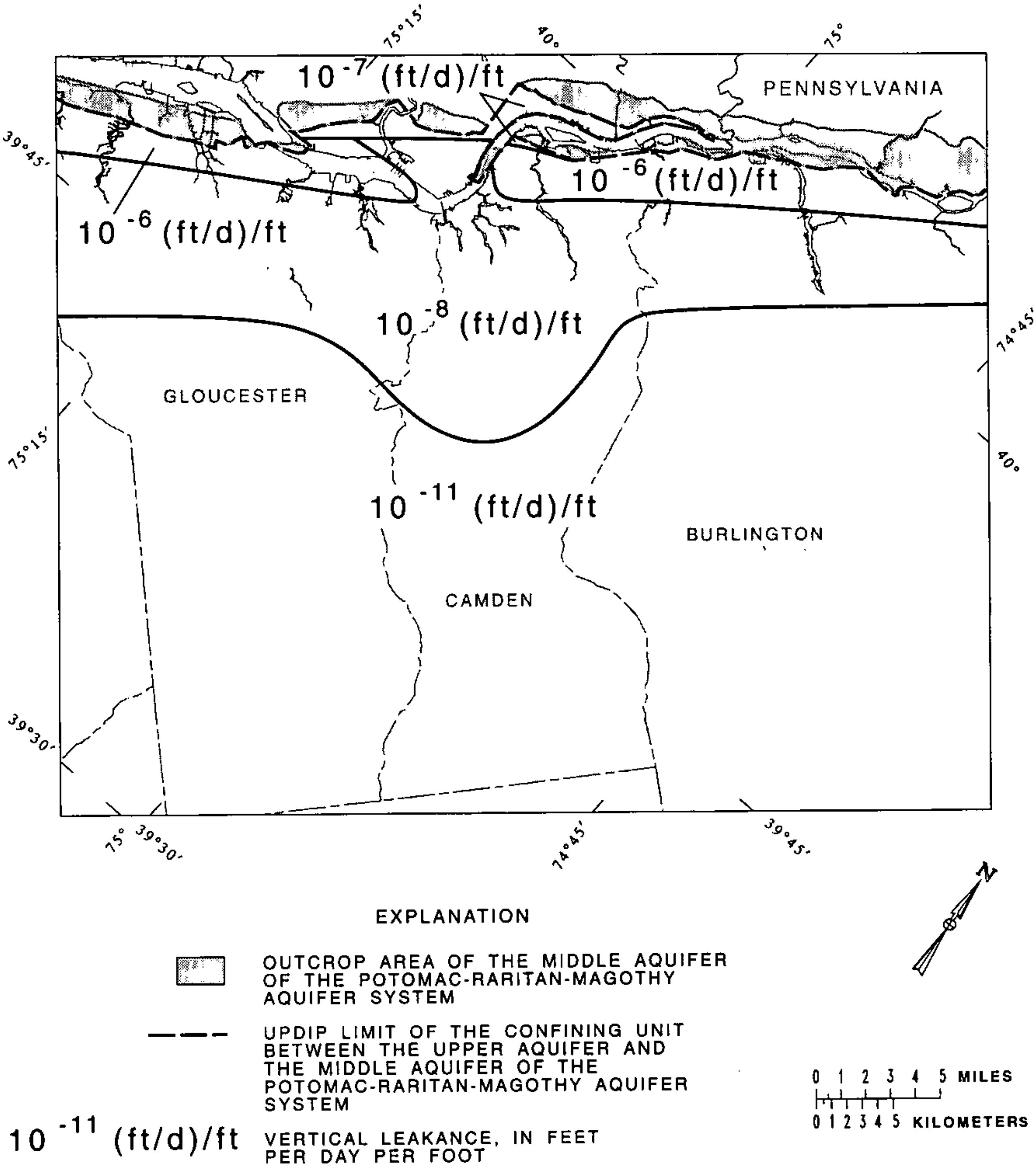


Figure 43. Vertical leakance used in the model for the confining unit between the upper and middle aquifers of the Potomac-Raritan-Magothy aquifer system.

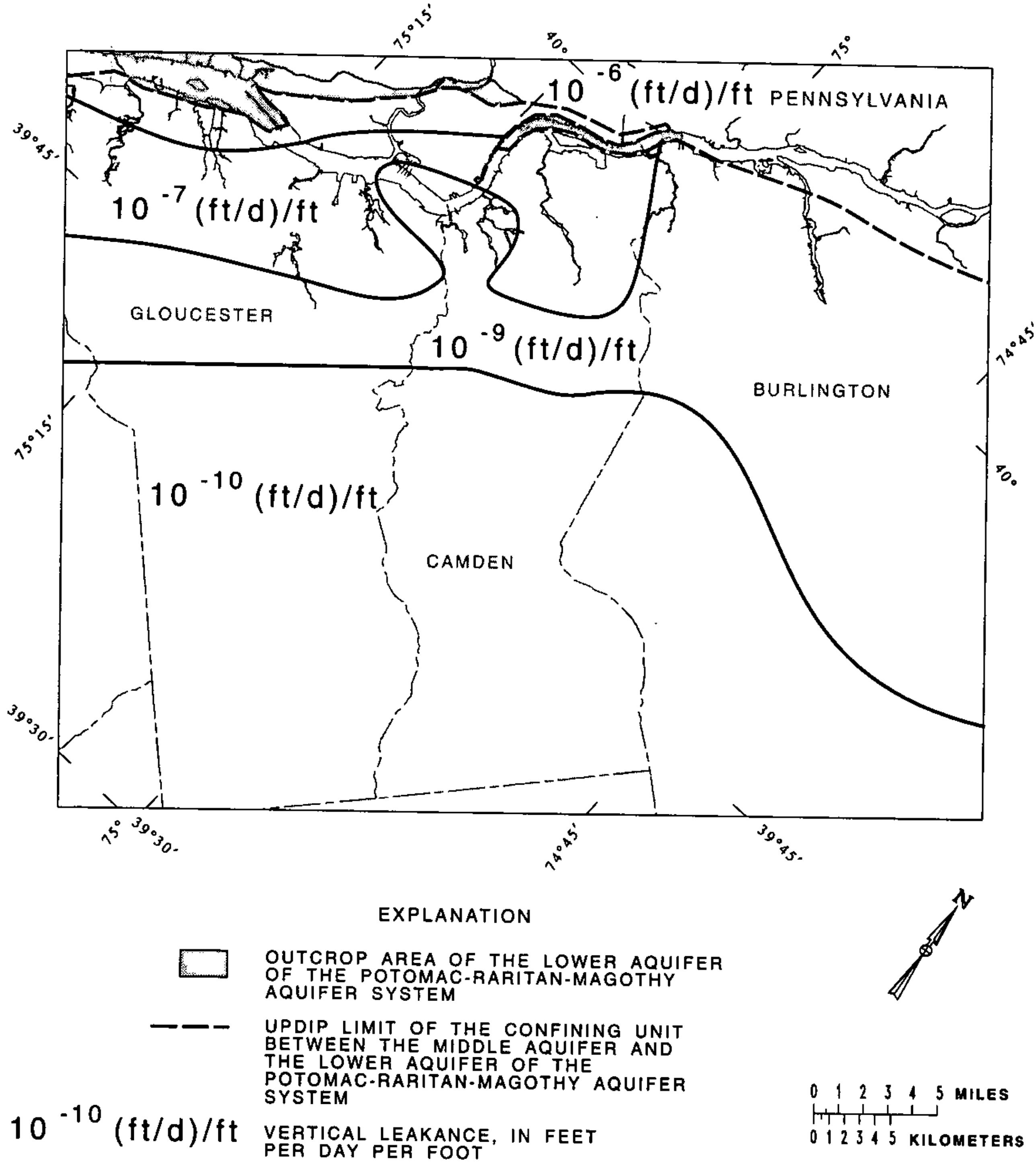


Figure 44. Vertical leakance used in the model for the confining unit between the middle and lower aquifers of the Potomac-Raritan-Magothy aquifer system.

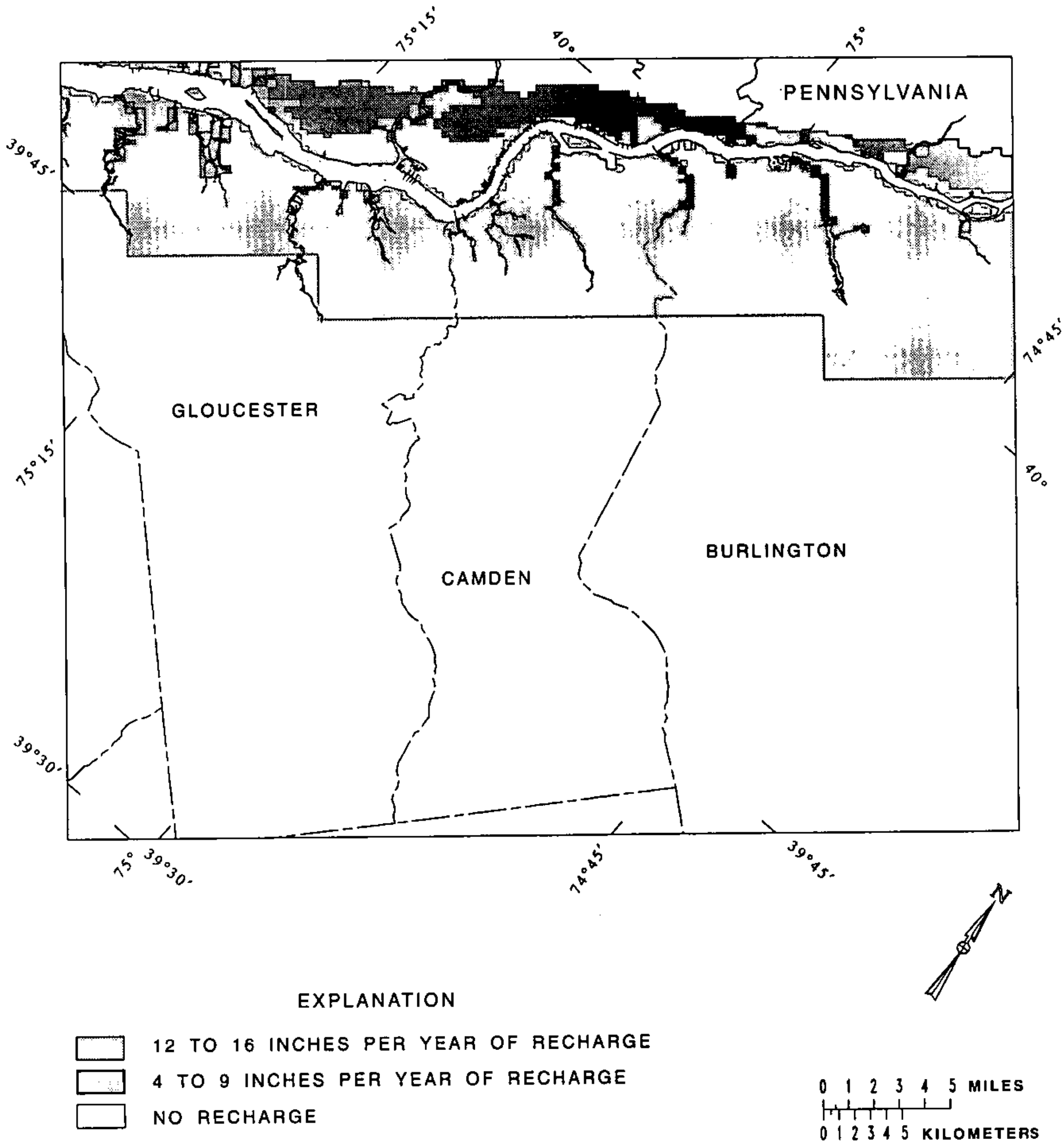


Figure 45. Distribution of recharge used in the model.

The connection of the Delaware River and its tributaries to the aquifer system was simulated by using the river package of the Modular Model computer program. For model cells at which river interaction is significant, the stage of the river, the riverbed conductance, and the elevation of the river bottom are specified. If the head in the aquifer system adjacent to the river is known, then the flow between the river and the aquifer system is directly calculated by the model. The Delaware River and its tributaries in contact with the aquifer system are generally under tidal conditions. Whereas river stage varies nearly 6 ft with every tidal cycle, it is the average stage that is significant for a multi-year ground-water model calibration. The river elevation is approximately 0.5 ft above sea level in the Camden area. The Delaware River bottom has been dredged to a consistent depth of about 40 ft throughout the study area. The tributaries are about 10 ft deep. The distribution of the material comprising the river bottom, discussed earlier, is shown on figure 23. The river-bottom material was classified as high, moderate, or low permeability. Values of 28, 0.028, and 0.00028 ft/d are used in the calibrated model for the vertical hydraulic conductivity through the riverbed of the high-, moderate- and low-permeability zones, respectively. At the start of the calibration process, typical values for the hydraulic conductivity of sand, silt, and clay, as reported by Freeze and Cherry (1979, p. 29) were used. These initial values were then adjusted to calibrate water levels near the river. The thickness of the riverbed sediments, differentiated from the aquifer-system material, is assumed to be 10 ft. The riverbed conductance is calculated as follows:

$$C_{rb} = \frac{K \times A_{rb}}{M} ,$$

where

C_{rb} = riverbed conductance (L^2),
K = vertical hydraulic conductivity of riverbed (L/t),
A_{rb} = area of riverbed (L^2), and
M = riverbed thickness (L).

Model Sensitivity

The model-calibration process involves the use of a trial-and-error approach to fit simulated ground-water levels to observed levels by modifying the initial values of model-input parameters. The most significant parameters in the Camden area model are recharge, transmissivity, vertical leakance, and riverbed hydraulic conductivity. The initial model-parameter values were based on measurements made at various observation points and values derived from the more coarsely gridded RASA model (Martin, 1990). Some of the data, such as riverbed hydraulic conductivities, were recorded as relative rankings (low, moderate, or high permeability). The absolute magnitude and areal variation of measured field parameters beyond the collection locations are speculative; however, the calibrated input data set of the Camden area model can provide information about them because model calibration yielded ground-water levels that are consistent with observed data. Therefore, these calibrated values can be considered a close representation of the actual values and distributions. The precision of this information derived from the model may, however, be affected by the sensitivity of simulated head values (the calibration criterion) to variation in values of particular input parameters. For instance, insensitivity of the model to variation in values of a particular parameter may allow values of that parameter to range widely without affecting values of the simulated heads. The degree of sensitivity can be tested by performing a sensitivity analysis.

A variety of strategies can be used to assess a model's sensitivity. The strategy that is most appropriate for this study is to determine the degree of change in an input-parameter value that will result in a change in simulated head that is sufficiently large to affect the model's calibration. The magnitude of change or variation that affects the model's calibration can be considered to approximate the precision of the calibrated model's input data, especially with regard to the use of the parameter values outside this modeling process.

The Camden area model, as previously stated, was calibrated by using a criterion of 15 ft for the fit between simulated and observed data. Most of the simulated hydrographs showed water levels that were within 5 to 10 ft of the observed data. Therefore, the significant sensitivity test is to determine the variation in parameter values that would cause simulated heads to change between 5 and 15 ft. A change of this magnitude would be sufficiently large to cause simulated long-term water levels in observation wells to violate the calibration criteria.

The sensitivity test was accomplished by using a trial-and-error method. A statistically based evaluation would certainly be feasible; however, during the calibration process, the sensitivity is readily apparent and estimation of the change in value that yields an approximate 15-ft change in simulated head is relatively easy. With this knowledge of the model's performance, the input parameters were varied. The intent of this analysis is to determine the sensitivity to changes in input parameters. The sensitivity could be expected to vary spatially and could depend on concurrent changes in several parameters. The model could also show temporal sensitivity. Determining the sensitivity to this degree is beyond the intent of the evaluation. Therefore, one parameter was varied at a time, and changes were applied over the entire model under steady-state conditions based on the withdrawals developed for stress-period 10 (1984-88). Values were both increased and decreased to test the relative sensitivity or symmetry of the direction of parameter change.

Recharge, when varied by +/- 35 percent; hydraulic conductivity, when varied by +/- 20 percent; vertical leakance, when varied by +/- 60 percent; and riverbed hydraulic conductivity, when varied by +/- 100 percent, all result in a 5- to 15-ft change in simulated heads. These variations represent sufficient changes in value to disrupt model calibration. Table 7 summarizes the changes applied to the input parameters and the general response of the simulated water levels.

Current Conditions

The results of the ground-water flow simulation are generally consistent with the concept of regional ground-water flow in the Potomac-Raritan-Magothy aquifer system in the Camden area developed previously in this report. Use of the model allows the various flow-system components to be quantified and their relative importance determined.

General Flow Budget and Pattern

The budget is of particular interest in understanding the flow system from a regional viewpoint. Table 8 shows the magnitude of the various flow-system components as simulated for the period 1983-88 (model stress period 10). The discrepancy between inflow and outflow of water for this simulation is low, indicating that the model is well-balanced.

The largest budget components are the inflow to the system from recharge along the aquifer system's outcrop (not including the outcrop in the river) and the discharge from wells. The outflow from constant heads represents the vertical boundary flow leaving the modeled area as flow from layer 2, the Englishtown aquifer system, into layer 1. The next largest components are incoming lateral boundary flows and river leakage (in and out). The outgoing lateral boundary flow is small. This budget represents the end of stress period 10, which has a duration of 5 years (1983-88). The flows attributable to changes in aquifer storage are small because the simulated system is approaching a steady-state configuration. This near-equilibrium may be the result of the model's fixed withdrawals during stress periods, rather than a reflection of the state of the real system where withdrawals continuously vary with time and, for the purposes of this investigation, is not significant.

Table 7. -- **Results of model sensitivity analysis**

[in/yr, inches/year; ft/d, feet/day; (ft/d)/ft, feet/day/foot;%, percent]

Parameter	Sensitivity variation	Range of value	Range of sensitivity
RECHARGE	+/- 35%	4 - 16 in/yr	1.4 - 5.6 in/yr
	Symmetrical response of water levels to increase or decrease. Greatest sensitivity in middle and lower aquifer outcrops on Pennsylvania side of Delaware River, in upper and middle aquifer outcrops in westernmost Gloucester County, and in middle aquifer outcrop in Burlington County. Less sensitive in outcrops in Camden County. Least sensitive in confined, downdip parts of the aquifer system that are distant from the outcrops.		
HYDRAULIC CONDUCTIVITY	+/- 20%	7 - 90 ft/d	1.4 - 18 ft/d
	Response of water levels to change is asymmetrical. More sensitive (by several ft) to decrease than to increase. Greatest sensitivity is in confined part of aquifer system, in area within the cone of depression.		
VERTICAL LEAKANCE	+/- 60%	10^{-6} - 10^{-12} (ft/d)/ft	$6.0\text{x}10^{-7}$ - $6.0\text{x}10^{-13}$ (ft/d)/ft
	Response of water levels to change is asymmetrical. More sensitive to decrease than to increase. Greatest sensitivity is in confined part of the aquifer system.		
RIVERBED HYDRAULIC CONDUCTIVITY	+/- 100%	.000283 - 28.34 ft/d	.000283 - 28.34 ft/d
	Response of water levels to change is asymmetrical. Greatest sensitivity is near river-proximal withdrawals. Areas showing sensitivity are different for parameter increase and decrease.		

Flow between aquifers takes place in response to the stresses applied to the system. The primary stresses are withdrawals from wells for water supply. Figures 46 to 48 show the locations of these withdrawals in the model for the upper, middle, and lower aquifers, respectively. Figures 49 to 51 show the direction and magnitude of the simulated flow between the respective simulated layers in response to the stress. Some trends are apparent. The middle aquifer acts as a conduit between the upper and lower aquifers outside Burlington County. In the vicinity of the City of Camden, the most intensive withdrawals are from the lower aquifer. In that same area, the outcrop of the upper aquifer is large. The model shows a strong downward flow to the lower aquifer caused by the withdrawals. In the central part of Camden and Gloucester Counties, the withdrawals are primarily from the upper aquifer. Simulated flow is generally upward from the middle aquifer into the upper aquifer. The cone of depression in the middle aquifer in Camden and Gloucester Counties is caused by the primary stresses, which are in the upper and lower aquifers. In Burlington County, the middle aquifer is used more extensively. The largest simulated vertical flows are into the middle aquifer from the adjacent aquifers.

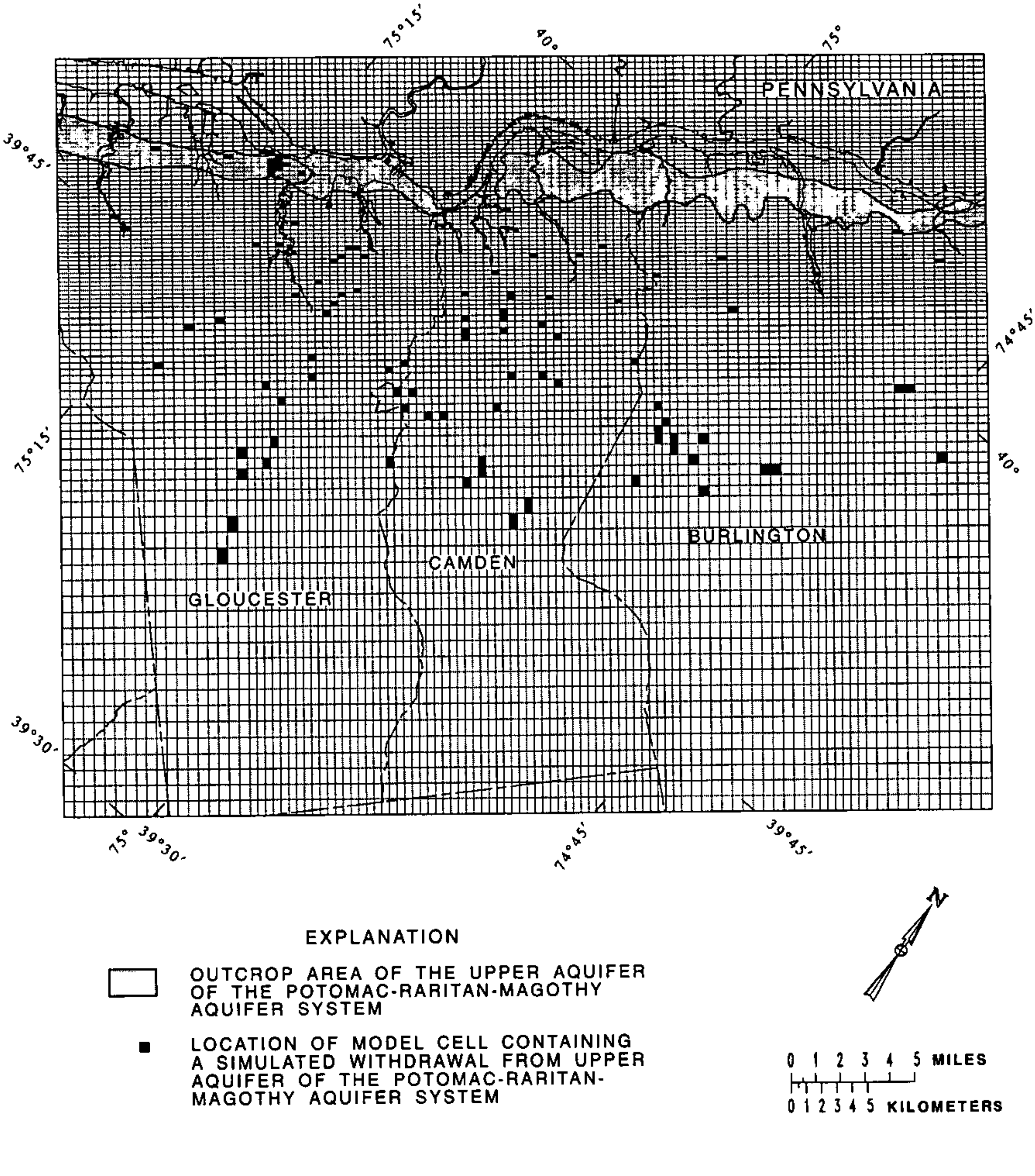


Figure 46. Locations of withdrawals in the flow model for 1983-88, for the upper aquifer of the Potomac-Raritan-Magothy aquifer system.

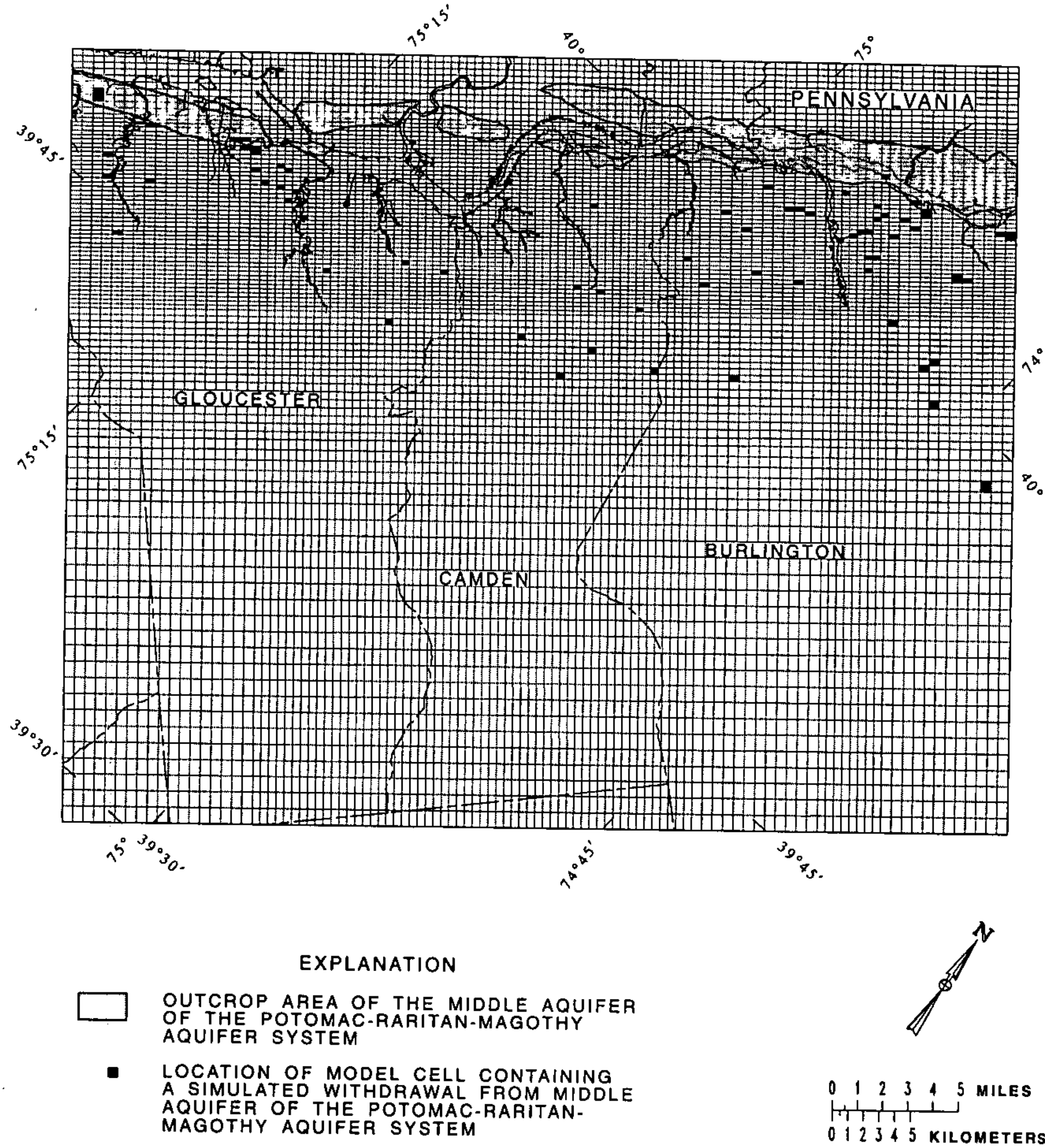


Figure 47. Locations of withdrawals in the flow model for 1983-88, for the middle aquifer of the Potomac-Raritan-Magothy aquifer system.

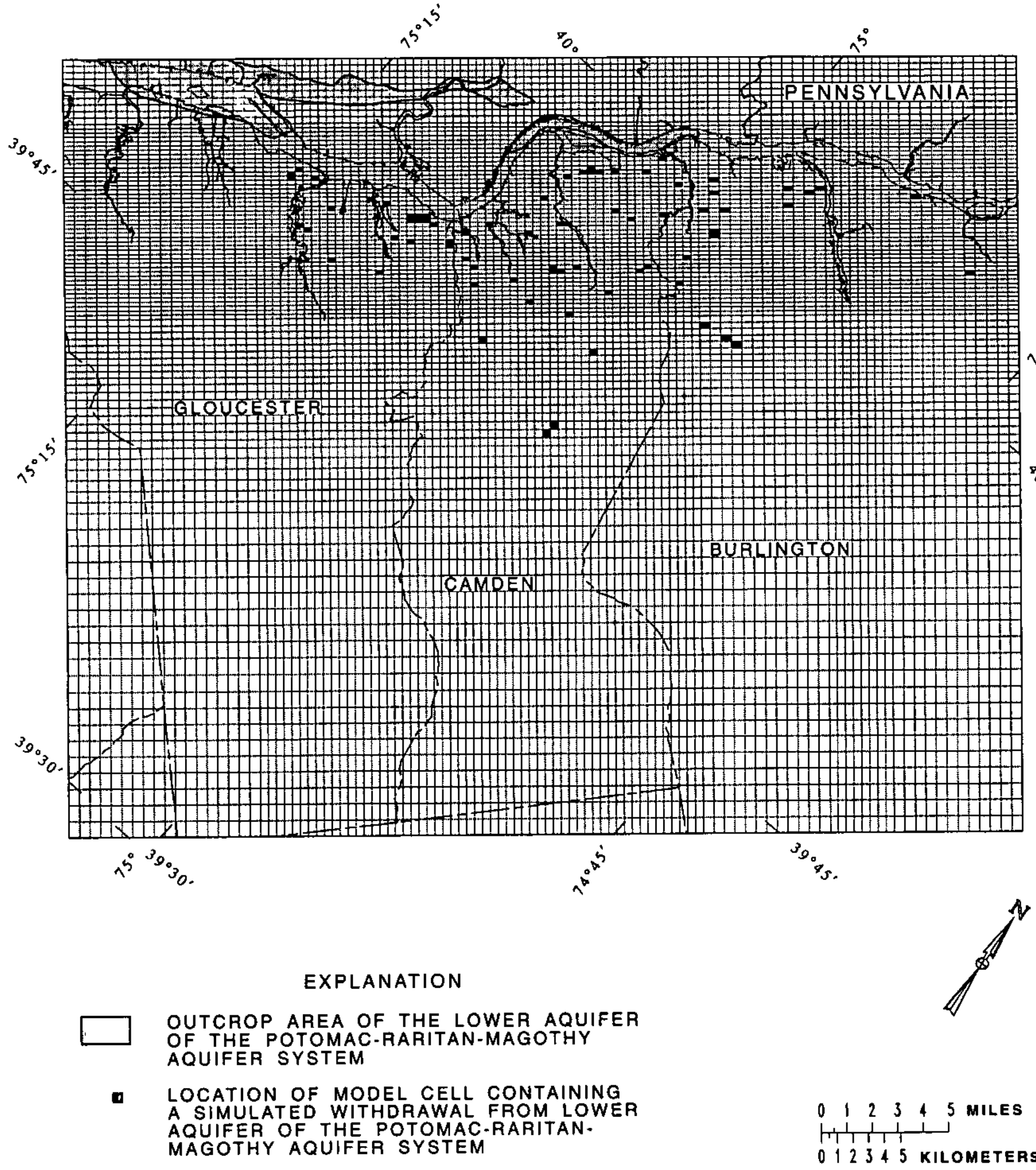


Figure 48. Locations of withdrawals in the flow model for 1983-88, for the lower aquifer of the Potomac-Raritan-Magothy aquifer system.

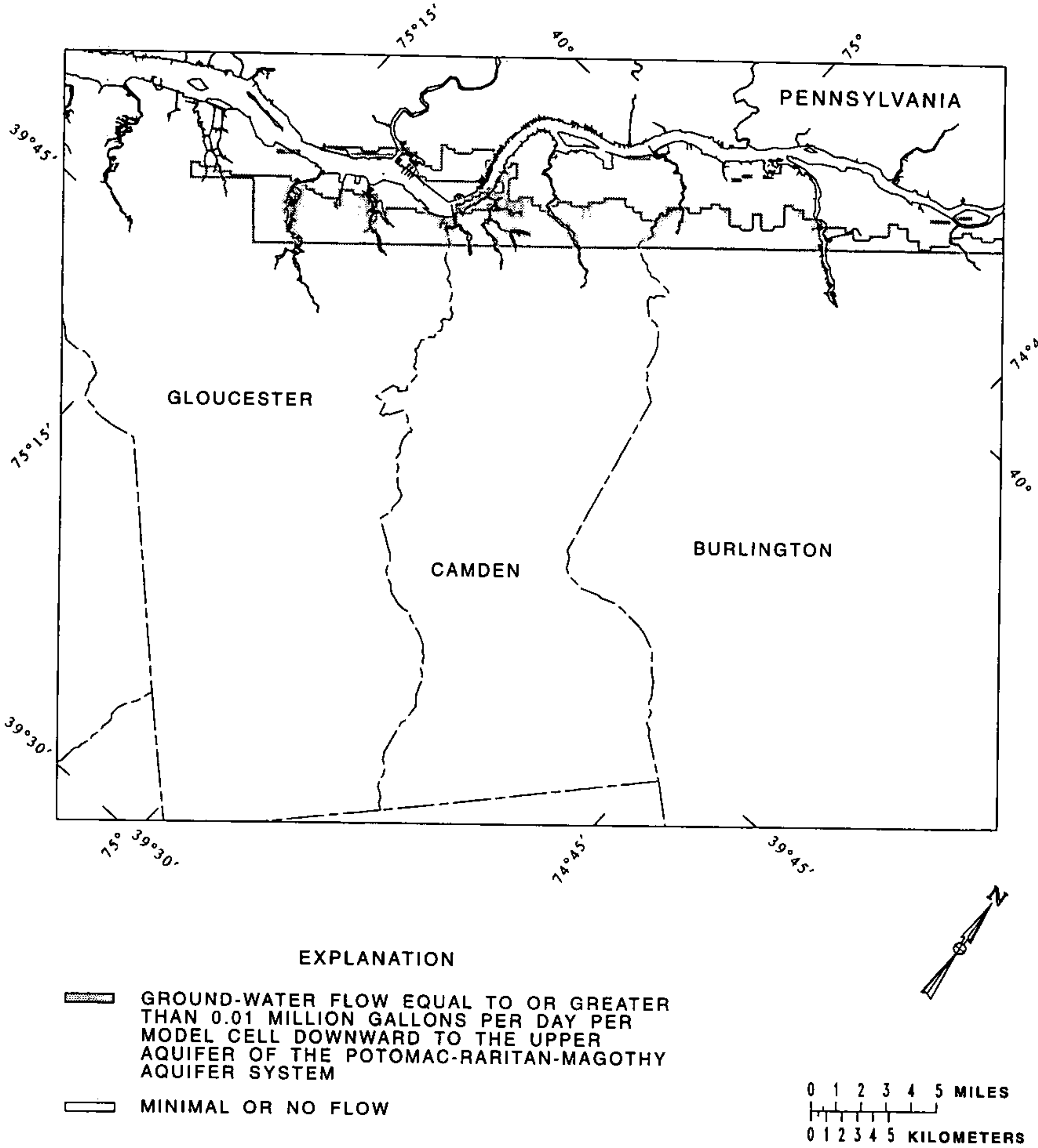
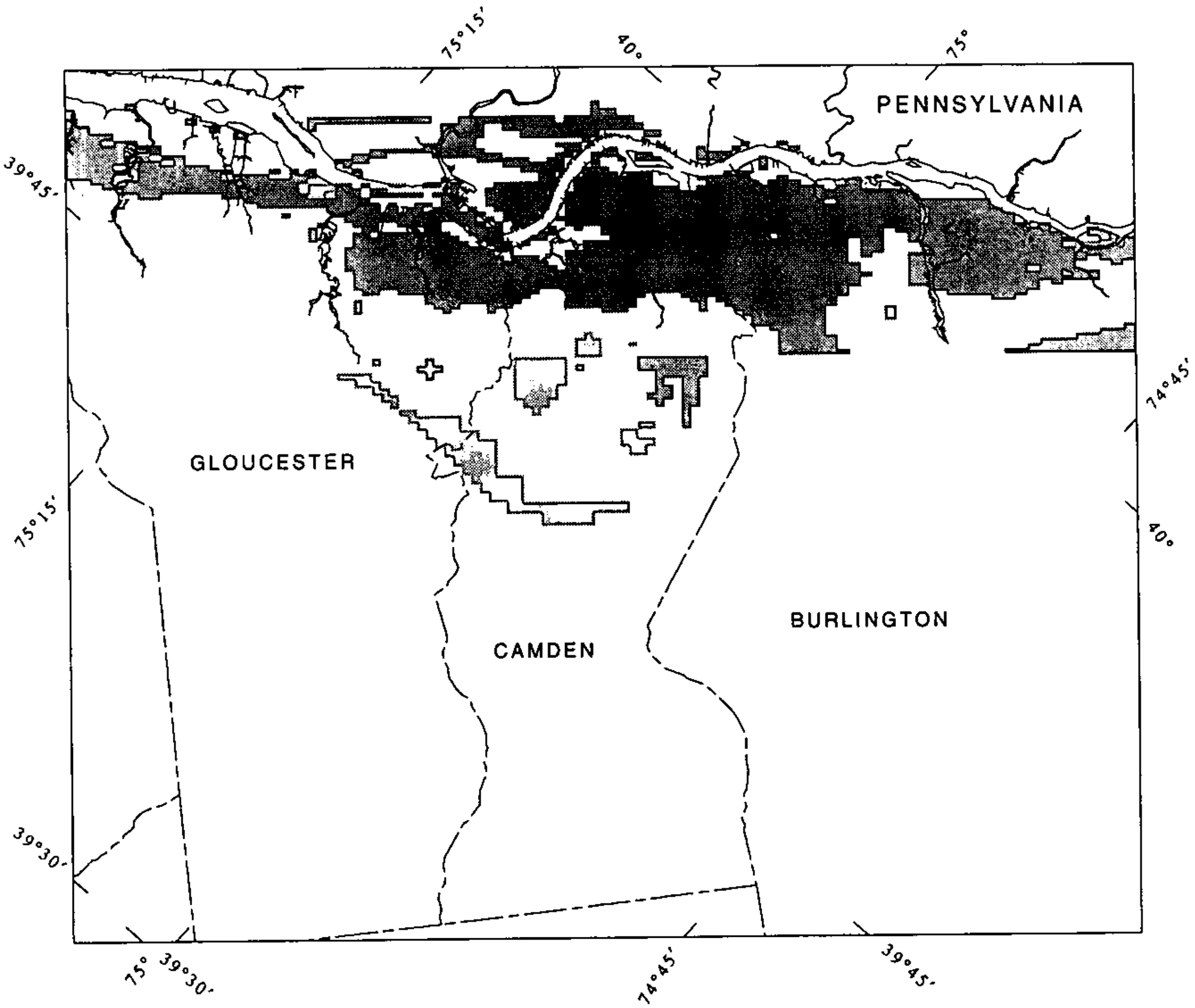
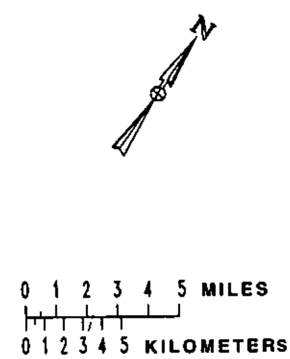


Figure 49. Simulated flow for 1983-88 between the Englishtown aquifer system or other overlying units and the upper aquifer of the Potomac-Raritan-Magothy aquifer system.





EXPLANATION

- GROUND-WATER FLOW EQUAL TO OR GREATER THAN 0.01 MILLION GALLONS PER DAY PER MODEL CELL DOWNWARD TO THE MIDDLE AQUIFER OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM
- GROUND-WATER FLOW EQUAL TO OR GREATER THAN 0.01 MILLION GALLONS PER DAY PER MODEL CELL UPWARD TO THE UPPER AQUIFER OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM
- MINIMAL OR NO FLOW

Figure 50. Simulated flow for 1983-88 between the upper and middle aquifers of the Potomac-Raritan-Magothy aquifer system.

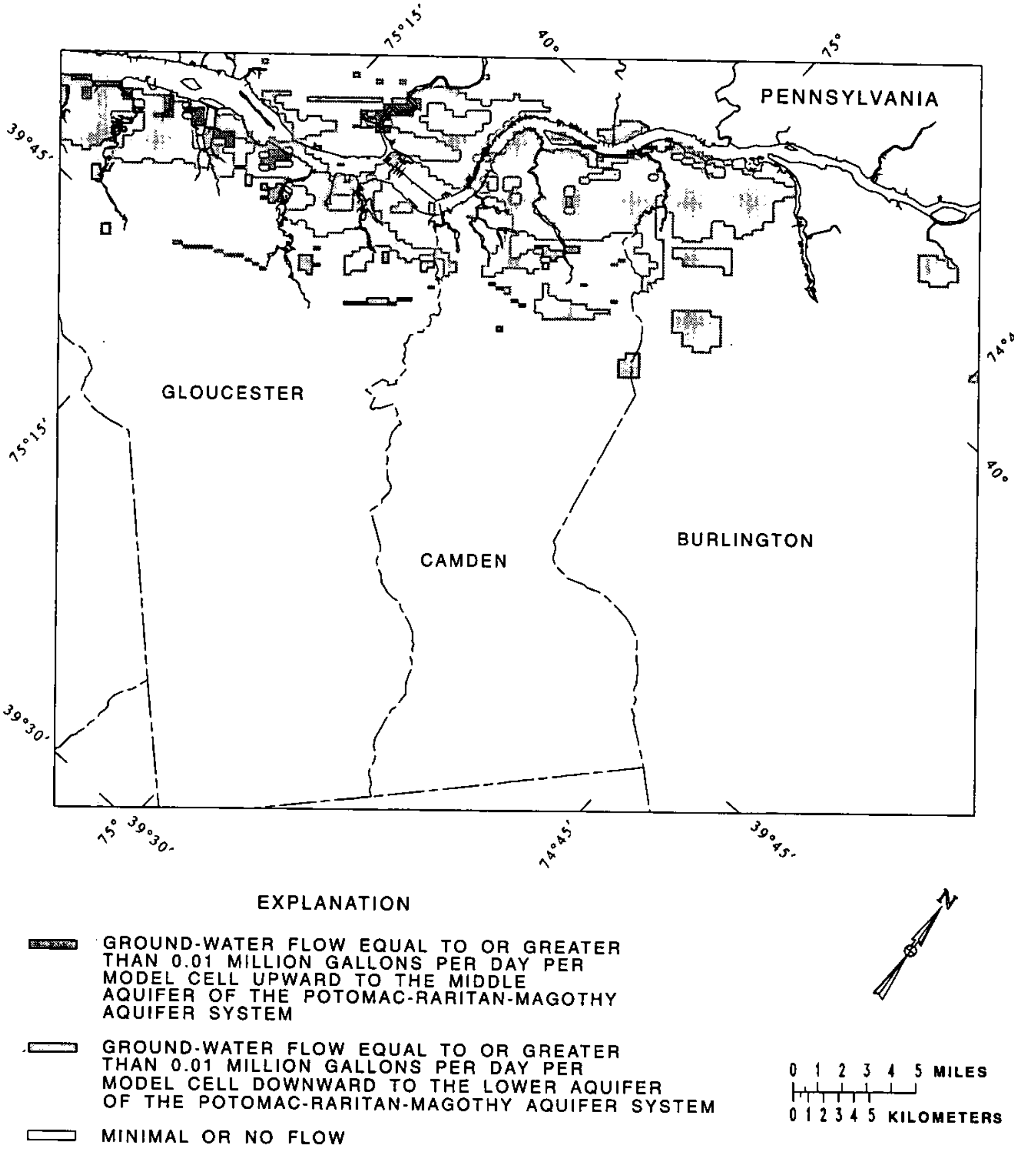


Figure 51. Simulated flow for 1983-88 between the middle and lower aquifers of the Potomac-Raritan-Magothy aquifer system.

Table 8.--Simulated flow budget for the Potomac-Raritan-Magothy aquifer system, 1983-88

[Mgal/d, million gallons per day; ft^3/s, cubic feet per second]

INFLOW TO MODEL		
Storage	0.35314 Mgal/d	0.54636 ft^3/s
Constant head	13.142	20.333
Boundary flow	20.675	31.989
Recharge	172.51	266.91
Leakage from river	29.470	45.596
Total Inflow	236.15	365.37
OUTFLOW FROM MODEL		
Storage	0.77513	1.1992
Constant head	91.099	140.95
Wells (withdrawal)	127.09	196.63
Boundary flow	.20102	.31094
Leakage to river	16.852	26.073
Total outflow	236.01	365.16
Inflow - Outflow	0.13730	0.21240

(percent discrepancy = 0.06)

The simulated hydrographs in figures 33 to 35 show that water levels stabilize within 3 to 5 years after the initiation of a stress period, with its associated changes in withdrawal. The question of the length of time required for the aquifer system's water levels to stabilize if withdrawals were maintained at a particular level is especially important with respect to the management of the aquifer system. Water managers are interested in understanding the conditions necessary to bring the aquifer system to a steady-state condition in order to maintain a sustainable long-term water supply. The measured water-level hydrograph does not show the same step-like water-level response to changes in withdrawals as does the simulated hydrograph. This results in part from the imposition of an increase in withdrawals at the beginning of the stress period that is held constant for the duration of the model stress period, rather than a realistic situation in which change is gradual and continuous. The model probably allows water levels to stabilize and reach apparent steady-state conditions earlier than would be expected in the real system. Therefore, the 3- to 5-year period required by the model to reach stability probably is the minimum time necessary to reach stability in an ideal situation in which all stresses are maintained at a constant rate. The actual time required to reach stability in the real world is likely to be longer, perhaps 10 to 15 years, but this estimate is speculative.

Given the 3- to 5-year stabilization period for simulated water levels after changes in stress, further analysis of the flow system could be accomplished by using the model in a steady-state mode without incurring serious error. Furthermore, due to the likelihood of a curtailment or restrictions on water use from the aquifer system in the future, a substantial future increase in withdrawals is unlikely. Thus, current (1987) withdrawal conditions can be used for further analysis as a likely future scenario.

River-Aquifer Interaction

River-aquifer interactive processes in the Camden area can be evaluated by using the Camden area ground-water flow model. The model can be used to determine the location and amount of flow between the river and the aquifer system, which otherwise would require a prohibitively expensive field program to collect data on differential head measurements or actual leakage flows.

Magnitude and distribution of river recharge

The amount of water from the river recharging the aquifer system was about 30 Mgal/d in 1983-88, as simulated by the model. This amount is smaller than that estimated by previous investigators. The models developed by Luzier (1980), Harbaugh and others (1980), and Martin (1990) have relatively coarse grid spacing and represent the Delaware River as a constant-head boundary with considerable overlap into the landward outcrop area of the aquifer system that also contributes recharge. At the coarse scale, the significance of the flow from the river relative to recharge from the outcrop area could not be resolved in any detail. The models may have overestimated the flow from the river while underestimating the recharge from the outcrop area. The simulation results obtained by using the model developed herein indicate that the recharge from the river is regionally less important than the recharge from the outcrop area. This becomes apparent when the grid spacing used is sufficiently fine that the river and outcrop area are represented realistically.

Although interest may focus on flow from the river to the aquifer system, flow in the opposite direction, from the aquifer system to the river, is significant and was simulated to be 17 Mgal/d within the study area. This flow is shallow and occurs along the outcrop area far from any intense withdrawals, where ground water flows through the aquifer system on a relatively short flow path that discharges into the river. Figure 52 shows the simulated areas of flow and relative magnitude of leakage from river to aquifer for the upper, middle, and lower aquifers. The areas in which water from the river is recharging the aquifer system (fig. 52) are in the immediate vicinity of the locations of the simulated water-supply withdrawals (figs. 46-48).

River-influenced zones

The orientation of the recharge sites, as seen on figure 52, indicates that only the withdrawals near the river induce water to flow from the river. The flow path from the river into the aquifer system can be determined by using particle-tracking techniques. Particle tracking is a process whereby hypothetical particles are simulated as if they are being carried along by the ground-water flow system. The results of a flow simulation, in terms of head distribution and associated data, can be used as a basis for this type of analysis. The particles are tracked explicitly through a flow field by computing the directional components of velocity at a particle's current position and moving it to a new position that is determined by multiplying those velocity components by a finite time step to obtain the incremental change in the particle's location over that interval of time. As this process is repeated, a series of locational and time coordinates are produced that trace the path of a particle through the flow field as a function of time, generating flow-path lines and time-of-travel information (Pollock, 1988).

Pollock (1989) presents a computer software package, referred to as "Modpath," that can perform particle-tracking analysis as a follow-on or post-processing role to the Modular computer program used in this study. The Modpath software, however, requires that the flow velocity field be specified in a steady-state condition. This requirement is compatible with the conclusion that further analysis with the model could be accomplished through steady-state analysis, as discussed previously.

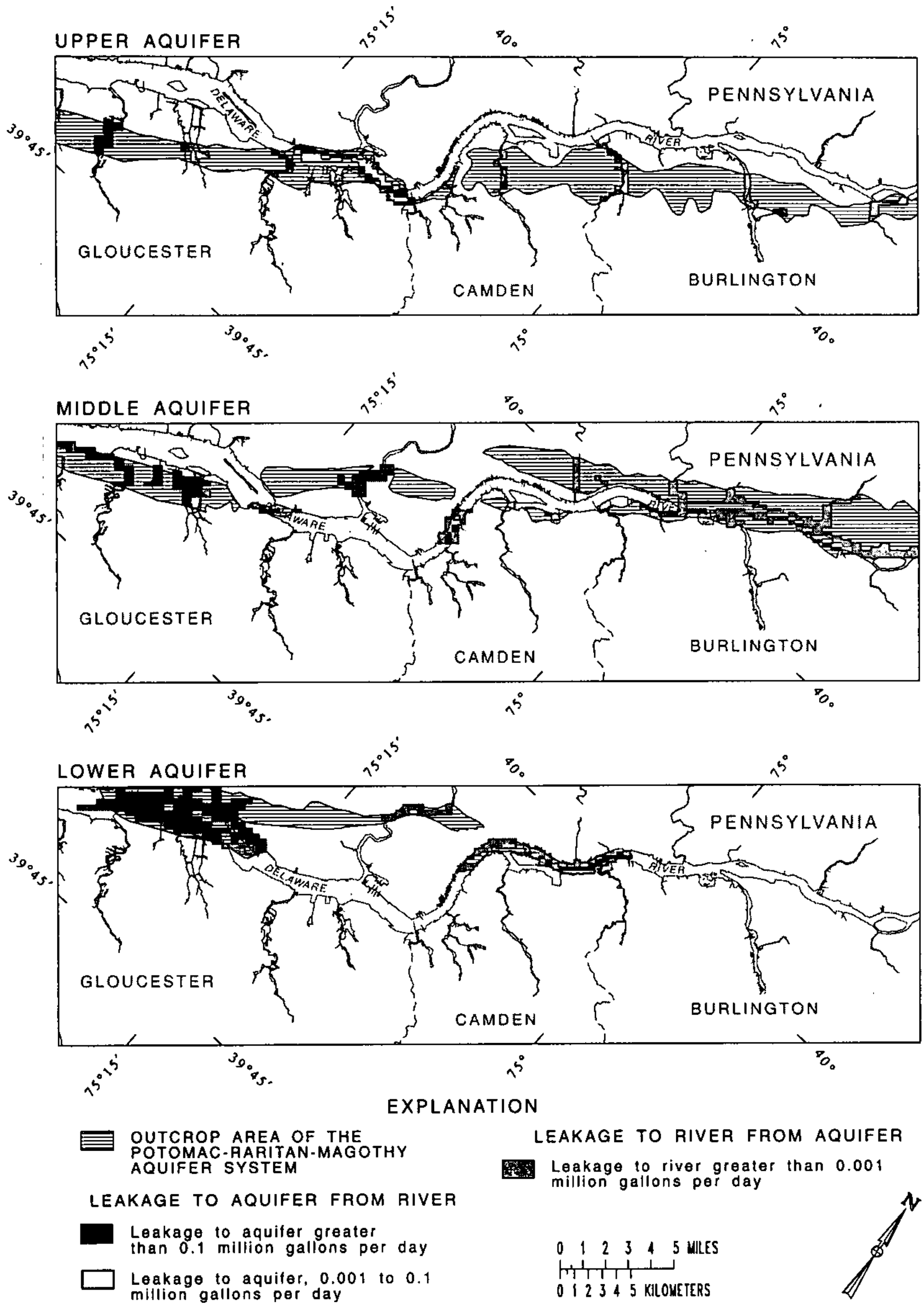


Figure 52. Simulated flow between the Delaware River and the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system, 1983-88

A steady-state simulation was performed by using stress-period 10 (1983-88) withdrawals. The results of the simulation were analyzed by using the Modpath particle-tracking package. Porosities of 25 percent, typical of sand, and 40 percent, typical of clay, were used in the simulation (Freeze and Cherry, 1979). Particles were distributed on the top face of model cells that provide recharge to the aquifer system (fig. 52), simulating the point at which water enters the aquifer system from the river, and were tracked on their path into the aquifer system. The areas in which the simulated flow paths extend through each of the three aquifers are shown in figure 53. Two zones are shown, the part of the aquifer in which travel time from the river to the aquifer system is less than 10 years, and the part in which travel time is between 10 and 20 years. These zones contain flow originating from other areas, such as the outcrop area, as well as flow from the river; nevertheless, they can be considered "river-influenced" zones.

The locations of the simulated withdrawals within the river-influenced zones are also shown in figure 53. The interaction between the river and aquifers does not occur in a broad area of infiltration along the entire reach of the river adjacent to the regional cone of depression, but rather the flow paths from the river are affected by and directed toward the locations of the local, river-proximal withdrawals. Although the scale of the interaction is decidedly local rather than regional in character, the Delaware River's significance as a major recharge feature is not diminished. Withdrawals within the 20-year river-influenced zone for average 1983-88 conditions are 33 Mgal/d, about one-third of the water-supply withdrawals in the Camden area.

Future Conditions

Future water-management practices, primarily the magnitude of withdrawals, will have a profound effect on the condition of the Potomac-Raritan-Magothy aquifer system in the Camden area. The Camden ground-water flow model was used to evaluate the effects of three ground-water withdrawal scenarios on the components of the flow system.

Withdrawal Scenarios

The management of the aquifer system in the future will likely follow or be similar to one of three scenarios. One scenario is that no water-management action will be taken and that unconstrained withdrawals from the aquifer system will be allowed to meet future demands. Another scenario is that withdrawals within the Camden area will be restricted to current (mid- to late-1980's) rates and that future demand will be satisfied by water from some alternative source. In the third scenario, withdrawals from the aquifer system within the Camden area would be reduced to 65 percent of the reported 1983 withdrawals. In this scenario, both the displaced current usage and future demand would be satisfied by water from some alternative source. This third scenario is consistent with that in the "Proposed Water Supply Critical Area #2" plan defined by NJDEP in 1986 (New Jersey Department of Environmental Protection, 1986). In this report, these scenarios are referred to as A, B, and C, as follows:

A -- Unconstrained aquifer-system withdrawals to meet future needs,
B -- Maintain aquifer-system withdrawals at present rates, and
C -- Reduce aquifer-system withdrawals to 65 percent of 1983 rates.

The withdrawal input data for the Camden ground-water flow model used to evaluate each of the three scenarios were developed by modifying the historical withdrawal records. For Scenario A, the unconstrained withdrawals were assumed to satisfy the future water demand in the Camden area. Camp Dresser and McKee (1984a, p. 3-46) determined that demand for water supply by public purveyors and self-supplied users would be 13.0 Mgal/d by the year 2000 and 25.9 Mgal/d by the year 2020-- increases of 12 percent

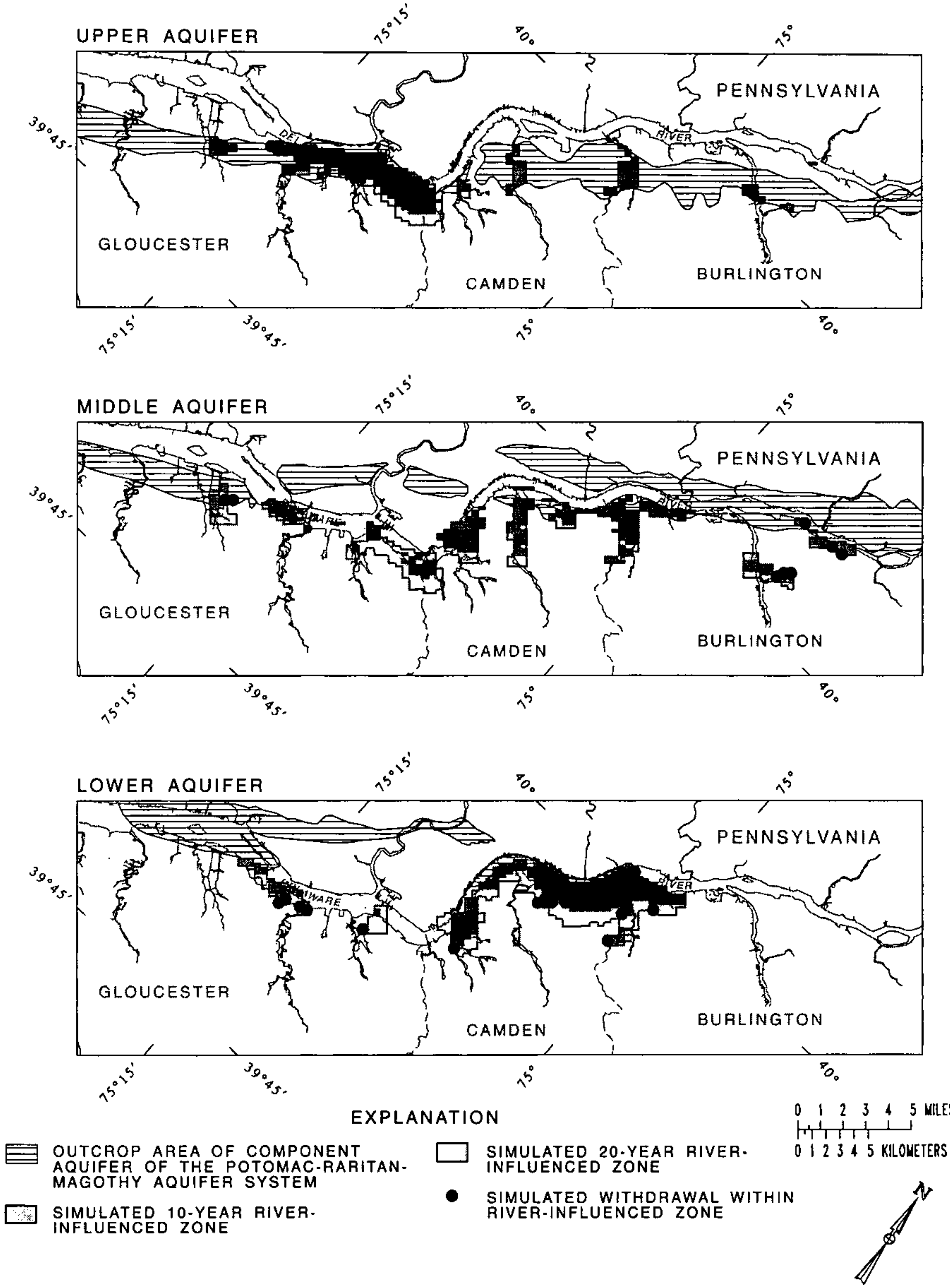


Figure 53. Simulated river-influenced zones, 1983-88, in the upper, middle, lower aquifers of the Potomac-Raritan-Magothy aquifer system.

and 24 percent, respectively, over present demand. Camp Dresser and McKee (1984a) projected that the increase in demand by self-supplied users would be minimal. They projected the demand by public purveyors to increase 14 percent by the year 2000 and 27 percent by 2020. The 27-percent increase was used as the basis of an unconstrained-growth scenario for this investigation and was applied linearly over the planning period to the year 2020 for all aquifer-system wells in the study area. For simulation purposes, the linear increase in withdrawal was proportioned over six stress periods, numbered 11 to 16. The total withdrawal rates in Scenario A for each stress period are shown in figure 54, and the model input data are listed in table 9 (at end of report).

The withdrawals in Scenario B are restricted to current (1987) rates. The model input data used to evaluate the scenario were stress period 10 withdrawal rates, the average of the period 1983-88, when relatively little change in aquifer-system withdrawals occurred. The stress-period 10 withdrawal rates were replicated for stress-periods 11 - 16, extending to the year 2020. The total withdrawal rates in Scenario B for each stress period are shown in figure 54, and the model input data are listed in table 9.

The withdrawals in Scenario C, restricted to 65 percent of reported 1983 withdrawals, were developed by reducing withdrawal rates from stress period 9 by 35 percent. This amount was attributed to stress-period 11 in the model, beginning in 1990, and was replicated for stress-periods 12 - 16, extending to the year 2020. The total withdrawal rates in Scenario C for each stress period are shown in figure 54, and model input data are listed in table 9.

General Regional Flow Conditions

The Camden ground-water-flow model was used to simulate each of the three withdrawal scenarios by using the withdrawal data described above. The results of the simulations are predicted aquifer heads. The flow budget for each scenario was determined and the hydrologic conditions resulting from each scenario were evaluated.

Potentiometric-surface maps of the simulated heads in each unit of the aquifer system in the year 2020 resulting from Scenario A withdrawals are shown in figures 55 - 57. The potentiometric surfaces of the aquifers decline through the simulated period to 2020, when the regional cone of depression extends to a maximum depth of 140 ft below sea level, about 40 ft deeper than in 1988 conditions.

Potentiometric-surface maps of the simulated heads in each unit of the aquifer system in the year 2020 resulting from Scenario B withdrawals are shown in figures 58 - 60. The potentiometric surfaces of the aquifers essentially stabilize at current levels through the period to 2020, because withdrawals have remained constant. The simulation results show that heads stabilize within several years. As discussed earlier, the time required for water levels to stabilize in the real system may be longer.

Potentiometric-surface maps of the simulated heads in each unit of the aquifer system in the year 2020 resulting from Scenario C withdrawals are shown in figures 61 - 63. The potentiometric surfaces of the aquifers recover in stress-period 11 and remain stable through the period to the year 2020. The regional cone of depression extends to a maximum depth of only about 60 ft below sea level, about 40 ft shallower than in 1988 and similar to conditions measured in the mid-1960's. Simulated hydrographs for the wells 15-297 (Shell Obs 6, upper aquifer), 05-261 (Medford 5, middle aquifer), and 07-412 (Elm Tree 2, lower aquifer) are shown in figures 64, 65, and 66, respectively. These hydrographs typify the response of water levels in each aquifer to the scenarios.

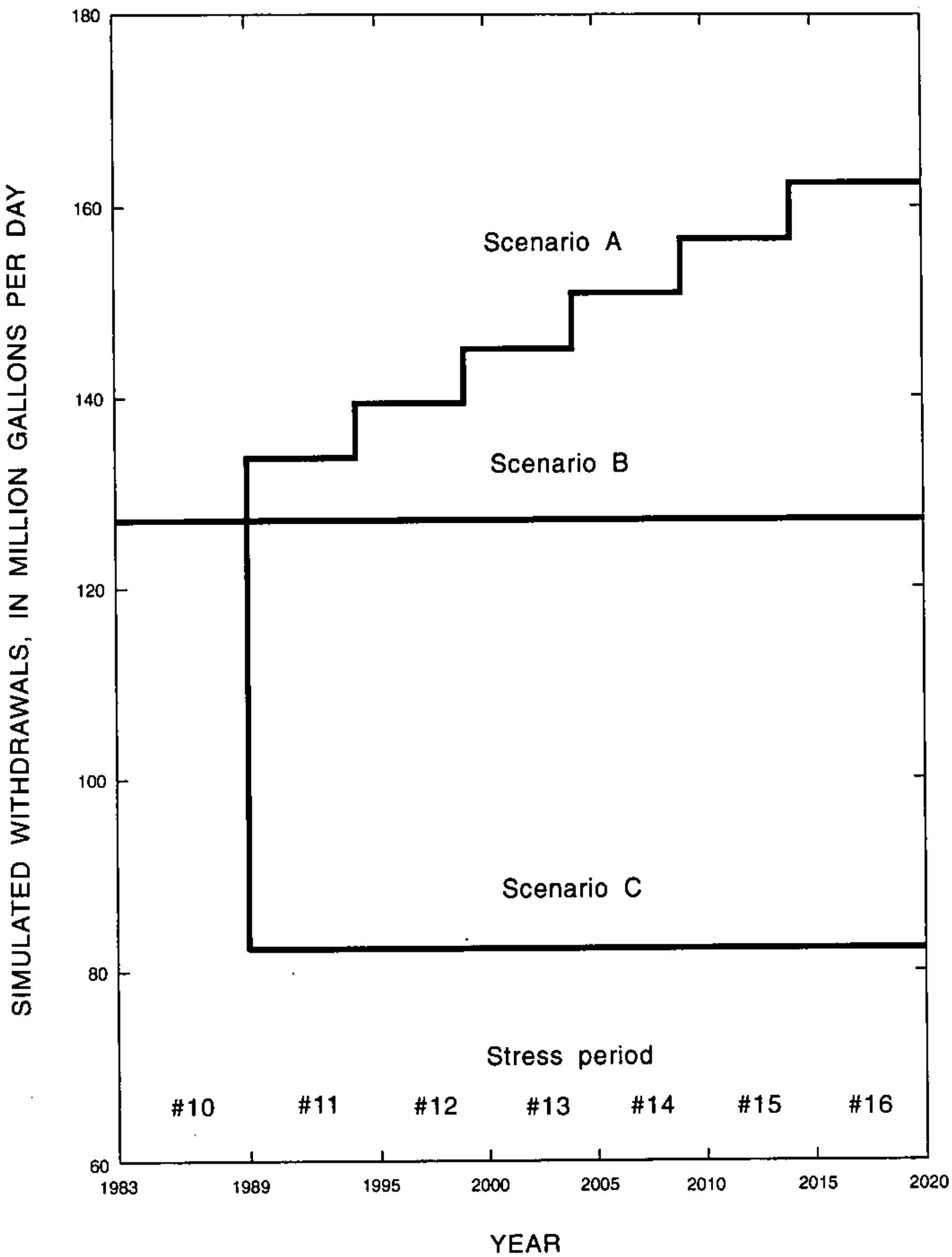


Figure 54. Simulated withdrawals for Scenarios A, B, and C.

