

POTENTIOMETRIC SURFACES OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM NEAR NATIONAL PARK, NEW JERSEY, 1996
By Robert Rosman

Abstract

During spring 1996, water levels were measured in 139 wells screened in the Upper, Middle, and Lower aquifers of the Potomac-Raritan-Magothy aquifer system. The data were used to construct potentiometric-surface maps of the study area, which includes parts of Gloucester and Camden Counties, N.J., and Philadelphia and Delaware Counties, Pa. Two disposal sites for dredged material from the Delaware River are present in the study area near National Park, Gloucester County.

Water levels in wells more than 0.5 mile from the Delaware River were considered to be unaffected by tides; water levels in wells 0.5 mile or less from the river were adjusted for the effects of tides. Altitudes of the potentiometric surface of the Upper Potomac-Raritan-Magothy aquifer ranged from 1 foot above sea level, near the dredge-disposal sites, to 76 feet below sea level; of the Middle-Potomac-Raritan-Magothy aquifer, from 1 foot above sea level, near the dredge-disposal sites, to 62 feet below sea level; and of the Lower Potomac-Raritan-Magothy aquifer, from 5 feet below sea level, near the dredge-disposal sites, to 68 feet below sea level. In the study area, the general direction of ground-water flow in the Upper aquifer is southeast; in the Middle aquifer, south-southeast; and in the Lower aquifer, east.

Introduction

The main shipping channel of the Delaware River is routinely dredged, and some of the dredged material has been deposited adjacent to two disposal sites--the National Park and the 17G disposal sites--near National Park, Gloucester County, N.J. (sheet 1, fig. 1). Both sites are in the outcrop area of the Potomac-Raritan-Magothy aquifer system. Dredged materials could contain contaminants, which could enter the aquifer system and adversely affect nearby public and private ground-water supplies (Navoy, 1994). A study was conducted by the U.S. Geological Survey (USGS), in cooperation with the U.S. Army Corps of Engineers, to provide water-level and potentiometric-surface data to be used as input to a computer model to simulate ground-water flow in the study area, which includes parts of Gloucester and Camden Counties, N.J., and Philadelphia and Delaware Counties, Pa. In order to refine the results of the simulation, additional water-level data were needed. This report documents the additional water-level data collected and presents potentiometric-surface maps for the Upper, Middle, and Lower aquifers of the Potomac-Raritan-Magothy aquifer system near the disposal sites.

Ground-water levels were measured in 139 wells on April 19, from May 20 to May 30, and on June 4, 1996. Each pumped well was shut down for at least one hour before water-level measurement. In general, ground-water withdrawals from nearby production wells continued on a regular schedule during the period of study. Water levels that were tidally influenced were adjusted to a mean-tide water-level altitude at the time of measurement to conform to sea-level datum (table 1). In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929. Hourly surface-water-level measurements from the tidal gaging station on the Delaware River at Fort Mifflin in Philadelphia, Pa., for May 1996 (sheet 1, fig. 2) were used to adjust water levels for the wells used in this study. Tidally adjusted water levels, which are presented in tables, were used to construct potentiometric-surface maps for the Middle and Lower Potomac-Raritan-Magothy aquifers (table 1). Water levels used to construct the potentiometric-surface map for the Upper aquifer were not adjusted.

The well numbering system used in this report is based on the system used by the USGS in the New Jersey District since 1978. The well number consists of a county code and a sequence number. For example, well 15-296 is located in Gloucester County and is the 296th well inventoried in that county. New Jersey county codes used in this report are Camden (7) and Gloucester (15). For wells in Pennsylvania, the letter "P" was placed in front of the county code 101 to avoid confusion with New Jersey county codes.

Description of Study Area

The National Park and 17G dredge-disposal sites are located in the outcrop area of the Upper Potomac-Raritan-Magothy aquifer in Gloucester County, N.J., near the town of National Park and adjacent to the Delaware River. This outcrop has a veneer of post-Cretaceous sands that are hydraulically connected to the Upper aquifer. Underlying the site, at depth, are the Middle and Lower Potomac-Raritan-Magothy aquifers. The three aquifers are separated by leaky confining units.

Acknowledgments

The author thanks the water purveyors and well owners who provided information about their wells and granted access for water-level measurements.