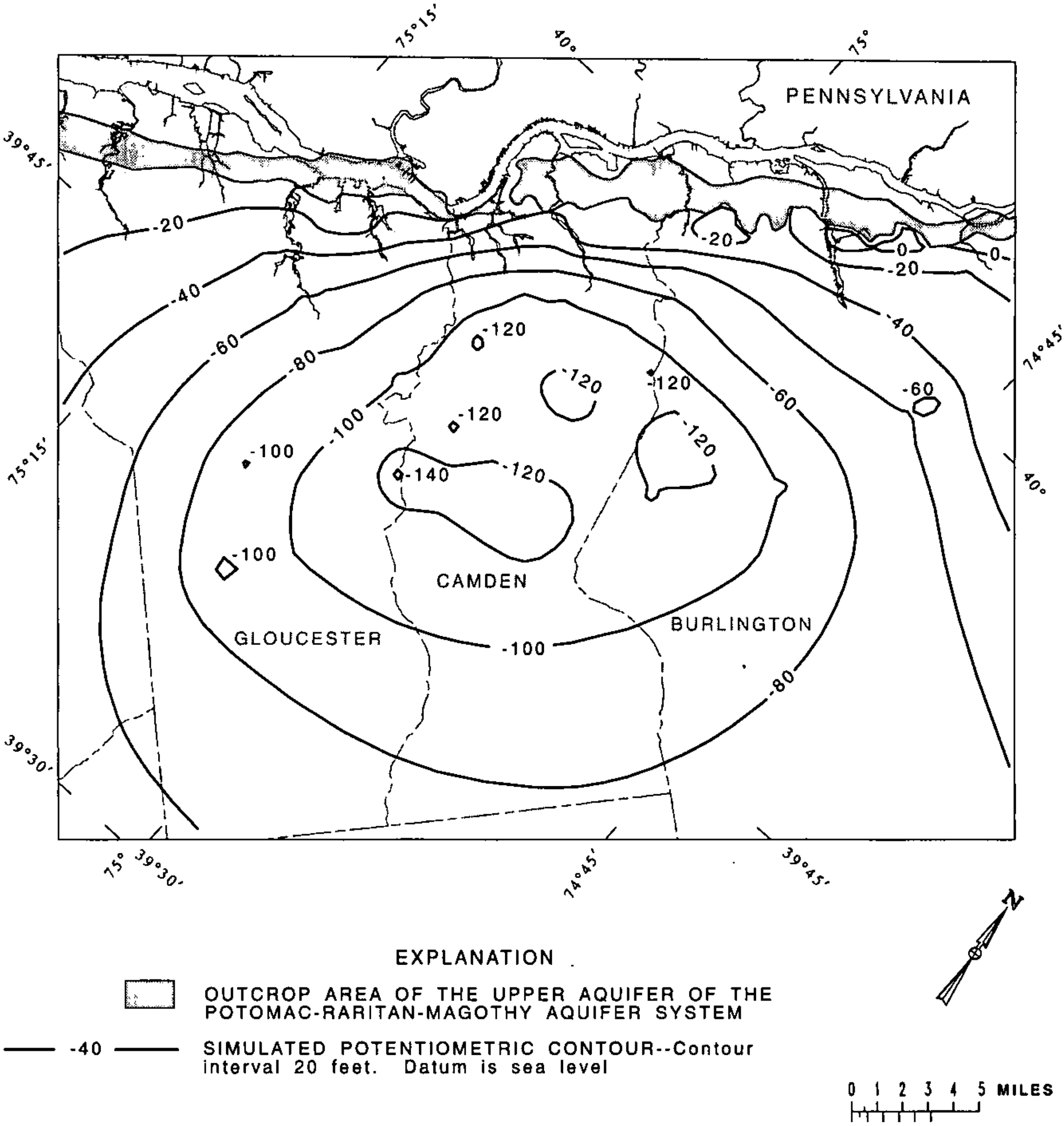


Figure 55. Simulated potentiometric surface for Scenario A (unconstrained withdrawals) in the year 2020, in the upper aquifer of the Potomac-Raritan-Magothy aquifer system.

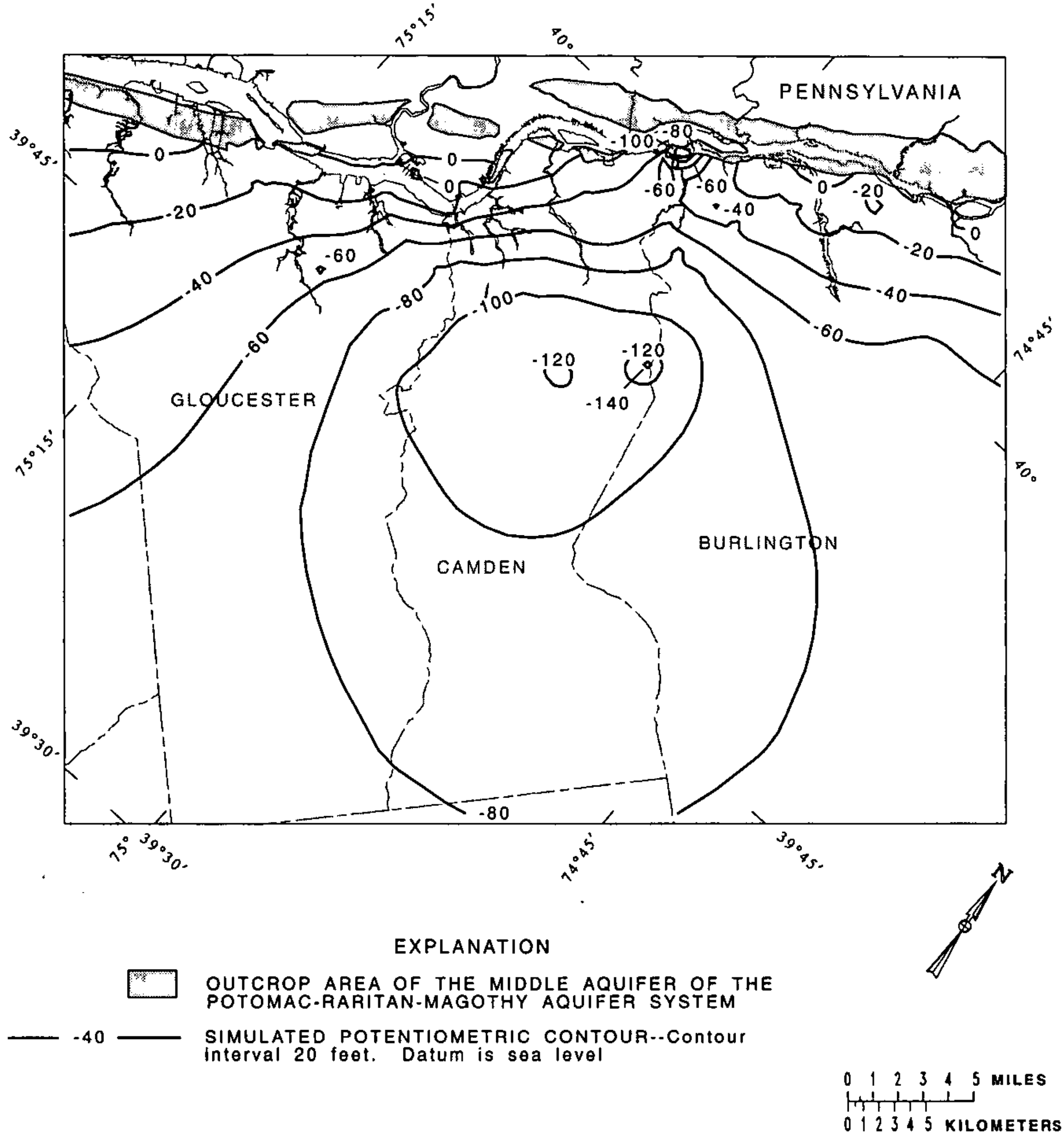


Figure 56. Simulated potentiometric surface for Scenario A (unconstrained withdrawals) in the year 2020, in the middle aquifer of the Potomac-Raritan-Magothy aquifer system.

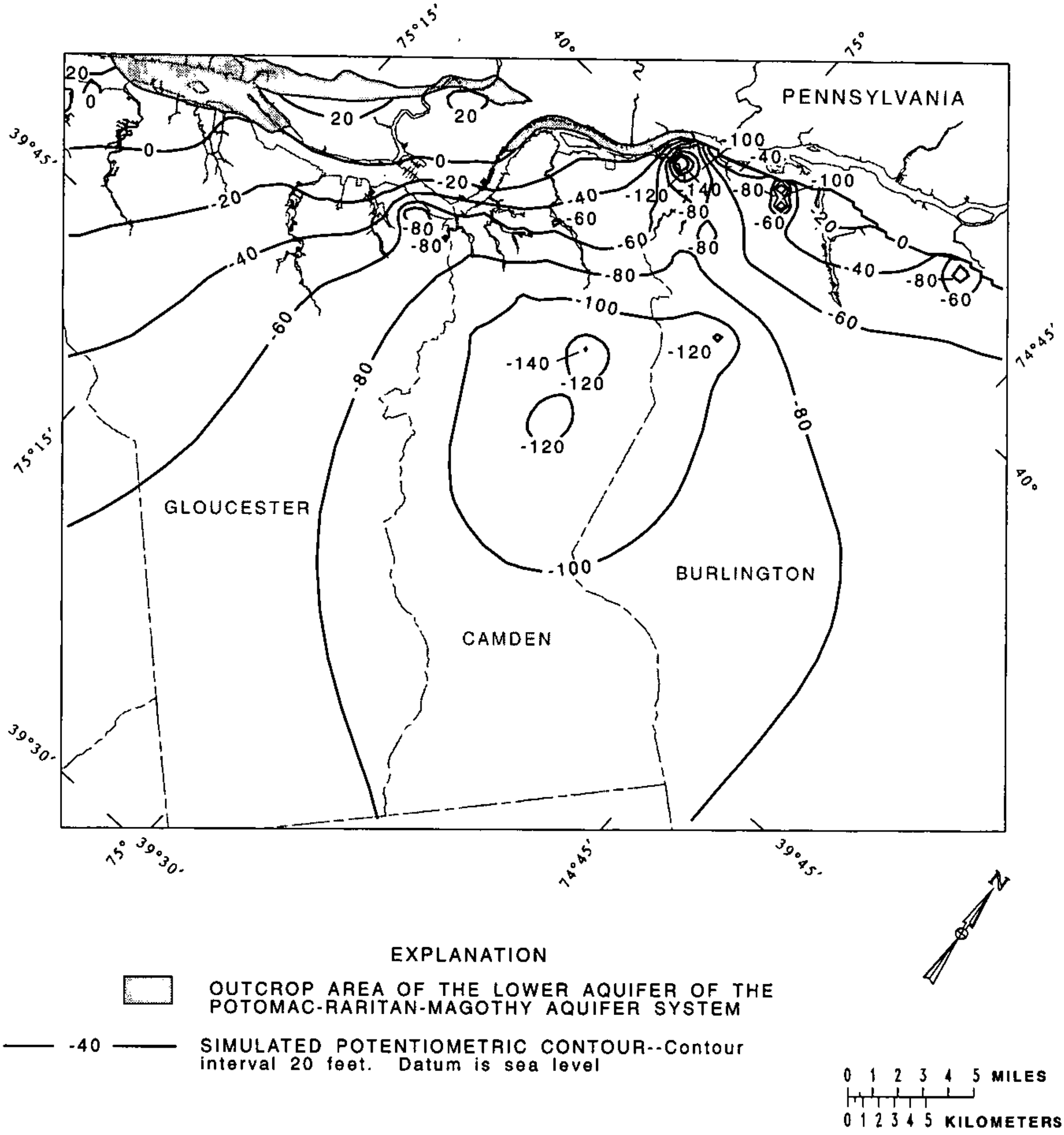


Figure 57. Simulated potentiometric surface for Scenario A (unconstrained withdrawals) in the year 2020, in the lower aquifer of the Potomac-Raritan-Magothy aquifer system.

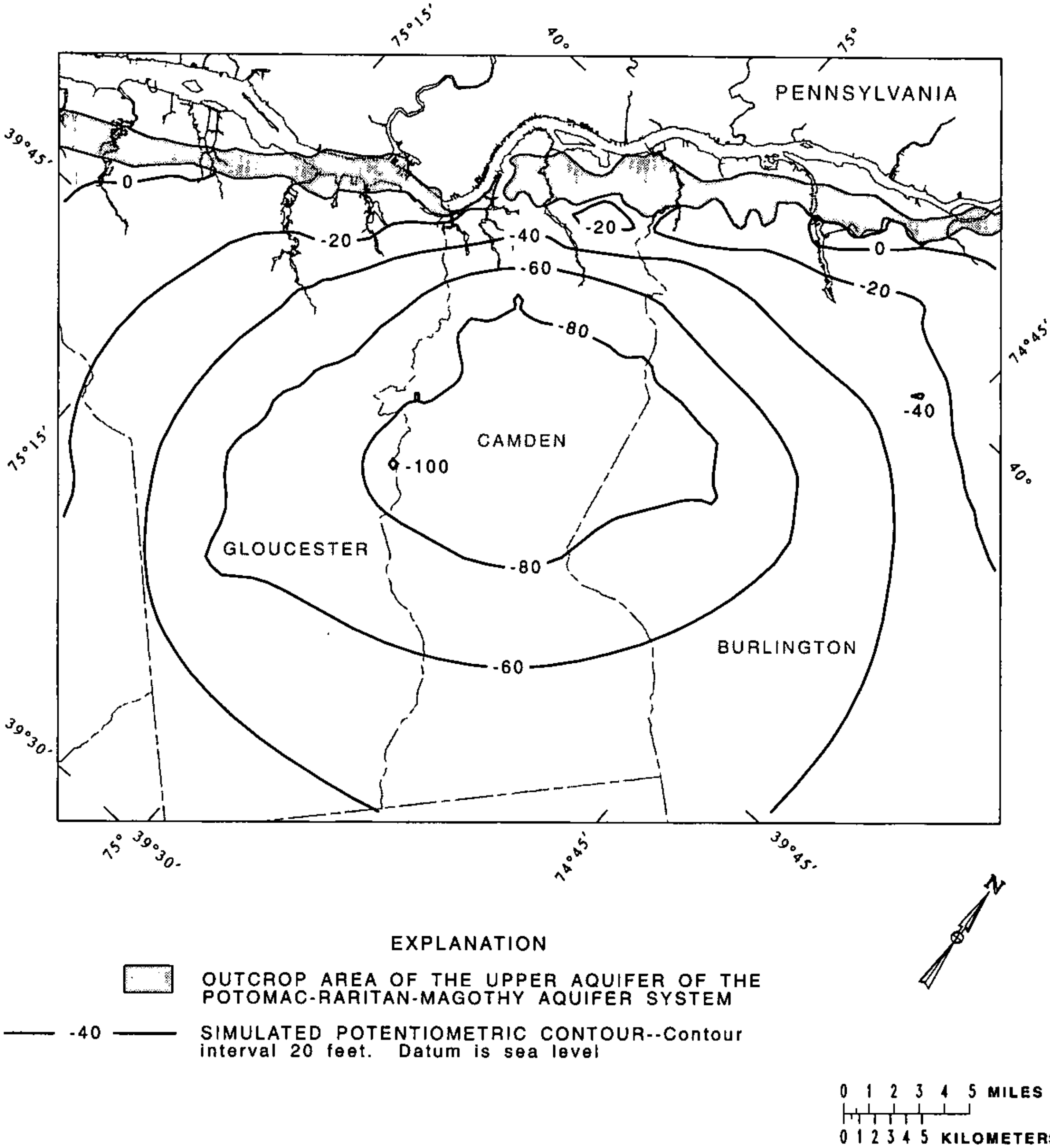


Figure 58. Simulated potentiometric surface for Scenario B (withdrawal maintained at current levels) in the year 2020, in the upper aquifer of the Potomac-Raritan-Magothy aquifer system.

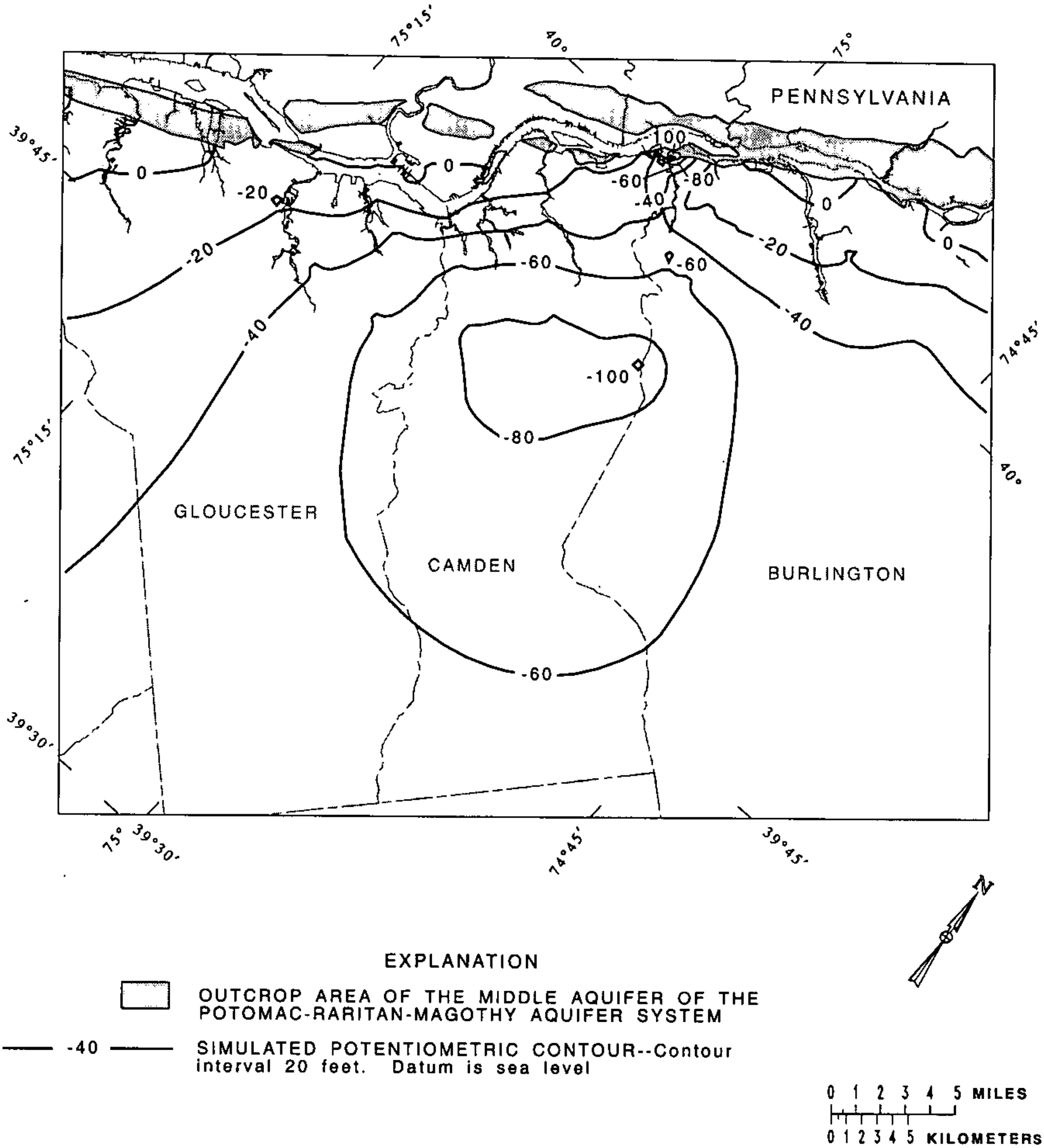


Figure 59. Simulated potentiometric surface for Scenario B (withdrawal maintained at current levels) in the year 2020, in the middle aquifer of the Potomac-Raritan-Magothy aquifer system.

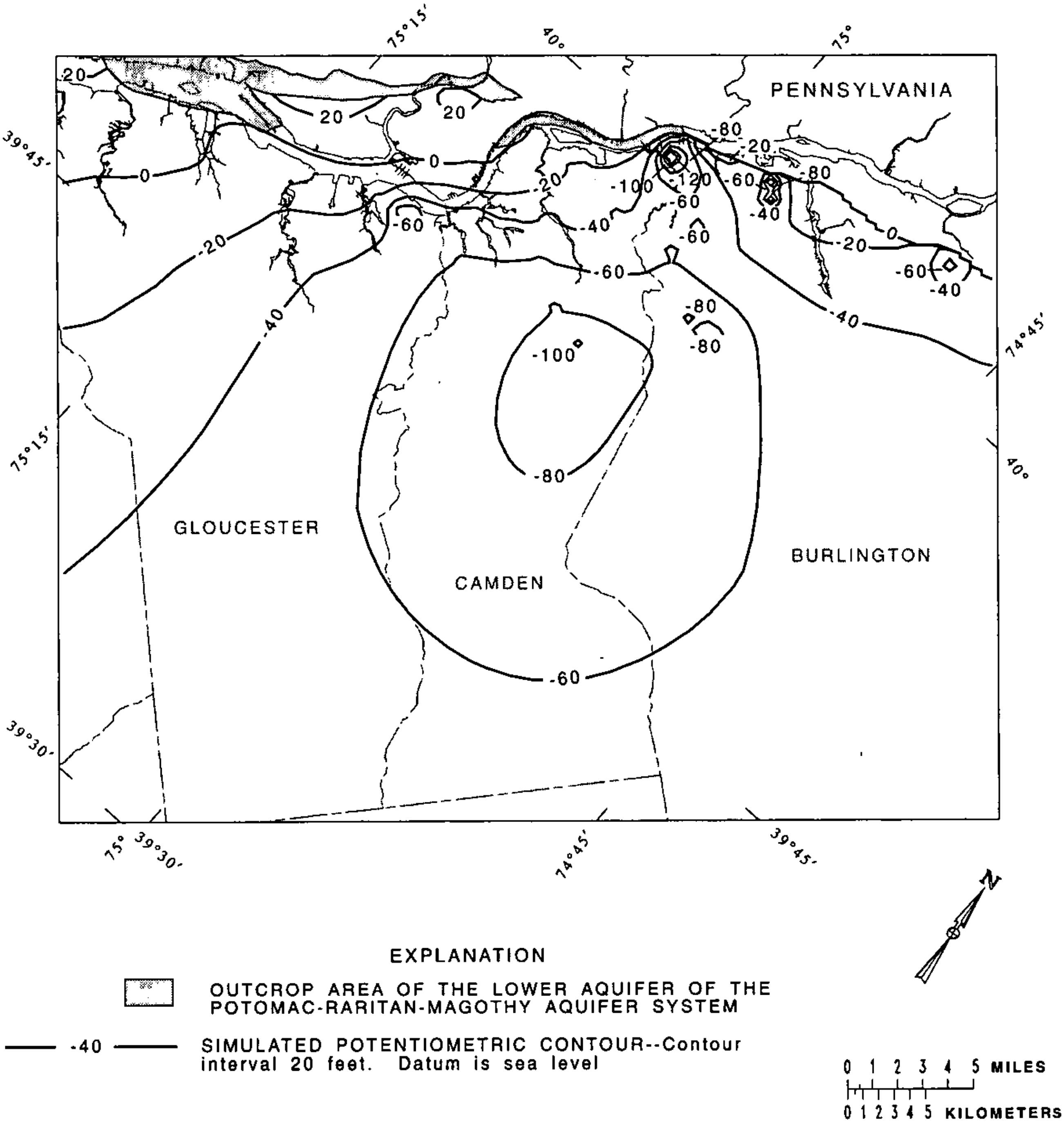


Figure 60. Simulated potentiometric surface for Scenario B (withdrawal maintained at current levels) in the year 2020, in the lower aquifer of the Potomac-Raritan-Magothy aquifer system.

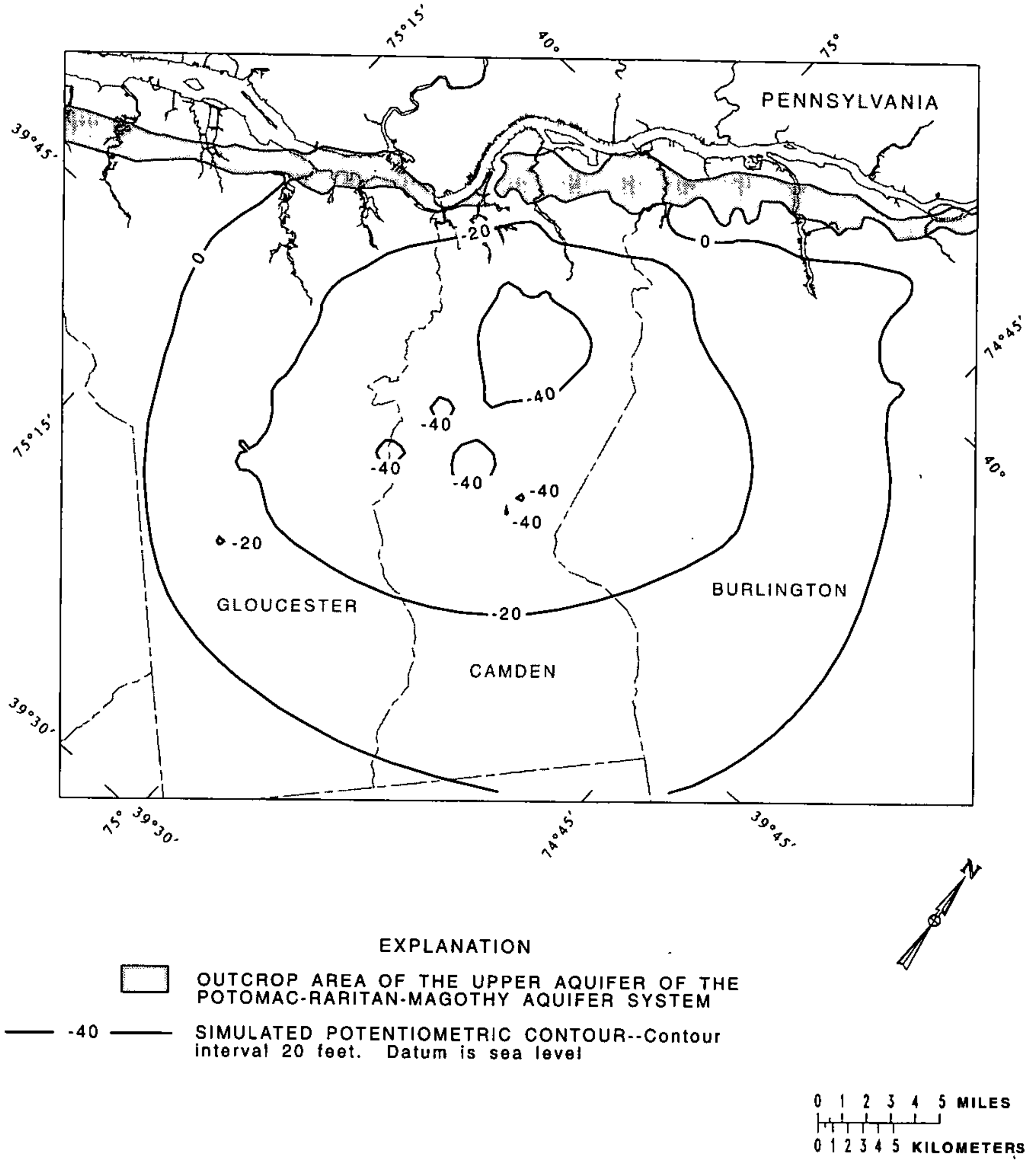


Figure 61. Simulated potentiometric surface for Scenario C (35 percent withdrawal reduction) in the year 2020, in the upper aquifer of the Potomac-Raritan-Magothy aquifer system.

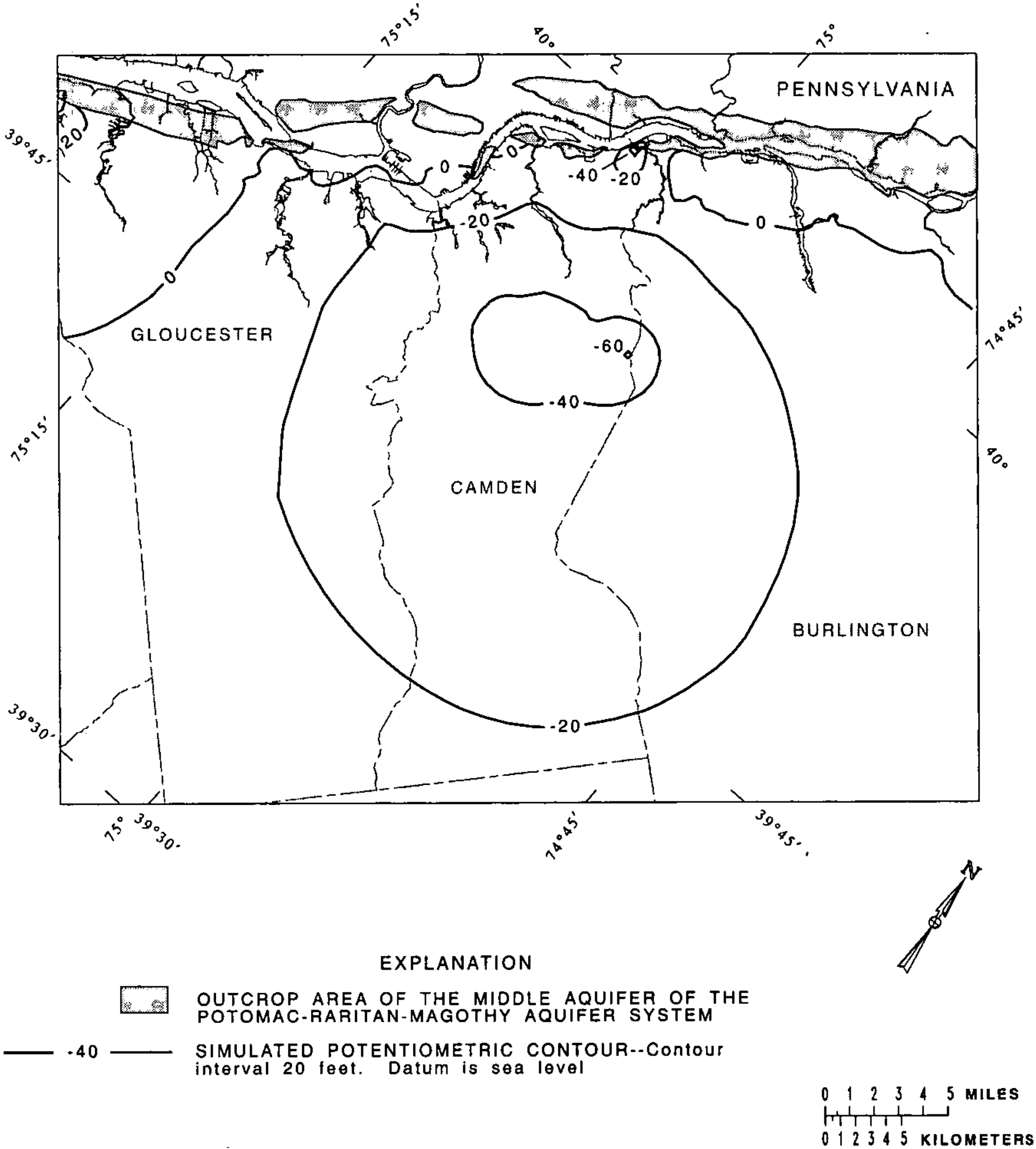


Figure 62. Simulated potentiometric surface for Scenario C (35 percent withdrawal reduction) in the year 2020, in the middle aquifer of the Potomac-Raritan-Magothy aquifer system.

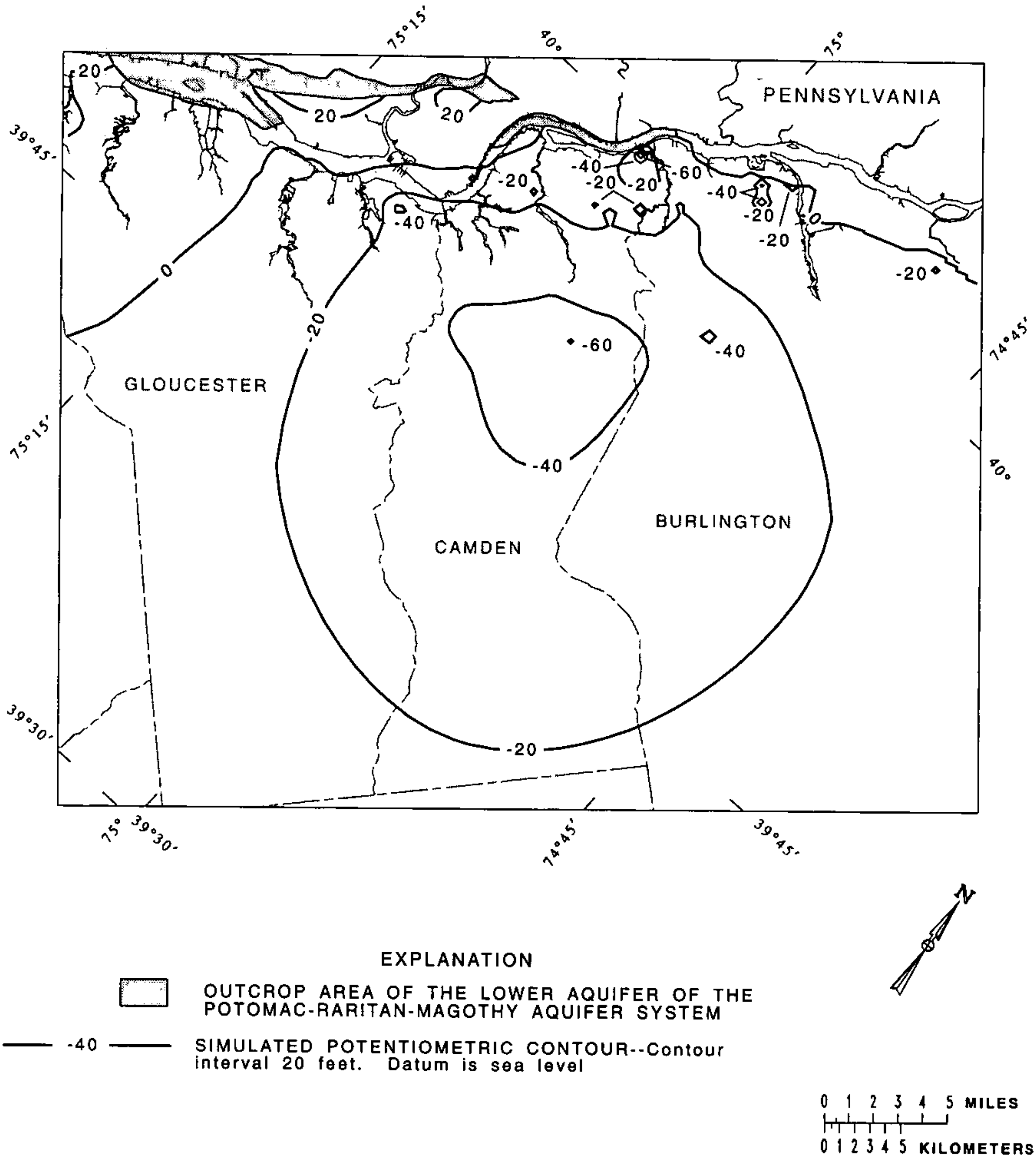


Figure 63. Simulated potentiometric surface for Scenario C (35 percent withdrawal reduction) in the year 2020, in the lower aquifer of the Potomac-Raritan-Magothy aquifer system.

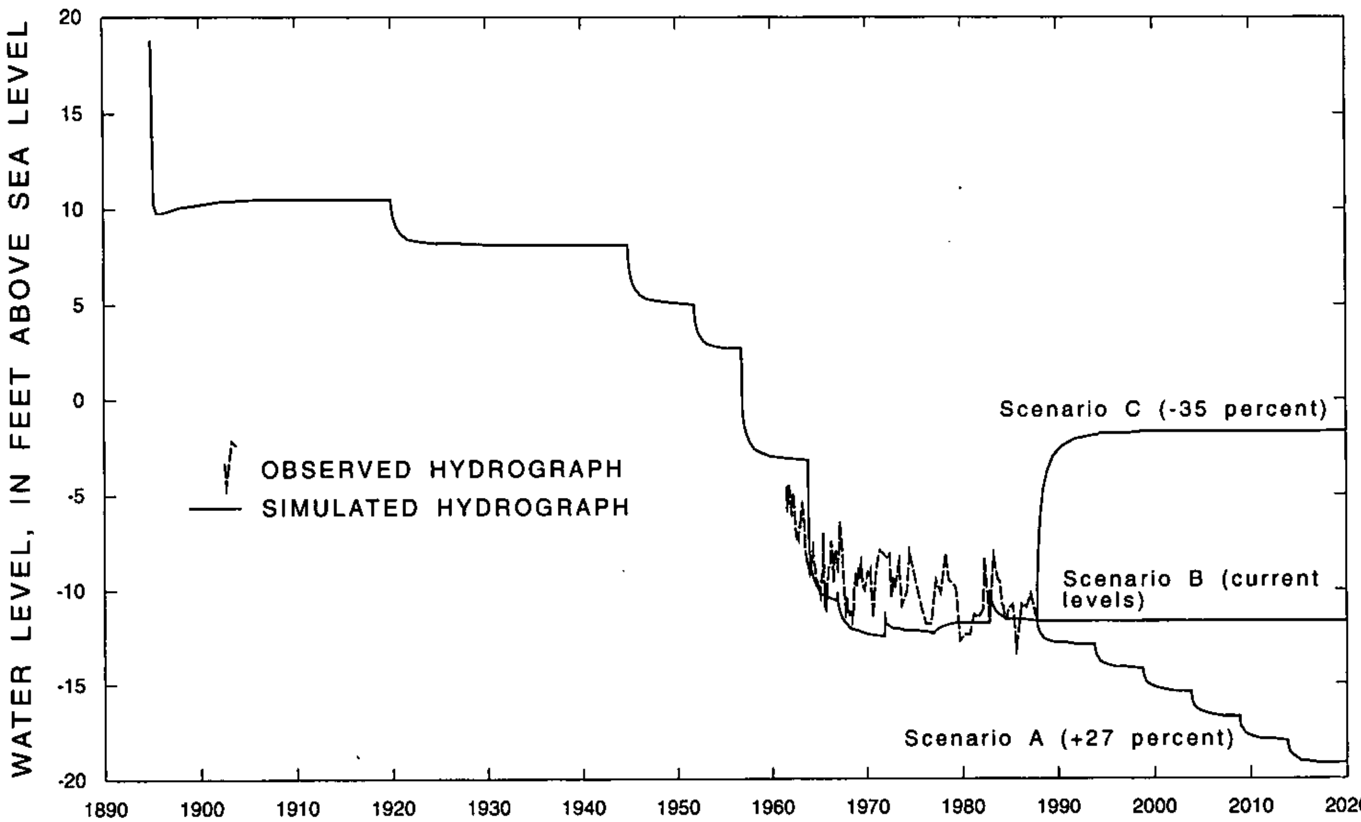


Figure 64. Simulated hydrographs showing water levels for Scenarios A, B, and C in observation well 15-297 (Shell Obs 6) in the upper aquifer of the Potomac-Raritan-Magothy aquifer system

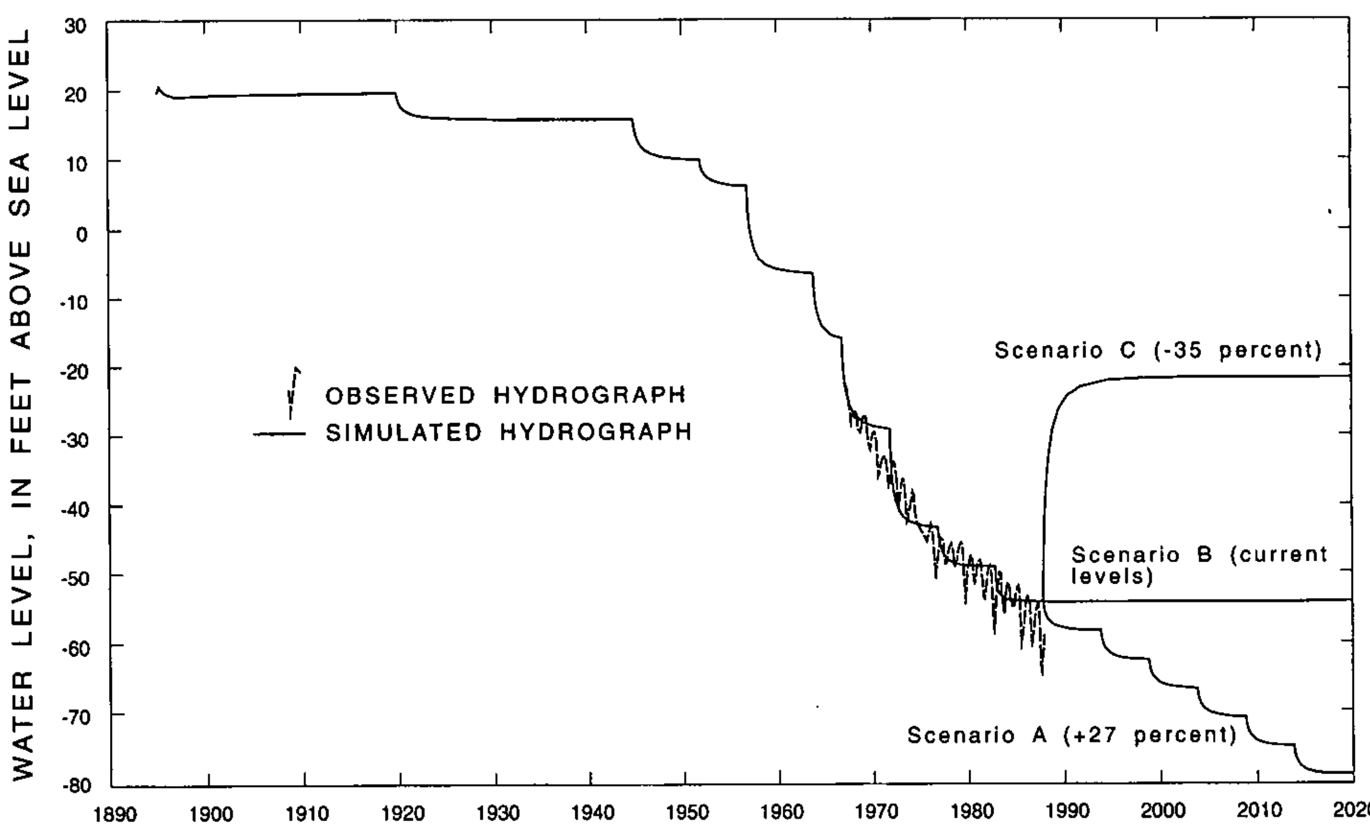


Figure 65. Simulated hydrographs showing water levels for Scenarios A, B, and C in observation well 05-261 (Medford 5) in the middle aquifer of the Potomac-Raritan-Magothy aquifer system.

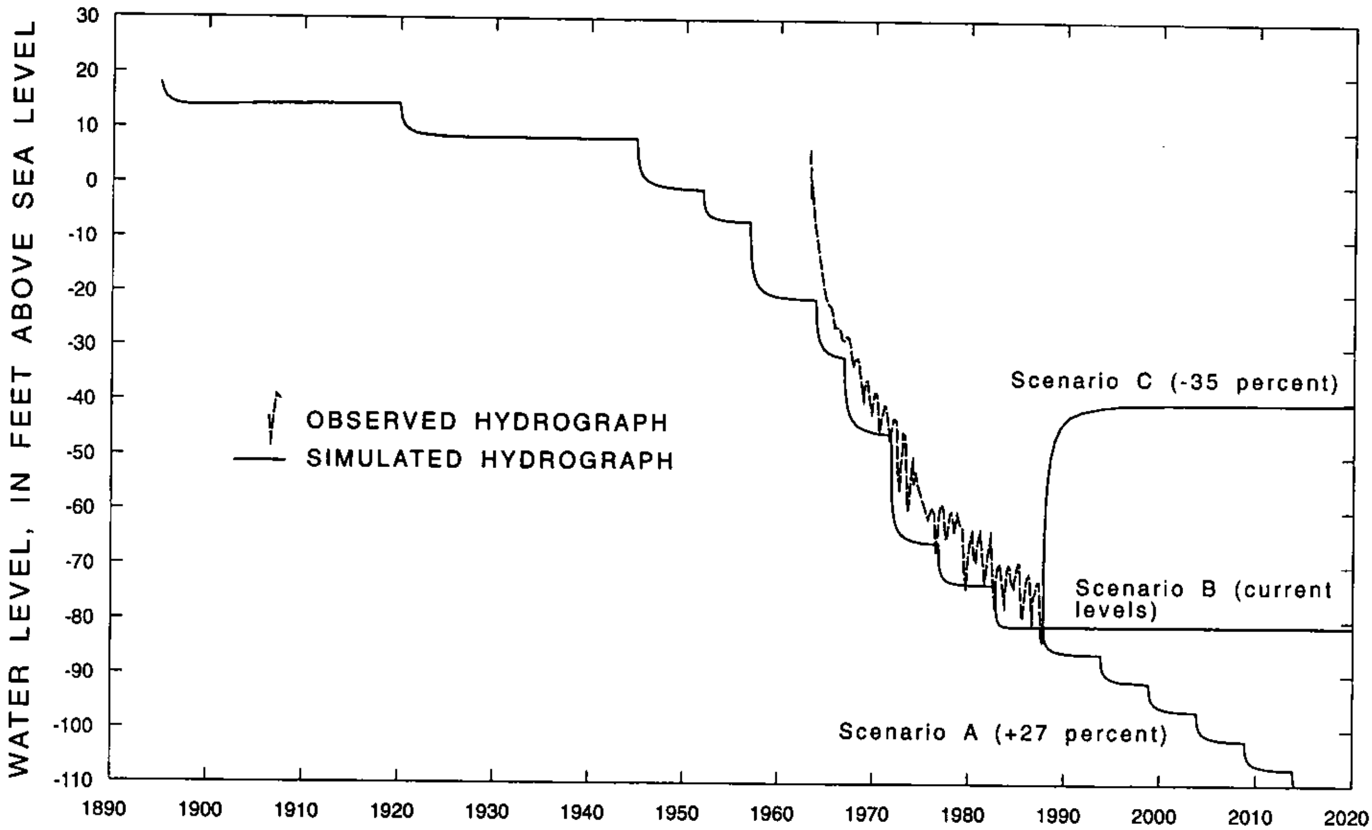


Figure 66. Simulated hydrographs showing water levels for Scenarios A, B, and C in observation well 07-412 (Elm Tree 2) in the lower aquifer of the Potomac-Raritan-Magothy aquifer system.

The comparison of simulated potentiometric surfaces or hydrographs is not sufficient to completely evaluate the effects of the withdrawal scenarios on the potential threats to water supply in the Camden area. These threats, discussed earlier, are primarily related to water-quality problems associated with downdip saline water in the southeastern part of the study area, human-related contamination of recharge from the outcrop area, and saltwater intrusion from the Delaware River. An evaluation of the magnitude and direction of flow from the areas associated with these particular deleterious conditions can be used to assess the relative importance of these threats, whereas a focus solely on potentiometric-surface changes can not.

The part of each aquifer that lies within the study area can be divided into several subareas, or zones. The purpose of these zones is to provide a basis for determining and comparing the net flows within the aquifer system and for tabulating a budget. This approach facilitates the comparison of aquifer-system responses to withdrawal scenarios. Three zones are defined within each of the three modeled aquifer-system layers: a zone encompassing the area of withdrawals; a zone in the southeastern part of the study area, where saltwater is likely to be present in the downdip part of the aquifer system; and a zone in the northeastern part of the study area, where freshwater is present in the deep parts of the aquifer system. The locations of these zones are shown in figures 67 - 69 for the upper, middle, and lower aquifers, respectively.

By using the flow-simulation results and a zone budget post-processor software package (Harbaugh, 1990), flow components contributing water to, or withdrawing water from, the zones were determined. The budgets were determined for the endpoint conditions of each scenario, simulated as a steady-state condition. This would be applicable to real conditions that had been in effect for at least 5 years. The flow components whose values are determined for each aquifer are the net flow

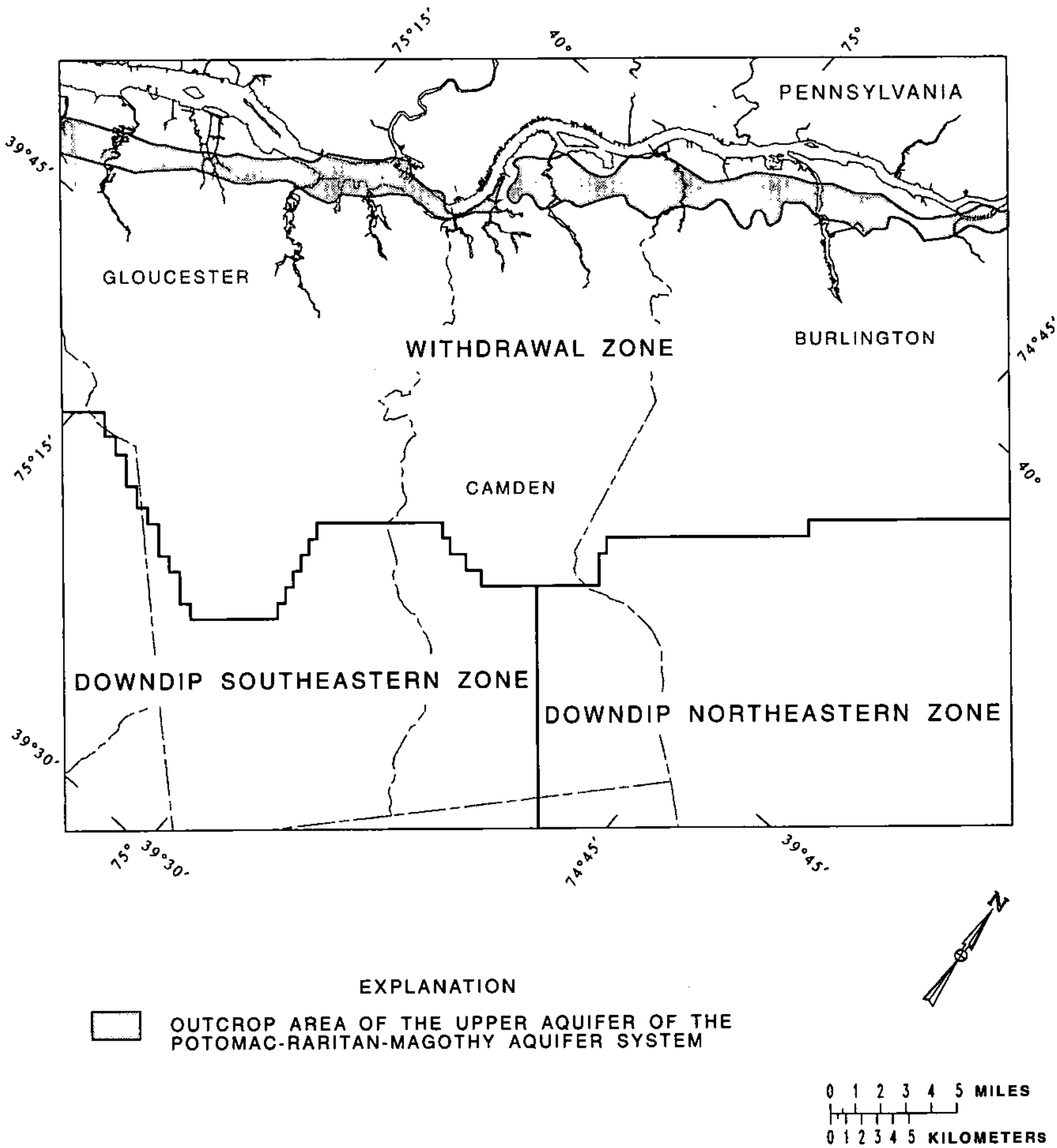


Figure 67. Water-budget zones for the upper aquifer of the Potomac-Raritan-Magothy aquifer system.

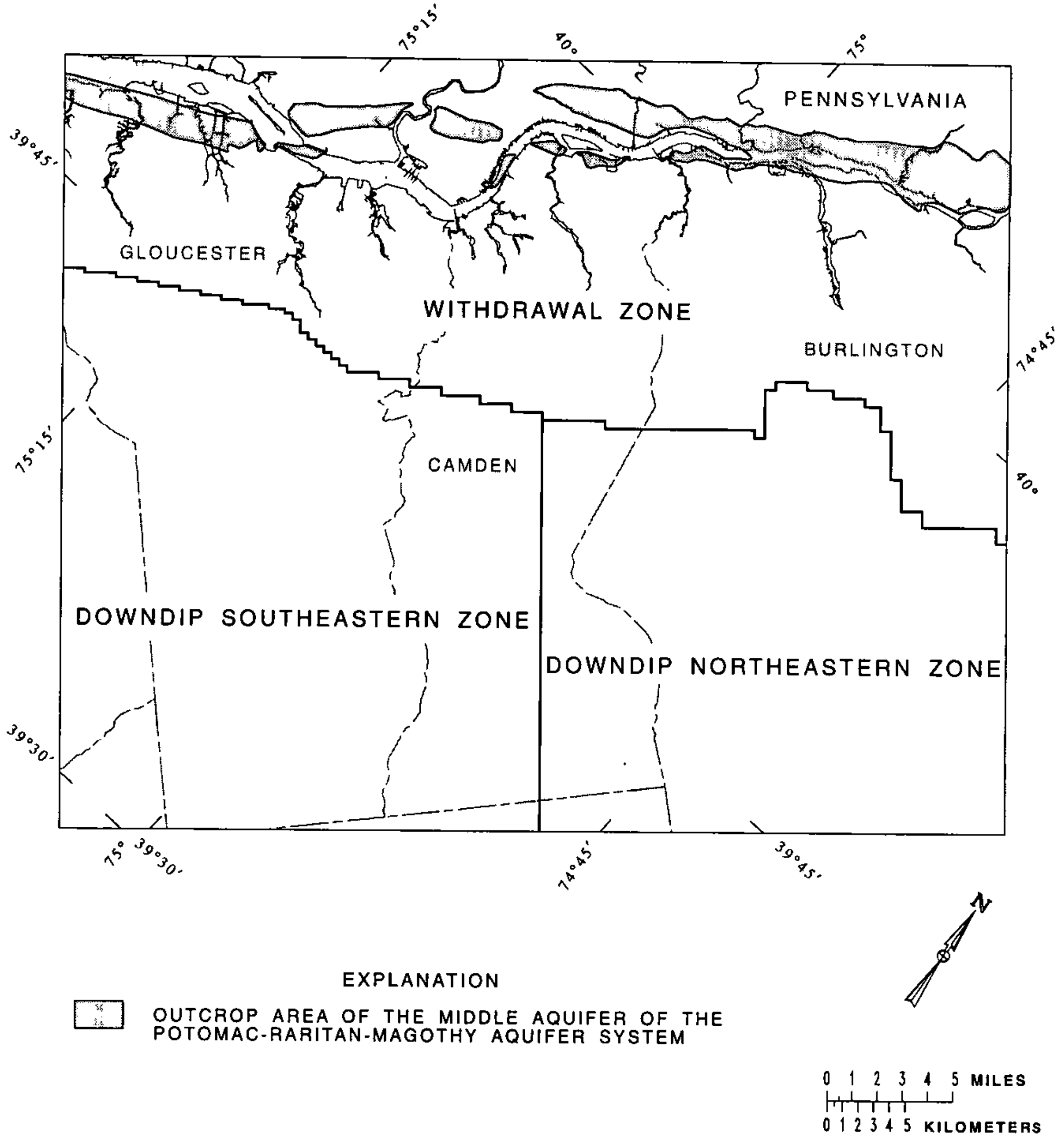


Figure 68. Water-budget zones for the middle aquifer of the Potomac-Raritan-Magothy aquifer system.

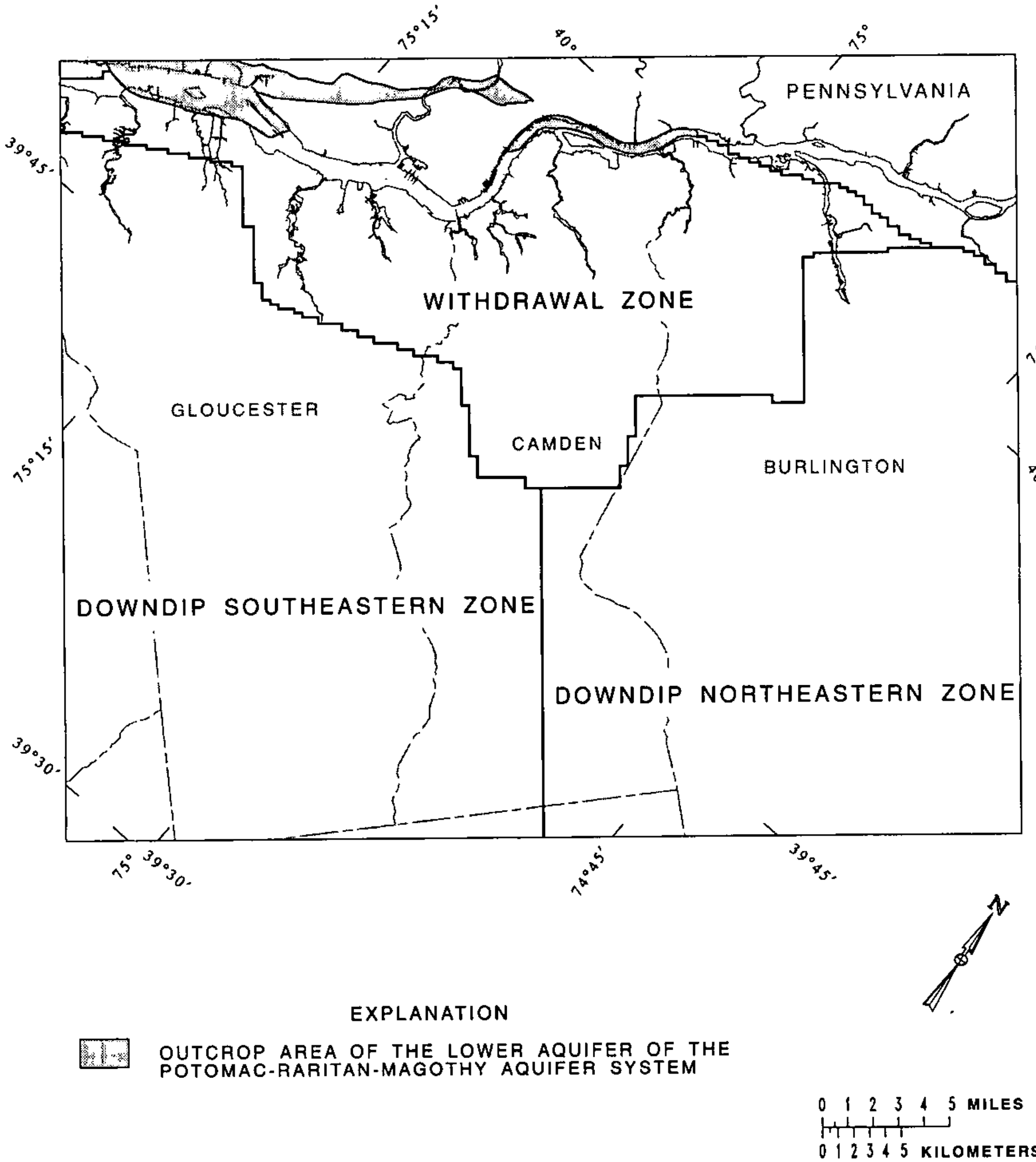


Figure 69. Water-budget zones for the lower aquifer of the Potomac-Raritan-Magothy aquifer system.

from the downdip area to the southeast (indicative of a deep saltwater source), the net flow from the downdip area to the northeast (indicative of a deep freshwater source), the net flow from the aquifers above and below, the net flow from the Delaware River and its tributaries, the flow from recharge on the outcrop of each aquifer, the net lateral flow to the aquifer from outside the modeled study area, and the amount of withdrawals from wells. Flow in and out of the pumped zone of each aquifer is shown schematically in figures 70 - 72 for Scenarios A, B, and C, respectively.

The flow-budget schematic diagrams for each scenario are similar because the distribution of withdrawals for each scenario is identical. Because the magnitude of withdrawals is different for each scenario, however, some distinctions exist. Ground water in the aquifer system, as discussed earlier, generally flows downward from the overlying Englishtown aquifer system toward the lower aquifer and "inward" toward the withdrawal zone of each aquifer from external sources, such as river leakage and recharge from the outcrop. This general pattern of flow is easily discernible from the budget schematic diagrams. The main exception to this general pattern is in the middle aquifer, where net flow is toward the downdip zones, away from the area of withdrawals. This flow pattern results from the fact that the areas encompassing withdrawals in the upper and lower aquifers are more extensive than that in the middle aquifer. Ground water in the middle aquifer flows from the withdrawal zone to the downdip areas and subsequently moves vertically into the adjacent aquifers. Flow between the river and the aquifer system changes its aspect to a net outflow from aquifer to river in the middle aquifer in Scenario B and in the upper and middle aquifers in Scenario C.

The flow-budget schematic diagrams show that the most significant source of water for withdrawals in the Camden area is the vertical flow between aquifers. Simulated vertical flows range from 58.3 to 80.3 Mgal/d for Scenario A, 47.6 to 65.9 Mgal/d for Scenario B, and 30.3 to 50.1 Mgal/d for Scenario C. The next most significant source of water is recharge entering the system through the outcrops of the upper and middle aquifers. The outcrop area of the lower aquifer is too small to allow significant amounts of recharge. Flow from the Delaware River is third in magnitude; net flow from the river to the aquifers is 29.6 Mgal/d for Scenario A and 11.2 Mgal/d for Scenario B. Because withdrawal rates in Scenario C are reduced, net flow is 12.7 Mgal/d in the opposite direction, from the aquifers to the river.

A comparison, shown in table 10, of the inflow components only (rather than net flows) among the three scenarios shows that the flow from the river and from external freshwater sources are most sensitive to the changes in withdrawals. External freshwater sources of flow are the downdip, northeastern zone; the lateral zone; and the Englishtown aquifer system. While withdrawals increase from 125.7 Mgal/d in Scenario B to 159.7 Mgal/d in Scenario A (a 27-percent increase) flow from the river increases 51 percent, and flow from the external freshwater sources increases 45 percent, providing additional water to satisfy the increased withdrawals. Inflow from the downdip, southeastern aquifer zones, which are likely to contain saline water, increase only 24 percent from Scenario B to Scenario A, indicating that the flow from the downdip, southeastern zones is less sensitive to changes in withdrawals than is the flow from the river. The difference between the magnitude of the flow from the river and the magnitude of flow from the downdip, southeastern zones indicates that the flow from downdip probably is not regionally significant.

Effects of Delaware River Ship-Channel Deepening

The ship channel of the Delaware River has been dredged to a depth of about 42 ft and extends to a point near the upstream end of the study area, where the channel has been dredged to a depth of about 35 ft. A proposal has been made to deepen the channel to a depth of 45, 50, or 55 ft. Because the aquifer-system outcrop coincides with the river, the proposed dredging could affect the aquifer system in two ways. First, the hydraulic connection between the river and the aquifer system could be enlarged or enhanced. Second, the enhanced connection could allow the transport of contaminants from the river into the aquifer system and toward water-supply wells.

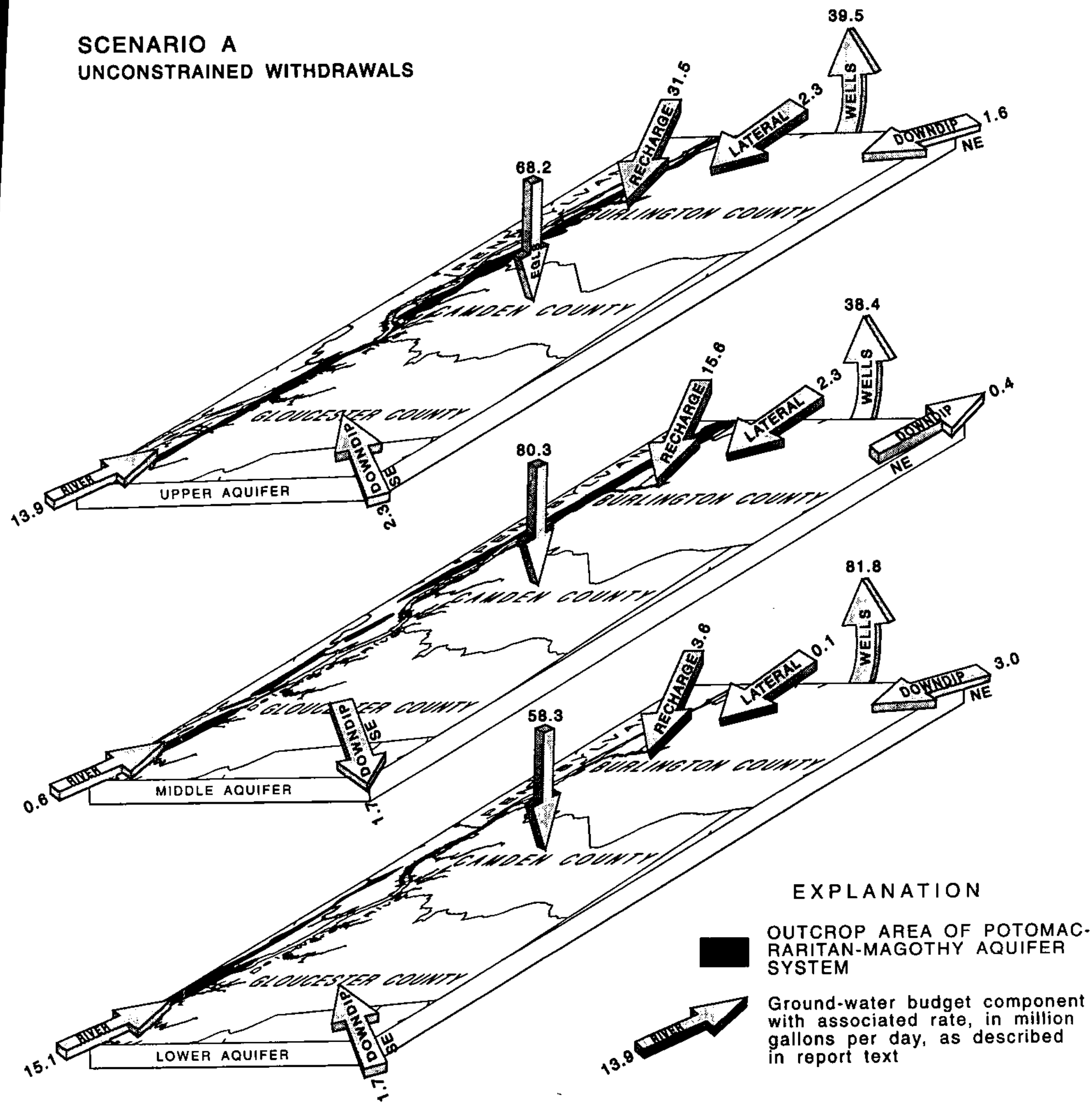


Figure 70. Schematic diagrams showing general flow budgets for the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system for Scenario A (unconstrained withdrawals).

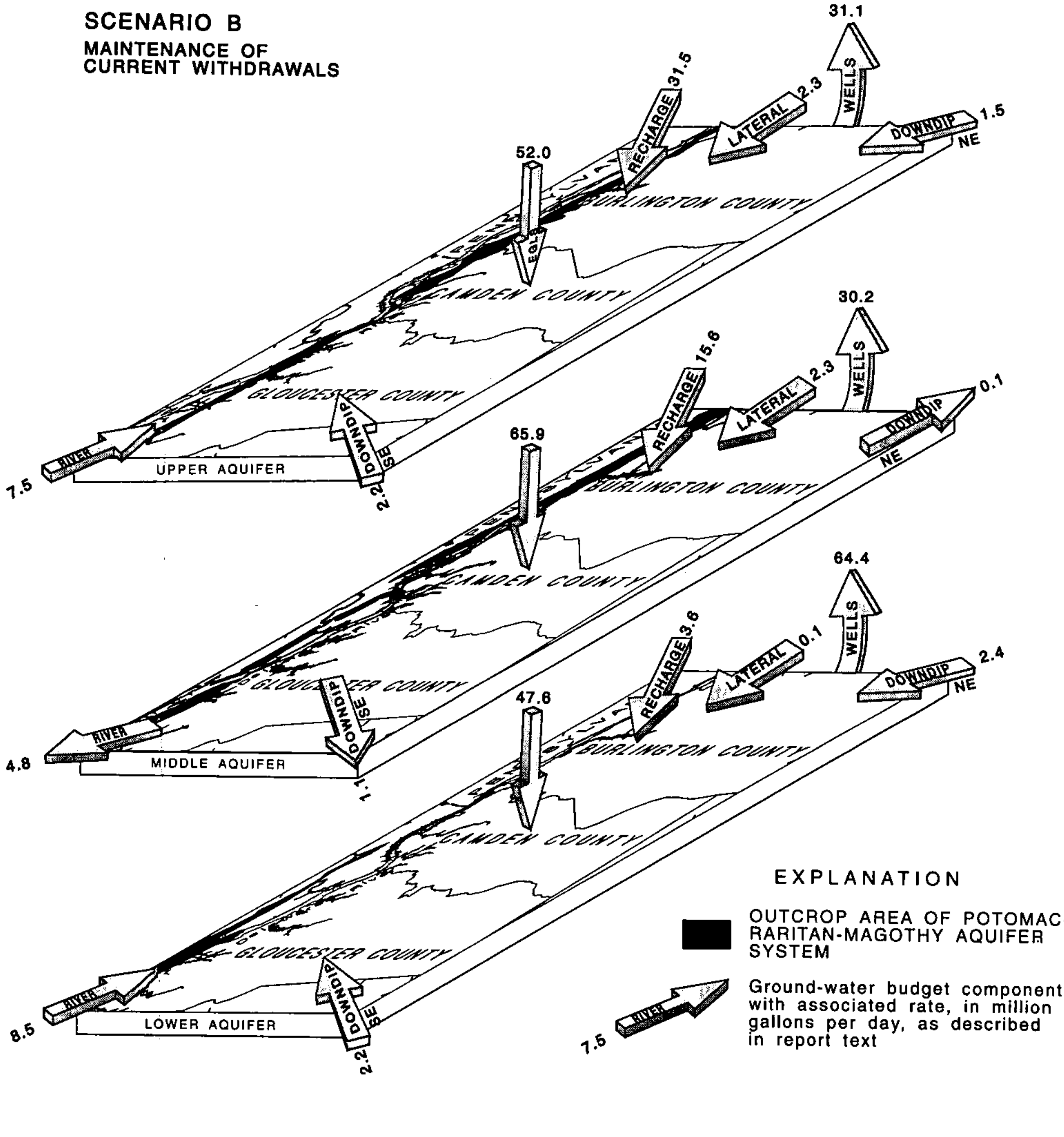


Figure 71. Schematic diagrams showing general flow budgets for the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system for Scenario B (withdrawals maintained at current levels).

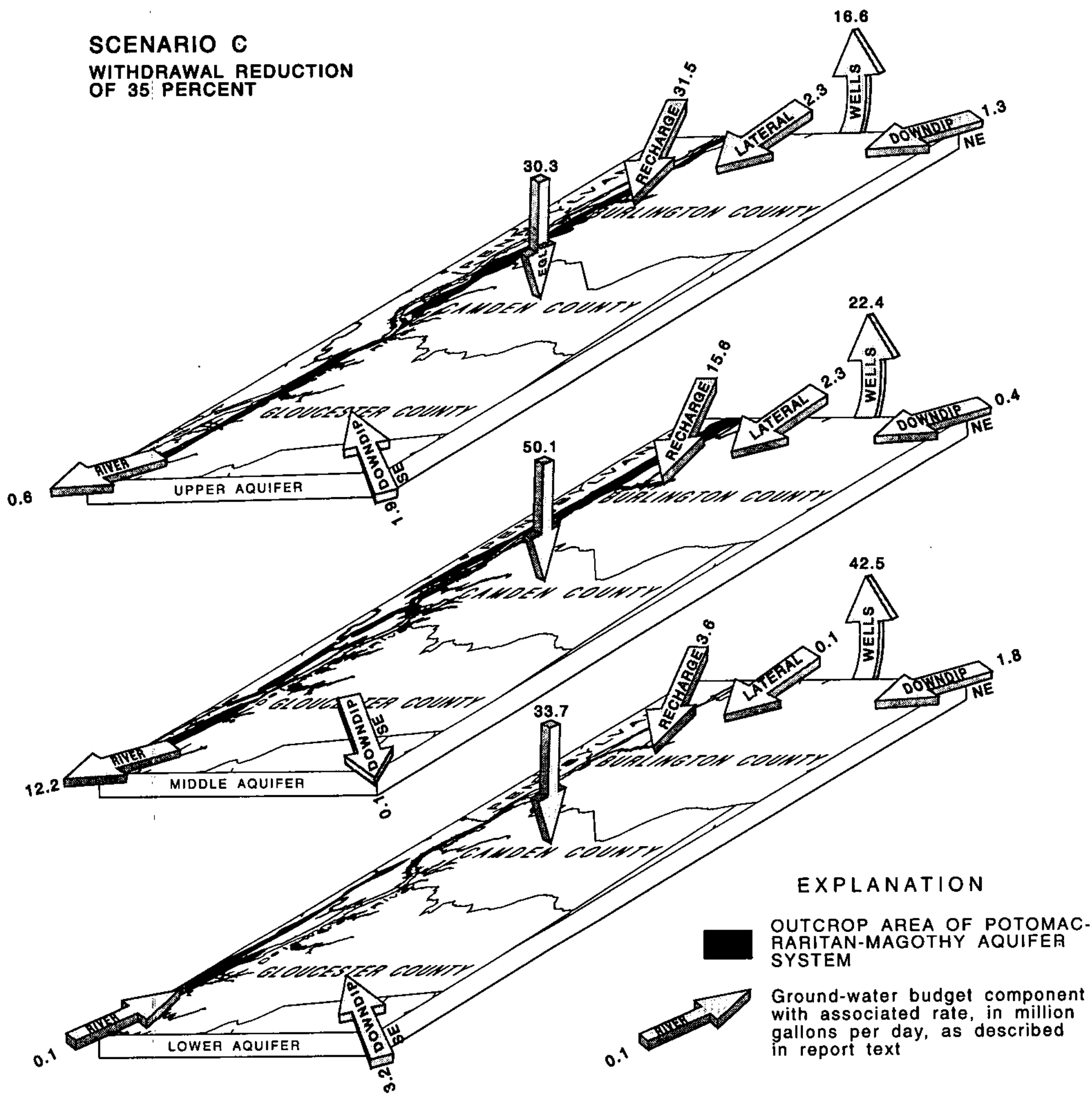


Figure 72. Schematic diagrams showing general flow budgets for the upper, middle, and lower aquifers of the Potomac-Raritan-Magothy aquifer system for Scenario C (35 percent withdrawal reduction).

Table 10.--Comparison of simulated Potomac-Raritan-Magothy aquifer system flow components among scenarios

[Mgal/d, million gallons per day;%, percent; percentage in parentheses indicates the difference from Scenario B]

Flow-system component (as inflow)		Flow, in Mgal/d, by scenario: A (unconstrained withdrawals)	B (maintain current withdrawals)	C (35% reduction in withdrawals)
Withdrawals		159.7 (+27%)	125.7	81.5 (-35%)
Locally available recharge	Recharge from precipitation	50.6	50.6	50.6
	Inflow from river	43.5 (+51%)	28.8	11.6 (-60%)
	Total	94.2	79.4	62.2
As percentage of withdrawals		59%	63%	76%
Inflow from downdip southeastern zones (potentially saline water)		10.3 (+24%)	8.3	7.3 (-12%)
As percentage of withdrawals		6%	7%	9%
Inflow from downdip northeastern, lateral zones, and Englishtown aquifer system		55.2 (+45%)	38.0	12.0 (-68%)
As percentage of withdrawals		35%	30%	15%

The results of the analysis performed in this investigation, namely the delineation of the riverbottom materials, the determination of their hydraulic connection to the aquifer system, and the delineation of the flow paths associated with flow from the river, can be used to address these concerns and aid in understanding the potential effects, deleterious or otherwise, of the proposed dredging. The hydrostratigraphic sections shown on plates 1 and 2 indicate that, within the limitations of resolution, the hydraulic connection between the river and aquifer system would not be affected by the removal of 5 to 10 ft of channel-bottom material from the bed of the Delaware River; that is, no confining unit would be breached. The dredging would increase the effective conductance controlling flow from the river to the aquifer system, but probably only imperceptibly.

Channel deepening could affect the position of the freshwater-saltwater interface in the Delaware River. Because channel deepening would increase the volume of the river, the interface could move upstream if the freshwater flow remains the same. Normally, as discussed earlier in this report, the interface is well downstream from the river reach, where flow from the river to the aquifer system is substantial near the intense river-proximal water-supply withdrawals. Under future drought or sea-level-rise conditions, however, channel deepening could cause saltwater to encroach upstream, possibly resulting in saltwater recharge moving toward the river-proximal water-supply wells. Assessment of the potential significance of this effect is beyond the scope of this investigation. A detailed evaluation of the dynamics of saltwater movement in the Delaware River and Estuary would be necessary to answer this question fully.

The river-influenced zones (fig. 53) of the aquifer system in the Camden area, identified earlier in this report, are those parts of the aquifer system that are in good hydraulic contact with and are receiving recharge water from the Delaware River. As long as the current withdrawal conditions prevail or remain nearly constant, wells within these zones are most likely to be affected by channel deepening.

SUMMARY AND CONCLUSIONS

The Potomac-Raritan-Magothy aquifer system is the principal source of water supply in the Coastal Plain of New Jersey. The aquifers and intervening confining units consist of a wedge of gravels, sands, silts, and clays that pinches out along the Fall Line, thickening and dipping to the southeast. The aquifer system in the Camden area is oriented so that its outcrop, in places, is directly connected to the Delaware River. In the Camden area, the aquifer system can be differentiated into three aquifer units, referred to as the upper, middle, and lower aquifers, which are separated from each other by intervening confining units. The aquifer system is overlain by the geologically younger Merchantville-Woodbury confining unit and is underlain by a mica schist.

Withdrawals from the aquifer system in the Camden area totaled about 125 Mgal/d in 1987. The use of the aquifer system for water supply in the area has increased since pumpage began about 1900. The withdrawal of water for public supply has significantly affected the flow regime of the aquifer system. Prior to the development of water supplies, ground water discharged to the Delaware River from the aquifer system. The aquifer system received recharge from the relatively higher altitude parts of the aquifer system's outcrop in Middlesex and Mercer Counties and from vertical flow from overlying units. The potentiometric surfaces of the upper, middle, and lower aquifers have declined markedly as a result of the withdrawals. The maximum depths of the regional cones of depression are about 100 ft below sea level. Now, instead of discharging, the river provides induced recharge to the aquifer system in many places.

The large magnitude of the withdrawals has threatened the continued availability of an adequate supply of potable water by (1) causing the formation of deep cones of depression and continued water-level decline, (2) causing the movement of saline water from the downdip parts of the aquifer system toward water-supply wells, (3) inducing recharge of saltwater from the Delaware River, and (4) inducing infiltration of contaminants resulting from human activities on the aquifer system's outcrop.

A ground-water-flow model was developed to evaluate the ground-water flow system, its sensitivity to the four consequences of withdrawals listed above, and the effects of future withdrawals. The model uses a finite-difference approach to simulate the aquifers, the water-supply withdrawals in the Camden area, the connection between the aquifer system and the Delaware River, flow from overlying aquifers, and the appropriate boundary conditions. The initial model input data were derived from the New Jersey Coastal Plain Regional Aquifer System Analysis (RASA) model. Because of the large differences in grid size between the RASA and Camden area models, recalibration of the Camden area model was necessary. The model was calibrated to reproduce historical water-level data, which were available as long-term hydrographs from observation wells and as potentiometric-surface maps. The primary criterion was to simulate aquifer-system water levels to within 15 ft of measured values.

Results of ground-water flow simulations indicate that the most significant sources of water to the aquifer system are recharge from precipitation on the outcrop and flow from overlying aquifer units. Induced flow from the Delaware River and its tributaries is estimated by simulation to be currently about 29 Mgal/d. Lateral flow from downdip and from parts of the aquifer system outside of the study area is toward the main pumping area, at about 12 Mgal/d. Of this amount, about 8 Mgal/d in inflow only (not net flow) is from the downdip, southeast direction.

Simulation results further indicate that the induced recharge of river water into the aquifer system is, perhaps contrary to some past beliefs, a local process. The recharge is directed primarily toward river-proximal wells or well fields rather than being distributed along the length of the river as a broad-scale process. Nevertheless, the volume of water introduced into the aquifer system in this way is significant. Results of particle-tracking analysis of the simulation show that about one-third of the water-supply withdrawals from the aquifer system in the Camden area are within the area influenced by induced recharge from the river and its tributaries. Up to 90 percent of the water pumped from the wells within this zone is derived from the river. The cones of depression in regional potentiometric surfaces, caused by ground-water withdrawals far from the river, draw flow predominantly from the aquifer system's outcrop on land, from intervening and overlying confining units, and from other parts of the aquifer system, but not from the river. Leakage from the aquifer system to the river, which occurred to a greater degree under unstressed conditions, still occurs in many places. This flow is primarily from the shallowest parts of the aquifer system near the river, away from high-intensity withdrawals.

In order to determine the effects of future water-supply withdrawals on ground-water flow in the aquifer system in the Camden area, three withdrawal scenarios were developed and evaluated with the ground-water flow model:

SCENARIO A.--Withdrawals continued in an unconstrained manner. Withdrawals have increased linearly to 27 percent above the rates of the 1980's by the end of the simulation period (2020);

SCENARIO B.--Withdrawals maintained at mid-1980's rates through the simulation period. Future demand is assumed to be satisfied by an unrelated source; and

SCENARIO C.--Withdrawals reduced to 65 percent of 1983 rates at the beginning of the simulation period and are fixed at that rate. The amount reduced as well as the future demand are assumed to be satisfied by an unrelated source.

The distribution of withdrawals in each of the scenarios is the same. The time base of the scenarios is 30 years (1990-2020). The regional cones of depression in Scenario A extend to a maximum depth of about 140 ft below sea level in 2020, a decline of about 40 ft from present levels. Because the simulated increase in withdrawals is distributed linearly through time, the rate of decline is constant. The regional cones of depression in Scenario B remain at about present levels because the withdrawals are fixed at current levels. The regional cones of depression in Scenario C extend to a maximum depth of about 60 ft below sea level in 2020, a recovery of approximately 40 ft from present levels. Simulation results indicate that most of the recovery would take place over the initial 5-year period. With withdrawals fixed, water levels would remain virtually constant thereafter until 2020.

For each scenario, the amount of flow attributable to recharge from precipitation on the aquifer system's outcrop is the same, about 50.6 Mgal/d for the aquifer system within the modeled area. Climate and the recharge process are assumed to remain invariant under the scenarios; however, the amount of flow that can be induced from the Delaware River and its tributaries into the aquifer system does vary. Inflow from the river is about 43.5 Mgal/d for Scenario A, 28.8 Mgal/d for Scenario B, and 11.6 Mgal/d For Scenario C. Adding the fixed amount of recharge from precipitation to the induced flow from the river yields values that can be considered to be the amount of locally available recharge to the aquifer system in the Camden area, about 94.2 Mgal/d for Scenario A, 79.4 Mgal/d for Scenario B, and 62.2 Mgal/d for Scenario C. Withdrawals from the aquifer system are substantially larger than recharge for all three scenarios. This available recharge represents 59, 63, and 76 percent of the amount withdrawn from the aquifer system for water supply for Scenarios A, B, and C, respectively.

Because the withdrawals in each scenario exceed the locally available recharge, ground water flows into the aquifer system vertically from overlying units, such as the Merchantville-Woodbury confining unit and Englishtown aquifer system, and laterally from parts of the aquifer system beyond the immediate area of pumping. Flow from these sources then satisfies the withdrawals, but the cones of depression develop, providing the gradient that causes ground water to flow from more distant sources. Inflow from the downdip, southeastern direction, which may contain saline water, is 10.3 Mgal/d in Scenario A, 8.3 Mgal/d in Scenario B, and 7.3 Mgal/d in Scenario C. These values represent 6, 7, and 9 percent of the amount withdrawn from the aquifer system for water supply in Scenarios A, B, and C, respectively.

The following conclusions pertaining to the future water-supply potential of the aquifer system can be drawn from these findings:

(1) The Potomac-Raritan-Magothy aquifer system of New Jersey's Coastal Plain provides a copious supply of water. The use of this resource has caused a drawdown in the aquifer system's potentiometric surface to nearly 120 ft below sea level in some places, as much as 130 ft below pre-withdrawal levels. Consequently, the ground-water-flow regime in the area has changed, and the withdrawals now induce water to flow from the Delaware River into the aquifer system.

(2) The major sources of water to the aquifer system in the Camden area under current conditions, in order of importance, are recharge from the local aquifer-system outcrop, vertical flow from adjacent confining units and aquifers, induced flow from the Delaware River and its tributaries, and lateral flow from parts of the aquifer system outside the Camden area. The relative magnitude of flow from each of these significant sources provides a useful indicator for evaluating effects of various withdrawal scenarios.

(3) The potability of ground-water supplies from the aquifer system in the Camden area is subject to three potential problems: recharge of water containing contaminants from the outcrop area of the aquifer system, saltwater intrusion from the Delaware River during drought or sea-level-rise conditions, and saltwater originating in downdip areas southeast of the Camden area.

(4) A continued increase in withdrawals from the aquifer system to meet future demand would most likely result in a continued decline of ground-water levels in the aquifer system. Locally available recharge to the aquifer system would account for about 59 percent of the water withdrawn. Inflow derived from downdip areas southeast of the Camden area may be saline and would account for about 6 percent of the water withdrawn.

(5) Maintenance of current withdrawals rates would most likely result in a stabilization of water levels at approximately present levels. Stabilization could occur within 5 years. Locally available recharge to the aquifer system would account for about 63 percent of the water withdrawn. Inflow derived from downdip areas southeast of the Camden area may be saline and would account for about 7 percent of the water withdrawn.

(6) A reduction in withdrawal rates to 65 percent of 1983 rates would most likely result in a recovery of water levels. The regional cones of depression would extend to a maximum depth of about 60 ft below sea level; this situation is comparable to mid-1960's conditions. Locally available

recharge to the aquifer system will account for about 76 percent of the water withdrawn. Inflow derived from downdip areas southeast of the Camden area may be saline and would account for about 9 percent of the water withdrawn.

(7) The aquifer system receives substantial flow from its local outcrop in all of the scenarios. Recharge from this source may contain contaminants. Therefore, minimizing the introduction of these substances into the soils in the outcrop area would reduce any deleterious effects of this water on the water supply. Furthermore, recharge augmentation in the local aquifer-system outcrop area (for example, through use facilities such as stormwater retention and infiltration basins) would add to the available water supply.

(8) Flow to the aquifer system from the Delaware River and its tributaries also is significant. During drought, saltwater could encroach upriver to areas where induced infiltration through the riverbed is taking place and affect a significant part of the Camden area's water supply. The Delaware River Basin Commission (DRBC) provides a certain degree of protection through its upper-basin reservoir system. The ability of the present reservoir system, maintained by the DRBC in the upper Delaware River basin, to mitigate future drought conditions, given the historical rate of sea-level rise in the area and the potential for an additional sea-level rise related to global warming, is unknown.

(9) The saline water in the downdip parts of the aquifer system, southeast of the Camden area, will move in response to withdrawals; the local withdrawals, however, have the greatest effect. Because the proportion of flow from this source to all flow in the aquifer system is low, this factor may be unimportant on a regional scale. A redistribution of withdrawals from the aquifer system in the southeastern part of the Camden area to other parts of the area, or the use of water from other sources, may be the most effective way to safeguard water supplies from the deep saline water.

(10)The major difference among the three withdrawal scenarios evaluated in this investigation is the relative proportion of locally available recharge-- namely, that recharge derived from precipitation on the aquifer-system outcrop within the Camden area and that infiltrating from the Delaware River and its tributaries-- to the amount of water withdrawn for water supply. That part of the water withdrawn not originating from local recharge is from overlying aquifers or from parts of the aquifer system distant from the Camden area. The simulation results show that dependence on this non-local water increases as withdrawal rates increase (about 60 percent and 75 percent of the water withdrawn in Scenarios C and A, respectively). Minimization of the dependence on water from non-local sources may constitute a viable water-management objective for the aquifer system.

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Table 3. -- Annual ground-water withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey, 1981-87

[TWP, Township; BORO, borough; MUA, Municipal Utilities Authority; WC, Water Company; WD, Water Department; WCM, Water Commission; CC, Country Club; GC, Golf Course; Mgal/d, million gallons per day; --, no information]

UPPER AQUIFER

Well Number	Permit Number	Owner	Local Identifier	Municipality	Model Layer	Model Row	Model Column	Average withdrawal, in Mgal/d 1981	1982	1983	1984	1985	1986	1987
05-053	27-05342	US PIPE	US PIPE 1	BURLINGTON CITY	3	34	104	0.000	0.000	0.000	0.000	0.000	0.000	0.000
05-076	31-01751	HEAL, CHARLES JR	HEAL	BURLINGTON TWP	3	38	98	.234	.223	.209	.189	.188	.181	.000
05-077	27-05716	BURLINGTON TWP WD	1-1973	BURLINGTON TWP	3	45	102	.008	.023	.067	.088	.088	.086	.104
05-165	31-05458	EVESHAM MUA	4	EVESHAM TWP	3	73	72	.087	.250	.251	.152	.081	.716	.598
05-166	--	INDIAN SPRINGS G C	1	EVESHAM TWP	3	74	74	.008	.009	.007	.009	.009	.011	.006
05-167	31-07453	EVESHAM MUA	5	EVESHAM TWP	3	76	76	.209	.262	.462	.540	.315	.299	.381
05-229	31-08922	MAPLE SHADE WD	9	MAPLE SHADE TWP	3	48	72	.616	.619	.623	.000	.165	.244	.306
05-249	31-05282	MEDFORD TWP WD	3 / 1	MEDFORD TWP	3	79	77	.301	.420	.968	.930	.482	.556	.604
05-252	31-05301	MEDFORD WC	1(3) / 8	MEDFORD TWP	3	77	83	.000	.000	.000	.000	.494	.542	.485
05-253	31-06056	MEDFORD LEASING	1-1972	MEDFORD TWP	3	77	84	.053	.055	.057	.059	.058	.077	.067
05-275	--	FIRST PRESB CHURCH	1964	MOORESTOWN TWP	3	44	79	.000	.000	.002	.000	.000	.007	.000
05-285	31-04637	MOUNT HOLLY WC	4	MOUNT HOLLY TWP	3	68	98	.000	.000	.000	.006	.073	.159	.344
05-289	--	MOUNT HOLLY WC	3	MOUNT HOLLY TWP	3	68	99	.629	.305	.339	.267	.715	.760	.417
05-310	--	NJ TURNPIKE AUTHORITY	MAINT 2	MOUNT LAUREL TWP	3	56	80	.002	.002	.002	.044	.037	.023	.034
05-383	32-00380	SYBRON CHEMICAL	IONAC 2	PEMBERTON TWP	3	77	104	.324	.324	.324	.000	.000	.000	.000
05-707	31-14627	EVESHAM MUA	7	EVESHAM TWP	3	70	72	.638	.467	.511	.538	.594	.164	.443
05-728	--	MOBILE ESTATES	FIELD	SOUTHAMPTON TWP	3	76	102	.063	.063	.051	.030	.080	.000	.000
05-755	31-06840	KING'S GRANT WC	1	EVESHAM TWP	3	78	69	.053	.064	.111	.160	.216	.283	.326
05-757	31-07453	EVESHAM MUA	6	EVESHAM TWP	3	74	77	.361	.636	.626	.305	.402	.541	.529
05-766	31-15450	LENAPE REGIONAL H S	CHEROKEE 1	EVESHAM TWP	3	74	72	.005	.003	.003	.003	.003	.000	.000
05-795	31-09595	MT LAUREL MUA	5	EVESHAM TWP	3	75	74	.544	.447	.575	.650	.552	.471	.572
05-824	31-20373	EVESHAM MUA	8	EVESHAM TWP	3	72	73	.000	.000	.000	.075	.569	.726	.507
07-003	31-02492	OWENS CORNING	CORNING 1	BARRINGTON BORO	3	57	52	.333	.223	.204	.550	.234	.215	.122
07-004	31-05360	WEYERHAEUSER CO	1	BARRINGTON BORO	3	56	52	.000	.000	.042	.005	.004	.005	.004
07-015	31-06208	BERLIN WD	11	BERLIN BORO	3	81	53	.000	.486	.587	.492	.125	.268	.444
07-018	31-02079	BERLIN WD	9	BERLIN BORO	3	80	55	.000	.000	.164	.366	.651	.540	.390
07-019	31-05173	BERLIN WD	10	BERLIN BORO	3	80	55	1.198	.747	.406	.089	.181	.241	.171
07-120	31-02946	HUSSMAN REFRIDG	HUSSMAN	CHERRY HILL TWP	3	60	59	.066	.037	.039	.042	.028	.032	.024
07-133	31-05217	NJ/AMERICAN WC	OLD ORCH 36	CHERRY HILL TWP	3	64	69	.000	.000	.000	.547	1.127	.769	.722
07-148	31-04742	NJ/AMERICAN WC	KINGSTON 28	CHERRY HILL TWP	3	54	67	.000	.000	.000	.015	.000	.000	.000
07-151	51-00094	GARDEN STATE RACE	RACE TRACK	CHERRY HILL TWP	3	43	62	.000	.000	.000	.000	.066	.031	.049
07-158	--	GARDEN STATE RACE	CHRY HLL INN 1	CHERRY HILL TWP	3	40	65	.000	.000	.000	.000	.000	.000	.000
07-160	--	RADIO CORP OF AMERICA	RCA 1	CHERRY HILL TWP	3	41	65	.001	.001	.002	.002	.001	.002	.002
07-245	51-00005	CAMDEN COUNTY	LAKELAND 1	GLOUCESTER TWP	3	68	38	.255	.137	.147	.123	.106	.102	.102
07-248	31-04650	GLOU TWP BD OF ED	LEWIS SCH	GLOUCESTER TWP	3	71	42	.000	.001	.003	.002	.000	.005	.000
07-249	31-02703	GARDEN STATE WC	BLKWD DIV 3	GLOUCESTER TWP	3	68	40	.251	.232	.614	.558	.628	.503	.434
07-250	31-08176	GARDEN STATE WC	BLKWD DIV 7	GLOUCESTER TWP	3	70	39	.697	.947	.553	.636	.630	.699	.983
07-252	31-05581	GARDEN STATE WC	BLKWD DIV 6	GLOUCESTER TWP	3	71	44	1.084	.976	1.042	.860	.691	.945	.770
07-256	31-05580	GLOUCESTER MUA	TREAT PLANT	GLOUCESTER TWP	3	64	39	.096	.066	.120	.030	.016	.006	.001
07-272	31-05041	NJ/AMERICAN WC	OTTERBROOK 34	GLOUCESTER TWP	3	60	47	.000	.000	.000	1.017	1.458	1.329	1.310

Table 3. -- Annual ground-water withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey, 1981-87 -- continued.

UPPER AQUIFER (continued)

Well Number	Permit Number	Owner	Local Identifier	Municipality	Model Layer	Model Row	Model Column	Average withdrawal, in Mgal/d 1981	1982	1983	1984	1985	1986	1987
07-274	31-05226	NJ/AMERICAN WC	OTTERBROOK 39	GLOUCESTER TWP	3	59	47	0.000	0.000	0.000	1.308	0.980	1.405	1.103
07-275	31-03375	NJ/AMERICAN WC	HADDON 20	BARRINGTON BORO	3	53	53	.000	.000	.000	.000	.094	.558	1.158
07-279	31-04798	NJ/AMERICAN WC	HADDON 30	HADDON HEIGHTS BORO	3	52	53	.538	.892	.982	.331	.420	.750	.026
07-280	51-00009	NJ/AMERICAN WC	HADDON 12	HADDON HEIGHTS BORO	3	52	53	.000	.000	.000	.151	.160	.040	.001
07-282	51-00008	NJ/AMERICAN WC	HADDON 11	HADDON HEIGHTS BORO	3	52	53	.000	.000	.000	.008	.011	.000	.000
07-285	31-03308	NJ/AMERICAN WC	EGGBERT 18	HADDON HEIGHTS BORO	3	47	51	.101	.054	.274	.206	.047	.077	.043
07-293	31-04986	HADDON TWP BD OF ED	HS 1	HADDON TWP	3	43	56	.001	.001	.001	.000	.000	.000	.019
07-299	21-02570	HADDONFIELD WD	LAYNE 2/ 1	HADDONFIELD BORO	3	53	58	.408	.337	.279	.072	.000	.384	.542
07-310	31-01363	NJ/AMERICAN WC	LAUREL 13	LAUREL SPRINGS BORO	3	70	51	.000	.000	.000	.007	.094	.095	.027
07-316	31-05100	NJ/AMERICAN WC	MAGNOLIA 33	MAGNOLIA BORO	3	59	52	.000	.000	.000	.994	.955	.533	.456
07-392	31-04521	PINE HILL MUA	1	PINE HILL BORO	3	78	47	.286	.330	.385	.136	.000	.114	.066
07-398	31-06646	PINE HILL MUA	2-1972	PINE HILL BORO	3	77	49	.396	.348	.421	.675	.810	.718	.728
07-404	31-03307	NJ/AMERICAN WC	RUNNEMEDE 19	RUNNEMEDE BORO	3	57	47	.000	.000	.000	.000	.142	.301	.466
07-407	31-05193	TRAP ROCK INDUSTRIES	3	RUNNEMEDE BORO	3	52	47	.000	.000	.000	.011	.005	.000	.000
07-410	31-02360	NJ/AMERICAN WC	SOMERDALE 14	SOMERDALE BORO	3	66	53	.007	.047	.098	.025	.033	.064	.055
07-411	31-05248	TAVISTOCK CLUB	CC 1	TAVISTOCK BORO	3	58	57	.000	.000	.000	.001	.007	.009	.003
07-422	31-03306	NJ/AMERICAN WC	ASHLAND 17	VOORHEES TWP	3	66	57	.000	.000	.000	1.003	.408	.298	.364
07-426	31-03872	NJ/AMERICAN WC	VOORHEES 21	VOORHEES TWP	3	67	59	.011	.049	.146	.134	1.013	1.591	1.226
07-521	31-12301	CLEMENTON WD	10	CLEMENTON BORO	3	76	49	.681	.697	.449	.521	.087	.463	.395
15-001	31-02889	CLAYTON WD	3	CLAYTON BORO	3	83	16	.517	.529	.533	.521	.573	.636	.554
15-003	31-06676	CLAYTON WD	4-1973	CLAYTON BORO	3	81	17	.000	.000	.000	.049	.007	.003	.036
15-006	31-05174	WOODBURY WD	SEWELL 1A	DEPTFORD TWP	3	63	27	.614	.232	.334	.895	1.023	.950	.658
15-008	--	WOODBURY WD	SEWELL 2A	DEPTFORD TWP	3	63	28	.000	.000	.000	.000	.000	.000	.000
15-009	31-05514	DEPTFORD TWP MUA	5	DEPTFORD TWP	3	65	37	.662	.776	.612	.476	.469	.494	.491
15-011	31-02118	DEPTFORD TWP MUA	2	DEPTFORD TWP	3	54	30	.223	.233	.240	.247	.235	.209	.320
15-016	31-02416	DEPTFORD TWP MUA	1	DEPTFORD TWP	3	52	31	.212	.238	.260	.256	.204	.274	.113
15-028	30-00432	E GREENWICH WD	2	EAST GREENWICH TWP	3	40	20	.327	.349	.385	.203	.200	.277	.423
15-059	31-04112	OWENS ILLINOIS	OWENS 1	GLASSBORO BORO	3	77	18	.244	.214	.268	.317	.286	.227	.140
15-060	31-02358	GLASSBORO WD	3	GLASSBORO BORO	3	75	18	.592	.478	.766	.582	1.428	1.550	1.552
15-062	51-00042	GLASSBORO WD	2	GLASSBORO BORO	3	76	21	.000	.000	.000	.166	.000	.000	.000
15-063	31-04176	GLASSBORO WD	4	GLASSBORO BORO	3	74	22	.234	.000	.000	.226	.000	.000	.000
15-130	30-00210	SOUTH JERSEY WC	3	HARRISON TWP	3	58	13	.331	.349	.170	.174	.166	.171	.150
15-131	--	CLEARVIEW BD OF ED	HS 1	HARRISON TWP	3	57	16	.003	.003	.003	.054	.057	.054	.054
15-183	31-05060	PITMAN COUNTRY CLUB	CC 1	MANTUA TWP	3	67	21	.004	.004	.004	.006	.006	.007	.008
15-187	--	INVERSAND CO	#2	MANTUA TWP	3	66	27	.142	.142	.142	.094	.124	.157	.000
15-194	31-05309	MANTUA TWP MUA	4	MANTUA TWP	3	52	25	.439	.520	.515	.487	.502	.557	.578
15-227	31-04061	PITMAN WD	P3	PITMAN BORO	3	69	23	1.030	.993	1.006	.962	.908	.914	.856
15-239	--	DEL MONTE CORP	8	SWEDESBORO BORO	3	36	7	.000	.000	.000	.000	.000	.001	.001
15-261	31-03913	WASHINGTON TWP MUA	1	WASHINGTON TWP	3	76	37	2.075	2.337	2.654	2.434	2.461	3.117	3.231
15-275	31-00170	WENONAH WD	2	WENONAH BORO	3	56	29	.207	.234	.250	.194	.182	.280	.285

Table 3. -- Annual ground-water withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey, 1981-87 -- continued.

UPPER AQUIFER (continued)

Well Number	Permit Number	Owner	Local Identifier	Municipality	Model Layer	Model Row	Model Column	Average withdrawal, in Mgal/d 1981	1982	1983	1984	1985	1986	1987
15-276	31-04567	W DEPTFORD TWP WD	4	WEST DEPTFORD TWP	3	49	28	0.488	0.518	0.401	0.334	0.647	0.004	0.000
15-281	31-03021	W DEPTFORD TWP WD	3	WEST DEPTFORD TWP	3	44	30	.643	.909	.448	.609	.817	.211	.358
15-284	30-00901	HUNTSMAN POLYPROP	SHELL 4	WEST DEPTFORD TWP	3	35	25	.664	.448	.428	.188	.034	.216	.225
15-295	31-06200	WESTWOOD GC	1-1973	WEST DEPTFORD TWP	3	43	31	.011	.011	.011	.011	.012	.019	.011
15-299	--	POLYREZ CO	1	WEST DEPTFORD TWP	3	41	32	.148	.245	.310	.000	.000	.000	.000
15-300	31-03864	POLYREZ CO	2	WEST DEPTFORD TWP	3	41	32	.000	.000	.000	.000	.000	.240	.000
15-330	31-06356	WOODBRY HEIGHTS	1 HELEN AVE	WOODBURY HTS BORO	3	51	33	.201	.276	.352	.278	.296	.308	.304
15-332	--	WOODBURY WD	PARKING LOT 3	WOODBURY CITY	3	43	34	.000	.000	.000	.008	.000	.000	.000
15-355	30-01426	E GREENWICH WD	3	EAST GREENWICH TWP	3	40	23	.000	.000	.000	.170	.197	.198	.000
15-361	31-07709	GLASSBORO WD	5	GLASSBORO BORO	3	77	18	.510	.872	.684	.446	.000	.000	.000
15-367	30-00649	GANGEMI, VICENT	1 SOUTH	HARRISON TWP	3	64	10	.056	.004	.084	.012	.003	.002	.007
15-394	30-01094	PMC CANNING CO	1-1966	WOOLWICH TWP	3	33	6	.013	.017	.018	.015	.013	.011	.011
15-437	31-17980	POLYREZ CO	1R	WOODBURY CITY	3	41	33	.000	.000	.000	.276	.275	.214	.040
15-548	30-02504	CHEMICAL LEAMAN	CLDW	LOGAN TWP	3	17	10	.000	.000	.000	.000	.000	.014	.000
15-814	30-02336	MOBIL OIL COMPANY	RW-12	GREENWICH TWP	3	21	22	.000	.139	.152	.134	.111	.105	.000
15-815	30-02335	MOBIL OIL COMPANY	RW-11	GREENWICH TWP	3	20	22	.000	.139	.152	.134	.111	.105	.000
15-816	30-02338	MOBIL OIL COMPANY	RW-17	GREENWICH TWP	3	18	22	.000	.004	.004	.004	.003	.003	.000
15-817	30-02341	MOBIL OIL COMPANY	RW-16	GREENWICH TWP	3	18	22	.000	.004	.004	.004	.003	.003	.000
15-818	30-02339	MOBIL OIL COMPANY	RW-15	GREENWICH TWP	3	23	22	.000	.004	.004	.004	.003	.003	.000
15-819	30-02334	MOBIL OIL COMPANY	RW-14	GREENWICH TWP	3	22	22	.000	.000	.000	.134	.111	.105	.000
15-820	--	MOBIL OIL COMPANY	RW-2	GREENWICH TWP	3	20	23	.000	.139	.152	.134	.111	.105	1.340
15-821	--	MOBIL OIL COMPANY	RW-3	GREENWICH TWP	3	19	24	.000	.139	.152	.134	.111	.105	.000
15-822	--	MOBIL OIL COMPANY	RW-4	GREENWICH TWP	3	20	23	.000	.139	.152	.134	.111	.105	.000
15-823	--	MOBIL OIL COMPANY	RW-5	GREENWICH TWP	3	21	24	.000	.139	.152	.134	.111	.105	.000
15-824	--	MOBIL OIL COMPANY	RW-6	GREENWICH TWP	3	21	24	.000	.139	.152	.134	.111	.105	.000
15-825	--	MOBIL OIL COMPANY	RW-7	GREENWICH TWP	3	21	23	.000	.139	.152	.134	.111	.105	.000
15-826	--	MOBIL OIL COMPANY	RW-8	GREENWICH TWP	3	22	23	.000	.139	.152	.134	.111	.105	.000
15-827	--	MOBIL OIL COMPANY	RW-9	GREENWICH TWP	3	20	22	.000	.139	.152	.134	.111	.105	.000
15-828	--	MOBIL OIL COMPANY	RW-18	GREENWICH TWP	3	18	21	.000	.004	.004	.004	.003	.003	.000
15-832	30-02340	MOBIL OIL COMPANY	RW-13	GREENWICH TWP	3	19	23	.000	.139	.152	.134	.111	.105	.000
15-836	--	HERCULES CHEMICAL	PW-8	GREENWICH TWP	3	19	17	.000	.000	.000	.000	.000	.001	.001
15-839	30-03430	BP OIL CO	RW-3	PAULSBORO BORO	3	23	26	.000	.000	.000	.000	.000	.047	.000
			UPPER AQUIFER TOTALS					21.14	23.26	24.91	27.28	28.80	31.62	29.70

Table 3. -- Annual ground-water withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey, 1981-87 -- continued.

MIDDLE AQUIFER

Well Number	Permit Number	Owner	Local Identifier	Municipality	Model Layer	Model Row	Model Column	Average withdrawal, in Mgal/d 1981	1982	1983	1984	1985	1986	1987
05-039	27-00356	NJ/AMERICAN WC	DVWC 15	BEVERLY CITY	4	22	94	0.128	0.208	0.292	0.207	0.000	0.000	0.000
05-040	27-01528	NJ/AMERICAN WC	DVWC 16	BEVERLY CITY	4	22	94	.000	.000	.000	.238	.230	.475	.949
05-074	27-05877	BURLINGTON TWP WD	3	BURLINGTON TWP	4	45	101	.076	.097	.056	.046	.091	.028	.107
05-075	--	KELLER, EARL B	EBK 1	BURLINGTON TWP	4	46	101	.017	.017	.015	.016	.016	.016	.015
05-079	27-05727	BURLINGTON TWP WD	2-1973	BURLINGTON TWP	4	46	102	.390	.672	.519	.131	.123	.225	.092
05-080	27-00196	HEISLER, ALBERT	1	BURLINGTON TWP	4	32	96	.001	.000	.000	.000	.001	.001	.000
05-081	27-02664	HEISLER, EDGAR B	HEISLER 1	BURLINGTON TWP	4	32	96	.001	.000	.017	.012	.002	.000	.000
05-082	--	MURPHY, ALBERT	FOX HILL FARM	BURLINGTON TWP	4	34	97	.016	.013	.014	.011	.016	.000	.000
05-086	27-04380	TENNECO CHEMICALS	5	BURLINGTON TWP	4	31	98	.249	.082	.058	.063	.000	.000	.000
05-089	27-05458	TENNECO CHEMICALS	7	BURLINGTON TWP	4	31	98	.977	.960	.277	.706	.430	.548	.564
05-091	27-04379	TENNECO CHEMICALS	4	BURLINGTON TWP	4	30	98	.646	.743	.765	.756	.467	.546	.360
05-092	27-03815	TENNECO CHEMICALS	1	BURLINGTON TWP	4	30	98	.392	.000	.000	.000	.000	.000	.000
05-094	27-03817	TENNECO CHEMICALS	3	BURLINGTON TWP	4	30	98	.386	.000	.000	.000	.000	.000	.000
05-097	47-00007	HERCULES POWDER	1	BURLINGTON TWP	4	35	105	.000	.135	.180	.000	.207	.293	.310
05-098	27-03568	HERCULES POWDER	3	BURLINGTON TWP	4	36	105	.148	.044	.029	.000	.000	.000	.000
05-100	--	HERCULES POWDER	2	BURLINGTON TWP	4	35	106	.226	.359	.063	.161	.000	.000	.000
05-126	31-04276	NJ/AMERICAN WC	DVWC 12-POMONA	CINNAMINSON TWP	4	31	77	.278	.502	.670	.467	.625	.740	.279
05-127	31-04697	NJ/AMERICAN WC	RIVERTON 14	CINNAMINSON TWP	4	35	79	.680	.907	.905	1.083	.905	.641	.519
05-128	31-04733	NJ/AMERICAN WC	DVWC 26	CINNAMINSON TWP	4	35	79	.119	.095	.148	.114	.197	.183	.121
05-135	27-00238	HOEGANAES IRON	HOEGANAES	CINNAMINSON TWP	4	25	81	.040	.050	.067	.058	.042	.038	.036
05-140	27-04480	CHANT, HARRY R	CHANT 1	DELANCO TWP	4	26	89	.002	.027	.033	.000	.000	.000	.000
05-144	27-04680	NJ/AMERICAN WC	DVWC 24	DELRAN TWP	4	30	83	.416	.588	.350	.145	.074	.434	.417
05-145	27-02821	HOLY CROSS H S	HIGH SCHOOL	DELRAN TWP	4	30	84	.043	.021	.021	.014	.003	.003	.005
05-147	27-05202	NJ/AMERICAN WC	FAIRVIEW ST	DELRAN TWP	4	31	85	.748	.253	.385	.178	.318	.512	.405
05-155	27-00853	CRAMP, MARTIN C	CRAMP 1	EDGEWATER PARK TWP	4	35	91	.005	.004	.012	.002	.000	.007	.013
05-156	27-04659	JAMAH CORP	CAR WASH 1	EDGEWATER PARK TWP	4	32	93	.002	.004	.010	.003	.004	.004	.004
05-159	27-00179	NJ/AMERICAN WC	DVWC 21	EDGEWATER PARK TWP	4	31	94	.794	.780	.720	.474	.000	.000	.000
05-160	27-04050	NJ/AMERICAN WC	DVWC 22	EDGEWATER PARK TWP	4	31	94	.000	.000	.000	.000	.786	.745	.827
05-161	27-05315	NJ/AMERICAN WC	DVWC 32	EDGEWATER PARK TWP	4	29	93	.600	.578	.611	.619	.630	.659	.685
05-232	31-06020	MAPLE SHADE WD	8	MAPLE SHADE TWP	4	42	73	.000	.000	.000	.000	.736	.859	.567
05-266	51-00041	MOORESTOWN TWP WD	3	MOORESTOWN TWP	4	48	75	.673	.833	1.074	.831	.538	1.109	.738
05-273	31-04770	MOORESTOWN F C	FIELD CLUB 1	MOORESTOWN TWP	4	45	80	.016	.019	.019	.000	.000	.008	.010
05-284	31-03806	MOORESTOWN TWP WD	4	MOORESTOWN TWP	4	47	84	.746	.511	.583	.590	.709	.644	.654
05-290	31-06674	MOUNT HOLLY WC	6	MOUNT HOLLY TWP	4	68	99	.326	.656	.769	.762	.340	.396	.454
05-292	27-06032	MOUNT HOLLY WC	7	WESTAMPTON TWP	4	63	98	.549	.348	.460	.217	.246	.283	.709
05-297	31-01610	RUDDEROW, J E	SPRING VALLEY	MOUNT LAUREL TWP	4	65	78	.002	.009	.003	.034	.052	.071	.000
05-382	32-02387	SYBRON CHEMICAL	IONAC CHEM 4	PEMBERTON TWP	4	77	104	.332	.332	.332	.337	.358	.653	.640
05-385	32-03778	SYBRON CHEMICAL	IONAC CHEM 5	PEMBERTON TWP	4	77	104	.672	.672	.672	.000	.000	.000	.000
05-634	--	MOUNT HOLLY WC	5	WESTAMPTON TWP	4	62	99	.700	.884	.727	.967	1.060	1.036	.680
05-635	--	INDEL INDUCT	1	WESTAMPTON TWP	4	56	95	.056	.019	.063	.063	.036	.068	.045

Table 3. -- Annual ground-water withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey, 1981-87 -- continued.

MIDDLE AQUIFER (continued)

Well Number	Permit Number	Owner	Local Identifier	Municipality	Model Layer	Model Row	Model Column	Average withdrawal, in Mgal/d 1981	1982	1983	1984	1985	1986	1987
05-649	27-03066	WILLINGBORO MUA	6	WILLINGBORO TWP	4	44	92	0.000	0.017	0.042	0.000	0.000	0.088	0.026
05-653	27-02941	WILLINGBORO MUA	4	WILLINGBORO TWP	4	36	90	.661	.610	.568	.594	.552	.748	.674
05-658	27-02919	WILLINGBORO MUA	7	WILLINGBORO TWP	4	41	93	.827	.853	.795	.805	.767	.000	.678
05-661	27-01615	WILLINGBORO MUA	1	WILLINGBORO TWP	4	35	92	.689	.846	.942	.807	.892	1.275	.880
05-667	27-02723	WILLINGBORO MUA	5	WILLINGBORO TWP	4	36	95	.329	.163	.434	.384	.388	.526	.351
05-706	27-06045	LIQUID CARBONIC	1	BURLINGTON CITY	4	36	106	.090	.088	.097	.082	.078	.010	.000
05-717	27-06754	WILLINGBORO MUA	9	WILLINGBORO TWP	4	41	92	1.068	.975	.908	.235	.873	1.167	1.001
05-749	31-07140	RAMBLEWOOD CC	3 TEE	MOUNT LAUREL TWP	4	63	75	.004	.004	.004	.000	.000	.000	.000
05-751	31-07139	RAMBLEWOOD CC	2 TEE	MOUNT LAUREL TWP	4	59	75	.000	.003	.004	.000	.000	.000	.000
05-758	27-07612	TENNECO CHEMICALS	10	BURLINGTON TWP	4	30	98	.000	.000	.000	.000	.460	.487	.523
05-761	27-06855	TENNECO CHEMICALS	9	BURLINGTON TWP	4	28	97	.096	.609	.747	.540	.362	.381	.441
07-043	31-00290	MAFCO	2	CAMDEN CITY	4	25	50	.188	.198	.131	.134	.135	.135	.143
07-058	31-03689	W JERSEY HOSPITAL	HOSP 1	CAMDEN CITY	4	26	54	.001	.001	.001	.000	.000	.000	.000
07-124	31-07020	NJ/AMERICAN WC	BROWNING 45	CHERRY HILL TWP	4	61	61	.000	.000	.000	.534	.294	.471	.372
07-134	31-05219	NJ/AMERICAN WC	OLD ORCHARD 37	CHERRY HILL TWP	4	64	69	4.403	4.331	4.145	1.415	1.559	1.676	1.956
07-135	31-05218	NJ/AMERICAN WC	OLD ORCHARD 38	CHERRY HILL TWP	4	64	69	.000	.000	.000	1.798	1.502	1.551	1.436
07-142	31-04098	NJ/AMERICAN WC	ELLISBURG 23	CHERRY HILL TWP	4	50	62	.000	.000	.000	.060	.021	.240	.218
07-146	31-04669	NJ/AMERICAN WC	KINGSTON 27	CHERRY HILL TWP	4	54	67	.000	.000	.000	.084	.001	.145	.134
07-147	51-00007	NJ/AMERICAN WC	KINGSTON 25	CHERRY HILL TWP	4	54	67	.189	.410	.662	.192	.005	.220	.155
07-304	31-05108	HADDONFIELD WD	LAKE ST WELL	HADDONFIELD BORO	4	49	59	.028	.179	.268	.033	.000	.226	.142
07-315	31-04743	NJ/AMERICAN WC	MAGNOLIA 16	MAGNOLIA BORO	4	59	52	2.461	2.205	2.069	.947	.863	.417	.397
07-329	31-04836	MCHVIL PNSK WCM	BROWNING 2A/1	PENNSAUKEN TWP	4	30	61	.801	.873	1.085	1.311	.974	1.108	1.059
07-423	--	NJ/AMERICAN WC	ASHLAND TER 32	VOORHEES TWP	4	65	57	2.068	1.986	1.874	1.029	.545	.299	.387
15-024	31-05513	DEPTFORD TWP MUA	4	DEPTFORD TWP	4	46	42	.316	.346	.422	.540	.469	.424	.195
15-069	30-00757	GREENWICH TWP WD	3(NEW 4)	GREENWICH TWP	4	23	18	.149	.175	.188	.607	.219	.277	.239
15-072	30-00037	E I DUPONT	REPAUNO 3	GREENWICH TWP	4	16	16	.000	.000	.000	.000	.391	.979	.829
15-076	30-01224	HERCULES CHEMICAL	4 1970	GREENWICH TWP	4	18	17	.058	.009	.075	.126	.097	.103	.107
15-079	30-01145	E I DUPONT	REPAUNO 6	GREENWICH TWP	4	16	17	.205	.272	.318	.288	.000	.000	.000
15-081	30-00907	E I DUPONT	REPAUNO 5	GREENWICH TWP	4	17	17	.022	.040	.000	.000	.000	.000	.000
15-092	30-00317	HERCULES CHEMICAL	GIBBSTOWN TH 6	GREENWICH TWP	4	18	18	.000	.000	.000	.000	.007	.006	.005
15-094	--	MOBIL OIL COMPANY	44	GREENWICH TWP	4	23	22	.000	.000	.361	.361	.200	.311	.000
15-098	--	MOBIL OIL COMPANY	45	GREENWICH TWP	4	22	21	.000	.000	.361	.361	.200	.311	.000
15-137	30-01371	PURELAND WATER CO	2(3-1973)	LOGAN TWP	4	25	4	.334	.412	.563	.380	.315	.404	.358
15-144	30-01370	PURELAND WATER CO	1-1973	LOGAN TWP	4	20	4	.092	.126	.072	.213	.047	.057	.049
15-158	30-00873	MONSANTO CHEMICAL	BRIDGEPORT W2	LOGAN TWP	4	7	3	.529	.770	.723	.636	.591	.522	.426
15-159	30-00872	MONSANTO CHEMICAL	BRIDGEPORT E1	LOGAN TWP	4	7	3	.567	.502	.415	.342	.422	.543	.545
15-166	30-00410	PENNS GROVE WSC	BRIDGEPORT 2	LOGAN TWP	4	13	8	.034	.041	.041	.042	.040	.033	.053
15-167	30-01170	MONSANTO CHEMICAL	1	LOGAN TWP	4	8	3	.331	.202	.371	.326	.428	.200	.186
15-210	30-01348	PAULSBORO WD	6-1973	PAULSBORO BORO	4	30	22	.699	.735	.729	.472	.539	.570	.820
15-212	30-00069	PAULSBORO WD	4	PAULSBORO BORO	4	27	21	.031	.050	.144	.119	.118	.191	.051

Table 3. -- Annual ground-water withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey, 1981-87 -- continued.

MIDDLE AQUIFER (continued)

Well Number	Permit Number	Owner	Local Identifier	Municipality	Model Layer	Model Row	Model Column	Average withdrawal, in Mgal/d 1981	1982	1983	1984	1985	1986	1987
15-213	30-00602	PAULSBORO WD	5	PAULSBORO BORO	4	28	23	0.110	0.126	0.125	0.329	0.208	0.230	0.070
15-236	30-01177	SWEDESBORO BORO WD	3	SWEDESBORO BORO	4	38	5	.249	.271	.264	.258	.251	.282	.252
15-286	30-00899	HUNTSMAN POLYPROP	SHELL 2	WEST DEPTFORD TWP	4	34	24	.045	.042	.042	.032	.024	.031	.026
15-347	30-01545	GREENWICH TWP WD	5 (2-A)	GREENWICH TWP	4	18	17	.198	.357	.313	.048	.125	.097	.094
15-348	30-01776	GREENWICH TWP WD	6	GREENWICH TWP	4	26	19	.344	.257	.244	.072	.398	.441	.422
15-374	31-13385	DEPTFORD TWP MUA	6	DEPTFORD TWP	4	57	35	.842	.854	.922	.527	.480	.232	.203
15-431	33-07973	WOODBURY WD	RED BANK 6	WOODBURY CITY	4	44	37	.358	.702	.708	.389	.251	.509	.509
15-435	31-17911	W DEPTFORD TWP WD	8	WEST DEPTFORD TWP	4	46	27	.000	.000	.392	.400	.228	1.476	.931
15-616	--	USGS-SHIVELER	MIDDLE WELL	LOGAN TWP	4	26	8	.019	.019	.019	.018	.019	.019	.019
15-692	30-03594	E I DUPONT	INTERCEPTOR 46	GREENWICH TWP	4	16	17	.000	.000	.000	.000	.000	.448	.000
15-833	--	HERCULES CHEMICAL	PW-10	GREENWICH TWP	4	19	18	.000	.000	.000	.000	.000	.006	.039
15-834	--	HERCULES CHEMICAL	PW-9	GREENWICH TWP	4	19	18	.000	.000	.000	.000	.000	.002	.040
15-835	--	HERCULES CHEMICAL	PW-8B	GREENWICH TWP	4	19	18	.000	.000	.000	.000	.006	.021	.004
15-837	--	HERCULES CHEMICAL	PW-7B	GREENWICH TWP	4	19	18	.000	.000	.000	.000	.008	.031	.009
15-838	--	HERCULES CHEMICAL	PW-5B	GREENWICH TWP	4	19	18	.000	.000	.000	.000	.014	.010	.028
			MIDDLE AQUIFER TOTALS					30.887	32.081	33.507	27.175	25.608	31.161	27.687

LOWER AQUIFER

Well Number	Permit Number	Owner	Local Identifier	Municipality	Model Layer	Model Row	Model Column	1981	1982	1983	1984	1985	1986	1987
05-123	31-05321	NJ/AMERICAN WC	DVWC 28	CINNAMINSON TWP	5	31	75	0.147	0.106	0.260	0.425	0.240	0.460	0.157
05-124	31-05437	NJ/AMERICAN WC	STEPHENS DR	CINNAMINSON TWP	5	31	75	.020	.029	.513	.396	.561	.370	.078
05-125	31-03835	NJ/AMERICAN WC	DVWC 10	CINNAMINSON TWP	5	31	77	.000	.000	.000	.359	.000	.000	.000
05-129	27-04844	RIVERTON CLUB	CC 2	CINNAMINSON TWP	5	27	76	.067	.035	.055	.054	.027	.036	.028
05-130	31-04576	NJ/AMERICAN WC	RIVERTON 13	CINNAMINSON TWP	5	24	76	.758	.662	.181	.031	.000	.090	.193
05-131	31-04864	NJ/AMERICAN WC	DVWC 27	CINNAMINSON TWP	5	24	76	.302	.134	.002	.054	.000	.000	.789
05-132	27-00731	RIVERTON CLUB	CC	CINNAMINSON TWP	5	25	77	.022	.028	.034	.000	.000	.000	.000
05-143	27-04247	NJ/AMERICAN WC	DVWC 23	DELRAN TWP	5	30	83	.621	.720	.982	.829	.686	.755	1.099
05-146	27-03080	NJ/AMERICAN WC	DVWC 19	DELRAN TWP	5	26	83	.518	.514	.476	.660	.686	.563	.577
05-228	31-08923	MAPLE SHADE WD	10	MAPLE SHADE TWP	5	48	72	.616	.619	.623	1.899	.171	.175	.175
05-272	--	MOORESTOWN TWP WD	7	MOORESTOWN TWP	5	37	76	.564	.786	.715	.694	.795	.906	.909
05-277	31-05715	CAMPBELL SOUP	CAMPBELL 3	MOORESTOWN TWP	5	36	76	.200	.181	.349	.267	.323	.336	.297
05-303	31-04347	MT LAUREL MUA	1	MOUNT LAUREL TWP	5	57	75	.000	.000	.155	.000	.000	.000	.000
05-392	27-04533	RIVERSIDE PUBLIC SCH	SCHOOL 1	RIVERSIDE TWP	5	27	85	.000	.001	.001	.001	.000	.001	.001
05-395	27-04851	NJ/AMERICAN WC	DVWC 29	RIVERSIDE TWP	5	26	86	.584	.326	.493	.309	.113	.000	.000
05-732	27-06673	BURLINGTON TWP WD	4	BURLINGTON TWP	5	46	102	.615	.318	.493	.897	.847	.977	.992
05-746	31-12925	MAPLE SHADE WD	11	MAPLE SHADE TWP	5	42	73	.616	.619	.623	.000	1.197	1.200	1.171
05-760	27-06854	TENNECO CHEMICALS	8	BURLINGTON TWP	5	28	97	.427	.924	.979	.848	.670	.869	.696
05-819	31-19212	MT LAUREL MUA	6	MOUNT LAUREL TWP	5	57	75	.000	.000	.000	.335	.314	.528	.585
05-822	--	MT LAUREL MUA	3	MOUNT LAUREL TWP	5	59	77	.078	.000	.000	.261	.379	1.463	1.129

Table 3. -- Annual ground-water withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey, 1981-87 -- continued.

LOWER AQUIFER (continued)

Well Number	Permit Number	Owner	Local Identifier	Municipality	Model Layer	Model Row	Model Column	Average withdrawal, in Mgal/d 1981	1982	1983	1984	1985	1986	1987
05-823	--	MT LAUREL MUA	4	MOUNT LAUREL TWP	5	60	78	1.162	1.298	1.367	1.119	0.984	0.229	0.769
07-008	31-04969	BELLMAWR BORO WD	4	BELLMAWR BORO	5	48	46	.407	.835	.854	.891	.069	.001	.000
07-012	31-02687	BELLMAWR BORO WD	3	BELLMAWR BORO	5	42	45	.743	.446	.145	.000	.117	.122	.000
07-057	31-04620	OUR LADY HOSP	STAND BY WELL	CAMDEN CITY	5	28	55	.000	.000	.000	.001	.001	.001	.000
07-088	--	CONCORD CHEMICAL	1	CAMDEN CITY	5	23	58	.000	.000	.000	.000	.003	.000	.000
07-098	31-04847	NJ/AMERICAN WC	CAMDEN DIV 52	CAMDEN CITY	5	22	60	4.230	1.266	.876	.782	.701	.878	.955
07-099	31-01696	H KOHNSTAMM CO	3	CAMDEN CITY	5	22	61	.165	.122	.095	.185	.085	.111	.084
07-107	31-04780	NJ/AMERICAN WC	CAMDEN DIV 51	CAMDEN CITY	5	22	61	.000	1.505	.519	.176	.234	.539	.506
07-111	31-03456	NJ/AMERICAN WC	CAMDEN DIV 50	CAMDEN CITY	5	21	61	.000	.411	.040	.004	.000	.000	.000
07-122	31-07021	NJ/AMERICAN WC	BROWNING 44	CHERRY HILL TWP	5	61	61	.000	.000	.000	1.306	.828	1.191	.779
07-123	31-07019	NJ/AMERICAN WC	BROWNING 46	CHERRY HILL TWP	5	61	61	2.013	2.985	3.662	1.874	1.792	1.895	1.773
07-144	31-00684	NJ/AMERICAN WC	ELLISBURG 13	CHERRY HILL TWP	5	50	63	.000	.000	.000	.045	.039	.149	.188
07-157	31-05033	NJ/AMERICAN WC	COLUMBIA 31	CHERRY HILL TWP	5	45	67	.000	.000	.000	.024	.006	.113	.141
07-163	31-04051	NJ/AMERICAN WC	COLUMBIA 22	CHERRY HILL TWP	5	44	68	.000	.105	.335	.001	.001	.134	.095
07-172	31-04799	COLLINGSWOOD WD	6(A)	COLLINGSWOOD BORO	5	36	53	.000	.000	.000	.440	.492	.604	.431
07-175	31-00079	COLLINGSWOOD WD	1R	COLLINGSWOOD BORO	5	34	57	.000	.000	.000	.070	.193	.035	.123
07-177	51-00030	COLLINGSWOOD WD	4	COLLINGSWOOD BORO	5	34	57	.000	.000	.000	.299	.569	.226	.544
07-178	31-04054	COLLINGSWOOD WD	3	COLLINGSWOOD BORO	5	34	57	2.357	2.340	2.477	1.388	.282	1.146	.857
07-179	51-00031	COLLINGSWOOD WD	5	COLLINGSWOOD BORO	5	34	58	.000	.000	.000	.663	1.173	.985	.908
07-183	31-05951	NJ/AMERICAN WC	GIBBSBORO 43	GIBBSBORO BORO	5	72	55	.000	.000	.000	1.768	1.867	1.597	1.352
07-188	31-05950	NJ/AMERICAN WC	GIBBSBORO 42	GIBBSBORO BORO	5	71	56	3.971	4.058	3.960	1.812	1.869	1.612	1.645
07-189	31-05949	NJ/AMERICAN WC	GIBBSBORO 41	GIBBSBORO BORO	5	71	56	.000	.000	.000	1.275	1.176	1.263	1.645
07-220	31-04306	GLOUCESTER CITY WD	40	GLOUCESTER CITY	5	34	48	1.990	1.969	2.317	1.883	1.651	1.552	1.470
07-273	31-04756	NJ/AMERICAN WC	OTTERBROOK 29	GLOUCESTER TWP	5	59	47	3.893	3.496	3.579	.653	.398	.380	.609
07-278	31-02434	NJ/AMERICAN WC	HADDON 15	HADDON HEIGHTS BORO	5	52	53	.000	.000	.000	.437	.357	.724	.099
07-281	31-01124	NJ/AMERICAN WC	HADDON 14	HADDON HEIGHTS BORO	5	52	53	.000	.000	.000	.169	.089	.373	1.167
07-284	31-05054	NJ/AMERICAN WC	EGGBERT 35	HADDON HEIGHTS BORO	5	47	51	.000	.000	.000	.285	.335	.205	.106
07-288	31-02146	HADDON TWP WD	3	HADDON TWP	5	45	56	.196	.339	.591	.600	.651	.386	.111
07-289	31-00432	HADDON TWP WD	2	HADDON TWP	5	45	56	.191	.270	.235	.404	.400	.207	.299
07-291	31-05243	HADDON TWP WD	1-R	HADDON TWP	5	45	57	.463	.487	.244	.151	.026	.677	.492
07-292	31-04855	HADDON TWP WD	4	HADDON TWP	5	44	56	.435	.293	.401	.000	.221	.281	.274
07-294	31-05138	DY-DEE SERVICE	REPLACEMENT	HADDON TWP	5	44	59	.000	.007	.033	.037	.040	.034	.034
07-302	31-02130	HADDONFIELD WD	RULON	HADDONFIELD BORO	5	55	58	.213	.308	.302	1.147	1.341	.281	.362
07-320	31-04642	MCHVIL PNSK WCM	WOODBINE 1	MERCHANTVILLE BORO	5	31	64	1.392	.724	.531	1.204	1.183	.681	.451
07-332	31-04641	MCHVIL PNSK WCM	MARION 2	PENNSAUKEN TWP	5	33	66	1.206	1.259	1.219	1.311	1.287	1.231	1.177
07-342	31-05228	MCHVIL PNSK WCM	DELA GARDEN 1A	PENNSAUKEN TWP	5	22	64	.115	.041	.195	.106	.104	.185	.177
07-349	31-00010	MCHVIL PNSK WCM	PARK AVE 1	PENNSAUKEN TWP	5	32	70	1.811	2.036	2.223	2.125	2.088	2.216	2.119
07-367	--	CAMDEN CITY WD	PUCHACK 3	PENNSAUKEN TWP	5	22	68	7.800	7.800	7.800	7.735	7.826	5.211	5.339
07-372	31-05110	MCHVIL PNSK WCM	NATIONAL HWY 1	PENNSAUKEN TWP	5	25	72	1.264	1.185	1.393	1.346	1.322	1.416	1.354
07-379	31-04251	CAMDEN CITY WD	MORRIS 10	PENNSAUKEN TWP	5	19	70	18.000	18.000	18.000	18.045	18.262	12.160	12.458

Table 3. -- Annual ground-water withdrawals from the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey, 1981-87 -- continued.

LOWER AQUIFER (continued)

Well Number	Permit Number	Owner	Local Identifier	Municipality	Model Layer	Model Row	Model Column	Average withdrawal, in Mgal/d 1981	1982	1983	1984	1985	1986	1987
07-520	31-04325	BROOKLAWN BORO WD	3	BROOKLAWN BORO	5	36	45	.250	.332	.329	.256	.270	.347	.288
07-523	31-12315	BELLMAWR BORO WD	--	BELLMAWR BORO	5	48	46	0.000	0.000	0.000	0.158	0.891	0.958	0.647
07-525	31-09694	HADDONFIELD WD	8/ 7	HADDONFIELD BORO	5	55	58	.419	.371	.603	.000	.000	.636	.438
07-547	31-18944	NJ/AMERICAN WC	54	CAMDEN CITY	5	22	62	.000	.000	1.155	1.142	1.289	1.092	.960
07-560	31-14563	MCHVIL PNSK WCM	WOODBINE 2	MERCHANTVILLE BORO	5	31	64	.000	.498	.661	.000	.000	.681	.451
07-597	31-20270	NJ/AMERICAN WC	55	CAMDEN CITY	5	22	60	.000	.000	.010	.233	.041	.058	.087
07-601	31-19218	BELLMAWR BORO WD	6	BELLMAWR BORO	5	44	46	.000	.000	.364	.287	.370	.354	.350
15-109	--	MOBIL OIL COMPANY	41	GREENWICH TWP	5	22	23	2.387	1.679	.323	.314	.258	.439	.969
15-118	30-00198	MOBIL OIL COMPANY	47	GREENWICH TWP	5	21	24	.000	.000	.208	.280	.267	.454	.000
15-207	31-02555	NATIONAL PK WD	2	NATIONAL PARK BORO	5	29	35	.302	.328	.339	.318	.315	.322	.311
15-220	30-00281	ESSEX CHEMICAL CO	OLIN 1	PAULSBORO BORO	5	24	27	.290	.636	.711	.235	.313	.544	.000
15-282	--	W DEPTFORD TWP WD	5 KINGS HIWAY	WEST DEPTFORD TWP	5	42	28	.518	.185	.235	.270	.218	.295	.084
15-283	30-00900	HUNTSMAN POLYPROP.	SHELL 3	WEST DEPTFORD TWP	5	35	25	.562	.466	.312	.377	.323	.049	.095
15-285	30-00898	HUNTSMAN POLYPROP.	SHELL 1	WEST DEPTFORD TWP	5	34	24	.055	.075	.112	.276	.480	.540	.488
15-304	30-01173	PENNWALT CORP	418	WEST DEPTFORD TWP	5	30	28	.000	.000	.000	.000	.111	.386	.425
15-312	--	W DEPTFORD TWP WD	6 RED BANK AVE	WEST DEPTFORD TWP	5	37	36	.613	.129	.033	.136	.002	.169	.218
15-313	31-04231	W DEPTFORD TWP WD	2	WEST DEPTFORD TWP	5	34	37	.000	.000	.000	.000	.000	.000	.000
15-314	31-00029	COASTAL OIL	EAGLE POINT 6	WEST DEPTFORD TWP	5	33	38	.074	1.101	.787	.979	.571	.395	.435
15-317	31-06834	COASTAL OIL	EAGLE POINT 7	WEST DEPTFORD TWP	5	32	38	.453	.082	1.088	.686	.404	.418	.592
15-318	31-00009	COASTAL OIL	EAGLE POINT 2	WEST DEPTFORD TWP	5	33	39	.580	.404	.616	.372	1.022	.428	.000
15-319	31-00002	COASTAL OIL	EAGLE POINT 4	WEST DEPTFORD TWP	5	32	39	.952	.561	.284	.090	.352	.782	.753
15-320	31-00007	COASTAL OIL	EAGLE POINT 1	WEST DEPTFORD TWP	5	33	40	.327	.083	.058	.521	.372	.627	.756
15-321	31-00028	COASTAL OIL	EAGLE POINT 5	WEST DEPTFORD TWP	5	34	41	.485	.275	.265	.522	.432	.400	.042
15-322	31-00008	COASTAL OIL	EAGLE POINT 3	WEST DEPTFORD TWP	5	32	40	.518	.042	.182	.057	.245	.191	.808
15-326	--	WESTVILLE WD	5	WESTVILLE BORO	5	39	43	.000	.000	.000	.000	.000	.111	.156
15-327	31-03418	WESTVILLE WD	4	WESTVILLE BORO	5	38	43	.680	.649	.706	.689	.727	.291	.315
15-331	31-04259	WOODBURY WD	RAILROAD 5	WOODBURY CITY	5	45	34	.102	.062	.179	.187	.283	.195	.195
15-373	31-17452	W DEPTFORD TWP WD	7	WEST DEPTFORD TWP	5	38	38	.000	.634	.726	.389	.573	.234	.667
15-411	30-01639	AIR PRODUCTS	NO-1-1978	GREENWICH TWP	5	17	25	.229	.191	.220	.180	.141	.035	.049
15-434	31-17923	WESTVILLE WD	6	WESTVILLE BORO	5	38	43	.000	.000	.000	.000	.000	.245	.165
15-439	30-01175	ESSEX CHEMICAL CO	2	PAULSBORO BORO	5	23	26	.000	.000	.000	.445	.253	.009	.252
15-672	30-01640	AIR PRODUCTS	2-NORTH WELL	GREENWICH TWP	5	23	23	.000	.000	.000	.000	.000	.060	.046
			LOWER AQUIFER TOTALS					44.17	42.57	45.03	69.48	67.59	61.51	60.81
			AQUIFER SYSTEM TOTALS					96.19	97.91	103.5	123.93	122.0	124.3	118.2

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey

[All altitudes are in feet above sea level; TWP, Township; BORO, Borough MUA, Municipal Utilities Authority; WC, Water Company; WD, Water Department; WCM, Water Commission; CC, Country Club; GC, Golf Course; TSA, Township Sewer Authority; --, no information]

UPPER AQUIFER

Well number	Owner	Well name	Site altitude	1978		1983		1984		1986		1988	
				Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude
05-060	BURLINGTON CITY WD	BCWD 2	21	--	--	--	--	--	--	9/05	4	11/02	4
05-076	HEAL, CHARLES J	HEAL	50	11/07	-3	10/31	-4	11/08	-3	8/23	-6	11/03	-6
05-077	BURLINGTON TWP WD	1-1973	60	--	--	--	--	--	--	--	--	10/31	-13
05-165	EVESHAM MUA	EMUA 4	110	11/14	-75	11/07	-81	11/16	-91	8/27	-87	11/28	-89
05-167	EVESHAM MUA	EMUA 5	50	11/14	-70	11/07	-79	--	--	8/26	-89	11/02	-84
05-211	LISEHORA, MARY	S J GROVE 1	80	11/07	-5	10/27	-5	11/07	-5	9/05	-8	11/04	-9
05-229	MAPLE SHADE WD	MSWD 9	40	11/09	-47	11/03	-57	11/17	-50	8/25	-59	11/04	-56
05-249	MEDFORD TWP WD	MTWD3/MTWD1	55	11/02	-65	11/03	-75	11/21	-85	8/27	-86	11/07	-84
05-251	MEDFORD WC	MWC 4(1968)	49	--	--	11/02	-71	--	--	--	--	12/12	-77
05-252	MEDFORD WC	MWC 1(3)/MWC 8	48	--	--	11/02	-73	--	--	--	--	10/26	-69
05-253	MEDFORD LEASING	1-1972	32	--	--	11/02	-72	--	--	--	--	10/26	-68
05-258	US GEOL SURVEY	MEDFORD 1	71	11/06	-52	--	--	1/09	-65	8/22	-67	11/07	-66
05-285	MOUNT HOLLY WC	MHWC 4	16	--	--	11/01	-37	--	--	--	--	12/50	-42
05-289	MOUNT HOLLY WC	MHWC 3	19	--	--	11/01	-34	--	--	--	--	12/50	-41
05-310	NJ TURNPIKE AUTHORITY	MAINT 2	40	11/14	-40	10/26	-48	11/13	-49	9/15	-52	12/19	-50
05-313	HAINES, WM JR	FARM WELL 2	25	11/16	-46	12/29	-51	11/13	-51	--	--	--	--
05-315	LARCHMONT FARMS	FARM WELL 1	55	11/17	-39	11/04	-45	--	--	8/25	-49	11/04	-49
05-317	NJ TURNPIKE AUTHORITY	4N-1	45	--	--	--	--	--	--	--	--	12/01	-45
05-318	NJ TURNPIKE AUTHORITY	4N-2	45	--	--	--	--	--	--	--	--	12/01	-43
05-383	SYBRON CHEMICAL	IONAC CHEM 2	30	--	--	11/03	-20	--	--	--	--	11/80	-38
05-438	THE GOLF FARM	SPRINGFIELD TWP	41	11/07	-22	10/28	-23	11/06	-24	8/21	-30	--	--
05-446	INTERSTATE S-P	INTERSTATE 1	75	11/07	-14	10/27	-15	11/06	-14	8/21	-19	11/02	-18
05-707	EVESHAM MUA	EMUA 7	100	--	--	11/07	-86	11/16	-80	8/27	-101	11/03	-94
05-728	MOBILE ESTATES	FIELD PUMP	55	--	--	10/31	-31	--	--	--	--	10/31	-37
05-729	MAPLE SHADE WD	MSWD 2	30	--	--	--	--	--	--	--	--	12/12	-26
05-745	BC COUNTRY CLUB	CLUB 1R	102	11/14	-16	10/31	-17	11/06	-17	8/21	-23	11/07	-21
05-747	DITTMAR	1949	80	11/24	-39	10/31	-46	11/15	-46	8/25	-50	11/01	-53
05-748	RCA	RANCOCAS 1	80	11/08	-35	11/08	-39	11/13	-40	8/25	-45	11/09	-45
05-755	KING'S GRANT WC	KGWC 1	90	--	--	11/04	-79	11/21	-78	9/03	-88	10/31	-91
05-757	EVESHAM MUA	EMUA 6	50	--	--	--	--	--	--	--	--	11/02	-87
05-795	MT LAUREL MUA	MLWC 5	60	11/14	-79	11/07	-96	11/16	-84	8/26	-104	11/02	-97
05-820	KING'S GRANT WC	KGWC 2	90	--	--	11/04	-78	--	--	--	--	11/14	-80
05-821	FEDERAL LAND BANK	1	65	--	--	11/02	-21	--	--	8/20	-24	11/02	-25
05-824	EVESHAM MUA	EMUA 8	85	--	--	--	--	--	--	8/27	-99	11/02	-128
07-003	OWENS CORNING	CORNING 1	70	--	--	11/09	-102	11/30	-82	9/04	-93	11/17	-96
07-013	BELLMAWR BORO WD	BBWD 1	31	--	--	11/09	-46	11/14	-42	9/04	-46	11/09	-44
07-015	BERLIN WD	BWD 11	150	11/01	-78	11/07	-89	11/27	-86	8/29	-99	11/17	-97
07-018	BERLIN WD	BWD 9	145	--	--	--	--	11/28	-19	8/28	-104	11/15	-95
07-019	BERLIN WD	BWD 10	145	11/16	-75	--	--	2/14	-83	8/28	-119	11/15	-97
07-030	SOUTH JERSEY PORT	NY SHIP 5A	11	--	--	--	--	11/20	-21	8/28	-17	--	--

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

UPPER AQUIFER (continued)

Well number	Owner	Well name	Site altitude	1978		1983		1984		1986		1988	
				Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude
07-115	WOODCREST CT CL	CLUB 1	70	--	--	11/09	-84	11/21	-81	9/03	-99	10/31	-101
07-117	NJ/AMERICAN WC	HUTTON HILL 1	158	11/17	-76	12/09	-79	11/16	-80	8/22	-99	11/19	-84
07-120	HUSSMAN REFRIDG	HUSSMAN	67	11/12	-83	11/10	-90	11/14	-77	9/03	-92	11/09	-84
07-131	NJ/AMERICAN WC	OLD ORCHARD B	71	11/08	-74	11/16	-79	11/14	-77	8/20	-100	11/03	-83
07-133	NJ/AMERICAN WC	OLD ORCHARD 36	80	--	--	--	--	--	--	--	--	11/08	-75
07-143	NJ/AMERICAN WC	ELLISBURG 16	40	11/09	-61	11/16	-65	11/14	-63	8/22	-72	11/09	-67
07-148	NJ/AMERICAN WC	KINGSTON 28	44	11/08	-63	11/10	-66	11/14	-63	8/20	-69	11/08	-66
07-149	NJ NATIONAL GD	1	15	11/15	-52	11/16	-54	11/19	-53	--	--	11/08	-59
07-151	GARDEN STATE RACE	RACE TRACK	30	--	--	11/09	-57	--	--	--	--	11/18	-57
07-162	NJ/AMERICAN WC	COLUMBIA 24	34	11/07	-46	11/10	-50	11/14	-48	8/22	-52	11/03	-52
07-193	CRESCENT TRAILER PARK	TRAILER PK 1	20	11/09	-39	11/14	-40	11/15	-37	8/25	-38	11/08	-37
07-242	SOCIETY DIVINE	SAVIOR	107	--	--	12/20	-76	11/16	-73	9/04	-86	11/16	-82
07-244	CAMDEN COUNTY	LAKELAND 3	50	11/08	-70	11/02	-74	11/13	-70	--	--	11/10	-79
07-249	GARDEN STATE WC	BLACKWOD DIV 3	65	--	--	--	--	--	--	--	--	11/09	-86
07-250	GARDEN STATE WC	BLACKWOD DIV 7	60	--	--	--	--	--	--	--	--	11/09	-89
07-252	GARDEN STATE WC	BLACKWOD DIV 6	75	11/09	-73	11/15	-84	11/14	-84	9/26	-84	11/09	-81
07-272	NJ/AMERICAN WC	OTTERBROOK 34	60	--	--	--	--	--	--	8/21	-89	11/07	-80
07-274	NJ/AMERICAN WC	OTTERBROOK 39	60	11/08	-81	11/07	-87	11/14	-86	--	--	11/07	-81
07-275	NJ/AMERICAN WC	HADDON 20	60	11/09	-77	11/07	-78	11/13	-71	8/21	-84	11/14	-79
07-279	NJ/AMERICAN WC	HADDON 30	65	11/09	-76	11/07	-72	--	--	8/21	-82	11/14	-77
07-282	NJ/AMERICAN WC	HADDON 11	84	--	--	11/07	-75	11/09	-70	8/21	-82	11/10	-77
07-285	NJ/AMERICAN WC	EGGBERT 18	24	11/09	-63	11/07	-64	11/14	-61	--	--	11/08	-64
07-293	HADDON TWP BD OF ED	HADDON TWP HS1	15	11/15	-56	11/10	-57	11/14	-57	8/26	-61	11/10	-57
07-297	HADDONFIELD WD	HWD 4	18	--	--	--	--	11/15	-80	9/03	-98	12/12	-79
07-299	HADDONFIELD WD	LAYNE 2/LAYNE 1	65	11/08	-80	11/04	-85	--	--	9/03	-91	11/10	-85
07-310	NJ/AMERICAN WC	LAUREL 13	77	11/08	-76	11/16	-83	11/13	-81	8/21	-107	11/14	-85
07-311	NJ/AMERICAN WC	LAUREL 15	75	11/08	-80	11/16	-86	11/13	-83	8/21	-110	11/10	-91
07-316	NJ/AMERICAN WC	MAGNOLIA 33	75	--	--	11/09	-87	11/13	-78	8/21	-92	11/07	-83
07-318	OWENS CORNING	CORNING 2	67	--	--	11/09	-92	11/16	-79	9/04	-90	11/17	-87
07-322	NJ/AMERICAN WC	OAKLYN TEST	33	11/07	-52	11/07	-53	11/13	-50	8/22	-54	11/04	-50
07-392	PINE HILL MUA	PHMUA 1	150	11/07	-71	11/01	-88	11/20	-84	9/02	-92	11/14	-96
07-398	PINE HILL MUA	PHMUA 2-1972	200	11/08	-81	11/01	-96	11/20	-89	9/02	-102	11/14	-97
07-404	NJ/AMERICAN WC	RUNNEMEDE 19	67	11/13	-78	11/07	-83	11/13	-77	8/21	-85	11/15	-82
07-410	NJ/AMERICAN WC	SOMERDALE 14	95	11/08	-90	11/09	-95	11/13	-89	8/21	-106	11/14	-94
07-411	TAVISTOCK CLUB	COUNTRY CLUB 1	30	11/12	-77	11/09	-81	11/15	-76	8/26	-96	11/09	-84
07-422	NJ/AMERICAN WC	ASHLAND 17	68	11/13	-87	11/09	-91	--	--	8/21	-109	11/02	-107
07-426	NJ/AMERICAN WC	VOORHEES 21	129	11/13	-84	11/09	-87	11/13	-80	8/21	-178	11/10	-92
07-477	US GEOL SURVEY	NEW BROOKLYN 2	111	11/16	-64	11/08	-73	12/07	-69	8/21	-81	11/18	-77
07-521	CLEMENTON WD	CWD 10	180	--	--	--	--	--	--	--	--	11/10	-103
07-573	US GEOL SURVEY	COAST GUARD 2	11	--	--	12/02	-9	11/27	-8	8/19	-6	11/18	-9

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

UPPER AQUIFER (continued)

Well number	Owner	Well name	Site altitude	1978 Date	1978 Altitude	1983 Date	1983 Altitude	1984 Date	1984 Altitude	1986 Date	1986 Altitude	1988 Date	1988 Altitude
07-600	LAKELAND HOSPITAL	LAKELAND H 4	40	--	--	11/02	-75	11/13	-78	9/29	-83	11/10	-82
15-001	CLAYTON WD	CWD 3	133	11/21	-62	11/14	-69	11/19	-68	8/28	-77	11/15	-77
15-003	CLAYTON WD	4-1973	140	--	--	--	--	11/19	-65	8/26	-36	11/15	-71
15-006	WOODBURY WD	SEWELL 1A	20	11/14	-52	11/08	-56	11/19	-52	9/03	-63	11/10	-59
15-008	WOODBURY WD	SEWELL 2A	21	11/14	-50	11/08	-53	11/19	-55	--	--	11/10	-61
15-009	DEPTFORD TWP MUA	DTMUA 5	78	11/09	-59	11/03	-64	--	--	9/23	-70	10/20	-68
15-011	DEPTFORD TWP MUA	DTMUA 2	58	11/09	-47	11/03	-53	11/13	-46	9/23	-53	11/10	-49
15-028	E GREENWICH WD	EGWD 2	70	11/08	-21	11/01	-23	11/16	-28	8/21	-27	11/07	-23
15-060	GLASSBORO WD	GWD 3	150	11/20	-60	11/09	-70	11/16	-63	8/26	-74	11/10	-66
15-062	GLASSBORO WD	GWD 2	145	11/20	-66	11/09	-72	--	--	8/26	-81	11/28	-79
15-063	GLASSBORO WD	GWD 4	150	11/20	-59	11/09	-65	11/16	-64	--	--	11/28	-64
15-127	LEONARD, WM	5	140	11/22	-46	11/14	-49	--	--	8/26	-54	11/10	-50
15-129	SOUTH JERSEY WC	SJWC 1	35	11/22	-25	11/14	-30	11/15	-31	8/28	-34	11/10	-31
15-147	SHOEMAKER, R A	1	18	11/20	-4	11/18	5	11/16	5	--	--	11/03	3
15-187	INVERSAND CO	--	2	--	--	--	--	--	--	--	--	11/08	-64
15-191	MANTUA TWP MUA	MTMUA 2	72	11/09	-60	11/08	-63	11/14	-49	8/20	-66	11/09	-70
15-192	MANTUA TWP MUA	MTMUA 5	80	11/08	-30	11/07	-43	11/14	-38	--	--	11/09	-38
15-194	MANTUA TWP MUA	MTMUA 4	10	11/09	-48	11/07	-53	11/15	-47	8/20	-53	11/09	-51
15-226	PITMAN WD	PWD P2	130	12/06	-67	11/14	-70	11/15	-69	8/20	-81	11/14	-82
15-227	PITMAN WD	PWD P3	99	12/06	-60	11/14	-64	11/15	-63	8/20	-75	11/14	-71
15-240	DEL MONTE CORP	9	32	11/15	-22	11/18	-19	11/14	-18	8/29	-22	11/01	-21
15-248	WASHINGTON TMUA	WTMUA 5	125	11/21	-63	11/08	-68	11/15	-80	8/21	-91	11/08	-80
15-253	WASHINGTON TMUA	6(FRIES MLS 1)	152	11/21	-65	11/08	-76	11/15	-80	8/21	-88	11/08	-81
15-260	WASHINGTON TMUA	8(BELS LK WC2)	130	--	--	11/08	-75	11/15	-75	--	--	11/08	-82
15-261	WASHINGTON TMUA	WTMUA 1	100	11/08	-72	11/08	-81	11/15	-77	8/21	-93	11/17	-85
15-268	WASHINGTON TMUA	WTMUA 4	77	11/21	-72	11/08	-79	11/15	-76	8/21	-95	11/08	-78
15-274	WENONAH WD	WWD 1	80	--	--	--	--	11/16	-61	9/05	-68	--	--
15-275	WENONAH WD	WWD 2	50	11/15	-51	11/03	-53	11/17	-49	--	--	11/14	-62
15-276	W DEPTFORD TWD	WDTWD 4	60	11/15	-39	11/03	-44	11/20	-39	--	--	11/14	-46
15-281	W DEPTFORD TWD	WDTWD 3	61	11/15	-35	11/03	-40	11/20	-36	--	--	11/14	-37
15-297	SHELL CHEMICAL CO	SHELL OBS 6	21	11/08	-11	10/31	-11	11/16	-10	8/28	-13	11/15	-11
15-303	PENNWALT CORP	TEST WELL 1	10	12/13	-6	11/04	-8	11/19	-7	9/02	-8	11/10	-9
15-330	WOODBRY HGTS BORO	1 HELEN AVE	40	11/16	-44	11/07	-50	11/20	-45	9/02	-55	11/08	-49
15-332	WOODBURY WD	PARKING LOT 3	50	11/14	-31	10/31	-45	11/19	-41	9/03	-69	11/10	-38
15-339	GRASSO, J S	1	90	11/13	-19	11/17	-19	11/16	-18	--	--	11/09	-20
15-342	DEL MONTE CORP	10	60	--	--	11/18	-21	11/16	-20	--	--	11/02	-21
15-345	MUSUMECI, PETER	1	62	11/16	-12	11/14	-12	11/14	-11	8/29	-14	11/03	-12
15-346	TOMARCHIO, ALFRED	1	80	--	--	11/08	-24	11/21	-21	9/05	-34	11/14	-29
15-355	E GREENWICH WD	EGWD 3	42	11/08	-28	11/01	-30	11/14	-27	8/21	-32	11/07	-28
15-361	GLASSBORO WD	GWD 5	140	--	--	--	--	--	--	--	--	11/15	-78

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

Well number	Owner	Well name	Site altitude	1978 Date	1978 Altitude	1983 Date	1983 Altitude	1984 Date	1984 Altitude	1986 Date	1986 Altitude	1988 Date	1988 Altitude
UPPER AQUIFER (continued)													
15-379	MANTUA TWP MUA	MTMUA 6	145	--	--	--	--	--	--	--	--	11/09	-40
15-392	NJ TURNPIKE AUTHORITY	1964-S-1	105	--	--	--	--	--	--	9/15	-28	--	--
15-433	WASHINGTON TMUA	WTMUA 9	135	--	--	11/15	-69	11/15	-81	8/21	-91	11/08	-78
15-511	FEHLAUER, ALBERT	2	10	--	--	--	--	--	--	--	--	11/02	1
15-546	CHEMICAL LEAMAN	CL2	10	--	--	11/16	3	11/09	3	9/02	2	11/23	3
15-554	US EPA REGION I	S-2A	9	--	--	11/16	2	11/14	1	--	--	11/21	1
15-560	US EPA REGION I	S-11A	11	--	--	11/16	8	--	--	--	--	11/21	6
15-564	US EPA-GAVENTA	S-9	7	--	--	--	--	--	--	--	2	11/15	3
15-585	ROLLINS ENVIRON	DP5	8	--	--	--	--	11/09	2	--	--	11/02	-1
15-591	ROLLINS ENVIRON	25	3	--	--	--	--	--	--	8/25	-8	--	--
15-617	US GEOL SURVEY	SHIVELER UPPER	31	--	--	--	--	--	--	8/22	-9	11/14	-7
15-627	LOGAN TWP-PUREL	MW 103 D	7	--	--	--	--	--	--	8/25	-4	--	--
15-677	EXXON CO	MW 8	28	--	--	--	--	--	--	8/25	2	11/08	-1
15-699	MOBIL OIL CO	29	9	--	--	--	--	--	--	8/27	3	--	--
15-700	MOBIL OIL CO	40	2	--	--	--	--	--	--	8/27	-4	--	--
15-707	US GEOL SURVEY	GAVENTA W TAB	7	--	--	--	--	--	--	--	--	11/15	2
15-709	ESSEX CHEMICAL	OBS 2	10	--	--	--	--	--	--	8/27	-2	--	--
15-710	BP OIL CO	BL-1	5	--	--	--	--	--	--	8/27	0	--	--
15-728	US GEOL SURVEY	STEFKA 4 OBS	4	--	--	--	--	--	--	--	--	11/15	-7
15-741	US GEOL SURVEY	MANTUA SHALLOW	82	--	--	--	--	--	--	9/05	-47	11/16	-46
15-773	US GEOL SURVEY	NATIONAL PARK	10	--	--	--	--	--	--	--	--	11/15	-7
15-777	US GEOL SURVEY	NATIONAL PARK	15	--	--	--	--	--	--	--	--	11/15	0
15-779	US GEOL SURVEY	NATIONAL PK	11	--	--	--	--	--	--	--	--	11/15	-5
15-843	BP OIL CO	P-13	20	--	--	--	--	--	--	--	--	11/08	1
15-1000	RAY ANGELINI IN	ANGELINI 1	75	--	--	--	--	--	--	--	--	11/16	-71
15-1012	PHILLIPS, NELSO	MILLSTREAM FARM	40	--	--	--	--	--	--	--	--	11/14	-43
15-1013	SCHULTES, RICHARD	SCHULTES 1	105	--	--	--	--	--	--	--	--	11/18	-65
15-1031	MATLACK TRUCKING	MATLACK TRUCKIN	47	--	--	--	--	--	--	--	--	--	--
33-075	BOY SCOUTS OF A	CM1 (AUBURN)	15	--	--	--	--	11/16	-11	--	--	11/14	-13
MIDDLE AQUIFER													
05-040	NJ/AMERICAN WC	DVWC 16	18	--	--	10/26	8	11/14	6	8/25	5	11/03	6
05-052	BURLINGTON C WD	BCWD 1 1943	10	--		--	--	11/07	0	--	--	11/02	8
05-063	WILLINGBORO MUA	WILLINGBORO 1 O	45	--	--	--	--	11/07	-16	8/21	-21	11/02	-21
05-070	BURLINGTON TWP WD	TEST 1	60	--	--	11/01	-11	11/07	-11	8/22	-14	10/31	-16
05-080	HEISLER, ALBERT	1	46	--	--	--	--	--	--	8/27	-14	11/01	-12
05-084	MASONIC HOME	MASONIC 1	60	11/12	-11	11/01	-10	11/06	-9	8/21	-5	10/31	-16
05-086	TENNECO CHEMICALS	TENNECO 5	18	--	--	--	--	11/14	-6	--	--	10/31	-3
05-087	TENNECO CHEMICALS	TENNECO 5-OBS	14	--	--	12/29	-8	11/14	-13	8/23	-6	10/31	-13
05-089	TENNECO CHEMICALS	TENNECO 7	10	--	--	12/29	-7	--	--	8/20	-10	--	--
05-090	TENNECO CHEMICALS	TENNECO 6-OBS	15	--	--	12/29	-3	11/14	-8	8/20	-7	10/31	-9

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

MIDDLE AQUIFER (continued)

Well number	Owner	Well name	Site altitude	1978 Date	1978 Altitude	1983 Date	1983 Altitude	1984 Date	1984 Altitude	1986 Date	1986 Altitude	1988 Date	1988 Altitude
05-098	HERCULES POWDER	HERCULES 3	27	11/13	3	11/04	1	11/06	1	9/21	2	11/03	0
05-101	HERCULES POWDER	HERCULES 3 OBS	19	11/13	2	11/04	2	11/06	2	8/22	2	11/03	2
05-106	OXIDENTAL CHEMICAL	HOOKER 2R/SUPPL	20	--	--	11/04	-4	11/06	-19	8/21	-7	11/04	-22
05-109	NATIONAL GYPSUM	NAT GYP 2	22	11/17	-4	11/04	-3	11/08	-2	--	--	11/03	-5
05-110	NATIONAL GYPSUM	NAT GYP 3	22	11/17	3	11/04	4	--	--	8/22	4	--	--
05-126	NJ/AMERICAN WC	DVWC 12-POMONA	73	11/09	-8	10/27	-17	11/14	-12	8/27	-17	11/03	-16
05-127	NJ/AMERICAN WC	RIVERTON 14	35	11/09	-13	10/27	-17	11/14	-17	8/27	-21	11/03	-20
05-134	CINNAMINSON TSA	TEST WELL 68 1	11	11/09	2	10/21	2	11/15	2	--	--	--	--
05-135	HOEGANAES IRON	HOEGANAES	35	11/07	7	10/24	5	11/16	6	--	--	--	--
05-136	TAYLOR, H G	TAYLOR 3	16	--	--	10/21	13	11/16	13	8/22	12	11/03	11
05-137	TAYLOR, H G	TAYLOR 2	14	11/06	11	10/21	11	11/16	11	8/22	11	11/03	11
05-138	TAYLOR, H G	TAYLOR 1	15	--	--	10/21	12	11/16	11	8/22	12	11/03	11
05-140	CHANT, HARRY R	CHANT 1	25	11/06	2	10/28	6	11/15	6	8/25	4	11/01	4
05-145	HOLY CROSS HIGH SCHOOL	HIGH SCHOOL	70	11/15	2	10/27	1	11/15	2	8/22	-2	11/01	-3
05-147	NJ/AMERICAN WC	FAIRVIEW ST	83	11/15	0	10/26	1	11/14	1	8/27	1	11/03	-2
05-150	AMICO SAND	AMICO	15	--	--	10/28	5	11/15	5	8/27	5	10/31	4
05-160	NJ/AMERICAN WC	DVWC 22	45	11/15	15	10/26	17	--	--	8/25	-12	11/03	4
05-161	NJ/AMERICAN WC	DVWC 32	40	--	--	10/26	5	11/14	4	8/27	3	11/03	-2
05-180	WORKMAN, JAMES	WORKMAN 1	41	11/12	8	12/29	9	11/08	9	8/22	7	11/08	8
05-187	FLORENCE TWP WD	FTWD 4	30	--	--	--	--	--	--	8/21	-6	--	--
05-188	FLORENCE TWP WD	FTWD 3	30	--	--	11/04	0	--	--	8/21	-9	11/04	-3
05-190	FLORENCE TWP WD	FTWD 1	30	11/07	2	11/04	3	11/08	-2	--	--	11/04	3
05-217	INDUSTRIAL PARK	TURNPIKE JCTN	60	10/26	-5	--	--	3/07	-5	--	--	--	--
05-232	MAPLE SHADE WD	MSWD 8	20	11/09	-29	11/03	-35	--	--	8/25	-38	11/04	-33
05-261	US GEOL SURVEY	MEDFORD 5	73	11/07	-48	9/30	-58	11/19	-53	9/20	-59	11/07	-61
05-264	MOORESTOWN TWD	MTWD 5	38	11/13	-40	11/01	-50	11/13	-44	8/26	-52	11/03	-48
05-265	MOORESTOWN TWD	MTWD 6	42	11/13	-38	11/01	-47	11/13	-43	8/26	-50	11/03	-47
05-266	MOORESTOWN TWD	MTWD 3	40	11/13	-42	11/01	-52	11/13	-46	8/26	-54	11/03	-52
05-268	MARLAC ELECTRONICS	LAYNE 1	70	11/15	-30	11/03	-35	11/15	-32	8/25	-38	11/01	-39
05-273	MOORESTOWN F C	FIELD CLUB 1	70	11/16	-27	12/20	-29	11/13	-30	8/27	-33	11/01	-32
05-276	CAMPBELL SOUP	CAMPBELL 2	41	--	--	--	--	--	--	--	--	12/06	-30
05-283	MOORESTOWN TWD	MTWD 8	65	11/24	-27	11/01	-35	11/16	-41	8/29	-40	12/19	-34
05-284	MOORESTOWN TWD	MTWD 4	59	11/24	-26	11/01	-32	--	--	8/29	-41	12/19	-31
05-290	MOUNT HOLLY WC	MHWC 6	15	--	--	11/01	-57	--	--	--	--	12/50	-63
05-297	RUDDEROW, J E	SPRING VALLEY	48	--	--	--	--	--	--	--	--	11/01	-71
05-304	MT LAUREL MUA	MLWC 2	20	11/15	-54	11/02	-63	11/14	-71	8/27	-34	11/02	-64
05-382	SYBRON CHEMICAL	IONIC CHEM 4	30	--	--	11/03	-52	--	--	--	--	11/80	-63
05-385	SYBRON CHEMICAL	IONAC CHEM 5	30	--	--	11/03	-52	--	--	--	--	11/80	-61
05-393	RIVERSIDE INDUSTRIES	FTC 39	15	11/07	2	10/28	2	11/16	2	9/02	1	10/31	1
05-440	RHODIA CORP	RHODIA 1	72	11/13	-29	--	--	1/06	-29	9/25	-33	10/27	-37

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

MIDDLE AQUIFER (continued)

Well number	Owner	Well name	Site altitude	1978		1983		1984		1986		1988	
				Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude
05-448	STATE OF NJ	1-REST AREA	36	--	--	10/27	-5	--	--	8/21	-10	11/07	-10
05-634	MOUNT HOLLY WC	MHWC 5	55	--	--	11/03	-58	--	--	--	--	12/50	-60
05-649	WILLINGBORO MUA	WMUA 6	33	11/09	-15	10/27	-22	11/15	-27	8/21	-31	11/02	-32
05-651	WILLINGBORO MUA	WMUA 9(OLD 3)	28	11/15	-20	10/27	-19	--	--	8/21	-21	11/02	-29
05-653	WILLINGBORO MUA	WMUA 4	28	11/15	-11	10/27	-11	--	--	8/21	-20	--	--
05-658	WILLINGBORO MUA	WMUA 7	19	11/09	-13	10/27	-19	11/15	-23	8/21	-25	--	--
05-661	WILLINGBORO MUA	WMUA 1	10	11/09	-10	10/27	-16	11/15	-11	8/21	-17	11/02	-22
05-667	WILLINGBORO MUA	WMUA 5	39	11/09	-11	10/27	-16	11/15	-18	8/21	-16	11/02	-17
05-668	WILLINGBORO MUA	WMUA DCB 28	43	11/09	-6	10/27	-9	--	--	8/21	-11	11/02	-11
05-749	RAMBLEWOOD CC	3 TEE	75	11/16	-60	11/02	-69	11/15	-68	8/25	-76	10/31	-75
05-751	RAMBLEWOOD CC	2 TEE	20	11/17	-55	11/02	-64	11/15	-61	8/25	-70	10/31	-69
05-782	RIVERSIDE TWP	SEWERAGE 1	10	--	--	--	--	--	--	--	--	11/01	0
05-801	TEXACO CO	OW 10	20	--	--	10/26	0	11/15	1	8/22	-2	10/31	-1
05-804	TAYLOR, JOSEPH	1	10	--	--	--	--	--	--	8/22	4	--	--
05-805	CINNAMINSON TSA	1	11	--	--	10/21	2	11/15	2	8/25	1	10/31	-1
05-807	HOEGANAES IRON	L1	12	--	--	10/24	4	11/16	5	8/22	4	10/31	3
05-812	HOEGANAES IRON	L6	8	--	--	10/24	5	11/16	4	9/23	4	10/31	4
05-814	HOEGANAES IRON	I2	18	--	--	10/24	8	11/16	8	8/22	8	10/31	10
05-1091	WILLINGBORO MUA	WMUA 11	28	--	--	--	--	--	--	--	--	11/02	-16
07-039	CAMDEN CITY WD	CITY 7N	21	--	--	--	--	--	--	--	--	11/04	-28
07-040	CAMDEN CITY WD	CITY 7	21	11/12	-34	11/21	-31	11/25	-27	9/03	-27	--	--
07-046	CAMDEN CITY WD	CITY 11	13	11/12	-31	11/21	-27	11/26	-23	9/03	-24	11/15	8
07-048	CAMDEN CITY WD	CITY 6N	14	11/12	-26	11/23	-26	11/28	-20	9/03	-21	11/03	-20
07-061	CAMDEN CITY WD	CITY 4	41	11/12	-37	11/21	-33	11/26	-29	9/03	-31	11/04	-29
07-124	NJ/AMERICAN WC	BROWNING 45	77	11/09	-77	11/10	-84	11/15	-72	8/20	-99	11/04	-92
07-132	NJ/AMERICAN WC	OLD ORCHARD C	71	11/08	-82	11/16	-81	11/14	-77	8/20	-118	11/03	-81
07-134	NJ/AMERICAN WC	OLD ORCHARD 37	68	--	--	--	--	--	--	--	--	11/08	-73
07-135	NJ/AMERICAN WC	OLD ORCHARD 38	72	--	--	--	--	--	--	--	--	11/08	-73
07-142	NJ/AMERICAN WC	ELLISBURG 23	32	--	--	--	--	11/14	-64	8/22	-73	11/09	-66
07-146	NJ/AMERICAN WC	KINGSTON 27	40	--	--	11/10	-70	--	--	--	--	11/80	-70
07-147	NJ/AMERICAN WC	KINGSTON 25	44	11/08	-65	11/10	-68	11/14	-65	8/20	-91	11/08	-67
07-186	NJ/AMERICAN WC	GIBBSBORO OB 3	70	11/13	-77	11/10	-84	11/15	-82	8/20	-98	11/02	-88
07-195	G & W NATURAL R	5-DEEP	10	7/12	-54	11/08	-56	11/21	-36	--	--	--	--
07-304	HADDONFIELD WD	LAKE ST WELL	50	--	--	--	--	11/20	-68	9/03	-78	11/10	-72
07-315	NJ/AMERICAN WC	MAGNOLIA 16	78	11/08	-89	11/16	-89	11/13	-81	8/21	-120	11/07	-87
07-329	MCHVIL PNSK WCM	BROWNING 2A/BRO	16	11/14	-36	11/03	-31	11/19	-32	8/26	-39	11/09	-34
07-338	US GEOL SURVEY	PETTY I EAST 3	5	--	--	11/03	-19	--	--	--	--	11/80	-19
07-413	NJ/AMERICAN WC	ELM TREE 3	149	11/16	-69	11/09	-78	11/16	-76	8/20	-89	11/18	-82
07-423	NJ/AMERICAN WC	ASHLAND TER 32	70	--	--	--	--	11/13	-96	8/21	-108	11/02	-83
07-476	US GEOL SURVEY	NEW BROOKLYN 1	111	11/16	-46	11/08	-53	12/07	-52	9/05	-55	11/18	-57

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

MIDDLE AQUIFER (continued)

Well number	Owner	Well name	Site altitude	1978 Date	1978 Altitude	1983 Date	1983 Altitude	1984 Date	1984 Altitude	1986 Date	1986 Altitude	1988 Date	1988 Altitude
07-564	NJ DEP	HARRISON 4	15	--	--	12/02	-12	11/26	-10	9/05	-13	11/04	-12
15-024	DEPTFORD TWP MUA	DTMUA 4	40	11/09	-48	11/03	-50	11/13	-43	9/23	-47	11/10	-46
15-069	GREENWICH TWD	GTWD 3(NEW 4)	10	11/14	-9	11/15	-9	11/14	-8	9/03	-12	11/01	-10
15-076	HERCULES CHEMICAL	4 1970	15	--	--	11/15	0	--	--	--	--	11/01	-1
15-084	HERCULES CHEMICAL	GIBBSTOWN 2	12	--	--	--	--	--	--	--	--	11/01	-9
15-094	MOBIL OIL CO	MOBIL 44	7	--	--	11/21	-31	--	--	--	--	11/30	-14
15-096	HERCULES CHEMICAL	GIBBSTOWN OB 2	14	11/14	-6	11/15	-6	--	--	8/26	-3	11/01	-7
15-097	HERCULES CHEMICAL	GIBBSTOWN TH8/T	6	--	--	11/15	-1	--	--	--	--	11/10	-1
15-098	MOBIL OIL CO	MOBIL 45	3	--	--	--	--	11/14	-11	--	--	--	--
15-134	PURELAND WC	TEST WELL 2	18	--	--	--	--	11/07	-8	--	--	--	--
15-135	SHELL OIL CO	OBS WELL 8A	7	--	--	11/16	4	11/16	-2	--	--	11/07	3
15-137	PURELAND WC	PURE 2(3-1973)	29	--	--	11/16	-6	--	--	--	--	11/09	-8
15-140	PURELAND WC	TEST WELL 4	6	11/16	--	11/16	1	11/07	-1	9/03	-4	11/09	0
15-143	PURELAND WC	LANDTECT TW-6C	19	11/16	3	11/16	2	11/07	2	--	--	11/07	1
15-144	PURELAND WC	1-1973	8	--	--	11/17	-2	--	--	--	--	11/09	-3
15-146	PURELAND WC	LANDTECT TW-9	5	--	--	11/16	-2	--	--	--	--	11/80	-3
15-161	MONSANTO CHEMICAL	OB1(TW5-OBC)	8	--	--	11/15	-9	11/07	-5	--	--	11/08	-7
15-166	PENNS GROVE WSC	BRIDGEPORT 2	5	11/16	2	11/17	1	11/16	--	--	--	11/01	2
15-167	MONSANTO CHEMICAL	MONSANTO 1	10	--	--	--	--	--	--	--	--	11/08	-12
15-170	VINE CONCRETE CO	REPAUP 1	11	--	--	--	--	--	--	--	--	11/16	4
15-212	PAULSBORO WD	PWD 4	25	11/15	-22	11/02	-22	11/14	-11	8/25	-19	11/07	-22
15-213	PAULSBORO WD	PWD 5	10	11/15	-10	11/02	-10	11/14	-9	8/25	-11	11/07	-10
15-236	SWEDESBORO BWD	SBWD 3	75	--	--	11/08	-20	--	--	--	--	11/10	-22
15-238	SWEDESBORO BWD	SBWD 2	30	--	--	11/08	-21	--	--	--	--	11/10	-24
15-242	DEL MONTE CORP	6	25	11/15	-21	11/18	-21	11/14	-20	8/29	-24	11/01	-21
15-279	SHELL CHEMICALCO	SHELL OBS 7	17	11/08	-23	11/04	-24	11/27	-24	8/28	-27	11/10	-26
15-347	GREENWICH TWD	GTWD 5 (2-A)	20	11/14	0	11/15	-2	--	--	9/03	-4	11/01	-2
15-348	GREENWICH TWD	GTWD 6	20	11/14	-9	11/16	-10	11/14	-9	9/03	-12	11/01	-11
15-354	ROLLINS ENVIRONMENTAL	DP 2	13	--	--	11/17	7	--	--	--	--	11/20	6
15-359	E I DUPONT	C POWER 22	5	--	--	11/15	2	--	--	--	--	11/20	0
15-374	DEPTFORD TMUA	DTMUA 6	50	--	--	11/03	-65	11/13	-60	9/23	-67	11/10	-63
15-387	ROLLINS ENVIRONMENTAL	DP 1	10	--	--	11/17	6	--	--	8/26	5	11/01	9
15-395	REPAUPO FIRE CO	30-1972	20	--	--	11/18	-4	11/14	-2	8/25	-12	11/01	-13
15-415	W DEPTFORD TWD	TEST 8-79	40	--	--	11/03	-42	11/20	-38	--	--	11/14	-39
15-431	WOODBURY WD	RED BANK 6	30	--	--	10/31	-46	11/19	-40	9/03	-51	--	--
15-435	W DEPTFORD TWD	WDTWD 8	40	--	--	11/03	-43	11/20	-39	8/21	-48	11/14	-38
15-490	ROLLINS ENVIRONMENTAL	MA-3I	3	--	--	11/17	1	--	--	--	--	11/20	0
15-492	ROLLINS ENVIRONMENTAL	MA-3D	3	--	--	11/17	3	--	--	--	--	11/20	-1
15-494	ROLLINS ENVIRONMENTAL	MA-3S	3	--	--	11/17	2	--	--	--	--	11/20	0
15-540	US EPA	EPA 108	7	--	--	--	--	--	--	--	--	11/15	2

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

MIDDLE AQUIFER (continued)

Well number	Owner	Well name	Site altitude	1978 Date	1978 Altitude	1983 Date	1983 Altitude	1984 Date	1984 Altitude	1986 Date	1986 Altitude	1988 Date	1988 Altitude
15-549	CHEMICAL LEAMAN	DW1	7	--	--	11/16	5	11/09	5	--	--	11/01	4
15-550	CHEMICAL LEAMAN	DW2	10	--	--	11/16	3	11/09	2	--	--	11/23	2
15-555	US EPA REGION I	S-2B	11	--	--	11/16	2	--	--	--	--	11/21	3
15-556	US EPA REGION I	S-2C	11	--	--	11/16	1	--	--	--	--	11/21	1
15-561	US EPA REGION I	S-11B	11	--	--	11/16	6	--	--	--	--	11/21	6
15-562	US EPA REGION I	S-11C	11	--	--	--	--	--	--	--	--	11/21	5
15-569	PURELAND WC	PWC 3	32	--	--	--	--	11/07	-12	--	--	11/09	-12
15-586	ROLLINS ENVIRONMENTAL	DP4	12	--	--	--	--	11/09	2	--	--	11/02	2
15-616	US GEOL SURVEY	SHIVELER MIDDLE	31	--	--	--	--	--	--	--	--	11/14	-8
15-620	US GEOL SURVEY	GAVENTA MIDDLE	7	--	--	--	--	--	--	--	--	11/14	2
15-647	HERCULES CHEMICAL	MW 19B	12	--	--	--	--	--	--	8/26	-5	--	--
15-652	HERCULES CHEMICAL	MW 12	1	--	--	--	--	--	--	8/26	-4	--	--
15-654	HERCULES CHEMICAL	MW 14	2	--	--	--	--	--	--	8/26	-3	--	--
15-657	E I DUPONT	OBS 38	9	--	--	--	--	--	--	8/28	-8	--	--
15-660	E I DUPONT	OBS 33	8	--	--	--	--	--	--	8/28	0	--	--
15-661	E I DUPONT	OBS 31	8	--	--	--	--	--	--	8/28	-5	--	--
15-665	HERCULES CHEMICAL	MW 20C	14	--	--	--	--	--	--	8/26	-6	--	--
15-667	HERCULES CHEMICAL	MW 20	14	--	--	--	--	--	--	8/26	-5	--	--
15-668	HERCULES CHEMICAL	MW 10C	8	--	--	--	--	--	--	8/27	0	--	--
15-679	MOBIL OIL CO	W-5D	10	--	--	--	--	--	--	8/27	-4	11/03	-3
15-681	MOBIL OIL CO	W-7D	9	--	--	--	--	--	--	8/27	0	11/03	1
15-682	MOBIL OIL CO	W-8D	11	--	--	--	--	--	--	8/27	-9	11/03	-3
15-683	MOBIL OIL CO	W-9D	11	--	--	--	--	--	--	8/27	-8	--	--
15-685	EXXON CO	MW 7	30	--	--	--	--	--	--	--	--	11/08	6
15-689	E I DUPONT	DUPONT 93	10	--	--	--	--	--	--	--	--	11/02	2
15-692	E I DUPONT	INTERCEPTOR 46	5	--	--	--	--	--	--	8/28	-3	--	--
15-693	E I DUPONT	42	5	--	--	--	--	--	--	8/28	-2	--	--
15-697	PENNS GROVE WC	BRIDGEPORT BACK	8	--	--	--	--	--	--	8/29	1	11/01	4
15-713	US GEOL SURVEY	STEFKA 2 OBS	6	--	--	--	--	--	--	--	--	11/15	-8
15-727	US GEOL SURVEY	STEFKA	3	--	--	--	--	--	--	--	--	11/15	-8
15-771	US GEOL SURVEY	NATIONAL PARK	10	--	--	--	--	--	--	--	--	11/15	-6
15-774	US GEOL SURVEY	NATIONAL PARK	10	--	--	--	--	--	--	--	--	11/15	-1
15-776	US GEOL SURVEY	NATIONAL PARK	15	--	--	--	--	--	--	--	--	11/15	-4
15-780	US GEOL SURVEY	NATIONAL PK	10	--	--	--	--	--	--	--	--	11/15	1
15-998	US GEOL SURVEY	CLAYTON 1	141	--	--	--	--	--	--	--	--	11/15	-109
15-1039	MOBIL OIL CO	MOBIL 48 DWTA	7	--	--	--	--	--	--	--	--	11/03	-11
33-080	AIR REDUCTION	AIRCO 1	15	--	--	--	--	11/07	0	--	--	11/08	-6
Ph-012	U S NAVY	--	9	--	--	--	--	11/20	-7	9/03	-7	11/08	-7

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

LOWER AQUIFER

Well number	Owner	Well name	Site altitude	1978		1983		1984		1986		1988	
				Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude
05-123	NJ/AMERICAN WC	DVWC 28	25	11/09	-10	10/27	-12	11/14	-12	8/27	-16	11/03	-16
05-125	NJ/AMERICAN WC	DVWC 10	79	11/09	-11	10/27	-15	11/14	-13	8/29	-16	11/03	-16
05-130	NJ/AMERICAN WC	RIVERTON 13	70	11/09	-4	10/26	-3	11/14	-12	8/29	-10	11/03	-14
05-131	NJ/AMERICAN WC	DVWC 27	75	--	--	--	--	--	--	8/29	-7	11/04	-10
05-143	NJ/AMERICAN WC	DVWC 23	36	--	--	--	--	--	--	--	--	11/03	-7
05-146	NJ/AMERICAN WC	DVWC 19	25	11/15	3	10/26	2	11/14	2	8/27	0	11/03	0
05-228	MAPLE SHADE WD	MSWD 10	40	11/08	-47	11/03	-51	--	--	8/25	-57	12/14	-60
05-262	US GEOL SURVEY	MEDFORD 4	72	11/06	-48	9/30	-58	12/12	-52	--	--	11/07	-60
05-272	MOORESTOWN TWD	MTWD 7	40	11/24	-16	11/01	-22	11/16	-37	8/29	-33	12/19	-34
05-274	CAMPBELL SOUP	CAMPBELL 1	40	11/24	-20	11/01	-26	11/15	-26	9/29	-26	12/06	-29
05-645	WILLINGBORO MUA	WILLINGBORO 2 O	40	11/07	-31	11/01	--	11/01	-35	8/21	-40	11/07	-41
05-648	WILLINGBORO MUA	WMUA 3-OBS	34	11/09	-20	10/27	-23	11/15	-24	8/21	-29	11/02	-29
05-717	WILLINGBORO MUA	WMUA 9	30	--	--	--	--	--	--	--	--	11/02	-27
05-732	BURLINGTON TWP WD	4	80	--	--	--	--	--	--	--	--	10/31	-14
05-746	MAPLE SHADE WD	MSWD 11	20	11/09	-29	11/03	-34	11/14	-34	8/25	-39	11/18	-36
05-819	MT LAUREL MUA	MLMUA 6	20	--	--	11/02	-59	--	--	--	--	11/20	-68
05-822	MT LAUREL MUA	MLMUA 3	35	--	--	11/02	-57	--	--	--	--	11/20	-74
05-823	MT LAUREL MUA	MLMUA 4	35	11/16	-48	11/02	-62	11/14	-64	8/27	-68	11/02	-75
05-1075	MT LAUREL MUA	ELBO LANE 7	40	--	--	--	--	--	--	--	--	11/02	-83
07-012	BELLMAWR BORO WD	BBWD 3	35	12/01	-53	11/07	-56	11/14	-58	9/03	-55	11/09	-48
07-029	NY SHIPBUILDING	9	12	--	--	--	--	--	--	8/25	-15	--	--
07-047	CAMDEN SEWAGE AUTHORITY	SEWAGE PLANT 1	9	11/09	-16	11/28	-14	11/15	-12	8/25	-13	11/18	-12
07-064	CAMDEN CITY WD	CITY 17	34	--	--	11/21	-39	--	--	--	--	11/50	-32
07-068	CAMDEN CITY WD	CITY 13	30	11/12	-36	11/21	-35	--	--	9/03	-33	11/05	-28
07-078	CAMDEN CITY WD	CITY 5N	22	11/12	-26	11/21	-21	11/28	-18	9/03	-20	11/04	-19
07-079	CAMDEN CITY WD	CITY 12	23	11/12	-17	11/21	-13	11/28	-11	9/03	-13	11/04	-11
07-083	CAMDEN CITY WD	CITY 1A	10	11/09	-33	11/21	-25	11/28	-22	9/03	-23	11/04	-22
07-090	CAMDEN CITY WD	CITY 10	10	11/09	-31	11/21	-24	11/28	-20	9/03	-22	11/04	-21
07-094	CAMDEN CITY WD	CITY 16	23	11/08	-32	11/21	-26	11/28	-23	9/03	-25	11/04	-24
07-098	NJ/AMERICAN WC	CAMDEN DIV 52	18	--	--	--	--	--	--	--	--	11/04	-26
07-107	NJ/AMERICAN WC	CAMDEN DIV 51	20	--	--	--	--	1/10	-35	8/22	-30	11/04	-30
07-108	NJ/AMERICAN WC	CAMDEN DIV 10	11	11/09	-34	1/10	-29	1/10	-29	--	--	--	--
07-111	NJ/AMERICAN WC	CAMDEN DIV 50	9	--	--	--	--	11/15	-30	8/22	-29	11/04	-26
07-112	NJ/AMERICAN WC	CAMDEN DIV 48	10	--	--	--	--	11/15	-27	8/22	-35	11/04	-34
07-121	NJ/AMERICAN WC	BROWING T-1	80	11/08	-85	11/10	-94	11/15	-140	8/20	-107	11/04	-103
07-122	NJ/AMERICAN WC	BROWNING 44	80	--	--	--	--	--	--	--	--	11/04	-100
07-123	NJ/AMERICAN WC	BROWNING 46	81	11/08	-84	11/10	-93	--	--	8/20	-109	11/04	-101
07-130	NJ/AMERICAN WC	OLD ORCHARD A	71	11/08	-67	11/10	-75	11/14	-74	8/20	-86	11/03	-80
07-144	NJ/AMERICAN WC	ELLISBURG 13	39	11/09	-60	11/16	-64	11/14	-64	--	--	11/09	-67
07-157	NJ/AMERICAN WC	COLUMBIA 31	45	--	--	--	--	11/14	-52	8/22	-56	11/09	-55

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

LOWER AQUIFER (continued)

Well number	Owner	Well name	Site altitude	1978 Date	1978 Altitude	1983 Date	1983 Altitude	1984 Date	1984 Altitude	1986 Date	1986 Altitude	1988 Date	1988 Altitude
07-163	NJ/AMERICAN WC	COLUMBIA 22	39	11/09	-46	11/10	-51	11/14	-56	8/22	-53	11/09	-53
07-171	COLLINGSWOOD WD	CWD 7(B)	10	--	--	11/03	-45	--	--	--	--	11/70	-33
07-172	COLLINGSWOOD WD	CWD 6(A)	10	11/07	-41	11/03	-40	11/14	-39	--	--	11/07	-37
07-175	COLLINGSWOOD WD	CWD 1R	25	--	--	11/03	-48	--	--	--	--	11/70	-47
07-176	COLLINGSWOOD WD	CWD 2R	12	--	--	--	--	11/14	-54	8/26	-50	--	--
07-178	COLLINGSWOOD WD	CWD 3	15	11/07	-44	11/03	-41	11/14	-55	8/26	-51	11/07	-41
07-179	COLLINGSWOOD WD	CWD 5	10	11/07	-46	11/03	-44	--	--	8/26	-50	11/07	-40
07-184	NJ/AMERICAN WC	GIBBSBORO OB 1	70	11/13	-77	11/10	-92	11/15	-131	8/20	-116	11/01	-98
07-185	NJ/AMERICAN WC	GIBBSBORO OB 2	70	11/13	-76	11/10	-84	11/15	-124	8/20	-132	11/01	-86
07-188	NJ/AMERICAN WC	GIBBSBORO 42	65	--	--	--	--	--	--	--	--	11/02	-89
07-194	G & W NATURAL R	4-DEEP	8	7/12	-55	11/08	-55	11/21	-33	--	--	--	--
07-196	G & W NATURAL R	2-DEEP	6	--	--	11/08	-59	11/21	-39	--	--	--	--
07-197	G & W NATURAL R	3-DEEP	8	--	--	11/08	-60	11/21	-36	--	--	--	--
07-201	AMSPEC CHEMICAL	AMSPEC 1	5	--	--	11/08	-57	11/26	-39	8/20	-41	11/15	-40
07-204	AMSPEC CHEMICAL	AMSPEC 4	5	--	--	11/08	-55	11/26	-38	8/20	-39	11/15	-39
07-205	CORSON'S FOOD	3	7	--	--	11/10	-50	11/20	-39	8/20	-38	11/18	-37
07-206	CORSON'S FOOD	2	9	--	--	11/10	-47	11/20	-35	8/20	-37	11/18	-35
07-207	CORSON'S FOOD	JERSEY AVE 1	9	--	--	11/10	-47	11/26	-34	8/20	-40	11/18	-36
07-220	GLOUCESTER CITY WD	GCWD 40	10	--	--	--	--	1/20	-41	9/04	-46	11/23	-49
07-221	US GEOL SURVEY	COAST GUARD 1	11	11/22	-38	12/02	-35	11/27	-30	819	-31	11/18	-30
07-222	GLOUCESTER CITY WD	GCWD 41	10	--	--	--	--	--	--	9/04	-39	--	--
07-273	NJ/AMERICAN WC	OTTERBROOK 29	60	11/08	-72	11/07	-71	11/13	-76	8/21	-92	11/07	-77
07-278	NJ/AMERICAN WC	HADDON 15	65	11/09	-72	11/07	-76	--	--	8/21	-86	11/09	-82
07-281	NJ/AMERICAN WC	HADDON 14	76	11/09	-72	11/07	-76	11/09	-74	8/21	-85	11/09	-79
07-283	NJ/AMERICAN WC	EGBERT	24	11/09	-63	11/07	-64	11/14	-81	8/22	-70	11/02	-64
07-290	HADDON TWP WD	HTWD 1	56	--	--	11/10	-66	--	--	--	--	11/18	-74
07-292	HADDON TWP WD	HTWD 4	45	11/09	-63	11/10	-64	11/15	-62	8/26	-76	11/18	-67
07-302	HADDONFIELD WD	RULON	25	11/08	-72	11/04	-79	11/20	-78	9/03	-92	11/10	-85
07-320	MCHVIL PNSK WCM	WOODBINE 1	65	11/14	-37	11/04	-40	--	--	8/26	-45	11/09	-38
07-332	MCHVIL PNSK WCM	MARION 2	65	11/14	-42	11/04	-45	11/19	-45	8/26	-52	11/09	-45
07-335	MCHVIL PNSK WCM	MARION 1	61	--	--	11/04	-35	--	--	--	--	11/09	-35
07-337	US GEOL SURVEY	PETTY ISLAND 2	5	--	--	11/03	-19	11/26	-17	8/25	-18	12/13	-19
07-341	MCHVIL PNSK WCM	DELA GARDEN 2	39	11/14	-28	11/03	-27	11/19	-26	8/26	-26	11/09	-25
07-343	US GEOL SURVEY	PETTY I WEST 1	5	--	--	--	--	--	--	8/25	-18	11/08	-19
07-348	MCHVIL PNSK WCM	PARK AVE 3	25	11/14	-34	11/03	-35	11/19	-35	8/26	-39	11/09	-34
07-354	GENERAL FOODS	PETTY IS OBS	12	--	--	11/04	2	11/26	1	8/25	1	11/08	1
07-359	CAMDEN CITY WD	PUCHACK 5	30	11/19	-20	12/06	-26	11/28	-25	8/28	-30	11/04	-17
07-367	CAMDEN CITY WD	PUCHACK 3	10	--	--	12/06	-33	--	--	--	--	11/04	-30
07-368	CAMDEN CITY WD	DELAIR 1	10	--	--	12/06	-22	--	--	--	--	11/50	-17
07-370	CAMDEN CITY WD	DELAIR 3	8	--	--	12/06	-17	--	--	--	--	11/50	-13

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

LOWER AQUIFER (continued)

Well number	Owner	Well name	Site altitude	1978 Date	1978 Altitude	1983 Date	1983 Altitude	1984 Date	1984 Altitude	1986 Date	1986 Altitude	1988 Date	1988 Altitude
07-372	MCHVIL PNSK WCM	NATIONAL HWY 1	40	--	--	--	--	--	--	--	--	11/08	-51
07-373	CAMDEN CITY WD	MORRIS 6	14	--	--	11/17	-25	--	--	--	--	11/50	-17
07-375	CAMDEN CITY WD	MORRIS 8	10	--	--	11/17	-22	--	--	--	--	11/50	-18
07-377	CAMDEN CITY WD	MORRIS 7	10	--	--	--	--	11/26	-12	--	--	--	--
07-379	CAMDEN CITY WD	MORRIS 10	16	11/19	-16	11/17	-12	11/28	-10	8/28	-13	11/05	-12
07-382	CAMDEN CITY WD	MORRIS 4A	8	11/19	-12	11/17	-11	--	--	8/28	-9	11/05	-13
07-390	CAMDEN CITY WD	MORRIS 1	9	11/19	-6	11/17	-5	11/28	-3	8/28	-5	11/05	-8
07-412	NJ/AMERICAN WC	ELM TREE 2	149	11/16	-63	11/09	-72	11/16	-73	8/20	-80	11/18	-78
07-523	BELLMAWR BORO WD	BELLMAWR BORO	75	12/01	-62	11/07	-64	11/14	-70	9/04	-70	11/09	-67
07-527	CAMDEN CITY WD	PARKSIDE 18	40	11/12	-37	11/21	-37	11/28	-33	--	--	11/05	-31
07-528	CAMDEN CITY WD	PUCHACK 7	20	11/19	-23	12/06	-28	11/28	-29	8/28	-33	11/04	-32
07-533	CADILLAC PET FO	1	8	--	--			1/30	-14	--	--	--	--
07-535	CAMDEN CITY WD	TW-1-79	10	--	--	--	--	11/28	-24	8/28	-23	--	--
07-537	CAMDEN CITY WD	TW-4-79	10	--	--	--	--	--	--	8/28	-30	--	--
07-538	CAMDEN CITY WD	TW-5-79	10	--	--	--	--	11/28	-39	8/28	-35	--	--
07-539	CAMDEN CITY WD	TW-6-79	10	--	--	11/17	-37	--	--	--	--	11/50	-31
07-540	CAMDEN CITY WD	TW-7-79	10	--	--	--	--	11/28	-29	8/28	-29	--	--
07-541	CAMDEN CITY WD	TW-8-79	20	--	--	11/21	-34	11/26	-30	9/05	-36	11/04	-31
07-547	NJ/AMERICAN WC	54	35	--	--	--	--	1/10	-33	8/22	-33	11/04	-32
07-548	BRENAMAN, JE	1	10	--	--	11/04	-5	--	--	--	--	12/13	-21
07-560	MCHVIL PNSK WCM	WOODBINE 2	50	--	--	--	--	11/19	-48	--	--	--	--
07-563	NJ DEP	HARRISON 3	15	--	--	11/30	-16	11/26	-13	9/05	-15	11/04	-15
07-596	BROOKLAWN BORO WD	BBWD 4	10	--	--	11/14	-52	--	--	--	--	11/23	-51
07-597	NJ/AMERICAN WC	55	11	--	--	--	--	1/10	-31	8/21	-31	11/04	-30
07-674	HADDON TWP WD	HTWD 2A	60	--	--	--	--	--	--	--	--	11/18	-68
15-109	MOBIL OIL CO	MOBIL 41	20	--	--	11/21	-9	11/14	-10	--	--	--	--
15-139	PURELAND WC	TEST WELL 3	7	11/16	-9	11/16	-9	11/07	-10	9/03	-12	11/09	-10
15-175	AM DREDGING CO	RACCOON IS T 1	8	11/15	0	11/17	1	11/16	0	--	--	11/16	-1
15-220	ESSEX CHEMICAL	OLIN 1	10	--	--	11/09	-7	11/15	-8	--	--	11/07	-7
15-282	W DEPTFORD TWP WD	5 KINGS HIWAY	55	--	--	--	--	--	--	8/20	-37	11/14	-34
15-285	SHELL CHEMICAL CO	SHELL 1	12	--	--	--	--	--	--	8/28	-35	--	--
15-296	SHELL CHEMICAL CO	SHELL OBS 5	21	11/08	-16	10/31	-16	11/27	-17	8/28	-19	11/15	-18
15-308	PENNWALT CORP	TEST WELL 8	10	12/13	-14	11/04	-15	11/19	-14	--	--	11/10	-19
15-309	PENNWALT CORP	TEST WELL 5	10	12/13	-13	11/04	-13	11/19	-13	--	--	11/10	-17
15-311	PENNWALT CORP	TEST WELL 7	10	12/13	-10	11/04	-10	11/19	-9	9/02	-11	11/10	-13
15-312	W DEPTFORD TWP WD	6 RED BANK AVE	20	--	--	10/25	-55	--	--	--	--	11/14	-56
15-313	W DEPTFORD TWP WD	WDTWD 2	23	11/15	-53	10/25	-50	11/20	-54	--	--	--	--
15-316	TEXAS OIL CO	EAGLE PT OBS 1	32	12/13	-67	10/25	-54	11/14	-55	--	--	11/08	-58
15-318	TEXAS OIL CO	EAGLE POINT 2	17	--	--	10/25	-51	11/14	-53	--	--	11/08	-54
15-320	TEXAS OIL CO	EAGLE POINT 1	20	--	--	10/25	-52	11/14	-59	--	--	11/08	-56

Table 4.--Water levels in the Potomac-Raritan-Magothy aquifer system in the Camden area, New Jersey--continued.

LOWER AQUIFER (continued)

Well number	Owner	Well name	Site altitude	1978		1983		1984		1986		1988	
				Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude	Date	Altitude
15-321	TEXAS OIL CO	EAGLE POINT 5	13	--	--	10/25	-57	11/14	-65	--	--	11/08	-61
15-322	TEXAS OIL CO	EAGLE POINT 3	20	--	--	--	--	11/14	-68	--	--	--	--
15-323	COASTAL OIL CO	EAGLE PT OBS 3	21	8/15	-52	9/29	-43	11/14	-40	9/05	-35	11/16	-44
15-326	WESTVILLE WD	WWD 5	12	11/16	-47	11/03	-48	11/16	-46	--	--	11/15	-48
15-327	WESTVILLE WD	WWD 4	16	--	--	11/03	-59	--	--	--	--	11/15	-51
15-331	WOODBURY WD	RAILROAD 5	35	11/14	-44	10/31	-47	11/19	-45	--	--	11/10	-53
15-349	PURELAND WC	LANDTECT 2	6	11/16	-6	11/16	-6	11/16	-5	--	--	11/08	-9
15-350	PURELAND WC	LANDTECT 1	20	11/16	-8	11/16	-9	11/07	-9	--	--	11/07	-9
15-373	W DEPTFORD TWD	WDTWD 7	28	--	--	--	--	--	--	8/21	-58	--	--
15-398	PETTIT, LOUIS	419	1	--	--	--	--	--	--	--	--	11/03	-2
15-430	TEXAS OIL CO	EAGLE POINT 6A	15	--	--	10/25	-49	11/14	-63	--	--	11/08	-53
15-434	WESTVILLE WD	WWD 6	15	--	--	11/03	-60	11/16	-72	--	--	11/15	-49
15-438	GLOUCESTER MUA	GCMUA 1	10	--	--	--	--	--	--	9/03	-19	11/14	-18
15-533	NATIONAL PARK WD	NPWD 6	22	--	--	11/07	-33	11/14	-31	8/21	-35	11/09	-34
15-696	MOBIL OIL CO	W-3D	8	--	--	--	--	--	--	8/27	-14	--	--
15-711	MOBIL OIL CO	W-8C	12	--	--	--	--	--	--	8/27	-8	11/03	-5
15-712	US GEOL SURVEY	STEFKA 1 OBS	7	--	--	--	--	--	--	--	--	11/15	-10
15-738	MOBIL OIL CO	W-4C	5	--	--	--	--	--	--	--	--	11/03	-9
15-742	US GEOL SURVEY	MANTUA DEEP	84	--	--	--	--	--	--	9/05	-39	11/16	-39
15-770	US GEOL SURVEY	NATIONAL PARK	10	--	--	--	--	--	--	--	--	11/15	-25
15-999	US GEOL SURVEY	CLAYTON 2 DEEP	142	--	--	--	--	--	--	--	--	11/15	-58
15-1004	US GEOL SURVEY	CEDAR LAKE DEEP	80	--	--	--	--	--	--	--	--	11/15	-118
15-1061	MOBIL OIL CO	W-4D	4	--	--	--	--	--	--	--	--	11/03	-5
33-086	B F GOODRICH CO	4 (PW-3)	13	--	--	11/18	-12	11/07	-37	--	--	11/09	-11
33-187	US GEOL SURVEY	POINT AIRY OBS	73	--	--	--	--	12/06	-25	8/27	-29	11/16	-28
Ph-001	U S NAVY	--	11	--	--	--	--	--	--	9/03	-8	11/08	-8
Ph-006	U S NAVY	--	10	--	--	--	--	--	--	9/03	-7	11/15	-47
Ph-019	U S NAVY	--	9	--	--	--	--	--	--	9/03	-19	11/08	-22
Ph-063	ROOSEVELT PARK	--	6	--	--	--	--	--	--	9/08	-5	11/08	-5
Ph-086	U S NAVAL HOSPITAL	--	8	--	--	--	--	--	--	9/16	-2	--	--
Ph-124	PRES. CATERERS	--	33	--	--	--	--	12/13	-1	9/04	3	--	--
Ph-127	DISCNT PLYWOOD	--	25	--	--	--	--	--	--	9/22	-1	--	--
Ph-417	PUBLICKER INDUSTRIES	--	5	--	--	--	--	11/13	-13	--	--	--	--
Ph-430	CROWN PAPER BOARD	--	14	--	--	--	--	12/13	-6	9/04	-1	--	--
Ph-750	S A F AMERICA	--	10	--	--	--	--	--	--	9/22	-9	11/08	-7
Ph-780	UNITED NESCO CONTAINERS	--	11	--	--	--	--	--	--	9/16	-3	--	--

Table 5.--Well-location and -construction data

[WSCH, Wissahickon Schist; MRPA, Potomac-Raritan-Magothy aquifer system (undifferentiated); MRPAL, lower aquifer of the Potomac-Raritan-Magothy aquifer system; MRPAM, middle aquifer of the Potomac-Raritan-Magothy aquifer system; MRPAU, upper aquifer of the Potomac-Raritan-Magothy aquifer system; EGLS, Englishtown aquifer system; PNPN, Piney Point aquifer; QRNR, Quaternary sands; n/a, not applicable; --, missing information; DMS, degrees, minutes, seconds; TWP, Township; BORO, Borough; MUA, Municipal Utilities Authority; WD, Water Department; WC, Water Company; WCM, Water Commission; CC, Country Club; GC, Golf Club; TSA, Township Sewer Authority; (G), information from Greenman and others (1961); (P), information from Paulachok and others (1984)]

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
05-039	NJ/AMERICAN WATER CO	DVWC 15	BEVERLY CITY	400404	745520	12.	MRPAM	57.	47.	57.	27-00356
05-040	NJ/AMERICAN WATER CO	DVWC 16	BEVERLY CITY	400405	745517	18.	MRPAM	51.	39.	51.	27-01528
05-052	BURLINGTON CITY WD	BCWD 1 1943	BURLINGTON CITY	400455	745121	10.	MRPAM	78.	57.	78.	47-00002
05-053	US PIPE	US PIPE 1	BURLINGTON CITY	400514	745020	15.	MRPAU	42.	15.	42.	27-05342
05-060	BURLINGTON CITY WD	BCWD 2	BURLINGTON CITY	400538	745053	21.	MRPAU	49.	33.	49.	27-00600
05-062	BURLINGTON CITY WD	BCWD 4	BURLINGTON CITY	400541	745043	18.	MRPAM	43.	27.	43.	27-00738
05-063	WILLINGBORO MUA	WMUA 1	BURLINGTON TWP	400213	745108	45.45	MRPAM	294.	284.	294.	--
05-064	FIRST NATIONAL BANK	BANK 2	BURLINGTON TWP	400234	745307	35.	MRPAM	209.	189.	209.	27-02917
05-070	BURLINGTON TWP WD	TEST 1	BURLINGTON TWP	400313	745004	60.	MRPAM	200.	140.	200.	27-05259
05-074	BURLINGTON TWP WD	3	BURLINGTON TWP	400313	745004	50.	MRPAM	270.	--	--	27-05877
05-075	KELLER, EARL B	EBK 1	BURLINGTON TWP	400320	744938	75.	MRPAM	202.	--	--	
05-076	HEAL, CHARLES JR	HEAL	BURLINGTON TWP	400324	745152	50.	MRPAU	80.	59.	80.	31-01751
05-077	BURLINGTON TWP WD	1-1973	BURLINGTON TWP	400326	744942	60.	MRPAU	165.	123.	165.	27-05716
05-079	BURLINGTON TWP WD	2-1973	BURLINGTON TWP	400327	744934	80.	MRPAM	224.	--	--	27-05727
05-080	HEISLER, ALBERT	1	BURLINGTON TWP	400331	745316	46.	MRPAM	252.	212.	252.	27-00196
05-081	HEISLER, EDGAR B	HEISLER 1	BURLINGTON TWP	400331	745317	30.	MRPAM	215.	185.	215.	27-02664
05-082	MURPHY, ALBERT	FOX HILL	BURLINGTON TWP	400338	745245	35.	MRPAM	82.	64.	82.	--
05-084	MASONIC HOME	MASONIC 1	BURLINGTON TWP	400342	744948	60.	MRPAM	194.	174.	194.	--
05-086	TENNECO CHEMICALS	TENNECO 5	BURLINGTON TWP	400404	745301	18.	MRPAM	132.	102.	132.	27-04380
05-087	TENNECO CHEMICALS	TENNECO 5-OBS	BURLINGTON TWP	400407	745246	14.40	MRPAM	60.	50.	60.	27-03694
05-089	TENNECO CHEMICALS	TENNECO 7	BURLINGTON TWP	400409	745247	10.	MRPAM	130.	100.	130.	27-05458
05-090	TENNECO CHEMICALS	T 6-OBS	BURLINGTON TWP	400409	745309	15.	MRPAM	65.	55.	65.	27-03695
05-091	TENNECO CHEMICALS	TENNECO 4	BURLINGTON TWP	400418	745250	14.	MRPAM	112.	82.	112.	27-04379
05-092	TENNECO CHEMICALS	TENNECO 1	BURLINGTON TWP	400418	745247	10.	MRPAM	120.	87.	117.	27-03815
05-094	TENNECO CHEMICALS	TENNECO 3	BURLINGTON TWP	400417	745257	7.	MRPAM	122.	97.	122.	27-03817
05-097	HERCULES POWDER	HERCULES 1	BURLINGTON TWP	400524	744951	22.	MRPAM	146.	105.	135.	47-00007
05-098	HERCULES POWDER	HERCULES 3	BURLINGTON TWP	400525	744938	27.40	MRPAM	136.	111.	136.	27-03568
05-100	HERCULES POWDER	HERCULES 2	BURLINGTON TWP	400535	744941	22.	MRPAM	146.	105.	135.	--
05-101	HERCULES POWDER	HERCULES 3 OBS	BURLINGTON TWP	400543	744948	19.24	MRPAM	104.	94.	104.	--
05-106	OXIDENTAL CHEM CO	2R/SUPPLY 2	BURLINGTON TWP	400617	744920	20.	MRPAM	146.	126.	146.	27-05263

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Table 5.--Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
05-109	NATIONAL GYPSUM	NAT GYP 2	BURLINGTON TWP	400632	744904	22.	MRPAM	123.	113.	123.	27-01773
05-110	NATIONAL GYPSUM	NAT GYP 3	BURLINGTON TWP	400632	744904	22.	MRPAM	142.	122.	142.	27-04436
05-123	NJ/AMERICAN WATER CO	DVWC 28	CINNAMINSON TWP	395904	750009	25.	MRPAL	262.	226.	261.	31-05321
05-124	NJ/AMERICAN WATER CO	STEPHENS DR	CINNAMINSON TWP	395906	750006	30.	MRPAL	270.	221.	267.	31-05437
05-125	NJ/AMERICAN WATER CO	DVWC 10	CINNAMINSON TWP	395929	745922	79.	MRPAL	281.	239.	281.	31-03835
05-126	NJ/AMERICAN WATER CO	DVWC 12	CINNAMINSON TWP	395929	745922	73.	MRPAM	196.	157.	196.	31-04276
05-127	NJ/AMERICAN WATER CO	RIVERTON 14	CINNAMINSON TWP	395938	745810	35.	MRPAM	229.	179.	229.	31-04697
05-128	NJ/AMERICAN WATER CO	DVWC 26	CINNAMINSON TWP	395938	745810	35.	MRPA	225.	--	--	31-04733
05-129	RIVERTON CLUB	COUNTRY CLUB 2	CINNAMINSON TWP	395945	750011	60.	MRPAL	174.	--	--	27-04844
05-130	NJ/AMERICAN WATER CO	RIVERTON 13	CINNAMINSON TWP	400002	750044	70.	MRPAL	198.	167.	198.	31-04576
05-131	NJ/AMERICAN WATER CO	DVWC 27	CINNAMINSON TWP	400002	750044	75.	MRPAL	176.	145.	176.	31-04864
05-132	RIVERTON CLUB	COUNTRY CLUB	CINNAMINSON TWP	400012	750013	30.	MRPAL	111.	91.	111.	27-00731
05-134	CINNAMINSON TSA	TEST WELL 68 1	CINNAMINSON TWP	400100	750035	10.85	MRPAM	100.	24.	100.	--
05-135	HOEGANAES IRON	HOEGANAES	CINNAMINSON TWP	400104	745859	35.	MRPAM	134.	119.	134.	27-00238
05-136	TAYLOR, H G	TAYLOR 3	CINNAMINSON TWP	400146	745932	16.	MRPAM	25.	--	--	27-03907
05-137	TAYLOR, H G	TAYLOR 2	CINNAMINSON TWP	400147	745934	14.	MRPAM	25.	--	--	27-03906
05-138	TAYLOR, H G	TAYLOR 1	CINNAMINSON TWP	400148	745936	15.	MRPAM	25.	--	--	27-03905
05-140	CHANT, HARRY R	CHANT 1	DELANCO TWP	400244	745607	25.	MRPAM	155.	140.	155.	27-04480
05-143	NJ/AMERICAN WATER CO	DVWC 23	DELRAN TWP	400105	745734	36.	MRPAL	176.	--	--	27-04247
05-144	NJ/AMERICAN WATER CO	DVWC 24	DELRAN TWP	400105	745734	30.	MRPAM	135.	105.	135.	27-04680
05-145	HOLY CROSS HIGH SCHOOL	HIGH SCHOOL	DELRAN TWP	400110	745713	70.	MRPAM	174.	154.	174.	27-02821
05-146	NJ/AMERICAN WATER CO	DVWC 19	DELRAN TWP	400122	745807	25.	MRPAL	130.	89.	130.	27-03080
05-147	NJ/AMERICAN WATER CO	FAIRVIEW ST	DELRAN TWP	400126	745647	83.	MRPAM	235.	180.	235.	27-05202
05-150	AMICO SAND	AMICO	DELRAN TWP	400207	745831	15.	MRPAM	37.	27.	37.	27-02375
05-155	CRAMP, MARTIN C	CRAMP 1	EDGEWATER PARK TWP	400208	745434	40.	MRPA	176.	--	--	27-00853
05-156	JAMAH CORP	CAR WASH 1	EDGEWATER PARK TWP	400249	745418	35.	MRPAL	138.	123.	138.	27-04659
05-159	NJ/AMERICAN WATER CO	DVWC 21	EDGEWATER PARK TWP	400313	745407	43.	MRPAM	135.	110.	135.	27-00179
05-160	NJ/AMERICAN WATER CO	DVWC 22	EDGEWATER PARK TWP	400315	745408	45.	MRPAM	123.	102.	123.	27-04050
05-161	NJ/AMERICAN WATER CO	DVWC 32	EDGEWATER PARK TWP	400318	745438	40.	MRPAM	167.	135.	167.	27-05315
05-165	EVESHAM MUA	EMUA 4	EVESHAM TWP	395233	745418	110.	MRPAU	500.	464.	500.	31-05458
05-166	INDIAN SPRINGS GOLF C	ISGC 1	EVESHAM TWP	395246	745326	60.	MRPAU	400.	443.	466.	--
05-167	EVESHAM MUA	EMUA 5	EVESHAM TWP	395247	745157	50.	MRPAU	555.	--	--	31-07453
05-180	WORKMAN, JAMES	WORKMAN 1	FLORENCE TWP	400532	744833	41.	MRPAM	194.	170.	194.	27-00204
05-187	FLORENCE TWP WD	FTWD 4	FLORENCE TWP	400703	744832	30.	MRPAM	134.	119.	134.	27-00023
05-188	FLORENCE TWP WD	FTWD 3	FLORENCE TWP	400704	744838	30.	MRPAM	138.	123.	138.	27-00022
05-190	FLORENCE TWP WD	FTWD 1	FLORENCE TWP	400712	744842	30.	MRPAM	119.	99.	119.	47-00005
05-211	LISEHORA, MARY	S J GROVE 1	MANSFIELD TWP	400438	744519	80.	MRPAU	220.	--	--	--
05-217	INDUSTRIAL PARK	TURNPIKE JCTN	MANSFIELD TWP	400632	744234	60.	MRPAM	315.	293.	329.	28-03192
05-228	MAPLE SHADE WD	MSWD 10	MAPLE SHADE TWP	395630	745855	40.	MRPAL	500.	440.	500.	31-08923
05-229	MAPLE SHADE WD	MSWD 9	MAPLE SHADE TWP	395630	745855	40.	MRPAU	200.	160.	200.	31-08922

Table 5.--Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
05-232	MAPLE SHADE WD	MSWD 8	MAPLE SHADE TWP	395727	745915	20.	MRPAM	270.	210.	270.	31-06020
05-249	MEDFORD TWP WD	MTWD3/MTWD1	MEDFORD TWP	395209	745043	55.	MRPAU	544.	523.	541.	31-05282
05-251	MEDFORD WC	MWC 4(1968)	MEDFORD TWP	395316	744946	49.	MRPAU	536.	506.	536.	31-027502
05-252	MEDFORD WC	MWC 1(3)/MWC 8	MEDFORD TWP	395413	744922	48.	MRPAU	536.	506.	536.	31-05301
05-253	MEDFORD LEASE	1-1972	MEDFORD TWP	395422	744858	31.50	MRPAU	471.	447.	471.	31-06056
05-258	US GEOLOGICAL SURVEY	MEDFORD 1	MEDFORD TWP	395524	745025	70.77	MRPAU	410.	400.	410.	31-04627
05-259	US GEOLOGICAL SURVEY	MEDFORD 2	MEDFORD TWP	395524	745025	72.92	EGLS	263.	253.	263.	--
05-261	US GEOLOGICAL SURVEY	MEDFORD 5	MEDFORD TWP	395525	745025	72.60	MRPAM	750.	740.	750.	--
05-262	US GEOLOGICAL SURVEY	MEDFORD 4	MEDFORD TWP	395524	745025	72.32	MRPAL	1,145.	1,125.	1,145.	--
05-264	MOORESTOWN TWP WD	MTWD 5	MOORESTOWN TWP	395704	745812	38.	MRPAM	288.	248.	288.	31-04663
05-265	MOORESTOWN TWP WD	MTWD 6	MOORESTOWN TWP	395702	745808	42.	MRPAM	288.	248.	288.	31-04727
05-266	MOORESTOWN TWP WD	MTWD 3	MOORESTOWN TWP	395703	745811	40.	MRPAM	299.	269.	299.	51-00041
05-268	MARLAC ELECTRONICS	LAYNE 1	MOORESTOWN TWP	395751	745832	70.	MRPAM	288.	--	--	--
05-272	MOORESTOWN TWP WD	MTWD 7	MOORESTOWN TWP	395834	745910	40.	MRPAL	375.	335.	375.	--
05-273	MOORESTOWN F C	FIELD CLUB 1	MOORESTOWN TWP	395835	745643	70.	MRPAM	302.	274.	302.	31-04770
05-274	CAMPBELL SOUP	CAMPBELL 1	MOORESTOWN	395841	745905	40.	MRPAL	262.	241.	262.	31-03674
05-275	FIRST PRESB CHURCH	1964	MOORESTOWN TWP	395840	745700	70.	MRPA	200.	--	--	--
05-276	CAMPBELL SOUP	CAMPBELL 2	MOORESTOWN TWP	395840	745903	41.	MRPAM	266.	232.	263.	31-03673
05-277	CAMPBELL SOUP	CAMPBELL 3	MOORESTOWN TWP	395841	745905	40.	MRPAL	369.	339.	369.	31-05715
05-283	MOORESTOWN TWP WD	MTWD 8	MOORESTOWN TWP	395933	745456	65.	MRPAM	332.	282.	332.	31-05387
05-284	MOORESTOWN TWP WD	MTWD 4	MOORESTOWN TWP	395936	745452	59.	MRPAM	338.	298.	338.	31-03806
05-285	MOUNT HOLLY WC	MHWC 4	MOUNT HOLLY TWP	395924	744702	16.	MRPAU	342.	307.	342.	31-04637
05-289	MOUNT HOLLY WC	MHWC 3	MOUNT HOLLY TWP	395935	744651	19.	MRPAU	346.	316.	346.	--
05-290	MOUNT HOLLY WC	MHWC 6	MOUNT HOLLY TWP	395936	744655	15.	MRPAM	600.	545.	600.	31-06674
05-292	MOUNT HOLLY WC	MHWC 7	WESTAMPTON TWP	400019	744815	60.	MRPAM	524.	413.	524.	27-06032
05-297	RUDDEROW, J E	SPRING VALLEY	MOUNT LAUREL TWP	395525	745416	48.	MRPAM	457.	441.	457.	31-01610
05-303	MT LAUREL MUA	MLWC 1	MOUNT LAUREL TWP	395607	745648	20.	MRPAL	589.	558.	589.	31-04347
05-304	MT LAUREL MUA	MLWC 2	MOUNT LAUREL TWP	395608	745644	20.	MRPAM	399.	362.	399.	31-04793
05-310	NJ TURNPIKE AUTHORITY	MAINT 2	MOUNT LAUREL TWP	395728	745504	40.	MRPAU	160.	120.	160.	--
05-313	HAINES, WM JR	FARM WELL 2	MOUNT LAUREL TWP	395830	745302	25.	MRPAU	238.	--	--	--
05-315	LARCHMONT FARMS	FARM WELL 1	MOUNT LAUREL TWP	395845	745240	55.	MRPAU	238.	200.	238.	--
05-317	NJ TURNPIKE AUTHORITY	4N-1	MOUNT LAUREL TWP	395850	745318	45.	MRPAU	222.	192.	222.	31-00212
05-318	NJ TURNPIKE AUTHORITY	4N-2	MOUNT LAUREL TWP	395850	745318	45.	MRPAU	230.	--	--	--
05-348	NJ/AMERICAN WATER CO	8-RPL 2&7	PALMYRA BORO	400038	750139	10.	MRPAL	84.	62.	84.	27-01583
05-382	SYBRON CHEMICAL INC	IONAC CHEM 4	PEMBERTON TWP	395839	744242	30.	MRPAM	829.	773.	824.	32-02387
05-383	SYBRON CHEMICAL INC	IONAC CHEM 2	PEMBERTON TWP	395839	744249	30.	MRPAU	521.	490.	521.	32-00380
05-385	SYBRON CHEMICAL INC	IONAC CHEM 5	PEMBERTON TWP	395839	744249	30.	MRPAM	828.	747.	823.	32-03778
05-392	RIVERSIDE PUBLIC SCH	SCHOOL 1	RIVERSIDE TWP	400158	745710	20.	MRPAM	100.	90.	100.	27-04533
05-393	RIVERSIDE INDUSTRIAL	FTC 39	RIVERSIDE TWP	400212	745748	15.	MRPAM	67.	54.	67.	--
05-395	NJ/AMERICAN WATER CO	DVWC 29	RIVERSIDE TWP	400210	745658	25.	MRPAL	120.	97.	120.	27-04851

Table 5.--Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
05-438	THE GOLF FARM	SPRINGFIELD	SPRINGFIELD TWP	400218	744604	41.	MRPAU	230.	220.	230.	--
05-440	RHODIA CORP	RHODIA 1 OBS	SPRINGFIELD TWP	400242	744223	71.65	MRPAM	615.	603.	613.	28-05128
05-446	INTERSTATE S-P	INTERSTATE 1	SPRINGFIELD TWP	400328	744636	75.	MRPAU	248.	220.	245.	--
05-448	STATE OF NJ	1-REST AREA	SPRINGFIELD TWP	400355	744809	36.	MRPAM	220.	200.	220.	27-05644
05-634	MOUNT HOLLY WC	MHWC 5	WESTAMPTON TWP	400041	744809	55.	MRPAM	516.	--	--	--
05-635	INDEL	INDUCT 1	WESTAMPTON TWP	400041	745049	60.	MRPAM	444.	411.	443.	--
05-645	WILLINGBORO MUA	WMUA 2	WILLINGBORO TWP	400010	745216	40.30	MRPAL	441.	431.	441.	--
05-648	WILLINGBORO MUA	WMUA 3-OBS	WILLINGBORO TWP	400103	745409	34.	MRPAL	316.	306.	316.	--
05-649	WILLINGBORO MUA	WMUA 6	WILLINGBORO TWP	400122	745308	39.	MRPAM	363.	--	--	27-03066
05-651	WILLINGBORO MUA	WMUA 9	WILLINGBORO TWP	400139	745325	28.	MRPAM	304.	203.	304.	27-03110
05-653	WILLINGBORO MUA	WMUA 4	WILLINGBORO TWP	400152	745435	28.	MRPAM	280.	177.	280.	27-02941
05-658	WILLINGBORO MUA	WMUA 7	WILLINGBORO TWP	400201	745308	19.	MRPAM	255.	179.	255.	27-02919
05-661	WILLINGBORO MUA	WMUA 1	WILLINGBORO TWP	400225	745402	10.	MRPAM	199.	147.	199.	27-01615
05-667	WILLINGBORO MUA	WMUA 5	WILLINGBORO TWP	400250	745321	39.	MRPAM	256.	230.	256.	27-02723
05-668	WILLINGBORO MUA	DCB 28	WILLINGBORO TWP	400308	745325	43.	MRPAM	242.	222.	242.	27-01689
05-706	LIQUID CARBONIC	1	BURLINGTON CITY	400536	744916	30.	MRPAM	140.	120.	140.	27-06045
05-707	EVESHAM MUA	EMUA 7	EVESHAM TWP	395315	745503	100.	MRPAU	441.	405.	441.	31-14627
05-717	WILLINGBORO MUA	WMUA 9	WILLINGBORO TWP	400139	745325	30.	MRPAL	295.	205.	295.	27-06754
05-728	MOBILE ESTATES	FIELD PUMP	SOUTHAMPTON TWP	395819	744341	55.	MRPAU	500.	485.	500.	--
05-729	MAPLE SHADE WD	MSWD 2	MAPLE SHADE TWP	395725	745914	30.	MRPAU	121.	91.	121.	31-00060
05-732	BURLINGTON TWP WD	4	BURLINGTON TWP	400327	744934	80.	MRPAL	366.	315.	366.	27-06673
05-745	BC COUNTRY CLUB	CLUB 1R	WESTAMPTON TWP	400157	744819	102.	MRPAU	290.	260.	290.	27-05937
05-746	MAPLE SHADE WD	MSWD 11	MAPLE SHADE TWP	395727	745915	20.	MRPAL	450.	389.	450.	31-12925
05-747	DITTMAR	1949	MOUNT LAUREL TWP	395921	745243	80.	MRPAU	257.	--	--	--
05-748	RADIO CORP OF AMERICA	RANCOCAS 1	MOORESTOWN TWP	395848	745407	80.	MRPAU	170.	--	--	--
05-749	RAMBLEWOOD CC	3 TEE	MOUNT LAUREL TWP	395508	745539	75.	MRPAM	425.	--	--	31-07140
05-751	RAMBLEWOOD CC	2 TEE	MOUNT LAUREL TWP	395546	745622	20.	MRPAM	325.	--	--	31-07139
05-755	KING'S GRANT WC	KGWC 1	EVESHAM TWP	395049	745338	90.	MRPAU	593.	546.	593.	31-06840
05-757	EVESHAM MUA	EMUA 6	EVESHAM TWP	395326	745223	50.	MRPAU	550.	458.	550.	31-07453
05-758	TENNECO CHEMICALS	TENNECO 10	BURLINGTON TWP	400418	745255	10.	MRPAM	114.	--	--	27-07612
05-760	TENNECO CHEMICALS	TENNECO 8	BURLINGTON TWP	400417	745327	18.	MRPAL	90.	50.	90.	27-06854
05-761	TENNECO CHEMICALS	TENNECO 9	BURLINGTON TWP	400417	745322	18.	MRPAM	105.	70.	105.	27-06855
05-766	LENAPE REGIONAL H S	CHEROKEE 1	EVESHAM TWP	395227	745401	110.	MRPAU	512.	492.	512.	31-15450
05-782	RIVERSIDE TWP	SEWERAGE 1	RIVERSIDE TWP	400224	745815	10.	MRPAM	47.	35.	47.	27-01433
05-790	TENNECO CHEMICALS	NO 5-1961	BURLINGTON TWP	400433	745247	5.	MRPAM	60.	50.	60.	--
05-795	MT LAUREL MUA	MLWC 5	EVESHAM TWP	395239	745308	60.	MRPAU	463.	416.	463.	31-09595
05-801	TEXACO CO	OW 10	PALMYRA BORO	400020	750114	20.	MRPAM	25.	5.	25.	27-06877
05-804	TAYLOR, JOSEPH	1	CINNAMINSON TWP	400145	745936	10.	MRPAM	47.	37.	47.	27-07380
05-805	CINNAMINSON TSA	1	CINNAMINSON TWP	400100	750035	10.85	MRPAM	--	--	--	--
05-807	HOEGANAES IRON	L1	CINNAMINSON TWP	400110	745947	12.19	MRPAM	25.	5.	25.	31-18740

Table 5.--Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
05-811	HOEGANAES IRON	L5	CINNAMINSON TWP	400117	750003	23.61	MRPAM	33.	13.	33.	31-18736
05-812	HOEGANAES IRON	L6	CINNAMINSON TWP	400123	750004	8.41	MRPAM	23.	3.	23.	31-18737
05-814	HOEGANAES IRON	I2	CINNAMINSON TWP	400121	745923	18.	MRPAM	25.	5.	25.	31-18744
05-819	MT LAUREL MUA	MLMUA 6	MOUNT LAUREL TWP	395608	745649	20.	MRPAL	590.	499.	590.	31-19212
05-820	KING'S GRANT WC	KGWC 2	EVESHAM TWP	395049	745334	90.	MRPAU	591.	545.	591.	31-06841
05-821	FEDERAL LAND BANK	1	WESTAMPTON TWP	400033	745131	65.	MRPAU	219.	214.	218.	27-07360
05-822	MT LAUREL MUA	MLMUA 3	MOUNT LAUREL TWP	395620	745529	35.	MRPAL	643.	592.	642.	--
05-823	MT LAUREL MUA	MLMUA 4	MOUNT LAUREL TWP	395615	745512	35.	MRPAL	640.	590.	640.	--
05-824	EVESHAM MUA	EMUA 8	EVESHAM TWP	395304	745412	85.	MRPAU	435.	375.	435.	31-20373
05-1075	MT LAUREL MUA	ELBO LANE 7	MOORESTOWN TWP	395632	745555	40.	MRPAL	620.	528.	644.	31-26130
05-1091	WILLINGBORO MUN	WMUA 11	WILLINGBORO TWP	400151	745432	28.	MRPAM	246.	197.	243.	27-09561
07-003	OWENS CORNING	CORNING 1	BARRINGTON BORO	395146	750254	60.	MRPAU	315.	285.	315.	31-02492
07-004	WEYERHAEUSER CO	1	BARRINGTON BORO	395200	750252	50.	MRPAU	283.	253.	285.	31-05360
07-008	BELLMAWR BORO WD	BBWD 4	BELLMAWR BORO	395146	750542	75.	MRPAL	557.	380.	557.	31-04969
07-012	BELLMAWR BORO WD	BBWD 3	BELLMAWR BORO	395221	750637	35.	MRPAL	359.	331.	359.	31-02687
07-013	BELLMAWR BORO WD	BBWD 1	BELLMAWR BORO	395221	750636	31.	MRPAU	160.	111.	160.	51-00032
07-015	BERLIN WD	BWD 11	BERLIN BORO	394648	745622	150.	MRPAU	745.	675.	745.	31-06208
07-018	BERLIN WD	BWD 9	BERLIN BORO	394738	745614	145.	MRPAU	713.	650.	713.	31-02079
07-019	BERLIN WD	BWD 10	BERLIN BORO	394738	745614	145.	MRPAU	713.	645.	713.	31-05173
07-029	NY SHIPBUILDING	9	CAMDEN CITY	395435	750720	12.	MRPAL	220.	189.	220.	31-03905
07-030	SO JERSEY PORT COMM	NY SHIP 5A	CAMDEN CITY	395447	750711	11.41	MRPAU	104.	87.	104.	--
07-037	NY SHIPBUILDING	3	CAMDEN CITY	395449	750716	12.	MRPAL	224.	190.	224.	--
07-039	CAMDEN CITY WD	CITY 7N	CAMDEN CITY	395457	750640	21.	MRPAM	163.	123.	163.	--
07-040	CAMDEN CITY WD	CITY 7	CAMDEN CITY	395457	750641	21.	MRPAM	160.	126.	165.	--
07-043	MAFCO	2	CAMDEN CITY	395507	750729	12.	MRPAM	103.	82.	103.	31-00290
07-046	CAMDEN CITY WD	CITY 11	CAMDEN CITY	395512	750640	13.	MRPAM	154.	124.	154.	--
07-047	CAMDEN SEWAGE AUTH	PLANT 1	CAMDEN CITY	395524	750729	9.	MRPAL	193.	163.	193.	--
07-048	CAMDEN CITY WD	CITY 6N	CAMDEN CITY	395527	750646	14.	MRPAM	136.	111.	135.	31-00013
07-057	OUR LADY HOSPITAL	STAND BY WELL	CAMDEN CITY	395539	750541	30.	MRPAL	258.	237.	258.	31-04620
07-058	WEST JERSEY HOSPITAL	1	CAMDEN CITY	395539	750630	30.	MRPAM	140.	119.	140.	31-03689
07-060	CAMDEN CITY WD	CITY 8A	CAMDEN CITY	395540	750742	6.	MRPAL	124.	--	--	31-00944
07-061	CAMDEN CITY WD	CITY 4	CAMDEN CITY	395541	750622	41.	MRPAM	156.	131.	156.	--
07-064	CAMDEN CITY WD	CITY 17	CAMDEN CITY	395546	750533	34.	MRPAL	265.	230.	265.	31-01250
07-065	CAMDEN CITY WD	CITY 2B	CAMDEN CITY	395550	750729	8.	MRPAL	132.	111.	132.	31-00941
07-068	CAMDEN CITY WD	CITY 13	CAMDEN CITY	395557	750535	30.	MRPAL	225.	185.	225.	31-00904
07-074	PUBLIC SERVICE CO	PSEGC 8	CAMDEN CITY	395603	750736	4.	MRPAL	149.	126.	149.	--
07-078	CAMDEN CITY WD	CITY 5N	CAMDEN CITY	395616	750632	22.	MRPAL	169.	134.	169.	31-04699
07-079	CAMDEN CITY WD	CITY 12	CAMDEN CITY	395617	750710	23.	MRPAL	166.	136.	166.	--
07-083	CAMDEN CITY WD	CITY 1A	CAMDEN CITY	395638	750622	10.	MRPAL	170.	135.	170.	31-00940
07-088	CONCORD CHEMICALS	1	CAMDEN CITY	395641	750546	10.	MRPA	197.	--	--	--

Table 5.--Well-location and -construction data -- continued.

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07-090	CAMDEN CITY WD	CITY 10	CAMDEN CITY	395652	750607	10.	MRPAL	158.	126.	158.	--
07-094	CAMDEN CITY WD	CITY 16	CAMDEN CITY	395706	750553	23.	MRPAL	179.	149.	179.	31-01249
07-098	NJ/AMERICAN WATER CO	CAMDEN DIV 52	CAMDEN CITY	395715	750519	18.	MRPAL	200.	147.	198.	31-04847
07-099	H KOHNSTAMM CO	3	CAMDEN CITY	395716	750507	30.	MRPAL	136.	116.	136.	31-01696
07-107	NJ/AMERICAN WATER CO	CAMDEN DIV 51	CAMDEN CITY	395720	750513	20.	MRPAL	192.	141.	192.	31-04780
07-108	NJ/AMERICAN WATER CO	DIV 10	CAMDEN CITY	395719	750518	11.	MRPAL	150.	115.	150.	--
07-111	NJ/AMERICAN WATER CO	CAMDEN DIV 50	CAMDEN CITY	395726	750518	9.	MRPAL	170.	139.	170.	31-03456
07-112	NJ/AMERICAN WATER CO	CAMDEN DIV 48	CAMDEN CITY	395728	750520	10.	MRPAL	164.	122.	164.	31-01430
07-115	WOODCREST CT CL	CLUB 1	CHERRY HILL TWP	395149	745909	70.	MRPAU	420.	400.	420.	31-00051
07-117	NJ/AMERICAN WATER CO	HUTTON HILL1	CHERRY HILL TWP	395229	745712	157.61	MRPAU	562.	552.	562.	31-04897
07-120	HUSSMAN REFRIDG	HUSSMAN	CHERRY HILL TWP	395237	750031	67.	MRPAU	306.	276.	306.	31-02946
07-121	NJ/AMERICAN WATER CO	BROWING T-1	CHERRY HILL TWP	395252	745943	80.	MRPAL	730.	672.	729.	--
07-122	NJ/AMERICAN WATER CO	BROWNING 44	CHERRY HILL TWP	395252	745943	80.	MRPAL	741.	684.	741.	31-07021
07-123	NJ/AMERICAN WATER CO	BROWNING 46	CHERRY HILL TWP	395252	745943	81.40	MRPAL	735.	664.	735.	31-07019
07-124	NJ/AMERICAN WATER CO	BROWNING 45	CHERRY HILL TWP	395252	745943	77.	MRPAM	626.	483.	626.	31-07020
07-130	NJ/AMERICAN WATER CO	OLD ORCHARD A	CHERRY HILL TWP	395353	745708	71.	MRPAL	748.	743.	748.	31-05077
07-131	NJ/AMERICAN WATER CO	OLD ORCHARD B	CHERRY HILL TWP	395353	745708	71.	MRPAU	342.	--	--	31-05096
07-132	NJ/AMERICAN WATER CO	OLD ORCHARD C	CHERRY HILL TWP	395353	745708	71.	MRPAM	500.	--	--	31-05095
07-133	NJ/AMERICAN WATER CO	OLD ORCHARD 36	CHERRY HILL TWP	395353	745708	80.	MRPAU	349.	299.	349.	31-05217
07-134	NJ/AMERICAN WATER CO	OLD ORCHARD 37	CHERRY HILL TWP	395353	745708	68.	MRPAM	488.	454.	488.	31-05219
07-135	NJ/AMERICAN WATER CO	OLD ORCHARD 38	CHERRY HILL TWP	395353	745708	72.	MRPAM	493.	443.	493.	31-05218
07-142	NJ/AMERICAN WATER CO	ELLISBURG 23	CHERRY HILL TWP	395438	750107	32.	MRPAM	375.	321.	378.	31-04098
07-143	NJ/AMERICAN WATER CO	ELLISBURG 16	CHERRY HILL TWP	395441	750104	40.	MRPAU	220.	187.	220.	31-03305
07-144	NJ/AMERICAN WATER CO	ELLISBURG 13	CHERRY HILL TWP	395442	750103	39.	MRPAL	527.	491.	527.	31-00684
07-146	NJ/AMERICAN WATER CO	KINGSTON 27	CHERRY HILL TWP	395455	745924	40.	MRPAM	417.	366.	417.	31-04669
07-147	NJ/AMERICAN WATER CO	KINGSTON 25	CHERRY HILL TWP	395455	745929	44.	MRPAM	367.	309.	367.	51-00007
07-148	NJ/AMERICAN WATER CO	KINGSTON 28	CHERRY HILL TWP	395455	745929	44.	MRPAU	207.	175.	207.	31-04742
07-149	NJ NATIONAL GD	1	CHERRY HILL TWP	395503	750221	15.	MRPAU	111.	96.	111.	--
07-151	GARDEN STATE RACEWAY	RACE TRACK	CHERRY HILL TWP	395514	750213	30.	MRPAU	158.	--	--	51-00094
07-157	NJ/AMERICAN WATER CO	COLUMBIA 31	CHERRY HILL TWP	395600	750031	45.	MRPAL	427.	376.	427.	31-05033
07-158	GARDEN STATE RACEWAY	CHRY HLL INN 1	CHERRY HILL TWP	395606	750148	80.	MRPAU	179.	154.	179.	--
07-160	RADIO CORP OF AMERICA	1	CHERRY HILL TWP	395602	750132	85.	MRPAU	--	220.	--	--
07-162	NJ/AMERICAN WATER CO	COLUMBIA 24	CHERRY HILL TWP	395608	750025	34.	MRPAU	167.	112.	167.	31-04274
07-163	NJ/AMERICAN WATER CO	COLUMBIA 22	CHERRY HILL TWP	395609	750028	39.	MRPAL	453.	371.	453.	31-04051
07-171	COLLINGSWOOD WD	CWD 7(B)	COLLINGSWOOD BORO	395426	750514	10.	MRPAL	313.	224.	313.	31-04797
07-172	COLLINGSWOOD WD	CWD 6(A)	COLLINGSWOOD BORO	395426	750514	10.	MRPAL	312.	218.	312.	31-04799
07-175	COLLINGSWOOD WD	CWD 1R	COLLINGSWOOD BORO	395521	750439	25.	MRPAL	306.	266.	306.	31-00079
07-176	COLLINGSWOOD WD	CWD 2R	COLLINGSWOOD BORO	395519	750432	12.	MRPAL	278.	248.	278.	31-04053
07-177	COLLINGSWOOD WD	CWD 4	COLLINGSWOOD BORO	395521	750435	9.	MRPAL	304.	274.	304.	51-00030
07-178	COLLINGSWOOD WD	CWD 3	COLLINGSWOOD BORO	395522	750432	15.	MRPAL	287.	257.	287.	31-04054

Table 5.--Well-location and -construction data -- continued.

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07-179	COLLINGSWOOD WD	CWD 5	COLLINGSWOOD BORO	395526	750424	10.	MRPAL	278.	248.	278.	51-00031
07-183	NJ/AMERICAN WATER CO	NJWC 43	GIBBSBORO BORO	394945	745855	70.	MRPAL	1,010.	923.	1,010.	31-05951
07-184	NJ/AMERICAN WATER CO	GIBBSBORO OB 1	GIBBSBORO BORO	394950	745855	70.	MRPAL	1,090.	1,080.	1,090.	31-05315
07-185	NJ/AMERICAN WATER CO	GIBBSBORO OB 2	GIBBSBORO BORO	394950	745855	70.	MRPAL	950.	940.	950.	--
07-186	NJ/AMERICAN WATER CO	GIBBSBORO OB 3	GIBBSBORO BORO	394950	745855	70.	MRPAM	680.	--	--	--
07-188	NJ/AMERICAN WATER CO	GIBBSBORO 42	GIBBSBORO BORO	395002	745851	65.	MRPAL	998.	934.	986.	31-05950
07-189	NJ/AMERICAN WATER CO	GIBBSBORO 41	GIBBSBORO BORO	395003	745851	65.	MRPAL	1,100.	1,020.	1100.	31-05949
07-193	CRSCENT TRLR PK	TRAILER PK 1	GLOUCESTER CITY	395256	750633	20.	MRPAU	73.	59.	71.	31-00560
07-194	G & W NATURAL RESOURCE	4-DEEP	GLOUCESTER CITY	395308	750744	8.	MRPAL	279.	249.	279.	31-03402
07-195	G & W NATURAL RESOURCE	5-DEEP	GLOUCESTER CITY	395308	750749	10.	MRPAM	175.	--	--	31-04454
07-196	G & W NATURAL RESOURCE	2-DEEP	GLOUCESTER CITY	395308	750757	6.	MRPAL	275.	245.	275.	31-01210
07-197	G & W NATURAL RESOURCE	3-DEEP	GLOUCESTER CITY	395313	750804	8.	MRPAL	255.	223.	253.	31-03401
07-198	G & W NATURAL RESOURCE	1R-1973	GLOUCESTER CITY	395314	750748	8.	MRPAL	260.	235.	260.	31-06642
07-201	AMSPEC CHEMICAL	AMSPEC 1	GLOUCESTER CITY	395318	750755	5.	MRPAL	266.	246.	266.	31-00019
07-202	AMSPEC CHEMICAL	HARSHAW 3	GLOUCESTER CITY	395321	750747	8.	MRPAL	265.	245.	265.	31-00673
07-204	AMSPEC CHEMICAL	AMSPEC 4	GLOUCESTER CITY	395322	750757	5.	MRPAL	260.	235.	260.	31-00761
07-205	HINDE AND DAUCH	3	GLOUCESTER CITY	395324	750736	7.	MRPAL	250.	230.	250.	--
07-206	CORSON'S FOOD INC	2	GLOUCESTER CITY	395329	750732	9.	MRPAL	261.	231.	251.	--
07-207	CORSON'S FOOD INC	JERSEY AVE 1	GLOUCESTER CITY	395332	750734	9.	MRPAL	261.	230.	250.	--
07-220	GLOUCESTER CITY WD	GCWD 40	GLOUCESTER CITY	395349	750651	10.	MRPAL	262.	221.	261.	31-04306
07-221	US GEOLOGICAL SURVEY	USCG 1	GLOUCESTER CITY	395356	750738	11.10	MRPAL	170.	162.	170.	--
07-222	GLOUCESTER CITY WD	GCWD 41	GLOUCESTER CITY	395359	750654	10.	MRPAL	266.	226.	266.	31-04903
07-242	SOCIETY DIVINE	SAVIOR	GLOUCESTER TWP	394712	750220	107.	MRPAU	512.	492.	512.	--
07-244	CAMDEN COUNTY	LAKELAND 3	GLOUCESTER TWP	394715	750419	50.	MRPAU	490.	--	--	--
07-245	CAMDEN COUNTY	LAKELAND 1	GLOUCESTER TWP	394717	750420	50.	MRPAU	420.	--	--	51-00005
07-248	GLOU TWP BOARD OF ED	LEWIS SCHOOL	GLOUCESTER TWP	394739	750227	117.	MRPAU	475.	455.	475.	31-04650
07-249	GARDEN STATE WC	BLACKWOD DIV 3	GLOUCESTER TWP	394754	750343	65.	MRPAU	447.	426.	447.	31-02703
07-250	GARDEN STATE WC	BLACKWOD DIV 7	GLOUCESTER TWP	394718	750336	60.	MRPAU	479.	437.	479.	31-08176
07-252	GARDEN STATE WC	BLACKWOD DIV 6	GLOUCESTER TWP	394759	750158	75.	MRPAU	480.	407.	477.	31-05581
07-256	GLOUCESTER MUA	TREAT PLANT	GLOUCESTER TWP	394820	750445	20.	MRPA	358.	--	--	31-05580
07-272	NJ/AMERICAN WATER CO	OTTERBROOK 34	GLOUCESTER TWP	395028	750344	60.	MRPAU	377.	--	--	31-05041
07-273	NJ/AMERICAN WATER CO	OTTERBROOK 29	GLOUCESTER TWP	395030	750347	60.	MRPAL	712.	612.	712.	31-04756
07-274	NJ/AMERICAN WATER CO	OTTERBROOK 39	GLOUCESTER TWP	395030	750347	60.	MRPAU	349.	269.	349.	31-05226
07-275	NJ/AMERICAN WATER CO	HADDON 20	BARRINGTON BORO	395231	750312	60.	MRPAU	275.	236.	267.	31-03375
07-278	NJ/AMERICAN WATER CO	HADDON 15	HADDON HEIGHTS BORO	395238	750316	65.	MRPAL	594.	452.	594.	31-02434
07-279	NJ/AMERICAN WATER CO	HADDON 30	HADDON HEIGHTS BORO	395238	750317	65.	MRPAU	275.	224.	275.	31-04798
07-280	NJ/AMERICAN WATER CO	HADDON 12	HADDON HEIGHTS BORO	395240	750318	66.	MRPA	267.	--	--	51-00009
07-281	NJ/AMERICAN WATER CO	HADDON 14	HADDON HEIGHTS BORO	395242	750323	76.	MRPAL	598.	506.	598.	31-01124
07-282	NJ/AMERICAN WATER CO	HADDON 11	HADDON HEIGHTS BORO	395243	750320	84.	MRPAU	272.	212.	272.	51-00008
07-283	NJ/AMERICAN WATER CO	EGBERT	HADDON HEIGHTS BORO	395246	750434	23.66	MRPAL	455.	445.	455.	31-04282

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07-284	NJ/AMERICAN WATER CO	EGGBERT 35	HADDON HEIGHTS BORO	395247	750432	22.	MRPA	484.	--	--	31-05054
07-285	NJ/AMERICAN WATER CO	EGGBERT 18	HADDON HEIGHTS BORO	395248	750433	24.	MRPAU	191.	144.	191.	31-03308
07-288	HADDON TWP WD	HTWD 3	HADDON TWP	395359	750322	61.	MRPAL	469.	432.	469.	31-02146
07-289	HADDON TWP WD	HTWD 2	HADDON TWP	395403	750322	60.	MRPAL	470.	439.	470.	31-00432
07-290	HADDON TWP WD	HTWD 1	HADDON TWP	395406	750317	56.	MRPAL	468.	436.	468.	31-00431
07-291	HADDON TWP WD	HTWD 1-R	HADDON TWP	395406	750317	56.	MRPA	480.	--	--	31-05243
07-292	HADDON TWP WD	HTWD 4	HADDON TWP	395406	750332	45.	MRPAL	448.	417.	448.	31-04855
07-293	HADDON TWP BOARD OF ED	HADDON HS1	HADDON TWP	395416	750336	15.	MRPAU	165.	142.	162.	31-04986
07-294	DY-DEE SERVICE	REPLACEMENT	HADDON TWP	395436	750252	50.	MRPAL	451.	431.	451.	31-05138
07-297	HADDONFIELD WD	HWD 4	HADDONFIELD BORO	395317	750141	18.	MRPAU	240.	186.	240.	--
07-299	HADDONFIELD WD	LAYNE 2/LAYNE 1	HADDONFIELD BORO	395322	750158	65.	MRPAU	246.	206.	246.	21-02570
07-302	HADDONFIELD WD	RULON	HADDONFIELD BORO	395319	750140	25.	MRPAL	572.	523.	572.	31-02130
07-304	HADDONFIELD WD	LAKE ST WELL	HADDONFIELD BORO	395404	750202	50.	MRPAM	372.	307.	372.	31-05108
07-310	NJ/AMERICAN WATER CO	LAUREL 13	LAUREL SPRINGS BORO	394928	750024	77.	MRPAU	456.	394.	456.	31-01363
07-311	NJ/AMERICAN WATER CO	LAUREL 15	LAUREL SPRINGS BORO	394928	750027	75.	MRPAU	473.	395.	473.	31-04723
07-315	NJ/AMERICAN WATER CO	MAGNOLIA 16	MAGNOLIA BORO	395134	750229	78.	MRPAM	510.	428.	510.	31-04743
07-316	NJ/AMERICAN WATER CO	MAGNOLIA 33	MAGNOLIA BORO	395134	750230	75.	MRPAU	348.	271.	348.	31-05100
07-318	OWENS CORNING	CORNING 2	MAGNOLIA BORO	395135	750246	67.	MRPAU	320.	290.	320.	31-02493
07-320	MERCHANTVIL PNSK WCM	WOODBINE 1	MERCHANTVILLE BORO	395652	750307	65.	MRPAL	285.	245.	285.	31-04642
07-322	NJ/AMERICAN WATER CO	OAKLYN TEST	OAKLYN BORO	395359	750445	32.65	MRPAU	112.	101.	112.	31-04283
07-329	MERCHANTVIL PNSK WCM	BROWNING 2A/ 1	PENNSAUKEN TWP	395628	750406	16.	MRPAM	140.	110.	140.	31-04836
07-332	MERCHANTVIL PNSK WCM	MARION 2	PENNSAUKEN TWP	395711	750220	65.	MRPAL	258.	223.	258.	31-04641
07-334	MERCHANTVIL PNSK WCM	MARION T 1	PENNSAUKEN TWP	395719	750225	60.	MRPAL	268.	247.	268.	31-02556
07-335	MERCHANTVIL PNSK WCM	MARION 1	PENNSAUKEN TWP	395720	750225	61.	MRPAL	278.	243.	278.	31-02915
07-337	US GEOLOGICAL SURVEY	PETTY ISLAND 2	PENNSAUKEN TWP	395737	750626	5.	MRPAL	129.	--	--	--
07-338	US GEOLOGICAL SURVEY	PETTY I EAST 3	PENNSAUKEN TWP	395737	750626	5.	MRPAM	55.	--	--	--
07-341	MERCHANTVIL PNSK WCM	DELA GAR 2	PENNSAUKEN TWP	395800	750417	39.	MRPAL	145.	115.	145.	31-01417
07-342	MERCHANTVIL PNSK WCM	DELA GARDEN 1A	PENNSAUKEN TWP	395756	750411	50.	MRPAL	139.	109.	139.	31-05228
07-343	US GEOLOGICAL SURVEY	PETTY I WEST 1	PENNSAUKEN TWP	395757	750640	5.	MRPAL	84.	--	--	--
07-348	MERCHANTVIL PNSK WCM	PARK AVE 3	PENNSAUKEN TWP	395801	750119	25.	MRPAL	275.	240.	275.	31-03534
07-349	MERCHANTVIL PNSK WCM	PARK AVE 1	PENNSAUKEN TWP	395802	750117	19.	MRPAL	270.	240.	270.	31-00010
07-354	GENERAL FOODS	PETTY IS OBS	PENNSAUKEN TWP	395811	750556	11.55	MRPAL	143.	--	--	--
07-359	CAMDEN CITY WD	PUCHACK 5	PENNSAUKEN TWP	395835	750308	30.	MRPAL	186.	136.	181.	--
07-361	CAMDEN CITY WD	PUCHACK 4	PENNSAUKEN TWP	395839	750306	10.	MRPAL	180.	136.	180.	--
07-363	CAMDEN CITY WD	PUCHACK 2	PENNSAUKEN TWP	395842	750312	14.	MRPAL	165.	126.	165.	51-00057
07-367	CAMDEN CITY WD	PUCHACK 3	PENNSAUKEN TWP	395840	750307	10.	MRPAL	175.	127.	175.	--
07-368	CAMDEN CITY WD	DELAIR 1	PENNSAUKEN TWP	395848	750347	10.	MRPAL	138.	104.	138.	51-00053
07-369	CAMDEN CITY WD	DELAIR 2	PENNSAUKEN TWP	395851	750355	5.	MRPAL	144.	109.	144.	51-00054
07-370	CAMDEN CITY WD	DELAIR 3	PENNSAUKEN TWP	395853	750348	8.	MRPAL	129.	87.	129.	51-00055
07-372	MERCHANTVIL PNSK WCM	NATIONAL HWY 1	PENNSAUKEN TWP	395902	750153	40.	MRPAL	231.	195.	230.	31-05110

Table 5.--Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
07-373	CAMDEN CITY WD	MORRIS 6	PENNSAUKEN TWP	395900	750318	14.	MRPAL	133.	98.	133.	51-00051
07-375	CAMDEN CITY WD	MORRIS 8	PENNSAUKEN TWP	395910	750307	10.	MRPAL	124.	--	--	31-00944
07-377	CAMDEN CITY WD	MORRIS 7	PENNSAUKEN TWP	395916	750303	10.	MRPAL	120.	85.	120.	51-00052
07-379	CAMDEN CITY WD	MORRIS 10	PENNSAUKEN TWP	395919	750302	16.	MRPAL	115.	75.	115.	31-04251
07-382	CAMDEN CITY WD	MORRIS 4A	PENNSAUKEN TWP	395929	750253	8.	MRPAL	134.	95.	134.	31-04252
07-390	CAMDEN CITY WD	MORRIS 1	PENNSAUKEN TWP	395944	750211	9.	MRPAL	107.	--	--	51-00050
07-392	PINE HILL MUA	PHMUA 1	PINE HILL BORO	394641	745909	150.	MRPAU	687.	627.	669.	31-04521
07-398	PINE HILL MUA	PHMUA 2-1972	PINE HILL BORO	394726	745911	200.	MRPAU	698.	668.	698.	31-06646
07-404	NJ/AMERICAN WATER CO	RUNNEMEDE 19	RUNNEMEDE BORO	395055	750420	67.	MRPAU	338.	297.	339.	31-03307
07-407	TRAP ROCK INDUSTRIES	3	RUNNEMEDE BORO	395133	750455	40.	MRPAU	215.	195.	205.	31-05193
07-410	NJ/AMERICAN WATER CO	SOMERDALE 14	SOMERDALE BORO	395041	750056	95.	MRPAU	441.	--	--	31-02360
07-411	TAVISTOCK CLUB	COUNTRY CLUB 1	TAVISTOCK BORO	395238	750121	30.	MRPAU	246.	219.	247.	31-05248
07-412	NJ/AMERICAN WATER CO	ELM TREE 2	VOORHEES TWP	394922	745630	148.68	MRPAL	1,092.	1,082.	1,092.	31-09560
07-413	NJ/AMERICAN WATER CO	ELM TREE 3	VOORHEES TWP	394922	745630	148.73	MRPAM	717.	706.	717.	31-04561
07-422	NJ/AMERICAN WATER CO	ASHLAND 17	VOORHEES TWP	395124	745952	68.	MRPAU	421.	379.	421.	31-03306
07-423	NJ/AMERICAN WATER CO	ASHLAND TER 32	VOORHEES TWP	395128	745954	70.	MRPAM	459.	--	--	--
07-426	NJ/AMERICAN WATER CO	VOORHEES 21	VOORHEES TWP	395129	745906	129.	MRPAU	482.	422.	482.	31-03872
07-476	US GEOLOGICAL SURVEY	NEW BKLYN 1	WINSLOW TWP	394215	745617	111.10	MRPA	1,495.	1,485.	1,495.	--
07-477	US GEOLOGICAL SURVEY	NEW BKLYN 2	WINSLOW TWP	394215	745617	111.13	MRPAU	839.	829.	839.	--
07-520	BROOKLAWN BORO WD	BBWD 3	BROOKLAWN BORO	395251	750732	10.	MRPAL	327.	307.	327.	31-04325
07-521	CLEMENTON WD	CWD 10	CLEMENTON BORO	394742	745931	180.	MRPAU	629.	600.	629.	31-12301
07-523	BELLMAWR BORO WD	--	BELLMAWR BORO	395152	750542	75.	MRPAL	557.	458.	557.	31-12315
07-525	HADDONFIELD WD	HWD 8/HWD 7	HADDONFIELD BORO	395319	750141	25.	MRPAL	550.	500.	550.	31-09694
07-527	CAMDEN CITY WD	PARKSIDE 18	CAMDEN CITY	395550	750537	40.	MRPAL	288.	258.	288.	--
07-528	CAMDEN CITY WD	PUCHACK 7	PENNSAUKEN TWP	395835	750302	20.	MRPAL	180.	140.	180.	31-08526
07-533	CADILLAC PET FOODS	1	PENNSAUKEN TWP	395932	750238	8.	MRPAL	117.	92.	117.	31-19157
07-535	CAMDEN CITY WD	TW-1-79	PENNSAUKEN TWP	395857	750344	10.	MRPAL	132.	100.	130.	31-15367
07-537	CAMDEN CITY WD	TW-4-79	PENNSAUKEN TWP	395909	750328	10.	MRPAL	128.	97.	128.	--
07-538	CAMDEN CITY WD	TW-5-79	PENNSAUKEN TWP	395914	750324	10.	MRPAL	129.	80.	110.	--
07-539	CAMDEN CITY WD	TW-6-79	PENNSAUKEN TWP	395902	750325	10.	MRPAL	142.	100.92	142.	31-14568
07-540	CAMDEN CITY WD	TW-7-79	PENNSAUKEN TWP	395858	750325	10.	MRPAL	141.	98.	138.	31-14569
07-541	CAMDEN CITY WD	TW-8-79	CAMDEN CITY	395611	750546	20.	MRPAL	255.	215.	253.	31-15720
07-547	NJ/AMERICAN WATER CO	54	CAMDEN CITY	395731	750458	35.	MRPAL	200.	160.	200.	31-18944
07-548	BRENAMAN, JE	1	PENNSAUKEN TWP	395802	750611	10.	MRPAL	83.	73.	83.	31-19463
07-560	MERCHANTVIL PNSK WCM	WOODBINE 2	MERCHANTVILLE BORO	395652	750307	50.	MRPAL	226.	196.	226.	31-14563
07-563	NJ DEPE	HARRISON 3	CAMDEN CITY	395712	750612	15.	MRPAL	117.	97.	117.	31-17116
07-564	NJ DEPE	HARRISON 4	CAMDEN CITY	395712	750612	15.	MRPAM	35.	15.	35.	--
07-573	US GEOLOGICAL SURVEY	COAST GUARD 2	GLOUCESTER CITY	395355	750738	11.30	MRPAU	89.	--	--	--
07-596	BROOKLAWN BORO WD	BBWD 4	BROOKLAWN BORO	395239	750754	10.	MRPAL	293.	263.	293.	31-19765
07-597	NJ/AMERICAN WATER CO	55	CAMDEN CITY	395718	750513	11.	MRPAL	176.	136.	176.	31-20270

Table 5.--Well-location and -construction data – continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
07-600	LAKELAND HOSPITAL	LAKELAND H 4	GLOUCESTER TWP	394658	750421	45.	MRPAU	453.	405.	453.	
07-601	BELLMAWR BORO WD	BBWD 6	BELLMAWR BORO	395212	750609	40.	MRPAL	381.	330.	381.	31-19218
07-674	HADDON TWP WD	HTWD 2A	HADDON TWP	395403	750322	60.	MRPAL	473.	430.	473.	31-29099
07-687	DEL R PORT AUTHORITY	B.ROSS E-1B	PENNSAUKEN TWP	395904	750358	-53.10	MRPAL	84.	--	--	--
07-693	DEL R PORT AUTHORITY	WHITMAN #12	GLOUCESTER CITY	395416	750734	8.80	MRPA	263.	--	--	--
101-007	US GEOLOGICAL SURVEY	HORSESHOE-D	PHILADELPHIA	395304	750914	-15.	MRPAL	238.	--	--	n/a
101-008	US GEOLOGICAL SURVEY	HORSESHOE-S	PHILADELPHIA	395304	750914	-15	MRPAM	50.	--	--	n/a
15-001	CLAYTON WD	CWD 3	CLAYTON BORO	393913	750517	133.	MRPAU	800.	746.	800.	31-02889
15-003	CLAYTON WD	4-1973	CLAYTON BORO	394015	750559	140.	MRPAU	740.	670.	740.	31-06676
15-006	WOODBURY WD	SEWELL 1A	DEPTFORD TWP	394627	750813	20.	MRPAU	311.	263.	308.	31-05174
15-008	WOODBURY WD	SEWELL 2A	DEPTFORD TWP	394628	750813	21.	MRPAU	307.	244.	307.	--
15-009	DEPTFORD TWP MUA	DTMUA 5	DEPTFORD TWP	394746	750511	78.	MRPAU	447.	414.	447.	31-05514
15-011	DEPTFORD TWP MUA	DTMUA 2	DEPTFORD TWP	394811	750914	58.	MRPAU	281.	255.	281.	31-02118
15-016	DEPTFORD TWP MUA	DTMUA 1	DEPTFORD TWP	394839	750911	70.	MRPAU	273.	252.	273.	31-02416
15-024	DEPTFORD TWP MUA	DTMUA 4	DEPTFORD TWP	395115	750706	40.	MRPAM	345.	282.	345.	31-05513
15-028	E GREENWICH WD	EGWD 2	EAST GREENWICH TWP	394755	751327	70.	MRPAU	216.	191.	216.	30-00432
15-059	OWENS ILLINOIS	OWENS 1	GLASSBORO BORO	394147	750714	144.	MRPAU	647.	606.	647.	31-04112
15-060	GLASSBORO WD	GWD 3	GLASSBORO BORO	394206	750758	150.	MRPAU	612.	562.	612.	31-02358
15-062	GLASSBORO WD	GWD 2	GLASSBORO BORO	394241	750642	145.	MRPAU	602.	562.	602.	51-00042
15-063	GLASSBORO WD	GWD 4	GLASSBORO BORO	394308	750702	150.	MRPAU	599.	549.	599.	31-04176
15-067	GREENWICH TWP WD	T W 1-58	GREENWICH TWP	394900	751658	5.	MRPAM	172.	157.	172.	30-00738
15-069	GREENWICH TWP WD	GTWD 3(NEW 4)	GREENWICH TWP	394920	751619	10.	MRPAM	168.	108.	168.	30-00757
15-072	E I DUPONT	REPAUNO 3	GREENWICH TWP	394936	751747	6.	MRPAM	101.	91.	101.	30-00037
15-074	HERCULES CHEMICAL	G.TWN OB 1	GREENWICH TWP	394939	751704	15.	MRPAM	121.	116.	121.	--
15-076	HERCULES CHEMICAL	4 1970	GREENWICH TWP	394939	751704	15.	MRPAM	120.	90.5	120.	30-01224
15-079	E I DUPONT	REPAUNO 6	GREENWICH TWP	394944	751734	10.	MRPAM	109.	84.	109.	30-01145
15-081	E I DUPONT	REPAUNO 5	GREENWICH TWP	394945	751717	10.	MRPAM	99.	81.	99.	30-00907
15-084	HERCULES CHEMICAL	GIBBSTOWN 2	GREENWICH TWP	394948	751639	12.	MRPAM	146.	121.	146.	30-00231
15-092	HERCULES CHEMICAL	GIBBSTOWN TH 6	GREENWICH TWP	394954	751642	4.	MRPAM	112.	107.	113.	30-00317
15-094	MOBIL OIL COMPANY	MOBIL 44	GREENWICH TWP	394958	751512	7.	MRPAM	136.	116.	136.	--
15-096	HERCULES CHEMICAL	GIBBSTOWN OB 2	GREENWICH TWP	394959	751650	14.18	MRPAM	134.	129.	134.	30-00188
15-097	HERCULES CHEMICAL	G.TWN TH 8	GREENWICH TWP	395000	751636	5.61	MRPAM	108.	102.	107.	30-00315
15-098	MOBIL OIL COMPANY	MOBIL 45	GREENWICH TWP	395006	751532	3.	MRPAM	118.	95.	115.	--
15-100	E I DUPONT	REPAUPO 6	GREENWICH TWP	395009	751706	3.	MRPAM	84.	79.	84.	--
15-109	MOBIL OIL COMPANY	MOBIL 41	GREENWICH TWP	395027	751503	20.	MRPAL	260.	229.	259.	
15-118	MOBIL OIL COMPANY	MOBIL 47	GREENWICH TWP	395036	751501	18.	MRPAL	240.	220.	240.	30-00198
15-127	LEONARD, WM	5	HARRISON TWP	394346	750959	140.	MRPAU	524.	--	--	31-03280
15-129	SOUTH JERSEY WATER CO	SJWC 1	HARRISON TWP	394409	751330	35.	MRPAU	263.	--	--	50-00049
15-130	SOUTH JERSEY WATER CO	SJWC 3	HARRISON TWP	394408	751330	35.	MRPAU	265.	234.	265.	30-00210
15-131	CLEARVIEW BD OF ED	CLEARVIEW HS 1	HARRISON TWP	394501	751229	45.	MRPAU	445.	--	--	--

Table 5.–Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
15-134	PURELAND WATER CO	TEST WELL 2	LOGAN TWP	394510	752244	18.	MRPAM	189.	136.	189.	--
15-135	SHELL OIL CO	OBS WELL 8A	LOGAN TWP	394516	752241	6.80	MRPAM	180.	130.	180.	30-01314
15-137	PURELAND WATER CO	PURE 2(3-1973)	LOGAN TWP	394535	752054	29.	MRPAM	208.	158.	208.	30-01371
15-139	PURELAND WATER CO	TEST WELL 3	LOGAN TWP	394608	752135	7.	MRPAL	345.	301.	345.	30-01223
15-140	PURELAND WATER CO	TEST WELL 4	LOGAN TWP	394608	752135	6.10	MRPAM	184.	132.	184.	30-01248
15-143	PURELAND WATER CO	LANDTECT TW-6C	LOGAN TWP	394551	752313	19.40	MRPAM	152.	102.	152.	30-01312
15-144	PURELAND WATER CO	1-1973	LOGAN TWP	394613	752129	7.60	MRPAM	138.	81.	136.	30-01370
15-146	PURELAND WATER CO	LANDTECT TW-9	LOGAN TWP	394648	752318	4.80	MRPAM	101.	82.	101.	--
15-147	SHOEMAKER, R A	1	LOGAN TWP	394706	751951	17.50	MRPAU	39.	33.	39.	--
15-158	MONSANTO CHEMICALS	BRIDGEPORT W2	LOGAN TWP	394733	752351	12.	MRPA	82.	57.	82.	30-00873
15-159	MONSANTO CHEMICALS	BRIDGEPORT E1	LOGAN TWP	394736	752344	11.	MRPA	81.	56.	81.	30-00872
15-161	MONSANTO CHEMICALS	OB1(TW5-OBC)	LOGAN TWP	394739	752232	8.	MRPAM	90.	70.	90.	30-00801
15-166	PENNS GROVE WSC	BRIDGEPORT 2	LOGAN TWP	394755	752108	5.	MRPAM	88.	65.4	85.4	30-00410
15-167	MONSANTO CHEMICALS	MONSANTO 1	LOGAN TWP	394726	752319	10.	MRPAM	96.	64.	94.	30-01170
15-170	VINE CONCRETE CO	REPAUP 1	LOGAN TWP	394854	751906	10.50	MRPAM	106.	85.4	106.	30-01220
15-175	AM DREDGING CO	RACCOON IS T 1	LOGAN TWP	394858	752225	8.	MRPAL	120.	100.	120.	30-01277
15-183	PITMAN CNTY CLB	COUNTRY CLUB 1	MANTUA TWP	394431	750911	85.	MRPAU	408.	378.	408.	31-05060
15-187	INVERSAND CO	#2	MANTUA TWP	394543	750746	45.	MRPAU	355.	325.	355.	--
15-191	MANTUA TWP MUA	MTMUA 2	MANTUA TWP	394629	750859	72.	MRPAU	368.	336.	368.	31-04791
15-192	MANTUA TWP MUA	MTMUA 5	MANTUA TWP	394635	751116	80.	MRPAU	337.	315.	337.	31-02987
15-194	MANTUA TWP MUA	MTMUA 4	MANTUA TWP	394732	751037	10.	MRPAU	265.	230.	265.	31-05309
15-207	NATIONAL PK WD	NPWD 2	NATIONAL PARK BORO	395156	751053	30.	MRPAL	282.	241.	282.	31-02555
15-210	PAULSBORO WD	6-1973	PAULSBORO BORO	394921	751417	15.	MRPAM	230.	185.	227.	30-01348
15-212	PAULSBORO WD	PWD 4	PAULSBORO BORO	394929	751447	25.	MRPAM	220.	192.	220.	30-00069
15-213	PAULSBORO WD	PWD 5	PAULSBORO BORO	394947	751416	10.	MRPAM	175.	135.	175.	30-00602
15-220	ESSEX CHEMICAL CO	OLIN 1	PAULSBORO BORO	395051	751349	10.	MRPAL	256.	234.	256.	30-00281
15-221	ESSEX CHEMICAL CO	PAULSBORO 1	PAULSBORO BORO	395057	751347	10.	MRPAL	286.	258.	286.	30-01185
15-226	PITMAN WD	PWD P2	PITMAN BORO	394411	750745	130.	MRPAU	515.	475.	515.	--
15-227	PITMAN WD	PWD P3	PITMAN BORO	394426	750747	99.	MRPAU	487.	447.	487.	31-04061
15-236	SWEDESBORO WD	SBWD 3	SWEDESBORO BORO	394434	751843	75.	MRPAM	312.	241.	312.	30-01177
15-238	SWEDESBORO WD	SBWD 2	SWEDESBORO BORO	394438	751833	30.	MRPAM	244.	217.	240.	--
15-239	DEL MONTE CORP	8	SWEDESBORO BORO	394510	751838	30.	MRPA	228.	--	--	--
15-240	DEL MONTE CORP	9	SWEDESBORO BORO	394510	751838	31.50	MRPAU	231.	190.	231.	30-00973
15-242	DEL MONTE CORP	6	SWEDESBORO BORO	394512	751830	25.	MRPAM	298.	267.	298.	--
15-248	WASHINGTON TMUA	WTMUA 5	WASHINGTON TWP	394339	750433	125.	MRPAU	618.	559.	618.	51-00029
15-253	WASHINGTON TMUA	6(FRIES MLS 1)	WASHINGTON TWP	394437	750249	152.	MRPAU	652.	584.	652.	31-04741
15-260	WASHINGTON TMUA	8(BELS LK WC2)	WASHINGTON TWP	394517	750300	130.	MRPAU	620.	544.	620.	31-05206
15-261	WASHINGTON TMUA	WTMUA 1	WASHINGTON TWP	394520	750218	100.	MRPAU	612.	581.	612.	31-03913
15-268	WASHINGTON TMUA	WTMUA 4	WASHINGTON TWP	394732	750447	77.	MRPAU	417.	369.	417.	31-06133
15-274	WENONAH WD	WWD 1	WENONAH BORO	394743	750902	80.	MRPAU	320.	273.	310.	51-00065

Table 5.--Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
15-275	WENONAH WD	WWD 2	WENONAH BORO	394751	750912	50.	MRPAU	310.	268.	310.	31-00170
15-276	W DEPTFORD TWP WD	WDTWD 4	WEST DEPTFORD TWP	394821	751026	60.	MRPAU	288.	242.	289.	31-04567
15-279	SHELL CHEMICAL CO	SHELL OBS 7	WEST DEPTFORD TWP	394857	751250	16.93	MRPAL	320.	315.	320.	30-00916
15-281	W DEPTFORD TWP WD	WDTWD 3	WEST DEPTFORD TWP	394912	751026	61.	MRPAU	243.	227.	243.	31-03021
15-282	W DEPTFORD TWP WD	5 KINGS HIWAY	WEST DEPTFORD TWP	394913	751105	55.	MRPAL	450.	388.	450.	--
15-283	HUNTSMAN POLYP CORP	SHELL 3	WEST DEPTFORD TWP	394919	751256	30.	MRPAL	384.	358.	383.	30-00900
15-284	HUNTSMAN POLYP CORP	SHELL 4	WEST DEPTFORD TWP	394919	751256	30.	MRPAU	159.	127.	157.	30-00901
15-285	HUNTSMAN POLYP CORP	SHELL 1	WEST DEPTFORD TWP	394917	751307	12.	MRPAL	360.	328.	358.	30-00898
15-286	HUNTSMAN POLYP CORP	SHELL 2	WEST DEPTFORD TWP	394917	751307	19.	MRPAM	290.	273.	288.	30-00899
15-295	WESTWOOD GOLF C	1-1973	WEST DEPTFORD TWP	394939	751007	20.	MRPAU	140.	120.	140.	31-06200
15-296	SHELL CHEMICAL CO	SHELL OBS 5	WEST DEPTFORD TWP	394942	751317	20.76	MRPAL	326.	321.	326.	30-00902
15-297	SHELL CHEMICAL CO	SHELL OBS 6	WEST DEPTFORD TWP	394942	751317	20.50	MRPAU	118.	113.	118.	30-00903
15-299	POLYREZ CO	POLYREZ 1	WEST DEPTFORD TWP	395002	751005	35.	MRPAU	125.	133.	165.	--
15-300	POLYREZ CO	POLYREZ 2	WEST DEPTFORD TWP	395002	751005	35.	MRPAU	165.	--	--	31-03864
15-303	PENNWALT CORP	TEST WELL 1	WEST DEPTFORD TWP	395030	751236	10.	MRPAU	114.	84.	114.	--
15-304	PENNWALT CORP	418	WEST DEPTFORD TWP	395032	751241	10.	MRPAL	290.	237.	289.	30-01173
15-308	PENNWALT CORP	TEST WELL 8	WEST DEPTFORD TWP	395044	751242	10.	MRPAL	271.	231.	271.	--
15-309	PENNWALT CORP	TEST WELL 5	WEST DEPTFORD TWP	395045	751255	10.	MRPAL	288.	248.	288.	--
15-311	PENNWALT CORP	TEST WELL 7	WEST DEPTFORD TWP	395104	751244	10.	MRPAL	243.	203.	243.	--
15-312	W DEPTFORD TWP WD	6 R B AVE	WEST DEPTFORD TWP	395107	750946	20.	MRPAL	372.	322.	372.	--
15-313	W DEPTFORD TWP WD	WDTWD 2	WEST DEPTFORD TWP	395139	750949	23.	MRPAL	353.	307.	353.	31-04231
15-314	COASTAL OIL CO	EAGLE POINT 6	WEST DEPTFORD TWP	395153	750946	15.	MRPAL	318.	280.	318.	31-00029
15-316	COASTAL OIL CO	EAGLE PT OBS 1	WEST DEPTFORD TWP	395159	750907	31.75	MRPAL	298.	288.	298.	31-00035
15-317	COASTAL OIL CO	EAGLE POINT 7	WEST DEPTFORD TWP	395200	750947	10.	MRPAL	306.	261.	301.	31-06834
15-318	COASTAL OIL CO	EAGLE POINT 2	WEST DEPTFORD TWP	395207	750930	17.	MRPAL	289.	259.	289.	31-00009
15-319	COASTAL OIL CO	EAGLE POINT 4	WEST DEPTFORD TWP	395213	750936	14.	MRPAL	289.	259.	289.	31-00002
15-320	COASTAL OIL CO	EAGLE POINT 1	WEST DEPTFORD TWP	395216	750915	20.	MRPAL	288.	248.	288.	31-00007
15-321	COASTAL OIL CO	EAGLE POINT 5	WEST DEPTFORD TWP	395221	750856	13.	MRPAL	277.	237.	277.	31-00028
15-322	COASTAL OIL CO	EAGLE POINT 3	WEST DEPTFORD TWP	395222	750918	20.	MRPAL	288.	258.	288.	31-00008
15-323	TEXAS OIL CO	EAGLE OBS 3	WEST DEPTFORD TWP	395235	750950	20.96	MRPAL	275.	255.	275.	31-00037
15-326	WESTVILLE WD	WWD 5	WESTVILLE BORO	395216	750739	12.	MRPAL	277.	243.	280.	--
15-327	WESTVILLE WD	WWD 4	WESTVILLE BORO	395221	750737	16.	MRPAL	319.	286.	313.	31-03418
15-330	WOODBRY HGTS BO	1 HELEN AVE	WOODBURY HGTS BORO	394858	750845	40.	MRPAU	235.	185.	230.	31-06356
15-331	WOODBURY WD	RAILROAD 5	WOODBURY CITY	394955	750908	35.	MRPAL	457.	405.	457.	31-04259
15-332	WOODBURY WD	PARKING LOT 3	WOODBURY CITY	395009	750922	50.	MRPAU	188.	148.	188.	--
15-333	WOODBURY WD	TATUM 4	WOODBURY CITY	395044	750907	20.	MRPAU	167.	129.	167.	31-00787
15-339	GRASSO, J S	1	WOOLWICH TWP	394350	751910	90.	MRPAU	267.	247.	267.	30-01161
15-342	DEL MONTE CORP	10	WOOLWICH TWP	394438	751914	60.	MRPAU	289.	192.	279.	30-01104
15-345	MUSUMECI, PETER	1	WOOLWICH TWP	394642	751823	62.	MRPAU	100.	94.	100.	--
15-346	TOMARCHIO, ALFRED S	1	HARRISON TWP	394529	751340	80.	MRPAU	343.	267.	343.	30-01565

Table 5.--Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
15-347	GREENWICH TWP WD	GTWD 5 (2-A)	GREENWICH TWP	394932	751722	20.	MRPAM	122.	82.	117.	30-01545
15-348	GREENWICH TWP WD	GTWD 6	GREENWICH TWP	394910	751541	20.	MRPAM	138.	105.	135.	30-01776
15-349	PURELAND WATER CO	LANDTECT 2	LOGAN TWP	394650	752316	6.	MRPAL	220.	170.	220.	--
15-350	PURELAND WATER CO	LANDTECT 1	LOGAN TWP	394550	752313	20.40	MRPAL	284.	234.	284.	--
15-354	ROLLINS ENVIR SERVICES	DP 2	LOGAN TWP	394716	752112	13.30	MRPAM	91.	81.	91.	30-01472
15-355	E GREENWICH WD	EGWD 3	EAST GREENWICH TWP	394822	751247	42.	MRPAU	246.	205.	245.	30-01426
15-359	E I DUPONT	C POWER 22	GREENWICH TWP	395015	751727	5.	MRPAM	103.	--	--	--
15-361	GLASSBORO WD	GWD 5	GLASSBORO BORO	394141	750710	140.	MRPAU	657.	610.	657.	31-07709
15-367	GANGEMI, VICENT	1	SOUTH HARRISON TWP	394234	751307	73.	MLRW	500.	--	--	30-00649
15-373	W DEPTFORD TWP WD	WDTWD 7	WEST DEPTFORD TWP	395126	750856	28.	MRPAL	366.	323.	363.	31-17452
15-374	DEPTFORD TWP MUA	DTMUA 6	DEPTFORD TWP	394843	750728	50.	MRPAM	489.	430.	486.	31-13385
15-379	MANTUA TWP MUA	MTMUA 6	MANTUA TWP	394601	751005	145.	MRPAU	408.	368.	398.	31-06640
15-387	ROLLINS ENVIR SERVICES	DP 1	LOGAN TWP	394713	752121	10.20	MRPAM	90.	80.	90.	30-01471
15-392	NJ TURNPIKE AUTH	1964-S-1	WOOLWICH TWP	394527	751607	105.	MRPAU	251.	241.	251.	30-01015
15-394	PMC CANNING COMPANY	CAN 1-1966	WOOLWICH TWP	394513	751913	30.	MRPAU	149.	124.	149.	30-01094
15-395	REPAUPO FIRE CO	30-1972	LOGAN TWP	394801	751759	20.	MRPAM	113.	93.	113.	30-01972
15-398	PETTIT, LOUIS	419	LOGAN TWP	394935	751938	1.	MRPAL	60.	50.	60.	30-02016
15-411	AIR PRODUCTS	NO-1-1978	GREENWICH TWP	395113	751513	20.	MRPAL	273.	238.	268.	30-01639
15-412	E I DUPONT	TEST 4 1965	GREENWICH TWP	395033	751740	5.	MRPAL	123.	--	--	30-01031
15-415	W DEPTFORD TWP WD	TEST 8-79	WEST DEPTFORD TWP	394834	751044	40.	MRPAM	308.	287.	307.	31-14478
15-430	COASTAL OIL CO	EAGLE POINT 6A	WEST DEPTFORD TWP	395156	750938	15.	MRPAL	331.	256.	328.	31-17788
15-431	WOODBURY WD	RED BANK 6	WOODBURY CITY	395034	750842	30.	MRPAM	305.	211.	305.	33-07973
15-433	WASHINGTON TMUA	WTMUA 9	WASHINGTON TWP	394631	750517	135.	MRPAU	552.	512.	552.	31-17801
15-434	WESTVILLE WD	WWD 6	WESTVILLE BORO	395224	750734	15.	MRPAL	--	265.	317.	31-17923
15-435	W DEPTFORD TWP WD	WDTWD 8	WEST DEPTFORD TWP	394836	751046	40.	MRPAM	312.	252.	312.	31-17911
15-437	POLYREZ CO	POLYREZ 1R	WOODBURY CITY	395008	751007	50.	MRPAU	142.	127.	142.	31-17980
15-438	GLOUCESTER MUA	GCMUA 1	WEST DEPTFORD TWP	395012	751333	10.	MRPAL	217.	202.	217.	31-17939
15-439	ESSEX CHEMICAL CO	ESSEX 2	PAULSBORO BORO	395048	751401	10.	MRPAL	235.	215.	235.	30-01175
15-490	ROLLINS ENVIR SERVICES	MA-3I	LOGAN TWP	394716	752103	3.14	MRPAM	40.	30.	40.	30-02611
15-492	ROLLINS ENVIR SERVICES	MA-3D	LOGAN TWP	394716	752103	2.65	MRPAM	60.	45.	60.	30-02609
15-494	ROLLINS ENVIR SERVICES	MA-3S	LOGAN TWP	394716	752103	3.10	MRPAM	10.	5.	10.	30-02610
15-496	NELSON, ROBERT	1	E GREENWICH TWP	394651	751632	45.	MRPAU	160.	150.	160.	30-01774
15-511	FEHLAUER, ALBERT	2	GREENWICH TWP	394828	751656	10.	MRPAU	47.	40.	47.	30-01519
15-512	FEHLAUER, ALBERT	3	GREENWICH TWP	394751	751654	10.	MRPAU	57.	47.	57.	31-11690
15-533	NATIONAL PARK WD	NPWD 6	NATIONAL PARK BORO	395155	751051	22.	MRPAL	272.	240.	272.	31-17938
15-540	US EPA	EPA 108	LOGAN TWP	394800	751936	7.10	MRPAM	97.	87.	97.	30-02621
15-546	CHEMICAL LEAMAN	CL2	LOGAN TWP	394759	751948	10.17	MRPAU	30.	20.	30.	30-02387
15-548	CHEMICAL LEAMAN	CLDW	LOGAN TWP	394755	751952	10.	MRPAU	45.	30.	45.	30-02504
15-549	CHEMICAL LEAMAN	DW1	LOGAN TWP	394757	751945	7.04	MRPA	97.	94.5	97.	30-02423
15-550	CHEMICAL LEAMAN	DW2	LOGAN TWP	394759	751949	10.17	MRPAM	102.	99.5	102.	30-02425

Table 5.–Well-location and -construction data – continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
15-554	US EPA REGION II	S-2A	LOGAN TWP	394808	751914	9.	MRPAU	14.	4.	14.	30-03071
15-555	US EPA REGION II	S-2B	LOGAN TWP	394808	751914	10.89	MRPAM	50.	40.	50.	30-03072
15-556	US EPA REGION II	S-2C	LOGAN TWP	394808	751914	11.13	MRPAM	108.	98.	108.	30-03073
15-560	US EPA REGION II	S-11A	LOGAN TWP	394800	751913	11.	MRPAU	14.5	4.5	14.5	30-03077
15-561	US EPA REGION II	S-11B	LOGAN TWP	394800	751913	11.	MRPAM	89.	79.	89.	30-03078
15-562	US EPA REGION II	S-11C	LOGAN TWP	394800	751913	11.	MRPAM	115.	105.	115.	30-03079
15-564	US EPA-GAVENTA	S-9	LOGAN TWP	394802	751933	6.80	MRPAU	52.	42.	52.	30-03081
15-569	PURELAND WATER CO	PWC 3	LOGAN TWP	394529	752045	32.	MRPAM	201.	161.	201.	30-02405
15-585	ROLLINS ENVIR SERVICES	DP5	LOGAN TWP	394704	752058	7.50	MRPAM	89.	79.	89.	30-02522
15-586	ROLLINS ENVIR SERVICES	DP4	LOGAN TWP	394720	752052	11.60	MRPAM	125.	95.	125.	30-02539
15-591	ROLLINS ENVIR SERVICES	25	LOGAN TWP	394716	752115	3.40	MRPAU	19.7	9.7	19.7	30-01303
15-616	US GEOLOGICAL SURVEY	SHIVELER MID.	LOGAN TWP	394637	751916	30.60	MRPAM	240.	230.	240.	--
15-617	US GEOLOGICAL SURVEY	SHIVELER UP.	LOGAN TWP	394637	751916	30.60	MRPAU	70.	60.	70.	--
15-620	US GEOLOGICAL SURVEY	GAVENTA MID.	LOGAN TWP	394804	751933	7.	MRPAM	141.	131.	141.	30-03677
15-627	LOGAN TWP-PURELAND	MW 103 D	LOGAN TWP	394644	752136	7.38	MRPAU	75.	65.	75.	30-33926
15-647	HERCULES CHEMICAL	MW 19B	GREENWICH TWP	394937	751646	12.	MRPAM	68.	48.	68.	30-03372
15-652	HERCULES CHEMICAL	MW 12	GREENWICH TWP	395017	751639	1.20	MRPAM	24.	17.	24.	30-03024
15-654	HERCULES CHEMICAL	MW 14	GREENWICH TWP	395015	751635	1.53	MRPAM	21.5	6.5	21.5	30-03026
15-657	E I DUPONT	OBS 38	GREENWICH TWP	394941	751737	9.16	MRPAM	94.	89.	94.	30-03461
15-660	E I DUPONT	OBS 33	GREENWICH TWP	394953	751733	8.16	MRPAM	24.6	19.6	24.6	30-03428
15-661	E I DUPONT	OBS 31	GREENWICH TWP	394953	751733	8.04	MRPAM	119.	109.	119.	30-03426
15-665	HERCULES CHEMICAL	MW 20C	GREENWICH TWP	394936	751711	14.05	MRPAM	121.	101.	121.	--
15-667	HERCULES CHEMICAL	MW 20	GREENWICH TWP	394936	751711	14.24	QRNR	29.	14.	29.	30-03429
15-668	HERCULES CHEMICAL	MW 10C	GREENWICH TWP	394944	751648	7.83	MRPAM	112.	92.	112.	30-03370
15-672	AIR PRODUCTS	2-NORTH WELL	GREENWICH TWP	395014	751459	20.	MRPAL	264.	244.	264.	30-01640
15-677	EXXON CO	MW 8	PAULSBORO BORO	395050	751449	27.60	QRNR	39.	19.	39.	30-03451
15-679	MOBIL OIL COMPANY	W-5D	GREENWICH TWP	394946	751612	9.70	MRPAM	128.	118.	128.	30-03624
15-681	MOBIL OIL COMPANY	W-7D	GREENWICH TWP	395038	751605	8.70	MRPAM	70.	60.	70.	30-03601
15-682	MOBIL OIL COMPANY	W-8D	GREENWICH TWP	395048	751518	10.79	MRPAM	115.	105.	115.	30-03607
15-683	MOBIL OIL COMPANY	W-9D	GREENWICH TWP	395021	751533	10.70	MRPAM	102.	92.	102.	30-03613
15-685	EXXON CO	MW 7	PAULSBORO BORO	395046	751446	30.40	MRPAM	28.	8.	28.	30-03450
15-689	E I DUPONT	DUPONT 93	GREENWICH TWP	395018	751650	9.50	MRPAM	17.	7.	17.	30-03778-6
15-692	E I DUPONT	INTERCEPTOR 46	GREENWICH TWP	394952	751734	5.	MRPAM	136.	96.	136.	30-03594
15-693	E I DUPONT	42	GREENWICH TWP	394940	751752	5.	MRPAM	23.	18.	23.	--
15-696	MOBIL OIL COMPANY	W-3D	GREENWICH TWP	394952	751502	8.40	MRPAM	172.	162.	172.	30-03610
15-697	PENNS GROVE WATER CO	BACKUP-2	LOGAN TWP	394755	752108	8.	MRPAM	84.	69.	84.	30-03332
15-699	MOBIL OIL COMPANY	29	GREENWICH TWP	395037	751605	9.40	QRNR	20.	0.	20.	30-02003.2
15-700	MOBIL OIL COMPANY	40	GREENWICH TWP	394952	751527	2.	QRNR	22.	2.	22.	30-02003.3
15-707	US GEOLOGICAL SURVEY	GAVENTA W TAB	LOGAN TWP	394800	751936	7.10	MRPAU	6.75	5.75	6.75	50-00077
15-709	ESSEX CHEMICAL CO	OBS 2	PAULSBORO BORO	395053	751346	9.60	QRNR	19.5	9.1	19.5	30-01512

Table 5.--Well-location and -construction data -- continued.

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15-710	BP OIL CO	BL-1	PAULSBORO BORO	395100	751420	5.20	QRNR	35.	10.	35.	30-02854
15-711	MOBIL OIL COMPANY	W-8C	GREENWICH TWP	395048	751518	11.50	MRPAL	163.	153.	163.	30-03608-9
15-712	US GEOLOGICAL SURVEY	STEFKA 1 OBS	GREENWICH TWP	394808	751724	6.50	MRPAL	295.	275.	290.	30-04347
15-713	US GEOLOGICAL SURVEY	STEFKA 2 OBS	GREENWICH TWP	394808	751724	5.64	MRPAM	155.	125.	155.	30-04348
15-727	US GEOLOGICAL SURVEY	STEFKA 3 OBS	GREENWICH TWP	394808	751724	5.06	MRPAM	210.	206.	205.	30-04548
15-728	US GEOLOGICAL SURVEY	STEFKA 4 OBS	GREENWICH TWP	394808	751724	4.46	MRPAU	56.	46.	56.	30-04549
15-738	MOBIL OIL COMPANY	W-4C	GREENWICH TWP	394948	751524	4.50	MRPAL	198.	188.	198.	30-03612-7
15-741	US GEOLOGICAL SURVEY	SHALLOW OBS	MANTUA TWP	394652	751004	82.	MRPAU	313.	293.	313.	--
15-742	US GEOLOGICAL SURVEY	DEEP OBS	MANTUA TWP	394652	751004	84.	MRPAL	777.	757.	777.	--
15-770	US GEOLOGICAL SURVEY	#1-PW-L	NATIONAL PARK BORO	395202	751115	10.5	MRPAL	229.	204.	224.	31-26237-6
15-771	US GEOLOGICAL SURVEY	#2-PW-M	NATIONAL PARK BORO	395202	751115	10.	MRPAM	128.	92.3	123.	31-26243
15-772	US GEOLOGICAL SURVEY	#3-OW-AL	NATIONAL PARK BORO	395206	751118	11.4	MRPAL	230.	196.	216.	31-26242
15-773	US GEOLOGICAL SURVEY	#5-OW-AU	NATIONAL PARK BORO	395206	751118	10.	MRPAU	55.	30.	50.	31-26238
15-774	US GEOLOGICAL SURVEY	#4-OW-AM	NATIONAL PARK BORO	395206	751118	10.	MRPAM	118.	93.	113.	31-26241
15-776	US GEOLOGICAL SURVEY	#7-0W-CM	NATIONAL PARK BORO	395202	751127	15.	MRPAM	140.	125.	135.	31-26247
15-777	US GEOLOGICAL SURVEY	#8-OW-CU	NATIONAL PARK BORO	395202	751127	15.	MRPAU	82.	57.	77.	31-26248
15-779	US GEOLOGICAL SURVEY	#11-OW-BU	NATIONAL PARK BORO	395223	751117	5.	MRPAU	40.	25.	35.	31-26239
15-780	US GEOLOGICAL SURVEY	#10-OW-BM	NATIONAL PARK BORO	395223	751117	5.	MRPAM	90.	75.	85.	31-26244
15-814	MOBIL OIL COMPANY	RW-12	GREENWICH TWP	395024	751521	21.30	QRNR	60.	15.	55.	30-02336
15-815	MOBIL OIL COMPANY	RW-11	GREENWICH TWP	395027	751528	18.50	QRNR	57.	12.	52.	30-02335
15-816	MOBIL OIL COMPANY	RW-17	GREENWICH TWP	395035	751543	23.20	QRNR	24.	3.	15.	30-02338
15-817	MOBIL OIL COMPANY	RW-16	GREENWICH TWP	395039	751547	17.40	QRNR	24.	4.	16.	30-02341
15-818	MOBIL OIL COMPANY	RW-15	GREENWICH TWP	395005	751517	13.70	QRNR	24.	2.	10.	30-02339
15-819	MOBIL OIL COMPANY	RW-14	GREENWICH TWP	395011	751513	17.	QRNR	60.	15.	55.	30-02334
15-820	MOBIL OIL COMPANY	RW-2	GREENWICH TWP	395038	751514	21.50	QRNR	48.3	18.3	48.3	--
15-821	MOBIL OIL COMPANY	RW-3	GREENWICH TWP	395047	751512	22.10	QRNR	59.	19.	54.	--
15-822	MOBIL OIL COMPANY	RW-4	GREENWICH TWP	395042	751515	20.30	QRNR	56.	16.	51.	--
15-823	MOBIL OIL COMPANY	RW-5	GREENWICH TWP	395037	751500	25.40	QRNR	58.	18.	53.	--
15-824	MOBIL OIL COMPANY	RW-6	GREENWICH TWP	395033	751457	18.80	QRNR	53.5	13.5	48.5	--
15-825	MOBIL OIL COMPANY	RW-7	GREENWICH TWP	395027	751506	17.30	QRNR	53.5	13.5	48.5	--
15-826	MOBIL OIL COMPANY	RW-8	GREENWICH TWP	395022	751458	19.	QRNR	55.	15.	50.	--
15-827	MOBIL OIL COMPANY	RW-9	GREENWICH TWP	395021	751533	11.10	QRNR	50.5	5.5	45.5	--
15-828	MOBIL OIL COMPANY	RW-18	GREENWICH TWP	395024	751600	11.70	QRNR	30.	1.	17.	--
15-832	MOBIL OIL COMPANY	RW-13	GREENWICH TWP	395043	751527	19.80	QRNR	58.	13.	53.	30-02340
15-833	HERCULES CHEMICAL	PW-10	GREENWICH TWP	394942	751655	11.	MRPAM	44.5	14.5	44.5	--
15-834	HERCULES CHEMICAL	PW-9	GREENWICH TWP	394941	751650	11.10	MRPAM	43.	13.	43.	--
15-835	HERCULES CHEMICAL	PW-8B	GREENWICH TWP	394938	751653	12.20	MRPAM	75.	29.5	69.5	--
15-836	HERCULES CHEMICAL	PW-8	GREENWICH TWP	394937	751655	14.50	QRNR	19.9	9.9	19.9	--
15-837	HERCULES CHEMICAL	PW-7B	GREENWICH TWP	394938	751649	15.20	MRPAM	75.	35.	75.	--
15-838	HERCULES CHEMICAL	PW-5B	GREENWICH TWP	394942	751655	11.60	MRPAM	43.	23.	43.	--

Table 5.--Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
15-839	BP OIL CO	RW-3	PAULSBORO BORO	395052	751408	11.60	QRNR	85.	25.	85.	30-03430
15-843	BP OIL CO	P-13	PAULSBORO BORO	395055	751415	20.40	MRPAU	40.	38.	40.	30-02307
15-998	US GEOLOGICAL SURVEY	CLAYTON 1	CLAYTON BORO	394031	750605	141.	MRPAM	843.	820.	837.	31-24775-0
15-999	US GEOLOGICAL SURVEY	CLAYTON 2 DEEP	CLAYTON BORO	394031	750605	142.	MRPAL	1,380.	1,330.	1,370.	31-24260
15-1000	RAY ANGELINI INC	ANGELINI 1	DEPTFORD TWP	394646	750631	75.	MRPAU	359.	354.	359.	31-21614
15-1004	US GEOLOGICAL SURVEY	CEDAR LK DEEP	WASHINGTON TWP	394421	750604	80.	MRPAL	1,050.	1,040.	1,210.	31-24259
15-1012	PHILLIPS, NELSON O	MILLSTREAM	MANTUA TWP	394710	751158	40.	MRPAU	260.	250.	260.	31-22169
15-1013	SCHULTES, RICHARD J	SCHULTES 1	WASHINGTON TWP	394351	750611	105.	MRPAU	498.	482.	492.	31-21557
15-1031	MATLACK TRUCKING INC	MW-1B	WOOLWICH TWP	394553	751920	47.	MRPAU	105.	95.	105.	30-03412
15-1039	MOBIL OIL COMPANY	MOBIL 48 DWTA	PAULSBORO BORO	394958	751512	7.	MRPAM	153.	100.	153.	30-05060
15-1061	MOBIL OIL COMPANY	W-4D	GREENWICH TWP	394948	751526	4.	MRPAL	152.	142.	152.	30-03612
33-075	MACKANNAN, C	CM1 (AUBURN HI)	OLDMANS TWP	394258	752200	16.	MRPAU	134.	129.	134.	--
33-080	AIR REDUCTION	AIRCO 1	OLDMANS TWP	394542	752510	15.	MRPAM	132.	112.	132.	30-00974
33-086	B F GOODRICH CO	4 (PW-3)	OLDMANS TWP	394557	752523	13.	MRPAL	189.	169.	189.	30-01139
33-187	US GEOLOGICAL SURVEY	POINT AIRY OBS	PILESGROVE TWP	394037	751914	72.97	MRPAL	672.	664.	672.	--
45-001	US GEOLOGICAL SURVEY	MIFFLIN BAR	TINICUM	395127	751447	-17.	--	231.	--	--	n/a
51-9002	--	--	BRISTOL	400431	745452	13.	--	45.	--	--	n/a
B-95 (G)	PA RAILROAD CO.	--	PHILADELPHIA	395903	750419	0.	WSCK	110.	--	--	n/a
B-103 (G)	TACONY BRIDGE	--	PHILADELPHIA	400142	750235	0.	--	75.	--	--	n/a
B-124 (G)	US ARMY ENGINEERS	--	PHILADELPHIA	400219	745931	0.	--	50.	--	--	n/a
B-125 (G)	US ARMY ENGINEERS	--	PHILADELPHIA	400256	745836	0.	--	50.	--	--	n/a
B-126 (G)	US ARMY ENGINEERS	--	BENSALEM	400352	745638	0.	--	50.	--	--	n/a
B-127 (G)	US ARMY ENGINEERS	--	BENSALEM	400421	745516	0.	--	50.	--	--	n/a
B-128 (G)	US ARMY ENGINEERS	--	BENSALEM	400419	745443	0.	--	50.	--	--	n/a
B-129 (G)	US ARMY ENGINEERS	--	BRISTOL	400428	745352	0.	--	50.	--	--	n/a
B-130 (G)	US ARMY ENGINEERS	--	BRISTOL	400431	745356	0.	--	50.	--	--	n/a
B-131 (G)	US ARMY ENGINEERS	--	BURLINGTON CITY	400515	745132	0.	--	50.	--	--	--
B-148 (G)	PA TURNPIKE COMM	--	BURLINGTON TWP	400702	744948	0.	--	158.	--	--	--
B-415 (G)	--	--	PHILADELPHIA	395848	750357	4.	WSCK	160.	--	--	n/a
Bk-520	MCKEE ESTATE	--	BRISTOL	400438	745342	15.	--	31.	--	--	n/a
Bk-534 (G)	BRISTOL BORO WD	--	BRISTOL	400609	745411	20.	--	64.	29.	--	n/a
De-025	WESTINGHOUSE ELEC	WELL #5	TINICUM	395152	751716	14.	--	--	--	--	n/a
Ph-001 (P)	US NAVY	--	PHILADELPHIA	395334	751009	11.24	MRPAL	233.	207.	233.	n/a
Ph-006 (P)	US NAVY	--	PHILADELPHIA	395348	751059	10.19	MRPAL	163.	138.	163.	n/a
Ph-012 (P)	US NAVY	--	PHILADELPHIA	395342	751021	8.64	MRPAM	101.	--	--	n/a
Ph-019 (P)	US NAVY	--	PHILADELPHIA	395314	751010	8.68	MRPAL	247.	242.	247.	n/a
Ph-020 (P)	US NAVY	--	PHILADELPHIA	395316	751049	13.	MRPAL	240.	235.	--	n/a
Ph-033 (P)	CONRAIL	--	PHILADELPHIA	395409	751202	11.	MRPAL	91.	74.	--	n/a
Ph-035 (P)	GULF OIL CORP	--	PHILADELPHIA	395431	751245	8.10	--	106.	--	--	n/a
Ph-039 (P)	GULF OIL CORP	--	PHILADELPHIA	395416	751246	8.10	--	73.	--	--	n/a

Table 5.--Well-location and -construction data -- continued.

Well Number	Owner	Local Identifier	Municipality	Latitude (DMS)	Longitude (DMS)	Land-Surface Elevation (ft)	Aquifer	Depth of Well (ft)	Depth to Well Opening (ft)	Bottom of Well Opening (ft)	N.J. Well Permit Number
Ph-050 (P)	ABBOTTS DAIRIES	--	PHILADELPHIA	395553	751021	27.	MRPAL	98.	83.	--	n/a
Ph-063 (P)	ROOSEVELT PARK	--	PHILADELPHIA	395408	751040	5.6	MRPAL	185.	--	--	n/a
Ph-086 (P)	US NAVAL HOSPITAL	--	PHILADELPHIA	395429	751050	8.0	MRPAL	142.	117.	142.	n/a
Ph-101 (P)	PA RANGE & BOILER CO	--	PHILADELPHIA	395621	751106	41.	WSCK	78.	--	--	n/a
Ph-108 (P)	BROADWAY THEATER	--	PHILADELPHIA	395529	751014	25.	--	100.	88.	--	n/a
Ph-113 (P)	US NAVAL HOME	--	PHILADELPHIA	395640	751055	38.	--	71.	--	--	n/a
Ph-124 (P)	PRESIDENT CATERERS	--	PHILADELPHIA	395534	751106	32.6	MRPAL	86.	65.	86.	n/a
Ph-127 (P)	DISCOUNT PLYWOOD	--	PHILADELPHIA	395534	750926	25.2	MRPAL	95.	72.	95.	n/a
Ph-141 (P)	LIQUID CARBONIC	--	PHILADELPHIA	395457	750854	10.	--	73.	53.	--	n/a
Ph-144 (P)	GENERAL COLD ST.	--	PHILADELPHIA	395437	750840	11.	MRPAL	161.	136.	--	n/a
Ph-152 (P)	CONRAIL	--	PHILADELPHIA	395346	750844	10.	MRPAL	199.	179.	--	n/a
Ph-206 (P)	WILDSTEIN & CO	--	PHILADELPHIA	395718	750826	10.55	MRPAL	61.	40.	--	n/a
Ph-240 (P)	MORGENTHALER	--	PHILADELPHIA	395515	750903	12.	MRPAL	154.	124.	--	n/a
Ph-249 (P)	CROWN PAPER BOARD	--	PHILADELPHIA	395542	750849	13.	MRPAL	136.	--	--	n/a
Ph-275 (P)	PA SUGAR CO	--	PHILADELPHIA	395747	750756	13.	WSCK	400.	72.	--	n/a
Ph-321 (P)	F W TUNNELL CO	--	PHILADELPHIA	395939	750526	20.	WSCK	49.	45.	--	n/a
Ph-324 (P)	ROHM AND HAAS CO	--	PHILADELPHIA	400006	750343	11.	MRPAL	67.	--	--	n/a
Ph-325 (P)	ROHM AND HAAS CO	--	PHILADELPHIA	400014	750344	10.	MRPAL	80.	--	--	n/a
Ph-345 (P)	QUAKER RUBBER CO	--	PHILADELPHIA	400039	750312	8.	MRPAL	48.	--	--	n/a
Ph-372 (P)	PA FORGE CO	--	PHILADELPHIA	400127	750132	10.	MRPAL	40.	29.	--	n/a
Ph-389 (P)	GENERAL SMELTING CO.	--	PHILADELPHIA	395859	750552	10.	--	55.	45.	--	n/a
Ph-400 (P)	PHILA DEPT OF REC	--	PHILADELPHIA	400227	745938	15.10	WSCK	139.	--	--	n/a
Ph-417 (P)	PUBLICKER IND.	--	PHILADELPHIA	395429	750803	5.3	MRPAL	165.	145.	165.	n/a
Ph-430 (P)	CROWN PAPER BOARD	--	PHILADELPHIA	395539	750840	13.7	MRPAL	118.	108.	118.	n/a
Ph-447 (P)	REGAL PETRO. PROD.	--	PHILADELPHIA	395524	751311	20.	WSCK	351.	22.	--	n/a
Ph-457 (P)	PUBLICKER IND.	--	PHILADELPHIA	395525	750845	11.	MRPAL	139.	119.	139.	n/a
Ph-459 (P)	PUBLICKER IND.	--	PHILADELPHIA	395521	750845	11.	MRPAL	157.	127.	157.	n/a
Ph-509 (P)	HAJOCA CORP	--	PHILADELPHIA	395708	751106	20.	WSCK	63.	42.	63.	n/a
Ph-731 (P)	BLACK, E N	--	PHILADELPHIA	395200	751220	10.	WSCK	456.	--	--	n/a
Ph-750 (P)	S A F AMERICA INC.	--	PHILADELPHIA	395445	750831	9.7	MRPAL	167.	122.	167.	n/a
Ph-780 (P)	UNITED NESCO CON. CO.	--	PHILADELPHIA	395529	750846	11.0	MRPAL	134.	112.	134.	n/a
Ph-822 (P)	CITY OF PHILADELPHIA	--	PHILADELPHIA	395303	751244	5.	--	171.	--	--	n/a
Ph-824 (P)	CITY OF PHILADELPHIA	--	PHILADELPHIA	395242	751251	5.	--	166.	--	--	n/a

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River

[All altitudes are in feet above sea level; QRNR, Cenozoic deposits; EGLS, Englishtown aquifer system; MRPAU, upper aquifer of the Potomac-Raritan-Magothy aquifer system; MRPAM, middle aquifer of the Potomac-Raritan-Magothy aquifer system; MRPAL, lower aquifer of the Potomac-Raritan-Magothy aquifer system; WSCK, Wissahickon Schist; -, indicates confining bed in aquifer list; TWP, Township; BORO, Borough; WD, Water Department; WC, Water Company; WCM, Water Commission, MUA, Municipal Utilities Authority; ft, feet]

Well number	Land-surface elevation	Owner	Well identifier
05-039	**12.0**	**NJ/AMERICAN WATER CO**	**DVWC 15**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
12.0	7.0	CLAY, sandy	-
7.0	4.0	SAND, yellow, fine-grained	MRPAM
4.0	-3.0	"Salt and pepper"; "Stones"	"
-3.0	-5.0	SAND; "Stones"	"
-5.0	-10.0	CLAY, sandy; "Stones"	"
-10.0	-17.0	"Stones", large; SAND	"
-17.0	-21.0	CLAY, brown; "Stones"	"
-21.0	-30.0	"Stones"; GRAVEL	"
-30.0	-40.0	"Stones"; SAND	"
-40.0	-46.0	SAND; "Stones"; Mica	MRPAM
-46.0		CLAY, white; Mica; BEDROCK	WSCK

Well number	Land-surface elevation	Owner	Well identifier
05-062	**18.0**	**BURLINGTON CITY WD**	**BCWD 4**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
18.0	17.0	SAND, fine-grained, dirty	MRPAU
17.0	4.0	SAND; GRAVEL	"
4.0	1.0	"Hardpan"	"
1.0	-8.0	SAND; GRAVEL; CLAY	"
-8.0		SAND; GRAVEL; "Stones"; CLAY	MRPAU

Well number	Land-surface elevation	Owner	Well identifier
05-064	**35.0**	**FIRST NATIONAL BANK**	**BANK 2**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
35.0	34.0	"Fill"	-
34.0	26.0	SAND, brown	MRPAU
26.0	24.0	SAND; "Stones"	"
24.0	16.0	SAND, yellow	"
16.0	-4.0	SAND, wet	"
-4.0	-41.0	SAND, brown	MRPAU
-41.0	-71.0	CLAY, gray	-
-71.0	-73.0	CLAY, sandy	-
-73.0	-80.0	SAND; CLAY	MRPAM
-80.0	-87.0	SAND, yellow	"
-87.0	-113.0	CLAY, red	"
-113.0	-121.0	SAND, white	"
-121.0	-129.0	CLAY, white	"
-129.0	-136.0	SAND, white	"
-136.0	-157.0	CLAY, sandy	"
-157.0		SAND; GRAVEL	MRPAM

Well number	Land-surface elevation	Owner	Well identifier
05-082	**35.0**	**MURPHY, ALBERT**	**FOX HILL FARM**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
35.0	29.0	SAND, brown, medium to coarse-grained; "Loam"	MRPAU
29.0	19.0	SAND, medium to coarse-grained; water seepage	MRPAU
19.0	17.0	CLAY, gray, heavy	-
17.0	10.0	CLAY, white; "grits"	-
10.0	5.0	CLAY, red; "grits"	-
5.0	-3.0	CLAY, red, gray, mixture	-
-3.0	-6.0	CLAY, gray; "grits"; "Stones"	-
-6.0	-16.0	SANDSTONE, brown; "Hardpan"	MRPAM
-16.0	-41.0	SAND, gray, medium to coarse-grained, water-bearing	"
-41.0	-47.0	SAND, gray, coarse-grained; GRAVEL; SAND, white, fine-grain	"
-47.0		End of water-bearing stratum; CLAY, white	MRPAM

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier
05-086	**18.0**	**TENNECO CHEMICAL CO**	**TENNECO 5**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
18.0	-50.0	SAND; GRAVEL	MRPAM
-50.0	-59.0	CLAY, white, tough	"
-59.0	-66.0	SAND, yellow, coarse-grained; GRAVEL, fine-grained	"
-66.0	-68.0	CLAY, white, tough	"
-68.0	-92.0	SAND, white and yellow, coarse-grained	"
-92.0	-96.0	CLAY, white, tough	"
-96.0	-111.0	SAND, white and yellow, coarse-grained; GRAVEL; CLAY streaks	"
-111.0	-112.0	CLAY, white, tough	"
-112.0		SAND, white, and yellow, hard packed; CLAY streaks, white	MRPAM

Well number	Land-surface elevation	Owner	Well identifier
05-090	**15.0**	**TENNECO CHEMICAL CO**	**TENNECO 6-OBS**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
15.0	10.0	"Soil"	-
10.0	0.0	"Soil"; CLAY; SAND, fine-grained	-
0.0	-31.0	SAND; GRAVEL	-
-31.0	-34.0	CLAY	-
-34.0	-50.0	SAND; GRAVEL	-
-50.0	-67.0	SAND	-
-67.0	-126.0	CLAY, sandy	-
-126.0	-159.0	CLAY; SAND	-
-159.0		BEDROCK	WSCK

Well number	Land-surface elevation	Owner	Well identifier
05-150	**15.0**	**AMICO SAND**	**AMICO**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
15.0	12.0	SAND	-
12.0	9.0	"Stones", big	-
9.0	0.0	CLAY, black	-
0.0	-3.0	SAND, dirty	MRPAM
-3.0	-15.0	SAND; GRAVEL	"
-15.0	-21.0	GRAVEL	MRPAM
-21.0	-34.0	CLAY	-
-34.0		BEDROCK	WSCK

Well number	Land-surface elevation	Owner	Well identifier
05-348	**10.0**	**NJ/AMERICAN WATER CO**	**8-REPLACES 2 and 7**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	9.0	"Topsoil"	-
9.0	1.0	SILT, brown	-
1.0	-8.0	SAND, brown; "Stones"	MRPAM
-8.0	-10.0	GRAVEL, SAND; "Stones"; CLAY, red	"
-10.0	-15.0	"Stones", large; GRAVEL	"
-15.0	-24.0	"Stones", large; GRAVEL; SAND, course-grained	"
-24.0	-25.0	SAND, white, coarse-grained	"
-25.0	-31.0	CLAY; GRAVEL; "Stones"	"
-31.0	-39.0	CLAY, white-yellow; GRAVEL	"
-39.0	-48.0	SAND, brown, coarse-grained; CLAY	"
-48.0	-52.0	CLAY, yellow-white; GRAVEL; SAND, coarse-grained	"
-52.0	-59.0	SAND, brown, coarse-grained	"
-59.0	-64.0	SAND, white; CLAY	"
-64.0	-69.0	CLAY, white; GRAVEL	"
-69.0	-71.0	SAND, brown, coarse-grained	"
-71.0	-74.0	"Stones", large; GRAVEL	MRPAM
-74.0	-83.0	CLAY, yellow	WSCK
-83.0	-86.0	CLAY, yellow; Mica	"
-86.0		BEDROCK	

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier
05-649	**39.0**	**WILLINGBORO MUA**	**WMUA 6**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
39.0	36.0	"Air".	-
36.0	33.0	CLAY; SAND; "Stones"	QRNR
33.0	23.0	CLAY	-
23.0	-1.0	MARL, sandy, black	-
-1.0	-2.0	"Hard spot"	-
-2.0	-16.0	CLAY, sandy, hard	-
-16.0	-36.0	CLAY, silty, dark gray	QRNR
-36.0	-46.0	SAND	MRPAU
-46.0	-51.0	CLAY, gray	"
-51.0	-56.0	GRAVEL	"
-56.0	-66.0	SAND, fine to medium-grained	"
-66.0	-69.0	SAND, fine to coarse-grained; GRAVEL, multi-color	"
-69.0	-71.0	SAND; CLAY, laminated	MRPAU
-71.0	-72.0	SAND, clayey, gray	-
-72.0	-73.0	GRAVEL, fine to coarse-grained	-
-73.0	-90.0	CLAY, sandy, multi-color	-
-90.0	-103.0	SAND, gray, fine-grained; CLAY	-
-103.0	-104.0	"Hard spot"	-
-104.0	-106.0	CLAY	-
-106.0	-111.0	SAND; "Stones"	MRPAM
-111.0	-163.0	SAND, gray, fine-grained	"
-163.0	-167.0	CLAY	"
-167.0	-168.0	SAND, gray, fine-grained	"
-168.0	-169.0	CLAY, light gray	"
-169.0	-176.0	SAND, gray, fine-grained	"
-176.0	-181.0	SAND, gray, fine to medium-grained; CLAY balls	"
-181.0	-204.0	CLAY balls, gray; SAND lamina	"
-204.0	-216.0	SAND, gray, fine-grained	"
-216.0	-231.0	SAND, gray, GRAVEL	"
-231.0	-245.0	CLAY, laminated; SAND, gray, fine-grained; GRAVEL	"
-245.0	-252.0	CLAY, sandy, light gray	"
-252.0	-257.0	SAND, gray, fine to medium-grained, laminated	"
-257.0	-266.0	CLAY, red	"
-266.0	-269.0	CLAY, gray	"
-269.0	-281.0	SAND, fine to coarse-grained, laminated	"
-281.0	-291.0	SAND, fine to coarse-grained; GRAVEL	"
-291.0		CLAY, light gray, hard	MRPAM

Well number	Land-surface elevation	Owner	Well identifier
05-651	**28.0**	**WILLINGBORO MUA**	**WMUA 9(OLD 3)**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	27.0	"Topsoil".	-
27.0	25.0	SAND, brown, coarse-grained; GRAVEL	-
25.0	20.0	CLAY, brown; "Hardpan"	-
20.0	-27.0	CLAY, gray; Mica	-
-27.0	-41.0	CLAY, gray; LIGNITE	MRPAU
-41.0	-52.0	SAND, multi-color	"
-52.0	-56.0	SAND, brown, fine-grained	MRPAU
-56.0	-62.0	CLAY, gray; sandy CLAY	-
-62.0	-92.0	CLAY, multi-color	-
-92.0	-97.0	CLAY, gray; sandy CLAY	MRPAM
-97.0	-101.0	SAND, gray, fine-grained	"
-101.0	-117.0	SAND, white, medium to fine-grained	"
-117.0	-125.0	SAND, white, fine-grained; CLAY, white	"
-125.0	-132.0	SAND, brown, medium-grained	"
-132.0	-137.0	SAND, white, fine-grained; Mica	"
-137.0	-143.0	SAND, white, fine-grained; CLAY	"
-143.0	-147.0	CLAY, gray; sandy CLAY streaks	"
-147.0	-149.0	CLAY, multi-color; SAND streaks, brown	"
-149.0	-167.0	CLAY, multi-color	"
-167.0	-170.0	CLAY, gray; sandy CLAY	"
-170.0	-176.0	SAND, white, fine-grained	"
-176.0	-186.0	SAND, white, fine to medium-grained; CLAY streaks	"
-186.0	-191.0	SAND, white, coarse-grained	"
-191.0	-205.0	SAND, white, fine to medium-grained; "grits"	"
-205.0	-212.0	SAND, white, fine to coarse-grained	"

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of 05-651 -- continued

Top	Bottom	Lithologic description	Aquifer
-212.0	-221.0	CLAY, multi-color	"
-221.0	-227.0	CLAY, sandy; LIGNITE	"
-227.0	-238.0	CLAY, multi-color	"
-238.0	-242.0	CLAY, sandy; LIGNITE	"
-242.0	-247.0	SAND, white, fine-grained; CLAY	"
-247.0	-253.0	CLAY, white	"
-253.0	-257.0	CLAY, white; SAND, medium-grained	"
-257.0	-263.0	SAND, brown, medium to coarse-grained; CLAY	"
-263.0	-268.0	SAND, brown, coarse-grained	"
-268.0	-271.0	CLAY, gray; SAND, coarse-grained	"
-271.0	-282.0	SAND, white, fine-grained; CLAY	MRPAM
-282.0	-292.0	CLAY, multi-color	-
-292.0		BEDROCK	WSCK

05-658 19.0 WILLINGBORO MUA WMUA 7

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
19.0	8.0	SAND, brown; GRAVEL	QRNR
8.0	-13.0	SILT, sandy, gray-black	-
-13.0	-28.0	SAND, gray, fine to medium-grained	MRPAU
-28.0	-43.0	CLAY, gray and white	-
-43.0	-47.0	CLAY, sandy, white	-
-47.0	-52.0	SAND, white	-
-52.0	-62.0	CLAY	-
-62.0	-67.0	CLAY, red and white; SAND	MRPAM
-67.0	-72.0	CLAY, sandy, brown.	"
-72.0	-77.0	SAND, brown, fine-grained; GRAVEL	"
-77.0	-82.0	CLAY, white; SAND; GRAVEL	"
-82.0	-92.0	SAND, brown, fine-grained	"
-92.0	-97.0	SAND, brown, fine to coarse-grained; GRAVEL	"
-97.0	-104.0	SAND, clayey, fine-grained	"
-104.0	-105.0	GRAVEL	"
-107.0	-111.0	CLAY, gray	"
-111.0	-123.0	SAND, brown, fine to coarse-grained	"
-123.0	-124.0	CLAY	"
-124.0	-133.0	SAND, brown, fine to coarse-grained	"
-133.0	-134.0	GRAVEL	"
-134.0	-145.0	CLAY, red and gray	"
-145.0	-157.0	SAND, white, fine-grained	"
-157.0	-162.0	SAND, brown, fine to medium-grained	"
-162.0	-168.0	SAND, white, fine to coarse-grained	"
-168.0	-173.0	CLAY, sandy, white	"
-173.0	-188.0	SAND, white, fine-grained	"
-188.0	-198.0	SAND, gray, fine-grained; CLAY	"
-198.0	-205.0	SAND, gray, fine to coarse-grained	"
-205.0	-208.0	CLAY, gray	"
-208.0	-214.0	SAND, gray, fine to coarse-grained	"
-214.0	-215.0	CLAY	"
-215.0	-221.0	SAND, gray, fine to coarse-grained	"
-221.0	-226.0	SAND, brown and white, fine to coarse-grained	"
-226.0	-237.0	SAND, gray, fine to coarse-grained; "grits".	MRPAM
-237.0	-241.0	CLAY, gray	-
-241.0	-287.0	CLAY, red	-
-287.0		BEDROCK	WSCK

05-667 39.0 WILLINGBORO MUA WMUA 5

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
39.0	36.0	"Air"	-
36.0	34.0	"Fill", "Dirt"	-
34.0	5.0	SAND, gray, fine-grained	MRPAU
5.0	-2.0	CLAY, gray	"
-2.0	-10.0	SAND, gray, fine-grained	MRPAU
-10.0	-48.0	CLAY, light gray	-
-48.0	-59.0	SAND, gray, fine-grained	MRPAM
-59.0	-62.0	CLAY, red	"
-62.0	-120.0	SAND, gray, fine-grained	"
-120.0	-148.0	CLAY, red	"
-148.0	-154.0	SAND, gray, fine- to coarse-grained	"

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier	
Log of 05-667 -- continued				
-154.0	-157.0	SAND		"
-157.0	-180.0	CLAY, light gray		"
-180.0	-183.0	SAND, silty, gray, fine-grained		"
-183.0	-193.0	CLAY, gray		"
-193.0	-217.0	SAND, gray, fine-grained		MRPAM
-217.0	-229.0	CLAY, sandy, gray		-
-229.0		BEDROCK, weathered		WSCK
05-668	**43.0**	**WILLINGBORO MUA**	**WMUA DCB 28**	
Altitude (ft) Top	Bottom	Lithologic description		Aquifer
43.0	37.0	"Loam", sandy, fine-grained		-
37.0	33.0	SAND, brown, fine-grained		-
33.0	23.0	SAND, fine to medium-grained		-
23.0	16.0	SAND, brown, fine-grained		MRPAU
16.0	13.0	CLAY, brown and white		"
13.0	7.0	SAND, gray; CLAY streaks		"
7.0	3.0	SAND, gray, coarse-grained		'
3.0	-15.0	CLAY, red and gray		"
-15.0	-17.0	CLAY, gray		MRPAU
-17.0	-32.0	SAND, gray, fine-grained		-
-32.0	-44.0	CLAY, gray		-
-44.0	-47.0	SAND, brown, fine to medium-grained		MRPAM
-47.0	-66.0	CLAY, sandy, gray		"
-66.0	-71.0	SAND, coarse-grained; GRAVEL; "grits"		"
-71.0	-73.0	CLAY, yellow and white		"
-73.0	-105.0	CLAY, gray, fine-grained		"
-105.0	-110.0	CLAY, red and white		"
-110.0	-120.0	SAND, brown, fine-grained		"
-120.0	-125.0	SAND, white; CLAY		"
-125.0	-150.0	SAND, gray; CLAY		"
-150.0	-157.0	SAND, white, medium-grained		"
-157.0	-167.0	SAND, white, medium-grained; GRAVEL		"
-167.0	-174.0	SAND, medium to coarse-grained; GRAVEL; "grits", CLAY streaks		"
-174.0	-179.0	SAND, coarse-grained; CLAY streaks		"
-179.0	-199.0	CLAY, white		"
-199.0	-205.0	SAND, gray, medium-grained; CLAY streaks; GRAVEL		"
-205.0	-210.0	SAND, brown, medium-grained; GRAVEL; CLAY streaks, white		MRPAM
-210.0	-215.0	CLAY, red and white		-
-215.0		BEDROCK"		WSCK
05-761	**18.0**	**TENNECO CHEMICAL CO**	**TENNECO 9**	
Altitude (ft) Top	Bottom	Lithologic description		Aquifer
18.0	-27.0	SAND		MRPAM
-27.0	-32.0	CLAY w/ SAND or SILT		"
-32.0	-47.0	CLAY		"
-47.0	-77.0	SAND		"
-77.0	-80.0	CLAY		"
-80.0	-84.0	SAND		"
-84.0	-86.0	CLAY		"
-86.0	-89.0	SAND		"
-89.0	-92.0	CLAY, end of log		MRPAM
05-790	**5.0**	**TENNECO CHEMICAL CO**	**NO 5-1961**	
Altitude (ft) Top	Bottom	Lithologic description		Aquifer
5.0	-7.0	SAND		MRPAM
-7.0	-27.0	SAND, brown, dirty		"
-27.0	-33.0	GRAVEL, white		"
-33.0	-37.0	GRAVEL, yellow		"
-37.0	-54.0	SAND, fine-grained; GRAVEL, white		"
-54.0	-83.0	CLAY, white		"
-83.0	-98.0	SAND, dirty; CLAY		"
-98.0	-121.0	SAND, dirty		"
-121.0	-127.0	SAND, coarse-grained		"
-127.0	-133.0	CLAY		"

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier	

Log of 05-790 -- continued

Top	Bottom	Lithologic description	Aquifer
-133.0	-138.0	SAND; GRAVEL	MRPAM
-138.0	-147.0	CLAY	WSCK
-147.0	-168.0	CLAY; SAND	"
-168.0		BEDROCK	

05-804 10.0 TAYLOR, JOSEPH 1

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	5.0	"Topsoil", black	-
5.0	0.0	SAND, brown	MRPAM
0.0	-6.0	SAND, orange	"
-6.0	-20.0	SAND, orange; "Stones"	"
-20.0	-44.0	"Stones", orange; CLAY	MRPAM
-44.0	-65.0	CLAY, green and white	-
-65.0		SAND, white; "Ironstone"	-

05-811 23.6 HOEGANAES IRON L5

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
23.6	19.6	SAND, brown-green, fine to coarse-grained	MRPAM
19.6	15.6	CLAY, sandy, brown; GRAVEL	"
15.6	-0.4	SAND, brown-green, medium to coarse-grained	"
-0.4	-3.4	CLAY, dark brown and black; SAND, dark gray, coarse-grained	"
-3.4		SAND, brown, coarse-grained	MRPAM

07-008 75.0 BELLMAWR BORO WD BBWD 4

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
75.0	72.0	SAND	-
72.0	64.0	SAND, brown	EGLS
64.0	56.0	SAND; "Ironstone"	"
56.0	52.0	SAND; "Stones"	"
52.0	48.0	SAND; CLAY chips	"
48.0	33.0	SAND, fine-grained	EGLS
33.0	13.0	CLAY, black	-
13.0	-7.0	CLAY, micaceous, black	-
-7.0	-36.0	CLAY, gray	-
-36.0	-48.0	CLAY, gray, fine-grained; SAND	-
-48.0	-106.0	CLAY, sandy, gray	-
-106.0	-124.0	SAND, coarse-grained	MRPAU
-124.0	-129.0	CLAY	"
-129.0	-158.0	SAND; CLAY streaks	"
-158.0	-186.0	SAND, coarse-grained; GRAVEL	"
-186.0	-194.0	SAND, GRAVEL; "Stones"	MRPAU
-194.0	-200.0	CLAY, red and gray	-
-200.0	-242.0	CLAY, red, black, gray, white	-
-242.0	-247.0	CLAY, white, hard	-
-247.0	-252.0	CLAY, black	MRPAM
-252.0	-258.0	SAND, coarse-grained; GRAVEL	"
-258.0	-283.0	CLAY, red, black, white	"
-283.0	-287.0	CLAY, gray	"
-287.0	-293.0	CLAY; SAND layers	"
-293.0	-295.0	CLAY	"
-295.0	-297.0	SAND, coarse-grained; GRAVEL	"
-297.0	-298.0	CLAY, gray	"
-298.0	-305.0	SAND; "Stones"; CLAY chips	"
-305.0	-308.0	SAND; CLAY balls	"
-308.0	-319.0	SAND, fine to coarse-grained	"
-319.0	-324.0	CLAY, black	"
-324.0	-325.0	SAND, fine to coarse-grained	MRPAM
-325.0	-332.0	SAND; CLAY balls	-
-332.0	-338.0	CLAY, gray; SAND streaks	-
-338.0	-343.0	SAND; "Ironstone"	-
-343.0	-375.0	CLAY, red and gray	-
-375.0	-380.0	SAND, fine-grained; "Hardpan"	MRPAL
-380.0	-400.0	CLAY; SAND	"
-400.0	-411.0	SAND; GRAVEL	"

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of 07-008 -- continued

Top	Bottom	Lithologic description	Aquifer
-411.0	-443.0	CLAY, red and white	"
-443.0	-485.0	SAND; CLAY chips	MRPAL
-485.0	-500.0	CLAY	WSCK
-500.0		BEDROCK	

07-037 12.0 NEW YORK SHIPBUILDING 3

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
12.0	-13.0	SAND, fine-grained	MRPAU
-13.0	-20.0	SAND, coarse-grained	"
-20.0	-26.0	SAND, coarse-grained; GRAVEL	"
-26.0	-34.0	GRAVEL, white	"
-34.0	-41.0	GRAVEL, red	"
-41.0	-44.0	SAND	MRPAU
-44.0	-51.0	CLAY, red	-
-51.0	-54.0	SAND; GRAVEL	MRPAM
-54.0	-70.0	SAND, fine-grained	"
-70.0	-72.0	SAND, coarse-grained	"
-72.0	-73.0	CLAY, white	"
-73.0	-80.0	SAND, white	"
-80.0	-86.0	SAND, coarse-grained; CLAY streaks	"
-86.0	-93.0	SAND, coarse-grained	"
-93.0	-95.0	CLAY, white	"
-95.0	-107.0	SAND, coarse; GRAVEL	MRPAM
-107.0	-136.0	CLAY, red	-
-136.0	-141.0	SAND, fine-grained; CLAY	MRPAL
-141.0	-159.0	SAND, fine-grained	"
-159.0	-166.0	CLAY, red	"
-166.0	-174.0	CLAY, brown and gray	"
-174.0	-181.0	SAND, white, coarse-grained; GRAVEL	"
-181.0	-186.0	GRAVEL, coarse-grained; SAND	"
-186.0	-189.0	SAND, white, coarse-grained	"
-189.0	-191.0	GRAVEL, coarse-grained; SAND, white	"
-191.0	-208.0	SAND, white, coarse-grained; GRAVEL	"
-208.0	-215.0	"Hardpan"; SAND; CLAY	MRPAL
-215.0		BEDROCK	WSCK

07-047 9.0 CAMDEN SEWAGE AUTHORITY SEWAGE PLANT 1

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
9.0	-10.0	"Fill"	-
-10.0	-20.0	SAND, coarse-grained	MRPAU
-20.0	-36.0	CLAY; GRAVEL	"
-36.0	-54.0	SAND; CLAY	"
-54.0	-80.0	SAND, coarse-grained; GRAVEL	MRPAU
-80.0	-85.0	CLAY, sandy	-
-85.0	-95.0	CLAY	-
-95.0	-119.0	CLAY, red	-
-119.0	-133.0	SAND	-
-133.0	-151.0	CLAY, tough; SAND streaks	-
-151.0	-176.0	SAND; GRAVEL; CLAY streaks	MRPAL
-176.0	-188.0	SAND; BOULDERS	MRPAL
-188.0	-192.0	CLAY	WSCK
-192.0		BEDROCK	

07-060 6.0 CAMDEN CITY WD CITY 8A

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
6.0	0.0	"Cinders"	-
0.0	-55.0	SAND; BOULDERS	MRPAU
-55.0	-63.0	CLAY	-
-63.0	-71.0	SAND	MRPAM
-71.0	-82.0	SAND; CLAY	MRPAM
-82.0	-104.0	CLAY, red	-
-104.0	-121.0	SAND, loose	MRPAL
-121.0	-130.0	SAND, muddy	"

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier	
Log of 07-060 -- continued				
-130.0	-177.0	SAND; GRAVEL		MRPAL
-177.0		CLAY, sandy		-
07-065	**8.0**	**CAMDEN CITY WD**	**CITY 2B**	
Altitude (ft) Top	Bottom	Lithologic description		Aquifer
8.0	6.0	"Fill"		-
6.0	2.0	CLAY		-
2.0	-5.0	SAND; GRAVEL		MRPAU
-5.0	-11.0	GRAVEL, hard		"
-11.0	-17.0	SAND; GRAVEL		"
-17.0	-34.0	CLAY, sandy		"
-34.0	-44.0	SAND; GRAVEL		"
-44.0	-68.0	SAND; GRAVEL; CLAY streaks		MRPAU
-68.0	-100.0	CLAY, gray, tough		-
-100.0	-128.0	SAND, coarse-grained; GRAVEL		-
-128.0	-141.0	CLAY, tough		-
-141.0	-149.0	SAND; GRAVEL		MRPAL
-149.0	-152.0	CLAY		"
-152.0	-161.0	SAND; BOULDERS		MRPAL
-161.0	-182.0	CLAY		WSCK
182.0		BEDROCK		
07-074	**4.0**	**PUBLIC SERVICE ELECTRIC AND GAS**	**PSEGC 8**	
Altitude (ft) Top	Bottom	Lithologic description		Aquifer
4.0	-2.0	"Fill"		-
-2.0	-9.0	"Mud"		-
-9.0	-20.0	SAND; GRAVEL		MRPAU
-20.0	-26.0	CLAY		"
-26.0	-32.0	SAND; GRAVEL		MRPAU
-32.0	-49.0	CLAY		-
-49.0	-54.0	SAND		MRPAM
-54.0	-83.0	CLAY		-
-83.0	-92.0	SAND; GRAVEL		MRPAL
-92.0	-93.0	CLAY		"
-93.0	-136.0	SAND; GRAVEL		MRPAL
-136.0	-139.0	CLAY		WSCK
-139.0		BEDROCK		
07-163	**39.0**	**NJ/AMERICAN WATER CO**	**COLUMBIA 22**	
Altitude (ft) Top	Bottom	Lithologic description		Aquifer
39.0	36.0	"Air"		-
36.0	27.0	CLAY, sandy, brown		-
27.0	-41.0	MARL, dark gray		-
-41.0	-64.0	CLAY, dark gray, hard		-
-64.0	-96.0	SAND, gray, fine-grained		MRPAU
-96.0	-101.0	CLAY, dark gray		"
-101.0	-135.0	SAND, multi-color, fine to medium-grained		MRPAU
-135.0	-148.0	CLAY, red		-
-148.0	-157.0	SAND, multi-color, fine to medium-grained		-
-157.0	-176.0	CLAY, red		-
-176.0	-181.0	SAND lamina		MRPAM
-181.0	-218.0	SAND, multi-color, fine to medium-grained		"
-218.0	-230.0	CLAY, red		"
-230.0	-232.0	SAND lamina		"
-232.0	-238.0	CLAY, red		"
-238.0	-261.0	SAND lamina		"
-261.0	-263.0	CLAY, red		"
-263.0	-271.0	SAND lamina		MRPAM
-271.0	-295.0	CLAY, red		-
-295.0	-298.0	SAND lamina		-
-298.0	-305.0	CLAY		-
-305.0	-307.0	SAND, fine to medium-grained		-
-307.0	-331.0	CLAY, red		-
-331.0	-358.0	SAND, multi-color, fine to medium-grained		MRPAL

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier	

Log of 07-163 -- continued

Top	Bottom	Lithologic description	Aquifer
-358.0	-360.0	CLAY, red	"
-360.0	-419.0	SAND, fine to medium-grained	"
-419.0	-431.0	CLAY lamina	MRPAL
-431.0		BEDROCK	WSCK

07-194 8.0 G & W NATURAL RESOURCES 4-DEEP

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
8.0	4.0	SAND, coarse-grained; GRAVEL	MRPAU
4.0	-3.0	CLAY, silty, black	"
-3.0	-46.0	CLAY, gray; grass roots	"
-46.0	-95.0	SAND, coarse-grained; CLAY, streaks, white	"
-95.0	-102.0	GRAVEL	MRPAU
-102.0	-105.0	CLAY, white, tough	-
-105.0	-116.0	CLAY, sandy, streaks, white; SAND, coarse-grained; GRAVEL	-
-116.0	-147.0	SAND, fine-grained; CLAY streaks, white	MRPAM
-147.0	-162.0	SAND, medium to coarse-grained; GRAVEL	MRPAM
-162.0	-172.0	CLAY, white, tough	-
-172.0	-187.0	CLAY, red, tough	-
-187.0	-206.0	CLAY, white, tough	-
-206.0	-230.0	SAND, coarse-grained; CLAY streaks, white	MRPAL
-230.0	-233.0	CLAY, white, tough	"
-233.0	-260.0	SAND, coarse-grained; GRAVEL	
-260.0	-261.0	CLAY, white	"
-261.0	-277.0	SAND, coarse-grained; GRAVEL	MRPAL
-277.0		BEDROCK	WSCK

07-198 8.0 G & W NATURAL RESOURCES 1R-1973

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
8.0	-2.0	"Fill"	-
-2.0	-23.0	SAND; GRAVEL	MRPAU
-23.0	-26.0	CLAY	"
-26.0	-77.0	SAND; CLAY streaks	MRPAU
-77.0	-92.0	CLAY	-
-92.0	-125.0	SAND, gray, coarse-grained; CLAY	MRPAM
-125.0	-181.0	CLAY, red	-
-181.0	-203.0	CLAY, sandy	MRPAL
-203.0	-247.0	SAND, coarse-grained; GRAVEL, fine-grained	MRPAL
-247.0	-257.0	CLAY, white	WSCK
-257.0		BEDROCK	

07-202 8.0 AMSPEC CHEMICAL HARSHAW 3

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
8.0	-4.0	"Fill"; "Mud"	-
-4.0	-15.0	GRAVEL	MRPAU
-15.0	-20.0	SAND, coarse-grained	"
-20.0	-77.0	SAND; fine-grained; CLAY	"
-77.0	-84.0	GRAVEL, coarse-grained	MRPAU
-84.0	-112.0	SAND; CLAY streaks	MRPAM
-112.0	-134.0	SAND; GRAVEL	"
-134.0	-158.0	SAND, coarse-grained	MRPAM
-158.0	-163.0	CLAY, white, tough	"
-163.0	-184.0	CLAY; SAND	"
-184.0	-187.0	CLAY	"
-187.0	-190.0	CLAY, soft	"
-190.0	-207.0	SAND; coarse-grained	MRPAL
-207.0	-223.0	SAND, hard	"
-223.0	-228.0	SAND, streaks	"
-228.0	-260.0	SAND, coarse-grained	MRPAL
-260.0		CLAY, hard, Mica	WSCK

Table 6. –Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier
07-205	**7.0**	**HINDE AND DAUCH**	**3**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
7.0	-1.0	"Fill"; "ashes"	-
-1.0	-5.0	SAND; GRAVEL	-
-5.0	-19.0	CLAY	-
-19.0	-37.0	CLAY, sandy	-
-37.0	-55.0	SAND, fine-grained	-
-55.0	-65.0	CLAY, sandy	-
-65.0	-77.0	CLAY	-
-77.0	-97.0	CLAY, sandy	-
-97.0	-141.0	SAND; GRAVEL	-
-141.0	-155.0	CLAY, white	-
-155.0	-164.0	SAND; GRAVEL	-
-164.0	-196.0	CLAY	-
-196.0	-251.0	SAND; GRAVEL	MRPAL
-251.0	-258.0	CLAY	WSCK
-258.0		BEDROCK	

Well number	Land-surface elevation	Owner	Well identifier
07-221	**11.1**	**US GEOLOGICAL SURVEY**	**COAST GUARD 1**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
11.1	6.1	CLAY; sandy, dark brown, fine-grained; PEBBLES	-
6.1	4.1	"Slag" fragments	-
4.1	2.1	SAND, brown, medium to fine-grained; slag fragments	MRPAU
2.1	-4.9	SAND, yellow-brown, medium-grained; quartz PEBBLES, rounded	"
-4.9	-13.9	SAND, white-tan, medium to coarse-grained	"
-13.9	-18.9	SAND, white-tan, medium to coarse-grained, subrounded; PEBBLES, 1/2-inch, quartz	"
-18.9	-22.9	SAND, very coarse-grained; quartz PEBBLES, rounded; CHERT, gray; CLAY matrix	"
-22.9	-23.9	SAND, medium to coarse-grained; quartz PEBBLES, rounded	"
-23.9	-29.9	GRAVEL; CLAY	"
-29.9	-31.9	SAND, very coarse-grained; quartz PEBBLES	"
-31.9	-33.9	SAND; COBBLES; CLAY matrix	"
-33.9	-43.9	GRAVEL, quartz, rounded; silty matrix; SAND, medium to coarse-grained	"
-43.9	-44.9	GRAVEL, quartz, rounded; silty matrix; SAND, medium to coarse-grained; COBBLES	"
-44.9	-67.9	SAND, coarse-grained, sub-rounded quartz PEBBLES, rounded	"
-67.9	-68.9	SAND, coarse-grained; limonite cement	"
-68.9	-69.9	SAND, white, coarse-grained, rounded; quartz COBBLES	"
-69.9	-76.9	SAND, medium to coarse-grained; quartz PEBBLES, rounded	"
-76.9	-78.9	SAND, yellow, coarse-grained; GRAVEL; limonite cement	"
-78.9	-79.9	SAND, yellowish, coarse to medium grained; quartz PEBBLES, rounded	"
-79.9	-80.9	CLAY, silty, white and brown; quartz PEBBLES, rounded	MRPAU
-80.9	-88.9	CLAY, silty, red; quartz PEBBLES, rounded	-
-88.9	-93.9	CLAY, sandy, white	-
-93.9	-103.9	CLAY, reddish	-
-103.9	-110.9	SAND, clayey, pink, fine to medium-grained; quartz PEBBLES	MRPAM
-110.9	-112.9	SAND, reddish, medium-grained; CLAY	"
-112.9	-115.9	SAND, pink, very coarse-grained; CLAY	"
-115.9	-120.9	SAND, very coarse-grained, sub-angular	MRPAM
-120.9	-121.9	CLAY, sandy, gray, coarse-grained	-
-121.9	-125.9	CLAY, silty, red and white, mottled	-
-125.9	-138.9	CLAY, red and white, mottled	-
-138.9	-152.9	SAND, medium-grained	MRPAL
-152.9	-156.9	SAND, clayey, white, medium to coarse-grained	"
-156.9	-158.9	SAND, white, coarse-grained	"
-158.9	-160.9	SAND, white, coarse-grained; CLAY	"
-160.9	-170.9	SILT, clayey, white	"
-170.9	-173.9	SAND, clayey, white, fine-grained	"
-173.9	-176.9	SAND, white, very fine- to coarse-grained; CLAY	"
-176.9	-181.9	SAND, white, fine-grained; CLAY, white; quartz PEBBLES	"
-181.9	-182.9	SAND, white, fine-grained; CLAY, white; shell fragments	"
-182.9	-183.9	SAND, medium-grained; CLAY, white	"
-183.9	-186.9	CLAY, silty, light gray	"
-186.9	-191.9	SAND, clayey, gray, medium-grained	"
-191.9	-199.9	SAND, clayey, gray	"
-199.9	-203.9	SAND, gray-pink, medium-grained; CLAY	"
-203.9	-207.9	SAND, coarse-grained; quartz PEBBLES	"
-207.9	-222.9	SAND, coarse-grained; quartz PEBBLES, pink, yellow, and white; CLAY, white	"
-222.9	-223.9	GRAVEL, sandy, coarse-grained	"

Table 6. –Logs of selected wells and test boreholes in the vicinity of the Delaware River–continued.

Well number	Land-surface elevation	Owner	Well identifier	

Log of 07-221 – continued

Top	Bottom	Lithologic description	Aquifer
-223.9	-228.9	SAND, multi-color, very coarse-grained; quartzite PEBBLES, rounded	"
-228.9	-235.9	SAND, very coarse-grained; quartzite PEBBLES; CLAY	MRPAL
-235.9	-240.9	SAND, very coarse-grained; muscovite	WSCK
-240.9		BEDROCK	"

07-332 65.0 MERCHANTVILLE PENNSAUKEN WCM MARION 2

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
65.0	61.0	"Fill"	-
61.0	57.0	CLAY, sandy, brown and yellow	-
57.0	14.0	CLAY, greenish gray	-
14.0	-20.0	SAND, coarse to medium-grained; GRAVEL; iron streaks	MRPAU
-20.0	-31.0	CLAY, gray and white; SAND seams, fine-grained	"
-31.0	-53.0	SAND, light brown, coarse to medium-grained	MRPAU
-53.0	-74.0	CLAY, sandy, white and gray; SAND seams, fine-grained; GRAVEL	-
-74.0	-95.0	GRAVEL, fine to medium grained; SAND	MRPAM
-95.0	-98.0	CLAY, gray and white	"
-98.0	-115.0	GRAVEL, fine to medium grained; SAND	MRPAM
-115.0	-155.0	CLAY, sandy, gray and white, fine-grained; GRAVEL streaks	-
-155.0	-165.0	SAND, fine to medium-grained; GRAVEL	-
-165.0	-175.0	CLAY, white and red	-
-175.0		GRAVEL, fine to medium-grained; SAND	MRPAL

07-334 60.0 MERCHANTVILLE PENNSAUKEN WCM MARION T 1

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
60.0	57.0	"Topsoil"	-
57.0	50.0	CLAY, sandy, brown, yellow and white	-
50.0	27.0	SAND, yellow, coarse-grained; GRAVEL	MRPAU
27.0	-28.0	CLAY, sandy, white; GRAVEL	"
-28.0	-60.0	SAND, brown, coarse-grained; CLAY streaks, white	MRPAU
-60.0	-70.0	CLAY, white and blue, soft	-
-70.0	-97.0	SAND, coarse-grained; GRAVEL; CLAY streaks, white	MRPAM
-97.0	-101.0	CLAY, sandy, white	"
-101.0	-153.0	SAND, brown, coarse-grained; CLAY streaks, white	MRPAM
-153.0	-162.0	CLAY, tough	-
-162.0	-172.0	SAND, coarse-grained; GRAVEL	MRPAL
-172.0	-188.0	CLAY, tough	"
-188.0	-208.0	SAND, brown, coarse-grained; GRAVEL; BOULDERS	MRPAL
-208.0	-223.0	CLAY, white	-
-223.0		BEDROCK	WSCK

07-341 39.0 MERCHANTVILLE PENNSAUKEN WCM DELA GARDEN 2

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
39.0	11.0	SAND, medium-grained; gray	MRPAM
11.0	-11.0	SAND; GRAVEL; BOULDERS	"
-11.0	-33.0	SAND; GRAVEL; CLAY streaks	"
-33.0	-75.0	SAND; GRAVEL; BOULDERS; CLAY streaks	MRPAM
-75.0	-77.0	CLAY	-
-77.0	-111.0	SAND; GRAVEL	MRPAL
-111.0		BEDROCK	WSCK

07-354 11.6 GENERAL FOODS PETTY IS OBS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
11.6	5.6	"Top" SAND and soil	-
5.6	2.6	SAND, dark gray	MRPAL
2.6	-2.4	SAND, gray	"
-2.4	-7.4	SAND, black, mucky	"
-7.4	-10.4	SAND, dark gray	"
-10.4	-18.4	SAND, gray; some PEBBLES	"
-18.4	-20.4	SAND, gray, coarse	"
-20.4	-38.4	SAND, GRAY; w/ mucky CLAY mixed at intervals	"
-38.4	-48.4	SAND, gray, coarse	"

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier	

Log of 07-354 -- continued

Top	Bottom	Lithologic description	Aquifer
-48.4	-53.4	SAND, gray, coarse; and PEBBLES	"
-53.4	-58.4	SAND, gray, very coarse	"
-58.4	-60.4	"Hard pan", coarse packed, gravelly, (water tight)	"
-60.4	-70.4	"Hard pan", with streaks of close packed CLAY, (water tight)	"
70.4	-77.4	"Muck", Blue	"
-77.4	-83.4	CLAY and SAND	"
-83.4	-86.4	SAND, gray	"
-86.4	-88.4	SAND, fine	"
-88.4	-97.4	SAND, coarse	"
-97.4	-103.4	SAND and GRAVEL	"
-103.4	-112.4	GRAVEL, coarse	"
-112.4	-115.4	SAND, coarse; some fine SAND	MRPAL
-115.4	-131.4	CLAY, yellow and blue	-
-131.4		Baltimore GNEISS, "basal rock"	WSCK

07-363 14.0 CAMDEN CITY WD PUCHACK 2

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
14.0	-4.0	SAND, coarse-grained	MRPAU
-4.0	-19.0	CLAY, red	-
-19.0	-48.0	SAND, brown	MRPAM
-48.0	-66.0	CLAY	-
-66.0	-73.0	SAND, brown, coarse-grained	MRPAL
-73.0	-86.0	CLAY	"
-86.0	-113.0	SAND, coarse-grained	"
-113.0	-116.0	"Hardpan"	"
-116.0	-144.0	SAND; GRAVEL	"
-144.0	-151.0	GRAVEL, sandy; BOULDERS	MRPAL
-151.0		"Rock"	WSCK

07-539 10.0 CAMDEN CITY WD TW-6-79

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	5.0	CLAY, sandy, black	-
5.0	0.0	SAND, fine to medium-grained; streaks, soft; GRAVEL, fine-grained	MRPAM
0.0	-5.0	SAND, white, fine to medium-grained; GRAVEL; CLAY streaks, brown	"
-5.0	-11.0	SAND, white, fine to medium-grained; GRAVEL	"
-11.0	-16.0	"Hard streaks"; GRAVEL	"
-16.0	-21.0	SAND; GRAVEL; "rubber"; CLAY	MRPAM
-21.0	-31.0	CLAY, white and yellow	-
-31.0	-41.0	CLAY, sandy, white; SAND and GRAVEL streaks	-
-41.0	-51.0	SAND, white, medium-grained; CLAY streaks, white	-
-51.0	-62.0	CLAY, white; SAND streaks	-
-62.0	-67.0	CLAY, sandy	-
-67.0	-71.0	CLAY, white	-
-71.0	-77.0	CLAY, white; SAND streaks	-
-77.0	-92.0	CLAY, white; SAND and GRAVEL streaks	MRPAL
-92.0	-113.0	SAND, fine to medium-grained; GRAVEL; CLAY streaks, white	"
-113.0	-123.0	SAND, fine to coarse-grained; GRAVEL; CLAY streaks, white	"
-123.0	-134.0	GRAVEL, coarse-grained; CLAY streaks, white	"
-134.0	-139.0	GRAVEL, coarse-grained; CLAY streaks	MRPAL
-139.0	-144.0	CLAY, white	WSCK
-144.0	-154.0	CLAY, white and yellow	"
-154.0		BEDROCK	"

07-687 -53.1 DELAWARE RIVER PORT AUTHORITY B.ROSS E-1B

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
-53.1	-55.1	SAND, brown, medium-grained	MRPAL
-55.1	-64.1	SAND, Fine, and GRAVEL, tan, silty	"
-64.1	-67.1	SAND, white, silty; CLAY lenses	"
-67.1	-73.1	SAND, brown, medium; trace SILT	"
-73.1	-83.1	SAND, brown and gray, course to fine, SILTY	"
-83.1	-92.1	SAND, white, medium to fine, CLAY and GRAVEL seams	"
-92.1	-112.1	SAND, Coarse, and GRAVEL, gray, Silty	MRPAL
-112.1	-126.6	MICA GNEISS, weathered	WSCK

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier
Log of 07-687 -- continued			
-126.6	-136.6	MICA GNEISS, weathered to intact	"

07-693 8.8 DELAWARE RIVER PORT AUTHORITY WHITMAN #12

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
8.8	7.3	Concrete	-
7.3	-5.2	"Fill","Cinders and rocks", black; loose	-
-5.2	-10.2	SILT, "river"; wood, light gray; moist, loose	-
-10.2	-21.2	SILT, "river"; some SAND, gray; wet, loose	-
-21.2	-30.2	SAND, gray, fine; wet, loose	MRPAU
-30.2	-41.2	SAND, gray; GRAVEL, fine, brown; moist	"
-41.2	-43.2	GRAVEL, fine; SILT, gray; loose, wet	"
-43.2	-50.2	SAND, silty; GRAVEL, yellow; loose, wet	"
-50.2	-51.2	SAND, coarse; GRAVEL; wet, loose	"
-51.2	-61.2	SAND, white, fine; some GRAVEL; moist, compact	"
-61.2	-62.2	SAND, gray, fine; some SAND and SILT, brown; moist, compact	"
-62.2	-71.2	SAND and GRAVEL, brown; wet, loose	"
-71.2	-73.2	SAND, fine, and GRAVEL, gray; moist, compact	MRPAU
-73.2	-80.2	SILT and SAND, black; moist, compact	-
-80.2	-91.2	SAND, gray, fine; moist, compact	MRPAM
-91.2	-100.2	SAND, fine, gray; CLAY, white; moist, compact	"
-100.2	-109.2	SAND, gray, fine; moist, compact	"
-109.2	-132.2	SAND, coarse; GRAVEL, fine; wet, loose	"
-132.2	-141.2	SAND, gray, fine; moist, compact	MRPAM
-141.2	-149.2	CLAY, white; some SAND; moist, compact	-
-149.2	-151.2	CLAY, white; GRAVEL, fine	-
-151.2	-170.2	CLAY, red and white; moist, compact	-
-170.2	-179.2	CLAY, brown and gray	-
-179.2	-182.2	SAND, fine; CLAY, moist, compact	MRPAL
-182.2	-188.2	SAND, white, fine; moist, compact	"
-188.2	-194.2	SAND, fine; GRAVEL; trace of CLAY; moist, compact	"
-194.2	-208.2	CLAY, gray; some SAND, GRAVEL; moist, compact	"
-208.2	-217.2	SAND, fine; GRAVEL; trace of CLAY; moist, compact	"
-217.2	-227.2	CLAY, red; SAND; GRAVEL; trace of Mica; moist, compact	MRPAL
-227.2	-249.2	MICA SCHIST, decomposed, gray, soft; moist	WSCK
-249.2	-254.2	MICA SCHIST, hard, end of log	"

101-007 -15.0 US GEOLOGICAL SURVEY HORSESHOE-D

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
-15.0	-35.0	SAND, olive gray, very coarse to fine, subangular; muscovite and biotite (1%); GRAVEL (4 mm), trace of CLAY; wood chips	MRPAU
-35.0	-40.0	SILT; GRAVEL (5 mm), subrounded; CLAY, olive gray; wood chips	"
-40.0	-45.0	GRAVEL (5 mm), olive gray; SAND, very coarse, angular; some CLAY; wood chips; biotite and muscovite	"
-45.0	-50.0	CLAY, dark olive-gray, silty; wood chips; Mica	"
-50.0	-55.0	GRAVEL (5 mm), olive-gray, subangular; CLAY, silty; wood chips, chunks of coal; Mica	"
-55.0	-60.0	SAND, olive-gray, fine to very fine rounded	"
-60.0	-63.0	SAND, olive-gray, very coarse, silty; abundant wood chips, organics	"
-63.0	-65.0	CLAY, olive-gray, silty; w/ some GRAVEL	"
-65.0	-70.0	GRAVEL, (3 mm), olive-gray, w/ some CLAY	"
-70.0	-75.0	CLAY, brownish-black; w/ some SAND, coarse	"
-75.0	-80.0	CLAY, olive-green w/ GRAVEL (5 mm) and SAND, coarse; Mica	"
-80.0	-85.0	CLAY, red w/ GRAVEL (5 mm); Mica	"
-85.0	-95.0	CLAY, white w/ GRAVEL (2.5 mm); Mica; minor CLAY, red	"
-95.0	-97.0	SAND, gray, fine to very fine, rounded	"
-97.0	-100.0	GRAVEL (2 mm), light gray; SAND, very coarse-medium; CLAY, white	"
-100.0	-105.0	GRAVEL (3 mm), brick red; SAND, very coarse; CLAY, red and white	MRPAU
-105.0	-108.0	CLAY, red; GRAVEL and coarse SAND	-
-108.0	-110.0	CLAY, white; GRAVEL and coarse SAND	-
-110.0	-113.0	CLAY, white; traces of SAND, coarse and GRAVEL (2 mm)	-
-113.0	-115.0	SAND, light gray, fine-medium, subrounded	-
-115.0	-120.0	CLAY, red; SAND, coarse, GRAVEL (2 mm)	-
-120.0	-125.0	SAND, light gray, medium-coarse, subangular; CLAY, red and white	MRPAM
-125.0	-130.0	SAND, dark gray, medium-coarse, subangular; some CLAY, gray; Mica	"
-130.0	-135.0	SAND, dark gray, medium-coarse, subangular; some CLAY, white; Mica	"
-135.0	-137.0	SAND, light gray, medium-coarse, subrounded, well sorted	"
-137.0	-155.0	SAND, gray, medium-coarse, subrounded; CLAY, red and white; Mica; coal fragments	"

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier	
Log of 101-007 -- continued				
-155.0	-165.0	GRAVEL (3 mm), light gray; SAND, very coarse-coarse, subangular; traces of CLAY, red; Mica		MRPAM
-165.0	-175.0	CLAY, red; GRAVEL (2 mm), traces of CLAY, white		-
-175.0	-185.0	CLAY, white to gray; w/ some SAND, coarse to very coarse		-
-185.0	-195.0	SAND, light gray, medium-coarse; w/some CLAY, red and white		MRPAL
-195.0	-197.0	SAND, light gray, fine-medium, rounded		"
-197.0	-205.0	no sample		
-205.0	-215.0	SAND, light gray, medium-very coarse, subrounded; biotite and muscovite		"
-215.0	-245.0	SAND, light gray, coarse-very coarse, increase in Mica content		MRPAL
-245.0	-253.0	Mica, more biotite than muscovite; SAND		WSCK
-253.0		BEDROCK, hard drilling, end of log		"

15-067 5.0 GREENWICH TWP WD — TEST WELL 1-58

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
5.0	2.0	"Air"	-
2.0	-45.0	CLAY, sandy, brown	-
-45.0	-86.0	SAND, fine to coarse-grained	MRPAM
-86.0	-87.0	CLAY, dark gray	"
-87.0	-106.0	SAND, gray, fine-grained; GRAVEL	"
-106.0	-123.0	SAND, fine to coarse-grained	"
-123.0	-127.0	CLAY, red	"
-127.0	-130.0	SAND, gray, fine-grained	"
-130.0	-164.0	SAND, fine and medium-grained	"
-164.0	-168.0	SAND; CLAY, lamina	MRPAM
-168.0	-194.0	CLAY, red	-
-194.0	-244.0	SAND, fine to coarse-grained; CLAY, gray, laminated	MRPAL
-244.0	-257.0	CLAY, sandy, gray	MRPAL
-257.0		CLAY, very tough; bedrock	WSCK

15-074 15.0 HERCULES CHEMICAL — GIBBSTOWN OB 1

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
15.0	14.0	"Topsoil"	-
14.0	12.0	CLAY, sandy, brown	-
12.0	-6.0	SAND, coarse-grained; GRAVEL	MRPAM
-6.0	-11.0	CLAY, sandy, mixed	"
-11.0	-28.0	SAND, brown and white, coarse-grained	"
-28.0	-46.0	SAND, white, coarse-grained	"
-46.0	-72.0	CLAY; GRAVEL, mixed	"
-72.0	-106.0	SAND, brown, coarse-grained	"
-106.0	-108.0	CLAY, sandy, yellow	"
-108.0		CLAY, red	MRPAM

15-100 3.0 E I DUPONT — REPAUNO OB 6

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
3.0	1.0	SAND, (based on geophysical log)	-
1.0	-3.0	CLAY, sandy	-
-3.0	-13.0	SAND	MRPAM
-13.0	-27.0	CLAY	"
-27.0	-41.0	SAND	MRPAM
-41.0	-55.0	CLAY	-
-55.0	-59.0	SAND	-
-59.0	-63.0	CLAY	-
-63.0	-87.0	SAND	MRPAL
-87.0	-92.0	CLAY, sandy	"
-92.0	-94.0	SAND, end of log	MRPAL

15-221 10.0 ESSEX CHEMICAL CO — PAULSBORO 1

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	7.0	"Fill"; "Dirt"	-
7.0	6.0	SAND, yellow, coarse-grained	MRPAU

Table 6. –Logs of selected wells and test boreholes in the vicinity of the Delaware River–continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of 15-221 -- continued

Top	Bottom	Lithologic description	Aquifer
6.0	2.0	SAND, black-pepper	"
2.0	-22.0	SAND, white, coarse-grained	"
-22.0	-27.0	CLAY, white; "Stones"	"
-27.0	-38.0	SAND, white, fine-grained; GRAVEL	"
-38.0	-47.0	CLAY, gray, tough	"
-47.0	-69.0	SAND; "Stones"	MRPAU
-69.0	-80.0	CLAY, gray	-
-80.0	-86.0	CLAY, red and white	-
-86.0	-107.0	SAND, fine-grained; GRAVEL	MRPAM
-107.0	-122.0	CLAY, red	"
-122.0	-136.0	SAND; GRAVEL	MRPAM
-136.0	-155.0	CLAY, red and gray	-
-155.0	-164.0	SAND; GRAVEL, coarse-grained	MRPAL
-164.0	-184.0	SAND, coarse-grained	"
-184.0	-211.0	SAND, white, fine to medium-grained; GRAVEL	"
-211.0	-238.0	CLAY, white, brown, red, gray	"
-238.0	-242.0	SAND, medium to coarse-grained	"
-242.0	-244.0	CLAY, white and gray	"
-244.0	-263.0	GRAVEL, coarse-grained; "Stones"; CLAY, white and black	"
-263.0	-273.0	GRAVEL, medium to coarse-grained	"
-273.0		"Stones", GRAVEL; CLAY, white	MRPAL

15-312 20.0 WEST DEPTFORD TWP WD 6 RED BANK AVE

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
20.0	-27.0	CLAY	-
-27.0	-65.0	CLAY, silty, hard	-
-65.0	-123.0	SAND; GRAVEL; "Stones"	MRPAU
-123.0	-126.0	CLAY; "Stones"	"
-126.0	-146.0	SAND	MRPAU
-146.0	-166.0	CLAY; "Hardpan"	-
-166.0	-254.0	CLAY, red, hard	MRPAM
-254.0	-294.0	SAND, hard packed	-
-294.0	-349.0	SAND	MRPAL
-349.0		CLAY	"

15-313 23.0 WEST DEPTFORD TWP WD WDTWD 2

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
23.0	20.0	"Air"	-
20.0	8.0	CLAY, brown	-
8.0	-8.0	CLAY, gray	-
-8.0	-19.0	SAND, gray	MRPAU
-19.0	-25.0	CLAY, gray	"
-25.0	-38.0	SAND, fine to coarse-grained	"
-38.0	-59.0	CLAY, gray	"
-59.0	-99.0	SAND, fine to medium-grained	"
-99.0	-102.0	CLAY, gray	"
-102.0	-111.0	SAND, gray, fine to coarse-grained	"
-111.0	-116.0	"Hardpan"	"
-116.0	-143.0	SAND, medium to coarse-grained; GRAVEL	MRPAU
-143.0	-150.0	CLAY, gray	-
-150.0	-177.0	SAND, gray, medium to coarse-grained; GRAVEL	MRPAM
-177.0	-186.0	CLAY, red	"
-186.0	-198.0	SAND, fine to medium-grained	"
-198.0	-215.0	CLAY, red	"
-215.0	-232.0	SAND, coarse-grained; GRAVEL	MRPAM
-232.0	-244.0	CLAY, red	-
-244.0	-282.0	CLAY; SAND	-
-282.0	-297.0	SAND, fine to medium-grained	MRPAL
-297.0	-302.0	SAND, fine to coarse-grained	"
-302.0	-308.0	SAND, fine-grained; GRAVEL, coarse-grained	"
-308.0	-315.0	CLAY, gray	"
-315.0	-325.0	SAND, coarse-grained; GRAVEL	"
-325.0	-333.0	SAND, coarse-grained; CLAY	MRPAL
-333.0		BEDROCK	WSCK

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier
15-323	**21.0**	**TEXAS OIL CO**	**EAGLE PT OBS 3**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
21.0	0.0	"Mud", river	-
0.0	-22.0	CLAY, sandy	-
-22.0	-45.0	SAND, CLAY streaks	MRPAU
-45.0	-91.0	SAND, coarse-grained; GRAVEL; CLAY streaks	MRPAU
-91.0	-111.0	CLAY, red	-
-111.0	-164.0	SAND, coarse-grained	MRPAM
-164.0	-205.0	CLAY, tough	-
-205.0	-224.0	SAND; CLAY streaks	-
-224.0	-266.0	SAND, coarse-grained	MRPAL
-266.0	-272.0	CLAY, blue; SAND; GRAVEL	MRPAL
-272.0		BEDROCK	WSCK

Well number	Land-surface elevation	Owner	Well identifier
15-333	**20.0**	**WOODBURY WD**	**TATUM 4**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
20.0	16.0	"Topsoil"; CLAY, brown	-
16.0	8.0	CLAY, yellow; "Stones", brown	-
8.0	-85.0	CLAY, blue, heavy	-
-85.0	-90.0	SAND, dirty; GRAVEL; CLAY	-
-90.0	-95.0	SAND, dirty gray, fine-grained	MRPAU
-95.0	-98.0	SAND, coarse-grained; GRAVEL, fine-grained	"
-98.0	-105.0	SAND, GRAVEL, coarse-grained	"
-105.0	-113.0	SAND, fine-grained	"
-113.0	-124.0	SAND, fine-grained; GRAVEL, coarse-grained	"
-124.0	-128.0	CLAY, blue, hard	"
-128.0	-130.0	SAND; GRAVEL, coarse-grained	"
-130.0	-134.0	SAND, white, fine to medium-grained	"
-134.0	-140.0	SAND, medium to coarse-grained	"
-140.0	-151.0	SAND, fine-grained	MRPAU
-151.0		CLAY	-

Well number	Land-surface elevation	Owner	Well identifier
15-412	**5.0**	**E I DUPONT**	**TEST 4 1965**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
5.0	-5.0	CLAY, black	-
-5.0	-14.0	SAND; GRAVEL	-
-14.0	-27.0	CLAY, sandy, brown	-
-27.0	-33.0	SAND; GRAVEL	MRPAL
-33.0	-35.0	"Hardpan"	"
-35.0	-63.0	SAND; GRAVEL; CLAY; "Stones"	"
-63.0	-77.0	"Hardpan"	MRPAL
-77.0		BEDROCK	WSCK

Well number	Land-surface elevation	Owner	Well identifier
15-439	**10.0**	**ESSEX CHEMICAL CO**	**ESSEX 2**

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	-15.0	SAND, fine-grained; CLAY brown	MRPAU
-15.0	-76.0	SAND, medium to coarse-grained; GRAVEL; CLAY streaks, red, white	MRPAU
-76.0	-106.0	CLAY, gray; SAND streaks	-
-106.0	-135.0	CLAY, red, white	-
-135.0	-145.0	SAND, coarse-grained	MRPAM
-145.0	-154.0	CLAY	-
-154.0	-178.0	SAND, coarse-grained; GRAVEL; CLAY streaks, red, white	MRPAL
-178.0	-230.0	SAND, coarse-grained; GRAVEL	"
-230.0		SAND; GRAVEL; CLAY streaks, white "Mica rock"	"

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier
15-496	**45.0**	**NELSON, ROBERT**	**1**
15-511	**10.0**	**FEHLAUER, ALBERT**	**2**
15-512	**10.0**	**FEHLAUER, ALBERT**	**3**
15-533	**22.0**	**NATIONAL PARK WD**	**NPWD 6**

15-496 45.0 NELSON, ROBERT 1

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
45.0	7.0	SAND, yellow, coarse-grained	QRNR
7.0	-10.0	CLAY, sandy, black	-
-10.0	-40.0	"Mud", graphite, black	-
-40.0	-73.0	CLAY, sandy, green	MCVL
-73.0	-78.0	CLAY, gray, hard	-
-78.0	-85.0	SAND, gray, fine to coarse-grained	MRPAU
-85.0	-90.0	CLAY, gray	"
-90.0		SAND, gray, fine to coarse-grained	MRPAU

15-511 10.0 FEHLAUER, ALBERT 2

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	4.0	CLAY, sandy, yellow	-
4.0	-2.0	SAND, gray, fine-grained; CLAY	-
-2.0	-8.0	SAND, yellow, fine to coarse-grained	MRPAU
-8.0	-18.0	CLAY, brown	"
-18.0		SAND, yellowish, coarse-grained; "Stones"	MRPAU

15-512 10.0 FEHLAUER, ALBERT 3

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	6.0	"Fill"	-
6.0	2.0	CLAY, gray	-
2.0	0.0	SAND, yellow, fine to coarse-grained	-
0.0	-13.0	CLAY, sandy, gray; "Stones"	-
-13.0	-19.0	SAND, gray, fine to coarse-grained; "Stones"	MRPAU
-19.0	-34.0	SAND, yellow, fine to coarse-grained; "Stones"	"
-34.0		SAND, gray, coarse-grained; "Stones"	MRPAU

15-533 22.0 NATIONAL PARK WD NPWD 6

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
22.0	18.0	SAND	QRNR
18.0	7.0	SAND, brown; GRAVEL	QRNR
7.0	-7.0	CLAY, yellow, SAND, brown	MRPAU
-7.0	-33.0	CLAY, white; GRAVEL; white	"
-33.0	-34.0	CLAY, white	"
-34.0	-38.0	SAND, coarse-grained; GRAVEL	"
-38.0	-57.0	"Stones", coarse-grained; GRAVEL	"
-57.0	-61.0	GRAVEL, brown, coarse-grained	"
-61.0	-68.0	"Stones", coarse-grained	"
-68.0	-85.0	CLAY, white; GRAVEL	MRPAU
-85.0	-88.0	CLAY, gray; LIGNITE	-
-88.0	-99.0	CLAY, white; LIGNITE; GRAVEL	-
-99.0	-101.0	CLAY, yellow	-
-101.0	-112.0	SAND, white and brown	MRPAM
-112.0	-117.0	CLAY, white; GRAVEL	"
-117.0	-121.0	CLAY, white	"
-121.0	-130.0	SAND, white; CLAY	"
-130.0	-131.0	GRAVEL, brown and white	MRPAM
-131.0	-134.0	CLAY, white	-
-134.0	-146.0	CLAY, red and white	-
-146.0	-160.0	CLAY, gray	-
-160.0	-170.0	LIGNITE; CLAY, gray; SAND	-
-170.0	-171.0	CLAY, light gray	-
-171.0	-185.0	SAND, gray, coarse-grained	MRPAL
-185.0	-198.0	CLAY, gray and red	"
-198.0	-213.0	CLAY, red	"
-213.0	-218.0	SAND, fine-grained	"
-218.0	-237.0	SAND, coarse-grained	"
-237.0	-238.0	CLAY, white	"
-238.0	-250.0	SAND, coarse-grained	MRPAL

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of 15-533 -- continued

Top	Bottom	Lithologic description	Aquifer
-250.0		CLAY, white and red	-

15-772 11.4 US GEOLOGICAL SURVEY #3-OW-AL

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
11.4	5.4	SOIL and Clayey SILT	MRPAU
5.4	-5.6	SAND	"
-5.6	-35.6	GRAVEL	"
-35.6	-39.6	SILT with SAND	"
-39.6	-51.6	GRAVEL; SAND and SILT	MRPAU
-51.6	-61.6	CLAY; SILT	-
-61.6	-68.6	CLAY	-
-68.6	-92.6	GRAVEL	MRPAM
-92.6	-94.6	SILT	"
-94.6	-100.6	GRAVEL; with SAND	"
-100.6	-105.6	Clayey SILT	"
-105.6	-113.6	GRAVEL and SAND	MRPAM
-113.6	-126.6	CLAY	-
-126.6	-168.6	CLAY	-
-168.6	-183.6	CLAY	-
-183.6	-204.6	GRAVEL; SAND	MRPAL
-204.6	-213.6	GRAVEL; SAND; SILT	MRPAL
-213.6	-218.6	MICA SCHIST	WSCK

15-770 10.5 US GEOLOGICAL SURVEY #1-PW-L

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.5	9.5	SAND	MRPAU
9.5	-1.5	SILT, clayey	"
-1.5	-14.5	SAND and GRAVEL	"
-14.5	-16.5	SILT, clayey; SAND AND GRAVEL	"
-16.5	-19.5	SAND and GRAVEL	"
-19.5	-29.5	SAND	"
-29.5	-44.5	GRAVEL	"
-44.5	-51.5	SAND, Very fine, SILT, and CLAY	MRPAU
-51.5	-57.5	CLAY; SILT and GRAVEL	-
-57.5	-60.5	GRAVEL, SAND, and CLAY	MRPAM
-60.5	-79.5	CLAY; SAND and GRAVEL lenses	"
-79.5	-99.5	GRAVEL	"
-99.5	-115.5	GRAVEL	MRPAM
-115.5	-122.5	CLAY	-
-122.5	-129.5	CLAY	-
-129.5	-184.5	CLAY	-
-184.5	-190.5	SILT	-
-190.5	-192.5	SILT	-
-192.5	-198.5	GRAVEL	MRPAL
-198.5	-200.5	SILT	"
-200.5	-206.5	GRAVEL	"
-206.5	-209.5	SILT	"
-209.5	-212.5	GRAVEL	MRPAL
-212.5	-220.5	SAPROLITE	WSCK
-220.5	-232.5	MICA SCHIST	"

45-001 -17.0 US GEOLOGICAL SURVEY MIFFLIN BAR

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
-17.0	-30.0	CLAY, olive green, silty, contains 1% quartz PEBBLES, subrounded	-
-30.0	-62.0	CLAY, olive green, silty and sandy (fine), contains 1% muscovite	-
-62.0	-72.0	CLAY, olive green, silty and sandy (fine-medium), contains 1% muscovite	-
-72.0	-87.0	CLAY, olive green, silty and sandy (fine-medium), contains 1% PEBBLES, 2.5 cm	-
-87.0	-102.0	SAND, gray, very coarse, contains muscovite (1%), subrounded to subangular; GRAVEL, quartz, feldspar, lithic fragments (red shale); PEBBLES (5 mm)	MRPAM
-102.0	-117.0	Same as above: except increase in CLAY - red and white	MRPAM
-117.0	-122.0	CLAY, white; w/GRAVEL (as above)	-
-122.0	-132.0	SAND, light gray, very coarse to fine, subrounded; GRAVEL (3 mm); muscovite and CLAY (30%)	MRPAL
-132.0	-142.0	SAND, light gray, very coarse; muscovite; GRAVEL (5 mm); CLAY, white and red	"

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of 45-001 -- continued

-142.0	-152.0	SAND, pinkish gray, very coarse, subrounded; GRAVEL (8 mm); CLAY, white	"
-152.0	-157.0	Same as above, less CLAY	"
-157.0	-172.0	SAND, pinkish gray, very coarse, subangular, GRAVEL (5 mm): quartz, feldspar, lithic fragments; Fe-cemented granules; and CLAY, white	"
-172.0	-187.0	Same as above, except increase in CLAY	"
-187.0	-202.0	GRAVEL (5 mm), pinkish gray w/ muscovite, feldspar, quartz; Fe-cemented granules, subangular SAND, coarse	"
-202.0	-227.0	GRAVEL and CLAY, GRAVEL getting coarser	"
-227.0	-237.0	GRAVEL as above	"
-237.0	-242.0	GRAVEL as above, except increase in muscovite (40%)	"
-242.0	-248.0	GRAVEL as above w/ muscovite (50%)	MRPAL
-248.0		BEDROCK - no sample, hard drilling, end of log	WSCK

51-9002 13.0

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
13.0	8.0	SAND, tannish-brown, coarse-grained	MRPAM
8.0	-2.0	SAND, dark gray, medium-grained	"
-2.0	-17.0	SAND, gray, fine-grained	"
-17.0	-29.0	SAND, brown, medium-grained	"
-29.0	-32.0	SAND, tannish-brown, coarse-grained; GRAVEL	MRPAM
-32.0		BEDROCK	WSCK

B-95 0.0 PENNSYLVANIA RAILROAD CO.

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
-3.0	-9.0	CLAY; SAND	-
-9.0	-12.0	"Mud"	-
-12.0	-22.0	SAND; GRAVEL	MRPAL
-22.0	-25.0	CLAY	"
-25.0	-51.0	SAND	"
-51.0	-54.0	CLAY	"
-54.0	-61.0	SAND	"
-61.0	-77.0	GRAVEL	"
-77.0	-87.0	GRAVEL, coarse-grained	MRPAL
-87.0		BEDROCK	WSCK

B-103 0.0 TACONY BRIDGE

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	-59.0	"Mud", Sandy	-
-59.0	-62.0	GRAVEL	MRPAL
-62.0	-75.0	GNEISS	WSCK

B-124 0.0 US ARMY ENGINEERS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	-30.0	SILT; SAND	-
-30.0	-34.0	SAND; GRAVEL	MRPAM
-34.0	-	BEDROCK	WSCK

B-125 0.0 US ARMY ENGINEERS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	-30.0	"Mud", river	-
-30.0	-32.0	SAND; GRAVEL	MRPAM
-32.0		BEDROCK	WSCK

Table 6. –Logs of selected wells and test boreholes in the vicinity of the Delaware River–continued.

Well number	Land-surface elevation	Owner	Well identifier

B-126 0.0 US ARMY ENGINEERS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	-25.0	"Mud", river	-
-25.0	-33.0	SAND; GRAVEL	MRPAM
-33.0		BEDROCK	WSCK

B-127 0.0 US ARMY ENGINEERS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	-25.0	"Mud", river	-
-25.0	-36.0	SAND; GRAVEL	MRPAM
-36.0		BEDROCK	WSCK

B-128 0.0 US ARMY ENGINEERS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	-25.0	"Mud", river	-
-25.0	-35.0	SAND; GRAVEL	MRPAM
-35.0		BEDROCK	WSCK

B-129 0.0 US ARMY ENGINEERS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	-25.0	"Mud", river	-
-25.0	-35.0	SAND; GRAVEL	MRPAM
-35.0		BEDROCK	WSCK

B-130 0.0 US ARMY ENGINEERS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	-20.0	"Mud", river	-
-20.0	-29.0	SAND	MRPAM
-29.0		BEDROCK	WSCK

B-131 0.0 US ARMY ENGINEERS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
0.0	-13.0	"River".	
-13.0	-32.0	SAND and GRAVEL	MRPAM
-32.0	-50.0	CLAY, brown, red, white; SAND, fine	MRPAM

B-415 4.0

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
4.0	-9.0	SAND; GRAVEL	-
-9.0	-15.0	CLAY	-
-15.0	-18.0	GRAVEL	-
-18.0	-21.0	CLAY	-
-21.0	-34.0	SAND; GRAVEL	MRPAM
-34.0	-42.0	CLAY	-
-42.0	-74.0	SAND	MRPAL
-74.0	-90.0	CLAY	"
-90.0	-92.0	CLAY; GRAVEL	"
-92.0	-113.0	SAND; GRAVEL	"
-113.0	-115.0	CLAY	"
-115.0	-126.0	SAND; GRAVEL	"
-126.0	-127.0	CLAY	"
-127.0	-136.0	SAND; GRAVEL	MRPAL

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of B-415 -- continued

Top	Bottom	Lithologic description	Aquifer
-136.0		BEDROCK	WSCK

Bk-520 15.0 MCKEE ESTATE

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
15.0	10.0	"Loam"	-
10.0	-16.0	GRAVEL	MRPAM
-16.0		BEDROCK	WSCK

Bk-534 20.0 BRISTOL BORO WD

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
20.0	-26.0	SAND, brown, coarse; GRAVEL; and CLAY	MRPAM
-26.0	-37.0	SAND, white, very fine; CLAY	MRPAM
-37.0	-44.0	CLAY, white	-
-44.0		BEDROCK	WSCK

De-025 14.0 WESTINGHOUSE ELECTRIC WELL #5

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
14.0	3.0	SAND, brown; GRAVEL; CLAY	MRPAM
3.0	-17.0	SILT	-
-17.0	-32.0	SAND, brown; GRAVEL	MRPAL
-32.0		BEDROCK	WSCK

Ph-019 8.7 US NAVY

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
8.7	3.7	"Fill", Sandy	MRPAU
3.7	-69.3	"Mud".	MRPAU
-69.3	-75.3	CLAY red	-
-75.3	-80.3	CLAY, white	-
-80.3	-94.3	CLAY, red	-
-94.3	-106.3	SAND, fine	MRPAM
-106.3	-109.3	CLAY, sandy	"
-109.3	-119.3	SAND	MRPAM
-119.3	-123.3	CLAY, red and white	-
-123.3	-163.3	CLAY, red	-
-163.3	-173.3	CLAY, red and white	-
-173.3	-180.3	CLAY, gray, hard	-
-180.3	-191.3	SAND, hard	MRPAL
-191.3	-201.3	GRAVEL	"
-201.3	-207.3	SAND, white; CLAY, gravelly	"
-207.3	-216.3	GRAVEL	"
-216.3	-220.3	SAND and GRAVEL	"
-220.3	-222.3	SAND, white	"
-222.3	-236.3	SAND and GRAVEL	"
-236.3	-243.3	SAND and fine GRAVEL	"
-243.3	-250.3	SAND, micaceous	MRPAL
-250.3	-265.3	MICA SCHIST, soft	WSCK

Ph-020 13.0 US NAVY

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
13.0	1.0	"Fill"	-
1.0	-30.0	"Mud"	MRPAU
-30.0	-43.0	SAND; GRAVEL, fine-grained	"
-43.0	-47.0	CLAY, white	"
-47.0	-51.0	CLAY, red	"
-51.0	-65.0	CLAY, gray	"
-65.0	-72.0	SAND, fine-grained	MRPAU
-72.0	-75.0	GRAVEL	-
-75.0	-97.0	CLAY, red	-

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of Ph-020 -- continued

-97.0	-109.0	CLAY, gray, hard	-
-109.0	-126.0	SAND, fine-grained, hard	MRPAM
-126.0	-130.0	CLAY, gray	-
-130.0	-141.0	CLAY, red	-
-141.0	-161.0	SAND, fine-grained	MRPAL
-161.0	-172.0	SAND; GRAVEL	"
-172.0	-177.0	CLAY, sandy	"
-177.0	-197.0	SAND, hard	"
-197.0	-198.0	CLAY, white	"
-198.0	-214.0	SAND; GRAVEL	"
-214.0	-228.0	GRAVEL	MRPAL
-228.0	-234.0	CLAY, sandy, white	WSCK
-234.0		BEDROCK	

Ph-033 11.0 CONRAIL

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
11.0	6.0	"Cinders"	-
6.0	0.0	GRAVEL; "Mud"	-
0.0	-5.0	CLAY, red	-
-5.0	-12.0	CLAY; GRAVEL	-
-12.0	-17.0	GRAVEL; coarse-grained	MRPAM
-17.0	-21.0	CLAY; GRAVEL	"
-21.0	-24.0	SAND, coarse-grained; GRAVEL	"
-24.0	-30.0	GRAVEL	MRPAM
-30.0	-42.0	CLAY, red, stiff	-
-42.0	-47.0	CLAY, white, stiff	-
-47.0	-60.0	SAND; GRAVEL	MRPAL
-60.0	-61.0	SAND; CLAY	"
-61.0	-71.0	SAND, yellow; GRAVEL	"
-71.0	-77.0	SAND, yellow, coarse-grained	"
-77.0	-85.0	CLAY, white; GRAVEL	MRPAL
-85.0		BEDROCK	WSCK

Ph-035 8.1 GULF OIL CORP

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
8.1	2.1	"Topsoil"; CLAY	-
2.1	-5.9	"Dirt"; CLAY, "Fill"	-
-5.9	-22.9	CLAY, "Fill"	-
-22.9	-47.9	CLAY, blue	-
-47.9	-55.9	CLAY; SAND, brown	-
-55.9	-64.9	SAND, brown; GRAVEL	MRPAL
-64.9	-69.9	SAND, brown, fine-grained	"
-69.9	-74.9	SAND; GRAVEL; PEBBLES	"
-74.9	-75.9	SAND, white, coarse-grained	MRPAL
-75.9		BEDROCK	WSCK

Ph-039 8.1 GULF OIL CORP

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
8.1	-6.9	"Topsoil"	-
-6.9	-22.9	CLAY, blue; "Mud"	-
-22.9	-50.9	CLAY, blue	-
-50.9	-57.9	SAND; purple; GRAVEL	MRPAL
-57.9	-61.9	SAND, white; GRAVEL	MRPAL
-61.9		BEDROCK	WSCK

Ph-050 27.0 ABBOTTS DAIRIES

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
27.0	-36.0	CLAY, buff; SAND; GRAVEL	-

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of Ph-050 -- continued

-36.0	-53.0	GRAVEL, yellow	MRPAM
-53.0	-62.0	CLAY, blue	-
-62.0	-75.0	GRAVEL, white, angular	MRPAL
-75.0	-85.0	Feldspathic fragments	WSCK
-85.0		BEDROCK	

Ph-101 41.0 PA RANGE & BOILER CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
41.0	31.0	"Depth to floor"	-
31.0	11.0	GRAVEL, yellowish	MRPAL
11.0	-14.0	GRAVEL; BOULDERS; SAND; "Mud"	"
-14.0	-15.0	CLAY, white, plastic	"
-15.0	-34.0	GRAVEL, SAND; BOULDERS; water	MRPAL
-34.0		BEDROCK	WSCK

Ph-108 25.0 BROADWAY THEATER

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
25.0	21.0	CLAY, tough	-
21.0	-29.0	SAND; GRAVEL	MRPAM
-29.0	-35.0	SAND, fine-grained	"
-35.0	-37.0	CLAY; SAND	"
-37.0	-42.0	SAND; GRAVEL	"
-42.0	-55.0	SAND, coarse-grained; CLAY	"
-55.0	-59.0	GRAVEL, medium-grained	"
-59.0	-62.0	CLAY	"
-62.0	-67.0	GRAVEL	"
-67.0	-73.0	SAND; GRAVEL	MRPAM
-73.0	-80.0	CLAY	-
-80.0	-86.0	SAND; GRAVEL	MRPAL
-86.0	-102.0	CLAY, sandy	MRPAL
-102.0		BEDROCK	WSCK

Ph-113 38.0 U S NAVAL HOME

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
38.0	31.0	CLAY	-
31.0	18.0	CLAY, river; SAND, hard	-
18.0	8.0	GRAVEL; SAND; CLAY	MRPAL
8.0	-6.0	GRAVEL; CLAY	MRPAL
-6.0	-27.0	CLAY	WSCK
-27.0		BEDROCK	

Ph-141 10.0 LIQUID CARBONIC CORP

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	-22.0	"Fill"; "Mud", river, gray	-
-22.0	-35.0	"Mud", river, gray	-
-35.0	-40.0	SAND, fine-grained; GRAVEL, coarse-grained	MRPAU
-40.0	-63.0	SAND, coarse-grained; GRAVEL	MRPAU
-63.0	-95.0	CLAY, red	-
-95.0	-97.0	SAND, fine-grained; GRAVEL	MRPAM
-97.0	-121.0	CLAY, red	-
-121.0	-175.0	SAND, coarse-grained; GRAVEL	MRPAL
-175.0		CLAY, white, weathered	WSCK

Ph-144 11.0 GENERAL COLD STORAGE

Altitude (ft) TopBottom		Lithologic description	Aquifer
11.0	1.0	"Depth to floor"	-
1.0	-23.0	CLAY	-
-23.0	-58.0	SAND; GRAVEL; BOULDERS	MRPAU

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of Ph-144 -- continued

Top	Bottom	Lithologic description	Aquifer
-58.0	-63.0	CLAY, yellow	-
-63.0	-77.0	CLAY, red; CLAY streaks, white	-
-77.0	-122.0	CLAY, blue, tough; CLAY streaks, white and red	-
-122.0	-133.0	SAND; CLAY	MRPAL
-133.0	-149.0	SAND; GRAVEL, coarse-grained	"
-149.0	-154.0	SAND; CLAY, white	MRPAL
-154.0	-166.0	CLAY, white, soft	WSCK
-166.0	-174.0	SAND, dark, packed	"
-174.0		BEDROCK	

Ph-152 10.0 CONRAIL

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	0.0	"Fill"	-
0.0	-6.0	SAND, coarse-grained	-
-6.0	-51.0	CLAY, blue, soft	-
-51.0	-72.0	SAND, coarse-grained; GRAVEL	MRPAU
-72.0	-132.0	CLAY, red	-
-132.0	-136.0	SAND; GRAVEL	MRPAM
-136.0	-141.0	CLAY, sandy	-
-141.0	-148.0	CLAY, tough	-
-148.0	-156.0	SAND, hard	MRPAL
-156.0	-161.0	SAND streaks	"
-161.0	-187.0	SAND, coarse-grained; GRAVEL	"
-187.0	-194.0	CLAY, tough	"
-194.0	-209.0	SAND; GRAVEL	MRPAL
-209.0	-225.0	CLAY	WSCK
-225.0		BEDROCK	

Ph-206 10.6 WILDSTEIN & CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.6	1.6	"Fill"	-
1.6	-3.4	Wood; CLAY; "Mud"	-
-3.4	-18.4	CLAY, gray; "Mud"	-
-18.4	-24.4	SAND, coarse-grained	MRPAL
-24.4	-49.4	SAND; GRAVEL	MRPAL
-49.4		BEDROCK	WSCK

Ph-240 12.0 MORGENTHALER BROTHERS

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
12.0	-7.0	"Loam"	-
-7.0	-20.0	SAND, dry; GRAVEL	MRPAU
-20.0	-35.0	CLAY, black	-
-35.0	-42.0	GRAVEL	-
-42.0	-47.0	CLAY, yellow	-
-47.0	-51.0	SAND; GRAVEL	-
-51.0	-64.0	CLAY, white	-
-64.0	-77.0	SAND	MRPAM
-77.0	-102.0	CLAY, red	-
-102.0	-108.0	SAND; GRAVEL	MRPAL
-108.0	-113.0	SAND; GRAVEL; CLAY, white	"
-113.0	-135.0	SAND; GRAVEL	"
-135.0	-137.0	CLAY, white	"
-137.0	-143.0	SAND; GRAVEL	MRPAL
-143.0		BEDROCK	WSCK

Ph-249 13.0 CROWN PAPER BOARD CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
13.0	-3.0	"Surface formation"	-
-3.0	-16.0	"Surface formation"; GRAVEL	-
-16.0	-34.0	CLAY, blue	-
-34.0	-46.0	SAND; GRAVEL; gray	MRPAM

Table 6. –Logs of selected wells and test boreholes in the vicinity of the Delaware River–continued.

Well number	Land-surface elevation	Owner	Well identifier

Log of Ph-249 -- continued

Top	Bottom	Lithologic description	Aquifer
-46.0	-74.0	CLAY, red	-
-74.0	-91.0	SAND, water-bearing	MRPAL
-91.0	-95.0	CLAY, white	"
-95.0	-121.0	SAND, white	MRPAL
-121.0	-131.0	CLAY, blue	
-131.0		BEDROCK	WSCK

Ph-275 13.0 PENNSYLVANIA SUGAR CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
13.0	-8.0	"Depth to river bed"	-
-8.0	-25.0	"Mud", meadow	-
-25.0	-50.0	CLAY, blue; SAND	-
-50.0		BEDROCK	WSCK

Ph-321 20.0 F W TUNNELL CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
20.0	15.0	GRAVEL, blue, coarse-grained	-
15.0	12.0	CLAY; GRAVEL	MRPAM
12.0	-1.0	SAND; GRAVEL	"
-1.0	-13.0	SAND, fine-grained; GRAVEL	"
-13.0	-29.0	GRAVEL, coarse-grained	MRPAM
-29.0		BEDROCK	WSCK

Ph-324 11.0 ROHM AND HAAS CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
11.0	6.0	"Topsoil"	-
6.0	-14.0	SAND; GRAVEL	MRPAM
-14.0	-29.0	CLAY, yellow	-
-29.0	-34.0	CLAY, sandy	-
-34.0	-54.0	SAND; GRAVEL	MRPAL
-54.0	-56.0	"Rock", end of log	WSCK

Ph-325 10.0 ROHM AND HAAS CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	-15.0	SAND and GRAVEL	MRPAM
-15.0	-30.0	CLAY, yellow and brown.	-
-30.0	-50.0	SAND, fine, brown; GRAVEL	MRPAL
-50.0	-70.0	"Mica Rock".	WSCK

Ph-345 8.0 QUAKER RUBBER CORP

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
8.0	5.0	Cinder "Fill"	-
5.0	-1.0	CLAY, brown	-
-1.0	-2.0	Wood	-
-2.0	-15.0	SAND, coarse-grained; "Stones"	MRPAM
-15.0	-27.0	CLAY, brown	-
-27.0	-34.0	SAND, coarse-grained; "Stones"	-
-34.0		BEDROCK	WSCK

Ph-372 10.0 PENNSYLVANIA FORGE CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	-10.0	GRAVEL, coarse-grained	MRPAM
-10.0	-25.0	GRAVEL, fine-grained	MRPAM
-25.0		BEDROCK	WSCK

Table 6. --Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier

Ph-389 10.0 GENERAL SMELTING CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	0.0	"Fill".	-
0.0	-6.0	SAND, dirty	MRPAM
-6.0	-12.0	CLAY, sandy	"
-12.0	-21.0	SAND, dirty	"
-21.0	-24.0	SAND, dirty; GRAVEL	"
-24.0	-30.0	SAND; GRAVEL, water	"
-30.0	-34.0	SAND; GRAVEL, coarse-grained	"
-34.0	-45.0	CLAY, sandy; GRAVEL	MRPAM
-45.0		BEDROCK	WSCK

Ph-400 15.0 PHILADELPHIA DEPT OF RECREATION

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
15.0	-33.0	"Earth"; loose rock	MRPAM
-33.0		BEDROCK	WSCK

Ph-447 20.0 REGAL PETROLEUM PRODUCTS CO

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
20.0	0.0	"Fill"	-
0.0		BEDROCK	WSCK

Ph-457 11.0 PUBLICKER INDUSTRIES INC

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
11.0	-2.0	"Fill"	-
-2.0	-14.0	"Mud", river	-
-14.0	-39.0	SAND, dark gray, coarse-grained	MRPAM
-39.0	-49.0	CLAY, red and white	-
-49.0	-79.0	CLAY, red, tough	-
-79.0	-99.0	CLAY, sandy, soft	-
-99.0	-107.0	SAND, fine-grained; CLAY streaks	MRPAL
-107.0	-126.0	SAND, gray, coarse-grained; GRAVEL	MRPAL
-126.0	-130.0	CLAY	WSCK
-130.0		BEDROCK	

Ph-459 11.0 PUBLICKER INDUSTRIES INC

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
11.0	-1.0	"Fill", "Cinders"	-
-1.0	-11.0	"Mud", river	-
-11.0	-31.0	SAND, fine-grained; BOULDERS	MRPAM
-31.0	-53.0	SAND, medium-grained; BOULDERS	MRPAM
-53.0	-97.0	CLAY, red	-
-97.0	-103.0	CLAY, sandy, soft	-
-103.0	-117.0	SAND, medium to coarse-grained; SAND streaks, white, fine-grained	MRPAL
-117.0	-125.0	SAND, gray, coarse-grained; GRAVEL	"
-125.0	-126.0	CLAY	"
-126.0	-141.0	SAND, coarse-grained; GRAVEL	MRPAL
-141.0		BEDROCK	WSCK

Ph-509 20.0 HAJOCA CORP

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
-41.0		BEDROCK	WSCK

Table 6. –Logs of selected wells and test boreholes in the vicinity of the Delaware River--continued.

Well number	Land-surface elevation	Owner	Well identifier
Ph-731	**10.0**	**BLACK, E N**	

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
10.0	-35.0	"Alluvium", blue	MRPAU
-35.0	-36.0	SAND	"
-36.0	-69.0	"Alluvium", blue	"
-69.0	-75.0	GRAVEL	MRPAU
-75.0	-77.0	CLAY, white	-
-77.0	-124.0	SAND, beach	MRPAM
-124.0	-134.0	GRAVEL	MRPAM
-134.0	-137.0	CLAY	-
-137.0	-143.0	GRAVEL, red	MRPAL
-143.0	-160.0	GRAVEL, white; SAND	"
-160.0	-198.0	SAND, beach; GRAVEL	MRPAL
-198.0		BEDROCK	WSCK

Well number	Land-surface elevation	Owner	Well identifier
Ph-822	**5.0**	**CITY OF PHILADELPHIA**	

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
5.0	0.0	"Fill", black, silty, sandy; CLAY	-
0.0	-6.0	CLAY, silty, organic, gray	-
-6.0	-13.0	SAND, gray, fine-grained	MRPAU
-13.0	-16.0	CLAY, red, SILT	"
-16.0	-29.0	GRAVEL, very coarse-grained, multi-color; SAND, coarse-grained; angular to subrounded	"
-29.0	-31.0	CLAY, white, lignitic; SAND, very fine-grained	"
-31.0	-32.0	SAND, white, fine-grained; SILT	MRPAU
-32.0	-36.0	CLAY, white, lignitic.	-
-36.0	-38.0	CLAY, white, laminated	-
-38.0	-85.0	CLAY, red, lignitic; SAND, very fine-grained; CLAY streaks, purple	-
-85.0	-134.0	GRAVEL, coarse-grained	MRPAL
-134.0	-135.0	CLAY, red	"
-135.0	-137.0	SAND, white-gray, medium-grained	MRPAL
-137.0	-143.0	CLAY, gray-white	WSCK
-143.0		BEDROCK	"

Well number	Land-surface elevation	Owner	Well identifier
Ph-824	**5.0**	**CITY OF PHILADELPHIA**	

Altitude (ft) Top	Bottom	Lithologic description	Aquifer
5.0	0.0	SILT, sandy, black; CLAY, "Fill"	-
0.0	-19.0	CLAY, silty, gray	-
-19.0	-26.0	GRAVEL, multi-color, fine to medium-grained; subangular to subrounded	MRPAU
-26.0	-28.0	CLAY	"
-28.0	-37.0	GRAVEL, multi-color, subangular to rounded; SAND	MRPAU
-37.0	-41.0	CLAY, silty, gray, SAND, fine to coarse-grained; GRAVEL	-
-41.0	-54.0	CLAY, sandy, gray; SAND, fine-grained; GRAVEL, fine-grained	-
-54.0	-63.0	SAND, fine-grained; GRAVEL fine-grained, angular to subangular	MRPAM
-63.0	-74.0	SAND, light colored, fine-grained	"
-74.0	-79.0	CLAY, white	"
-79.0	-89.0	SAND, fine to coarse-grained; GRAVEL, fine-grained, subangular to subrounded; CLAY, red and white	MRPAM
-89.0	-110.0	CLAY, red and white; GRAVEL, fine-grained; angular to subangular	-
-110.0	-130.0	CLAY, white and red; rock fragments; GRAVEL fine-grained, subrounded; SAND	MRPAL
-130.0	-140.0	CLAY, white and red; SAND, fine-grained	"
-140.0	-149.0	CLAY, red and white; SAND, medium to coarse-grained; GRAVEL fine to medium-grained, subangular to subrounded	"
-149.0	-153.0	CLAY, white and red; GRAVEL, fine grained, subangular to subrounded	MRPAL
-153.0	-159.0	CLAY, red and white; GRAVEL, fine to medium-grained; SAND, fine-grained	WSCK
-159.0		BEDROCK	

Table 9. -- Simulated withdrawals for the three ground-water withdrawal scenarios

[Mgal/d, million gallons per day]

SCENARIO A

			Withdrawals, by stress period, in Mgal/d						
Layer	Row	Column	10	11	12	13	14	15	16
2	61	77	0.016	0.017	0.017	0.018	0.019	0.020	0.020
2	70	77	.005	.005	.005	.005	.006	.006	.006
2	70	90	.131	.137	.143	.148	.154	.160	.166
2	77	54	.312	.326	.340	.354	.368	.382	.396
			--------	--------	--------	--------	--------	--------	--------
LAYER 2 TOTAL			0.464	0.485	0.506	0.527	0.548	0.569	0.590
3	17	10	0.014	0.014	0.015	0.015	0.016	0.017	0.017
3	18	21	.003	.003	.003	.004	.004	.004	.004
3	18	22	.007	.007	.007	.008	.008	.008	.008
3	19	17	.004	.004	.004	.004	.004	.005	.005
3	19	23	.116	.122	.127	.132	.137	.143	.148
3	19	24	.116	.122	.127	.132	.137	.143	.148
3	20	22	.233	.244	.254	.265	.275	.286	.296
3	20	23	.679	.709	.740	.770	.801	.831	.862
3	21	22	.116	.122	.127	.132	.137	.143	.148
3	21	23	.116	.122	.127	.132	.137	.143	.148
3	21	24	.233	.244	.254	.265	.275	.286	.296
3	22	22	.116	.122	.127	.132	.137	.143	.148
3	22	23	.116	.122	.127	.132	.137	.143	.148
3	23	22	.003	.003	.003	.004	.004	.004	.004
3	23	26	.046	.048	.050	.053	.055	.057	.059
3	33	6	.012	.012	.013	.013	.014	.014	.015
3	35	25	.141	.147	.153	.160	.166	.172	.179
3	36	7	.001	.001	.001	.001	.001	.001	.000
3	38	98	.179	.187	.195	.203	.211	.220	.228
3	40	20	.315	.329	.343	.357	.372	.386	.400
3	40	23	.188	.196	.205	.213	.222	.230	.239
3	41	32	.080	.083	.087	.090	.094	.098	.101
3	41	33	.161	.168	.175	.183	.190	.197	.205
3	41	65	.001	.001	.001	.001	.002	.002	.002
3	43	31	.014	.014	.015	.015	.016	.017	.017
3	43	34	.002	.002	.002	.002	.003	.003	.003
3	43	56	.003	.004	.004	.004	.004	.004	.005
3	43	62	.046	.048	.051	.053	.055	.057	.059
3	44	30	.479	.500	.522	.543	.565	.587	.608
3	44	79	.001	.001	.001	.001	.001	.002	.002
3	45	102	.107	.112	.117	.122	.127	.132	.137
3	47	51	.097	.101	.106	.110	.114	.119	.123
3	48	72	.235	.246	.256	.267	.277	.288	.299
3	49	28	.246	.257	.268	.279	.290	.301	.313
3	51	33	.298	.312	.325	.339	.352	.366	.379
3	52	25	.549	.574	.599	.624	.648	.673	.698
3	52	31	.230	.241	.251	.262	.272	.282	.293
3	52	47	.007	.008	.008	.008	.009	.009	.009
3	52	53	.434	.453	.473	.492	.512	.531	.551
3	53	53	.539	.563	.587	.612	.636	.660	.684
3	53	58	.380	.397	.414	.432	.449	.466	.483
3	54	30	.232	.243	.253	.264	.274	.285	.295
3	54	67	.015	.016	.016	.017	.018	.018	.019
3	56	29	.236	.247	.257	.268	.279	.289	.300
3	56	52	.004	.004	.005	.005	.005	.005	.005
3	56	80	.027	.029	.030	.031	.032	.034	.035
3	57	16	.056	.058	.061	.063	.066	.068	.071
3	57	47	.332	.346	.361	.376	.391	.406	.421
3	57	52	.280	.293	.305	.318	.330	.343	.356
3	58	13	.166	.173	.181	.188	.196	.203	.211

Table 9. -- Simulated withdrawals for the three ground-water withdrawal scenarios -- continued.

SCENARIO A (continued)

Layer	Row	Column	Withdrawals, by stress period, in Mgal/d						
			10	11	12	13	14	15	16
3	58	57	0.006	0.007	0.007	0.007	0.008	0.008	0.008
3	59	47	1.234	1.289	1.345	1.400	1.456	1.511	1.567
3	59	52	.668	.699	.729	.759	.789	.819	.849
3	60	47	1.220	1.275	1.330	1.385	1.439	1.494	1.549
3	60	59	.029	.030	.031	.033	.034	.035	.037
3	63	27	.742	.776	.809	.842	.876	.909	.943
3	64	10	.004	.004	.005	.005	.005	.005	.006
3	64	39	.011	.011	.012	.012	.013	.013	.014
3	64	69	.715	.747	.779	.811	.844	.876	.908
3	65	37	.470	.491	.512	.533	.554	.575	.597
3	66	27	.125	.130	.136	.142	.147	.153	.158
3	66	53	.052	.054	.056	.059	.061	.064	.066
3	66	57	.516	.539	.562	.585	.608	.632	.655
3	67	21	.007	.007	.007	.008	.008	.008	.009
3	67	59	.925	.967	1.008	1.050	1.092	1.133	1.175
3	68	38	.110	.115	.120	.125	.130	.134	.139
3	68	40	.536	.560	.584	.608	.632	.656	.680
3	68	98	.156	.163	.171	.178	.185	.192	.199
3	68	99	.504	.527	.549	.572	.595	.618	.640
3	69	23	.916	.957	.999	1.040	1.081	1.122	1.164
3	70	39	.763	.798	.832	.867	.901	.935	.970
3	70	51	.088	.092	.096	.100	.104	.108	.112
3	70	72	.465	.486	.507	.528	.549	.570	.591
3	71	42	.001	.001	.001	.001	.001	.002	.002
3	71	44	.818	.855	.892	.929	.965	1.002	1.039
3	72	73	.442	.461	.481	.501	.521	.541	.561
3	73	72	.445	.465	.486	.506	.526	.546	.566
3	74	22	.225	.235	.246	.256	.266	.276	.286
3	74	72	.004	.004	.004	.004	.005	.005	.005
3	74	74	.009	.009	.010	.010	.010	.011	.011
3	74	77	.469	.491	.512	.533	.554	.575	.596
3	75	18	1.338	1.398	1.458	1.518	1.579	1.639	1.699
3	75	74	.556	.581	.606	.631	.657	.682	.707
3	76	21	.165	.173	.180	.188	.195	.203	.210
3	76	37	2.970	3.104	3.238	3.371	3.505	3.639	3.772
3	76	49	.333	.348	.363	.378	.393	.408	.423
3	76	76	.371	.388	.405	.421	.438	.455	.471
3	76	102	.056	.059	.061	.064	.066	.069	.071
3	77	18	.669	.699	.729	.760	.790	.820	.850
3	77	49	.635	.664	.692	.721	.750	.778	.807
3	77	83	.380	.397	.414	.431	.449	.466	.483
3	77	84	.067	.070	.073	.076	.079	.082	.085
3	78	47	.230	.240	.251	.261	.271	.282	.292
3	78	69	.276	.288	.301	.313	.326	.338	.351
3	79	77	.734	.767	.800	.833	.866	.899	.932
3	80	55	.648	.677	.706	.736	.765	.794	.823
3	81	17	.022	.023	.024	.025	.026	.027	.028
3	81	53	.363	.379	.395	.412	.428	.444	.461
3	83	16	.563	.588	.613	.639	.664	.689	.715
			--------	--------	--------	--------	--------	--------	--------
LAYER 3 TOTAL			31.113	32.513	33.913	35.313	36.714	38.114	39.514
4	7	3	1.011	1.056	1.102	1.147	1.193	1.238	1.284
4	8	3	.269	.281	.293	.305	.318	.330	.342
4	13	8	.046	.048	.050	.052	.054	.056	.058
4	16	16	.616	.643	.671	.699	.727	.754	.782
4	16	17	.736	.770	.803	.836	.869	.902	.935

Table 9. -- Simulated withdrawals for the three ground-water withdrawal scenarios -- continued.

SCENARIO A (continued)

			Withdrawals, by stress period, in Mgal/d						
Layer	Row	Column	10	11	12	13	14	15	16
4	18	17	0.205	0.214	0.223	0.232	0.242	0.251	0.260
4	18	18	.005	.005	.005	.006	.006	.006	.006
4	19	18	.099	.104	.108	.113	.117	.122	.126
4	20	4	.073	.076	.080	.083	.086	.090	.093
4	22	21	.290	.303	.317	.330	.343	.356	.369
4	22	94	.676	.706	.737	.767	.798	.828	.859
4	23	18	.342	.357	.373	.388	.403	.419	.434
4	23	22	.290	.303	.317	.330	.343	.356	.369
4	25	4	.387	.405	.422	.440	.457	.475	.492
4	25	50	.135	.141	.147	.153	.159	.165	.172
4	25	81	.041	.043	.045	.047	.049	.051	.053
4	26	8	.019	.019	.020	.021	.022	.023	.024
4	26	19	.324	.338	.353	.367	.382	.396	.411
4	26	89	.001	.001	.001	.001	.001	.001	.000
4	27	21	.143	.149	.156	.162	.169	.175	.181
4	28	23	.210	.220	.229	.239	.248	.258	.267
4	28	97	.427	.446	.465	.485	.504	.523	.542
4	29	93	.681	.712	.742	.773	.804	.834	.865
4	30	22	.559	.584	.609	.634	.660	.685	.710
4	30	61	1.122	1.172	1.223	1.273	1.324	1.374	1.425
4	30	83	.297	.310	.323	.337	.350	.364	.377
4	30	84	.005	.006	.006	.006	.007	.007	.007
4	30	98	1.016	1.062	1.108	1.154	1.199	1.245	1.291
4	31	77	.500	.523	.545	.568	.590	.613	.635
4	31	85	.391	.409	.427	.444	.462	.480	.497
4	31	94	1.305	1.364	1.423	1.481	1.540	1.599	1.658
4	31	98	.602	.629	.657	.684	.711	.738	.765
4	32	93	.003	.004	.004	.004	.004	.004	.004
4	32	96	.005	.005	.006	.006	.006	.006	.007
4	34	24	.029	.030	.031	.033	.034	.035	.037
4	34	97	.008	.009	.009	.010	.010	.010	.011
4	35	79	.849	.887	.926	.964	1.002	1.040	1.079
4	35	91	.007	.007	.008	.008	.008	.009	.009
4	35	92	.918	.959	1.000	1.042	1.083	1.124	1.166
4	35	105	.212	.221	.231	.240	.250	.259	.269
4	35	106	.080	.084	.087	.091	.094	.098	.102
4	36	90	.575	.601	.627	.653	.678	.704	.730
4	36	95	.418	.437	.456	.475	.493	.512	.531
4	36	106	.045	.047	.049	.051	.053	.055	.057
4	38	5	.259	.271	.282	.294	.306	.317	.329
4	41	92	.889	.929	.969	1.009	1.049	1.089	1.129
4	41	93	.650	.679	.709	.738	.767	.796	.826
4	42	73	.718	.751	.783	.815	.848	.880	.912
4	44	37	.530	.553	.577	.601	.625	.649	.673
4	44	92	.028	.029	.031	.032	.033	.035	.036
4	45	80	.009	.009	.009	.010	.010	.011	.011
4	45	101	.077	.081	.084	.088	.091	.095	.098
4	46	27	.718	.751	.783	.815	.848	.880	.912
4	46	42	.360	.376	.392	.409	.425	.441	.457
4	46	101	.012	.013	.013	.014	.014	.015	.016
4	46	102	.158	.165	.172	.179	.186	.193	.200
4	47	84	.629	.657	.686	.714	.742	.771	.799
4	48	75	.833	.871	.908	.946	.983	1.021	1.059
4	49	59	.149	.155	.162	.169	.175	.182	.189
4	50	62	.139	.145	.151	.157	.164	.170	.176

Table 9. -- Simulated withdrawals for the three ground-water withdrawal scenarios -- continued.

SCENARIO A (continued)

			Withdrawals, by stress period, in Mgal/d						
Layer	Row	Column	10	11	12	13	14	15	16
4	54	67	0.229	0.240	0.250	0.260	0.271	0.281	0.291
4	56	95	.052	.055	.057	.059	.062	.064	.067
4	57	35	.430	.449	.468	.488	.507	.526	.546
4	59	52	.603	.630	.657	.684	.711	.738	.766
4	61	61	.485	.507	.529	.551	.573	.595	.616
4	62	99	.932	.974	1.016	1.058	1.100	1.142	1.184
4	63	98	.414	.433	.452	.470	.489	.508	.526
4	64	69	3.256	3.402	3.549	3.695	3.842	3.988	4.135
4	65	57	.541	.566	.590	.614	.639	.663	.687
4	65	78	.052	.054	.056	.059	.061	.063	.066
4	68	99	.557	.582	.607	.632	.657	.682	.707
4	77	104	.494	.517	.539	.561	.583	.606	.628
			--------	--------	--------	--------	--------	--------	--------
LAYER 4 TOTAL			3.210	31.570	32.929	34.289	35.648	37.008	38.367
5	17	25	0.088	0.092	0.096	0.100	0.104	0.108	0.112
5	19	70	14.596	15.253	15.909	16.566	17.223	17.880	18.537
5	21	24	.334	.349	.364	.379	.394	.409	.424
5	21	61	.003	.003	.003	.004	.004	.004	.004
5	22	23	.558	.583	.608	.633	.658	.683	.708
5	22	60	.930	.972	1.014	1.056	1.097	1.139	1.181
5	22	61	.519	.543	.566	.589	.613	.636	.660
5	22	62	1.049	1.096	1.144	1.191	1.238	1.285	1.332
5	22	64	.152	.159	.166	.173	.180	.187	.194
5	22	68	6.255	6.537	6.818	7.099	7.381	7.662	7.944
5	23	23	.047	.049	.051	.053	.055	.057	.059
5	23	26	.225	.235	.245	.255	.265	.276	.286
5	23	58	.001	.001	.001	.001	.001	.001	.000
5	24	27	.364	.380	.397	.413	.429	.446	.462
5	24	76	.526	.550	.574	.597	.621	.645	.669
5	25	72	1.383	1.445	1.507	1.570	1.632	1.694	1.756
5	26	83	.629	.657	.686	.714	.742	.770	.799
5	26	86	.084	.088	.091	.095	.099	.103	.107
5	27	76	.037	.038	.040	.042	.043	.045	.047
5	27	85	.001	.001	.001	.001	.001	.001	.001
5	28	55	.001	.001	.001	.001	.001	.001	.001
5	28	97	.774	.809	.844	.879	.914	.949	.984
5	29	35	.317	.331	.346	.360	.374	.389	.403
5	30	28	.360	.376	.392	.408	.424	.441	.457
5	30	83	.806	.842	.878	.914	.951	.987	1.023
5	31	64	1.381	1.443	1.505	1.567	1.629	1.691	1.754
5	31	75	.597	.624	.651	.678	.705	.732	.759
5	31	77	.359	.375	.391	.407	.423	.440	.456
5	32	38	.643	.672	.700	.729	.758	.787	.816
5	32	39	.501	.524	.546	.569	.591	.614	.637
5	32	40	.388	.406	.423	.441	.458	.476	.493
5	32	70	2.173	2.270	2.368	2.466	2.564	2.662	2.759
5	33	38	.601	.628	.655	.683	.710	.737	.764
5	33	39	.455	.476	.496	.517	.537	.558	.578
5	33	40	.561	.586	.611	.637	.662	.687	.712
5	33	66	1.258	1.315	1.372	1.428	1.485	1.542	1.598
5	34	24	.424	.443	.462	.481	.500	.519	.538
5	34	41	.279	.291	.304	.316	.329	.341	.354
5	34	48	1.631	1.704	1.777	1.851	1.924	1.998	2.071
5	34	57	1.343	1.404	1.464	1.525	1.585	1.646	1.706

Table 9. -- Simulated withdrawals for the three ground-water withdrawal scenarios -- continued.

SCENARIO A (continued)

Layer	Row	Column	Withdrawals, by stress period, in Mgal/d						
			10	11	12	13	14	15	16
5	34	58	0.971	1.015	1.058	1.102	1.146	1.189	1.233
5	35	25	.239	.250	.260	.271	.282	.293	.304
5	36	45	.330	.345	.360	.375	.390	.405	.420
5	36	53	.393	.411	.429	.447	.464	.482	.500
5	36	76	.300	.314	.327	.341	.355	.368	.382
5	37	36	.124	.130	.136	.141	.147	.153	.158
5	37	76	.863	.902	.940	.979	1.018	1.057	1.096
5	38	38	.573	.599	.625	.650	.676	.702	.728
5	38	43	.656	.685	.715	.744	.774	.804	.833
5	39	43	.163	.171	.178	.185	.193	.200	.207
5	42	28	.273	.286	.298	.310	.322	.335	.347
5	42	45	.059	.062	.065	.067	.070	.073	.075
5	42	73	1.105	1.155	1.204	1.254	1.304	1.354	1.403
5	44	46	.373	.389	.406	.423	.440	.457	.473
5	44	56	.263	.275	.287	.299	.311	.323	.335
5	44	59	.032	.033	.035	.036	.037	.039	.040
5	44	68	.089	.093	.097	.101	.105	.109	.113
5	45	34	.204	.213	.223	.232	.241	.250	.259
5	45	56	.700	.731	.763	.794	.826	.857	.889
5	45	57	.367	.384	.400	.417	.434	.450	.467
5	45	67	.094	.098	.102	.106	.110	.115	.119
5	46	102	.904	.945	.986	1.026	1.067	1.108	1.148
5	47	51	.220	.230	.240	.250	.260	.270	.280
5	48	46	.899	.940	.980	1.021	1.061	1.101	1.142
5	48	72	.573	.598	.624	.650	.676	.702	.727
5	50	63	.114	.119	.124	.129	.134	.140	.145
5	52	53	.992	1.037	1.082	1.126	1.171	1.216	1.260
5	55	58	1.181	1.234	1.287	1.340	1.393	1.446	1.500
5	57	75	.484	.506	.528	.549	.571	.593	.615
5	59	47	.576	.602	.628	.654	.680	.706	.732
5	59	77	.861	.900	.939	.977	1.016	1.055	1.094
5	60	78	.764	.798	.833	.867	.901	.936	.970
5	61	61	2.853	2.982	3.110	3.238	3.367	3.495	3.624
5	71	56	3.094	3.233	3.372	3.511	3.651	3.790	3.929
5	72	55	1.720	1.798	1.875	1.953	2.030	2.107	2.185
LAYER 5 TOTAL			66.071	69.045	72.018	74.991	77.964	8.938	83.911
SCENARIO A TOTAL			127.861	133.614	139.368	145.122	15.876	156.629	162.383

SCENARIO B

NOTE: Scenario B withdrawals for stress periods 10 through 16 are equal to the withdrawals for Scenario A's stress period 10.

Table 9. -- Simulated withdrawals for the three ground-water withdrawal scenarios -- continued.

SCENARIO C

Layer	Row	Column	Withdrawals, by stress period, in Mgal/d 10	11	12	13	14	15	16
3	18	21	0.002	Stress period 11 - 16 withdrawals are equal to stress period 10 withdrawals.					
3	18	22	.005						
3	19	23	.098						
3	19	24	.098						
3	20	22	.197						
3	20	23	.197						
3	21	22	.098						
3	21	23	.098						
3	21	24	.197						
3	22	23	.098						
3	23	22	.002						
3	33	6	.011						
3	35	25	.278						
3	37	20	.000						
3	38	98	.135						
3	40	20	.250						
3	41	32	.201						
3	41	65	.001						
3	42	14	.011						
3	43	31	.007						
3	43	56	.000						
3	44	30	.291						
3	44	79	.001						
3	45	102	.043						
3	47	51	.178						
3	48	72	.405						
3	49	28	.260						
3	50	63	.257						
3	51	33	.229						
3	52	25	.334						
3	52	31	.169						
3	52	53	.638						
3	53	58	.181						
3	54	30	.155						
3	54	58	.006						
3	56	29	.162						
3	56	52	.027						
3	56	80	.001						
3	56	85	.027						
3	56	106	.000						
3	57	16	.001						
3	57	52	.132						
3	57	101	.027						
3	58	13	.110						
3	58	85	.016						
3	60	59	.025						
3	63	27	.217						
3	64	10	.054						
3	64	39	.077						
3	65	37	.398						
3	66	27	.092						
3	66	53	.063						
3	67	21	.002						
3	67	59	.094						
3	68	38	.095						

Table 9. -- Simulated withdrawals for the three ground-water withdrawal scenarios -- continued.

SCENARIO C (continued)

Layer	Row	Column	Withdrawals, by stress period, in Mgal/d 10	11	12	13	14	15	16
3	68	40	0.399	Stress period 11 - 16 withdrawals are equal to stress period 10 withdrawals.					
3	68	99	.220						
3	69	23	.654						
3	69	95	.025						
3	70	39	.359						
3	70	51	.130						
3	70	72	.332						
3	70	73	.014						
3	71	42	.001						
3	71	44	.677						
3	73	72	.163						
3	74	72	.001						
3	74	74	.004						
3	74	77	.407						
3	75	18	.498						
3	75	74	.373						
3	76	37	1.726						
3	76	49	.292						
3	76	76	.300						
3	76	102	.033						
3	77	18	.619						
3	77	49	.273						
3	77	84	.037						
3	77	104	.210						
3	78	47	.250						
3	78	69	.072						
3	79	77	.629						
3	80	55	.371						
3	81	53	.381						
3	83	16	.346						

LAYER 3 TOTAL			16.588						
4	7	3	0.740						
4	8	3	.241						
4	13	8	.026						
4	16	17	.207						
4	18	17	.252						
4	20	4	.047						
4	22	21	.234						
4	22	94	.189						
4	23	18	.122						
4	23	22	.234						
4	25	4	.366						
4	25	50	.085						
4	25	81	.043						
4	26	8	.012						
4	26	19	.158						
4	26	54	.000						
4	26	89	.021						
4	27	21	.093						
4	27	52	.552						
4	28	23	.081						
4	28	97	.485						
4	29	93	.397						
4	30	22	.474						
4	30	61	.705						
4	30	83	.227						

Table 9. – Simulated withdrawals for the three ground-water withdrawal scenarios – continued.

SCENARIO C (continued)

Layer	Row	Column	Withdrawals, by stress period, in Mgal/d 10	11	12	13	14	15	16
4	30	84	0.013	Stress period 11 - 16 withdrawals are equal to stress period 10 withdrawals.					
4	30	98	.497						
4	31	77	.435						
4	31	85	.250						
4	31	94	.468						
4	31	98	.217						
4	32	93	.006						
4	32	96	.011						
4	34	24	.027						
4	34	95	.011						
4	34	97	.009						
4	35	79	.684						
4	35	91	.007						
4	35	92	.612						
4	35	105	.116						
4	35	106	.040						
4	36	90	.369						
4	36	95	.282						
4	36	105	.018						
4	36	106	.063						
4	38	5	.171						
4	41	92	.590						
4	41	93	.517						
4	44	37	.460						
4	44	92	.027						
4	45	80	.012						
4	45	101	.036						
4	46	27	.255						
4	46	42	.274						
4	46	101	.009						
4	46	102	.337						
4	47	84	.379						
4	48	75	.698						
4	49	59	.174						
4	54	67	.430						
4	56	95	.040						
4	56	99	.000						
4	57	35	.599						
4	59	52	1.345						
4	59	75	.002						
4	62	99	.472						
4	63	75	.002						
4	63	98	.299						
4	64	69	2.696						
4	65	57	1.219						
4	65	78	.001						
4	68	99	.500						
4	77	104	.653						

LAYER 4 TOTAL			22.361						
5	17	25	0.143						
5	19	70	9.653						
5	21	24	.135						
5	21	61	.026						
5	22	23	.209						

Table 9. -- Simulated withdrawals for the three ground-water withdrawal scenarios -- continued.

SCENARIO C (continued)

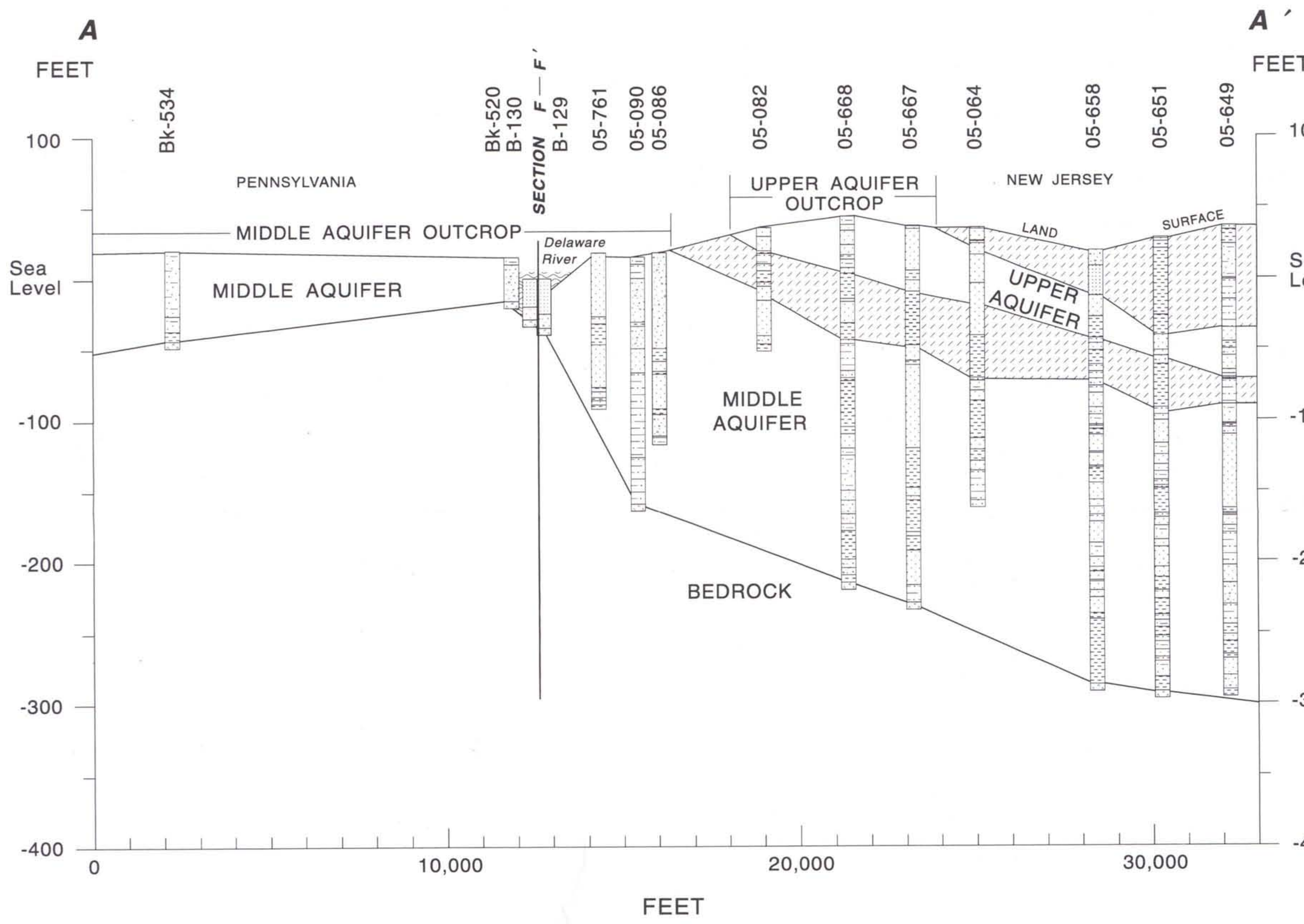
Layer	Row	Column	Withdrawals, by stress period, in Mgal/d 10	11	12	13	14	15	16
5	22	55	0.147	Stress period 11 - 16 withdrawals are equal to stress period 10 withdrawals.					
5	22	60	.576						
5	22	61	.399						
5	22	62	.751						
5	22	64	.126						
5	22	68	2.515						
5	24	27	.462						
5	24	76	.119						
5	25	72	.905						
5	25	77	.022						
5	26	83	.309						
5	26	86	.320						
5	27	56	.401						
5	27	76	.035						
5	27	85	.000						
5	28	55	.000						
5	28	56	1.400						
5	28	97	.637						
5	29	35	.220						
5	30	83	.638						
5	31	64	.775						
5	31	75	.502						
5	32	38	.707						
5	32	39	.184						
5	32	40	.118						
5	32	70	1.446						
5	33	38	.511						
5	33	39	.400						
5	33	40	.037						
5	33	66	.792						
5	34	24	.073						
5	34	41	.172						
5	34	48	1.507						
5	34	57	1.611						
5	35	25	.202						
5	36	45	.214						
5	36	76	.226						
5	37	36	.021						
5	37	76	.464						
5	38	38	.472						
5	38	43	.459						
5	42	28	.152						
5	42	45	.094						
5	42	73	.405						
5	44	46	.236						
5	44	56	.260						
5	44	59	.021						
5	44	68	.217						
5	45	34	.116						
5	45	56	.537						
5	45	57	.158						
5	46	102	.320						
5	48	46	.555						
5	48	72	.405						
5	55	58	.588						

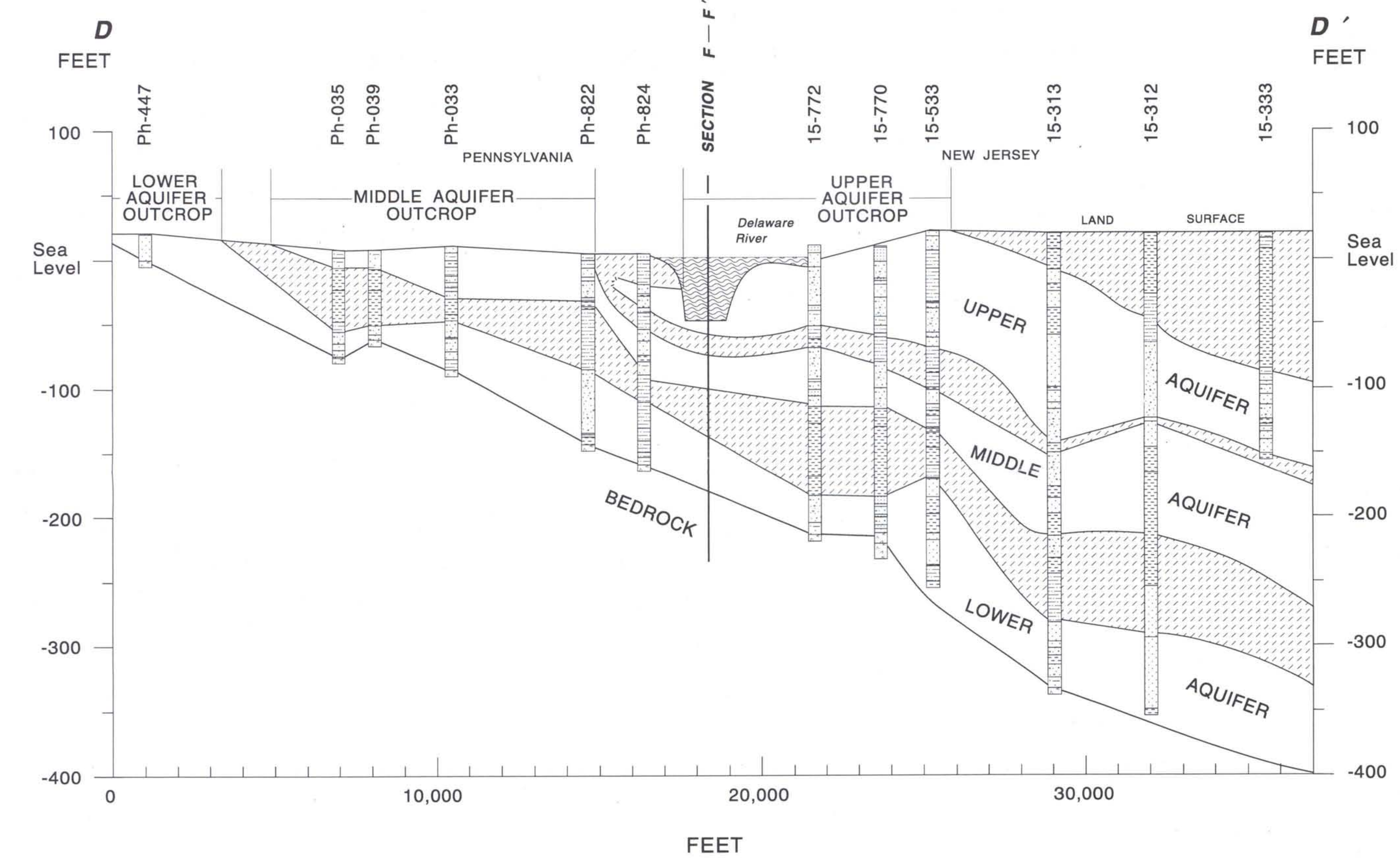
Table 9. -- Simulated withdrawals for the three ground-water withdrawal scenarios -- continued.

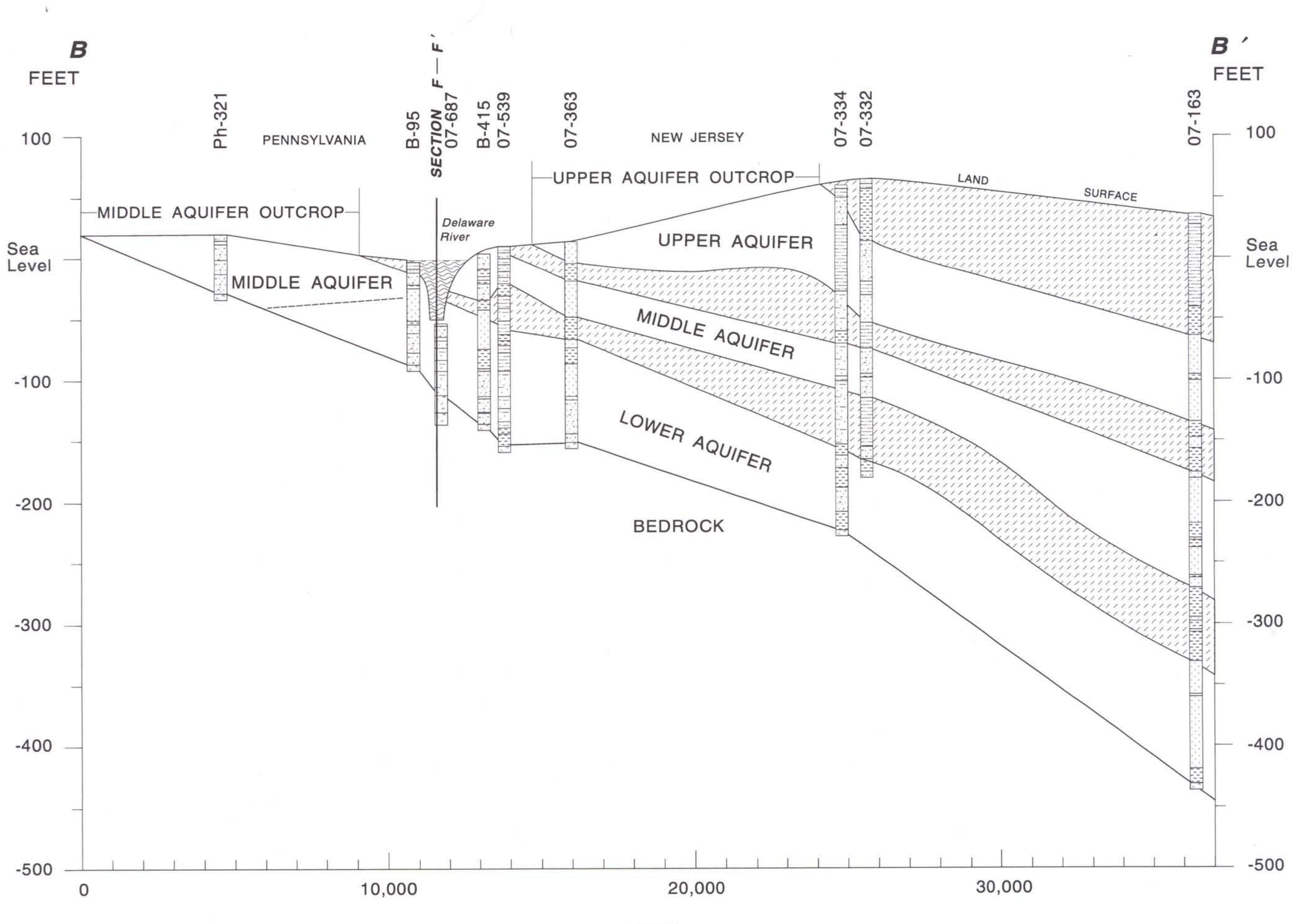
SCENARIO C (continued)

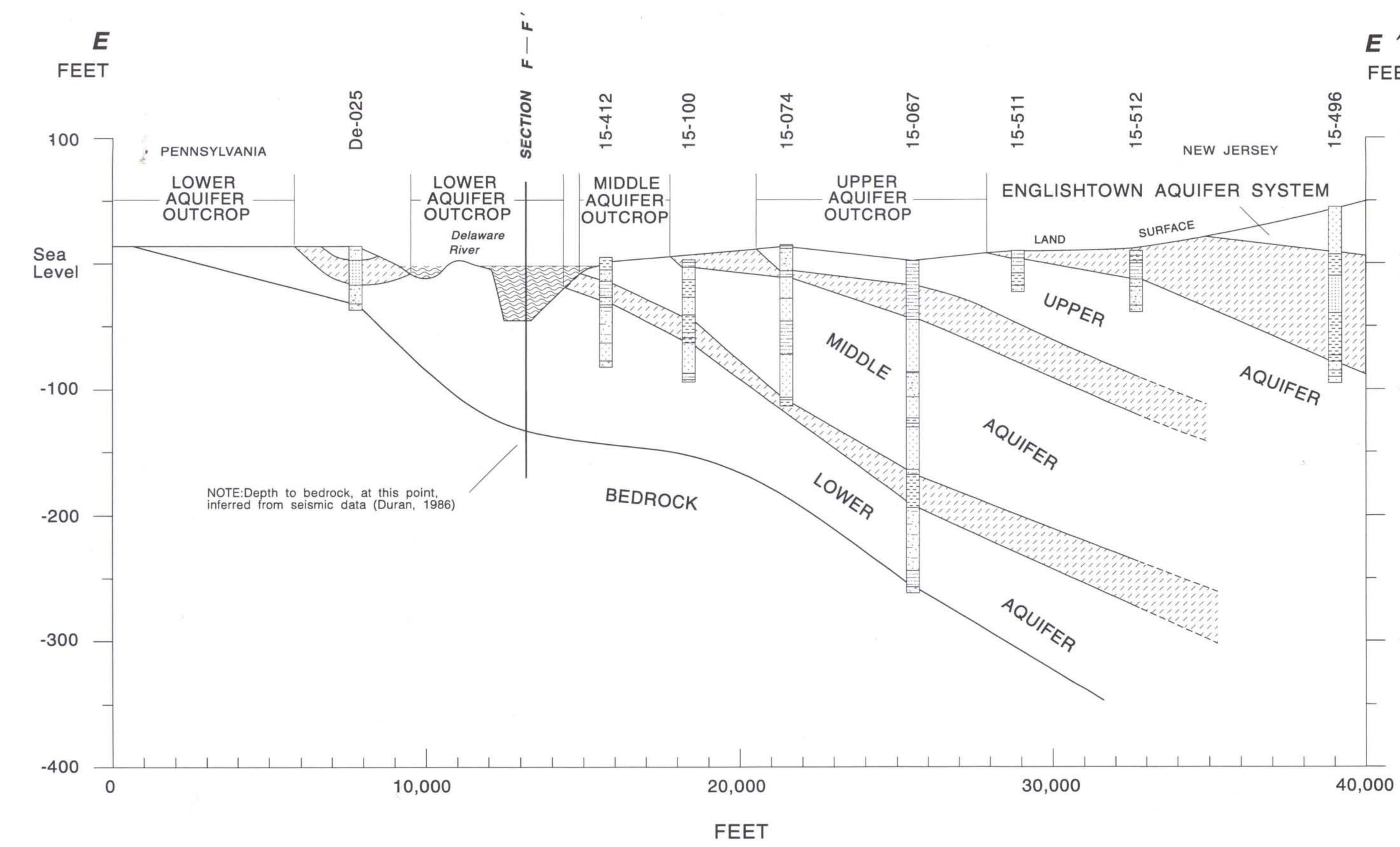
Layer	Row	Column	Withdrawals, by stress period, in Mgal/d 10	11	12	13	14	15	16
5	57	75	0.100	Stress period 11 - 16 withdrawals are equal to stress period 10 withdrawals.					
5	59	47	2.327						
5	60	78	.889						
5	61	61	2.381						
5	71	56	2.575						

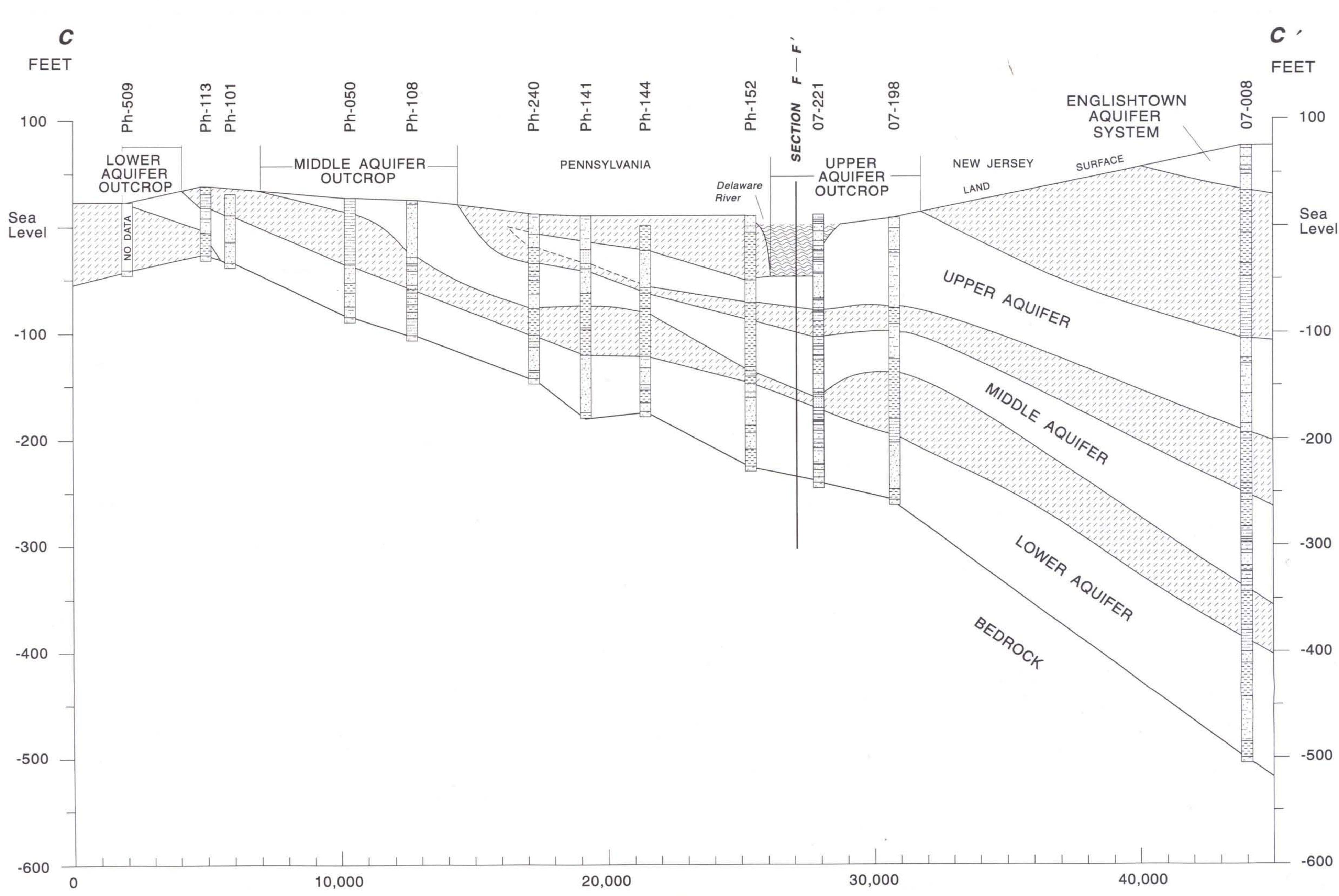
LAYER 5 TOTAL			43.409						
			=======						
SCENARIO C TOTAL			82.359						











EXPLANATION

- Sand and gravel
- Sand
- Clayey/silty sand
- Silt
- Sandy/silty clay
- Clay
- Bedrock
- Confining Unit
- Bedrock contact determined by surface-geophysical methods (Duran, 1986)
- 15-312 Well number
- SECTION F—F′ Line of section shown on figure 22

HYDROSTRATIGRAPHIC SECTIONS A-A′ TO E-E′ THROUGH THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM IN THE VICINITY OF THE DELAWARE RIVER, CAMDEN AREA, NEW JERSEY

By

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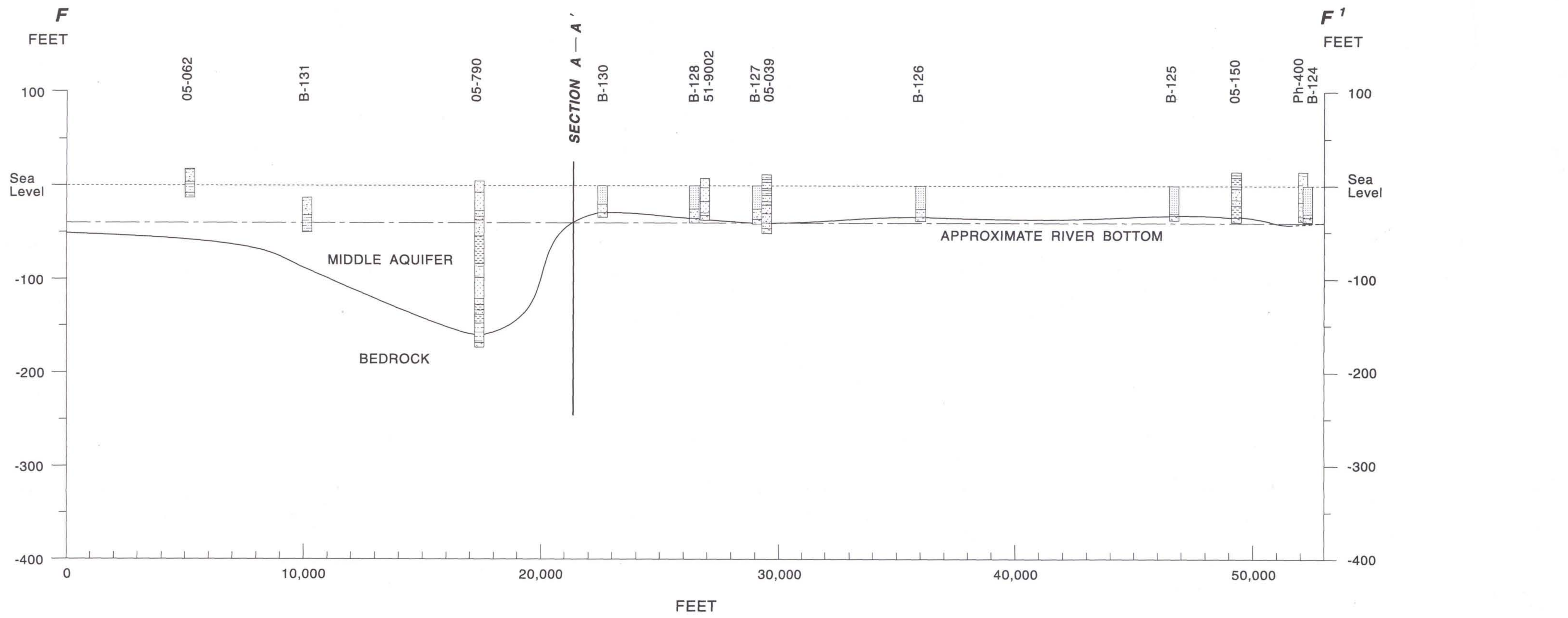
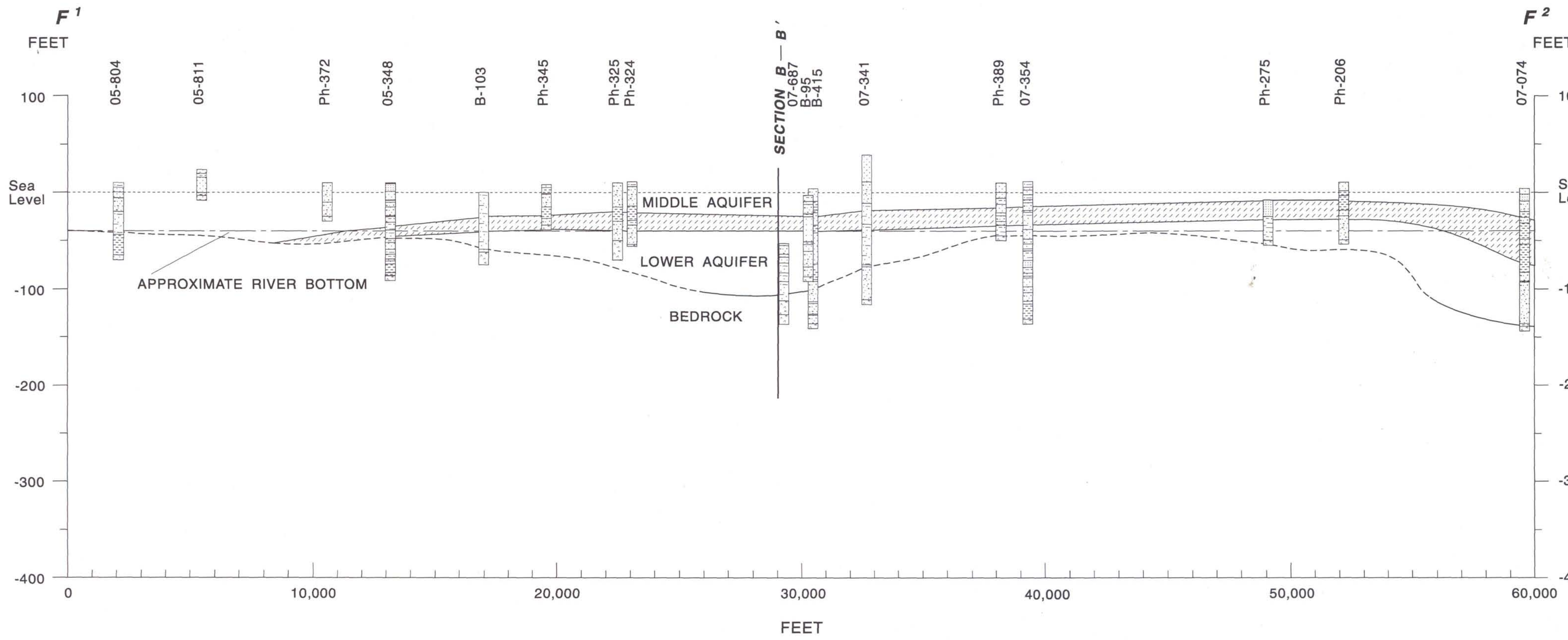
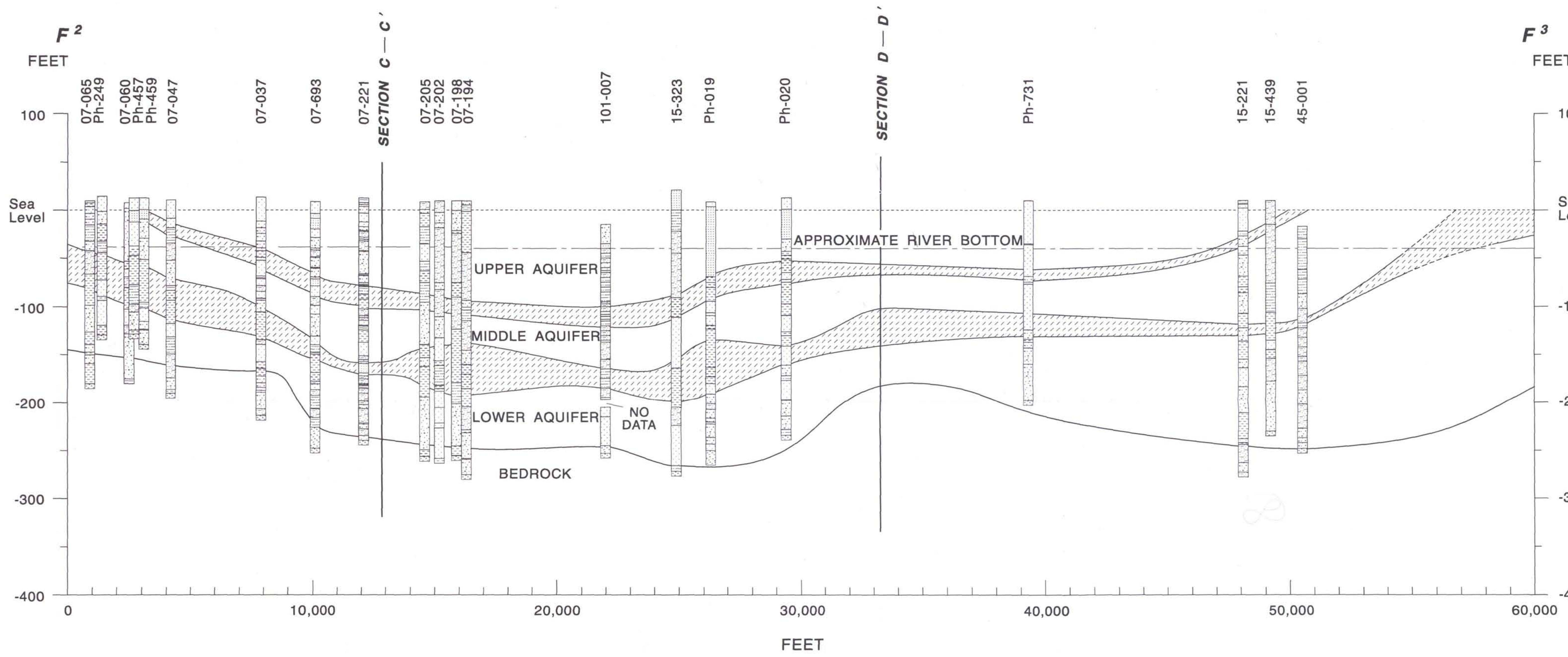
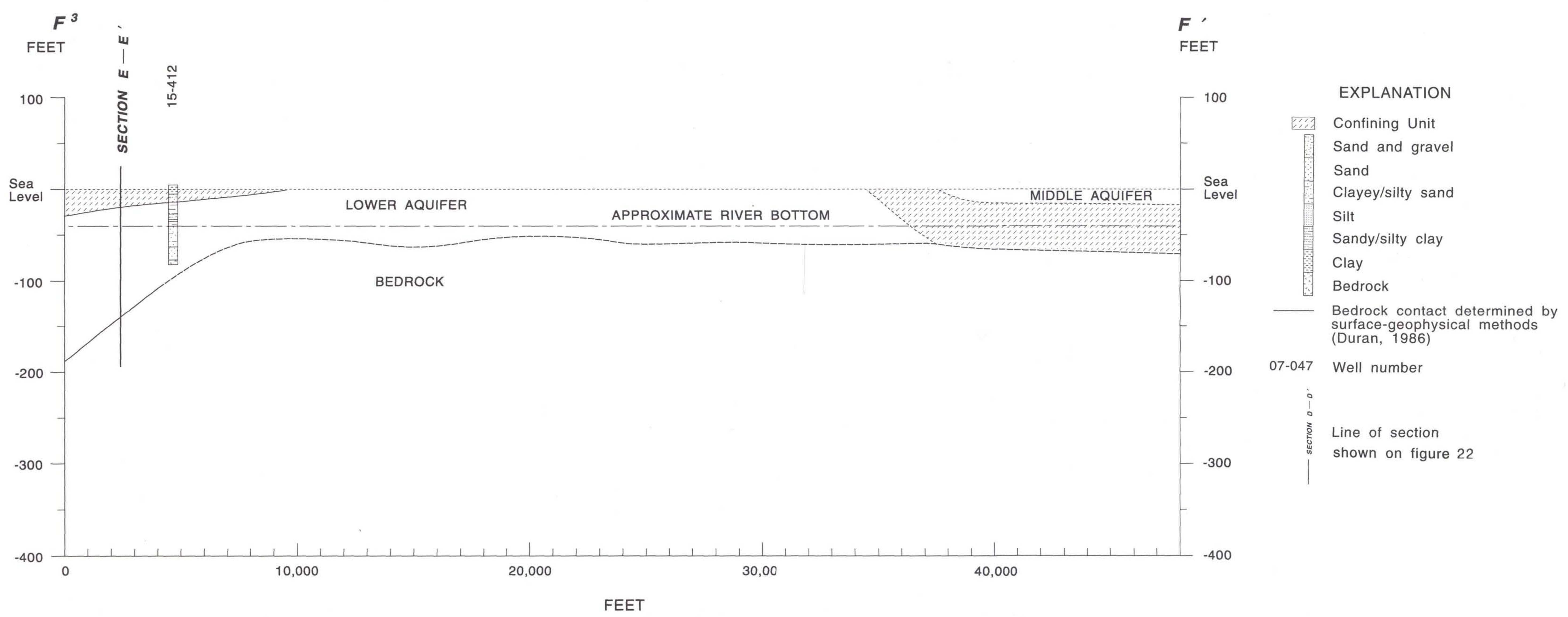
1995









HYDROSTRATIGRAPHIC SECTIONS F-F' THROUGH THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM IN THE VICINITY OF THE DELAWARE RIVER, CAMDEN AREA, NEW JERSEY

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