Tidal Fluctuations of Surface-Water Levels

The U.S. Army Corps of Engineers maintains a tidal gaging station at the Delaware River at Fort Mifflin, Philadelphia, Pa. Tidal surface-water levels measured hourly during May 1996, which were used to determine the mean-tide water level, fluctuated from about 5.6 ft (feet) above to 2.8 ft below mean tide; mean tide was 1.4 ft above sea level (sheet 1, fig. 2). The water levels measured on May 30, 1996, (sheet 1, fig. 3a) are typical for tidal cycles in the Delaware River.

Tidal Fluctuations of Ground-water Levels

Water levels were measured in six observation wells (sheet 1, fig. 3b-3d) during one tidal cycle (12 hours) on May 30, 1996, to determine the effect of tides on ground-water levels. Wells 15-778, 15-779, and 15-780 are located about 150 ft from the bank of the Delaware River, and wells 15-772, 15-773, and 15-774 (sheet 1, fig. 3b-3d) are about 1,600 ft

from the river. Water levels in wells screened in the Upper Potomac-Raritan-Magothy aquifer did not fluctuate with the tide (sheet 1, fig. 3b). Water levels in the Middle Potomac-Raritan-Magothy aquifer (sheet 1, fig. 3c) fluctuated about 2.1 ft in observation well 15-780 near the river and 1.1 ft in well 15-774 distant from the river. The lag time between high tide in the river and the tidally influenced high water level in well 15-780 was about 1 hour, and in well 15-774, about 2 hours (sheet 1, fig. 3a and 3c). Water levels in the Lower Potomac-Raritan-Magothy aquifer fluctuated about 2.7 ft in well 15-778 with a lag time of about 0.5 hour, and water levels fluctuated about 1.9 ft in well 15-772 with a lag time of about 1.5 hours (sheet 1, fig. 3d). Water levels in well 15-772 also showed the effects of localized pumping during the tidal cycle.

In general, water levels in the Middle and Lower Potomac-Raritan-Magothy aquifers fluctuated more than 0.5 ft in the zone from the banks of the Delaware River to 0.5 mi (mile) inland as a result of tides. Water levels in wells in this zone were adjusted for the effects of the tide. The tidally adjusted water levels were used to construct potentiometric-surface maps for the Middle and Lower aquifers.

Correction of Ground-water Levels for Tidal Fluctuation

Water levels in wells screened in the Middle and Lower aquifers of the Potomac-Raritan-Magothy aquifer system within 0.5 mi of the river were corrected for tidal fluctuations. First, the perpendicular distance from the river to each well was measured on a topographic map. Wells more than 0.5 mi from the river were considered not to be affected by the tide. The remaining wells were assigned a percentage equal to the distance of the well from the river divided by 0.5 mi. For example, a well 0.25 mi from the river was assigned a value of 50 percent. Next, the mean tide was calculated for the Delaware River for each day that tidally affected water-level measurements were made. The time and the measurement of the water level were plotted on a daily mean-tide hydrograph (sheet 1, fig. 3a). The difference between the measured water level and the mean-tide water level was multiplied by the distance percentage. The resulting value was added to the measured water level. Measurements were then rounded to the nearest foot.

Potentiometric Surface of the Upper-Potomac-Raritan-Magothy Aquifer

Water levels were measured in 48 wells screened in the Upper Potomac-Raritan-Magothy aquifer (sheet 2, fig. 4; table 2). No tidal effect was noted for the observation wells (sheet 1, fig. 3b); therefore, no tidal adjustments were made. The altitude of the potentiometric surface near the two dredge-disposal sites ranged from 1 ft above to 5 ft below sea level. In the southeastern part of the study area, water levels reached depths of 76 ft below sea level (sheet 2, fig. 4; table 2). The general direction of ground-water flow in the area is southeast.

Potentiometric Surface of the Middle Potomac-Raritan-Magothy Aquifer

Water levels were measured in 40 wells screened in the Middle Potomac-Raritan-Magothy aquifer (sheet 3, fig. 5; table 3). Tidal corrections were applied to 13 wells. The tidally adjusted potentiometric surface near the dredge-disposal sites ranged from 1 ft above to 12 ft below sea level. Water levels in the southern part of the study area reached a depth of 62 ft below sea level (sheet 3, fig. 5; table 3). The general direction of ground-water flow in the area is south-southeast (sheet 3, fig. 5).

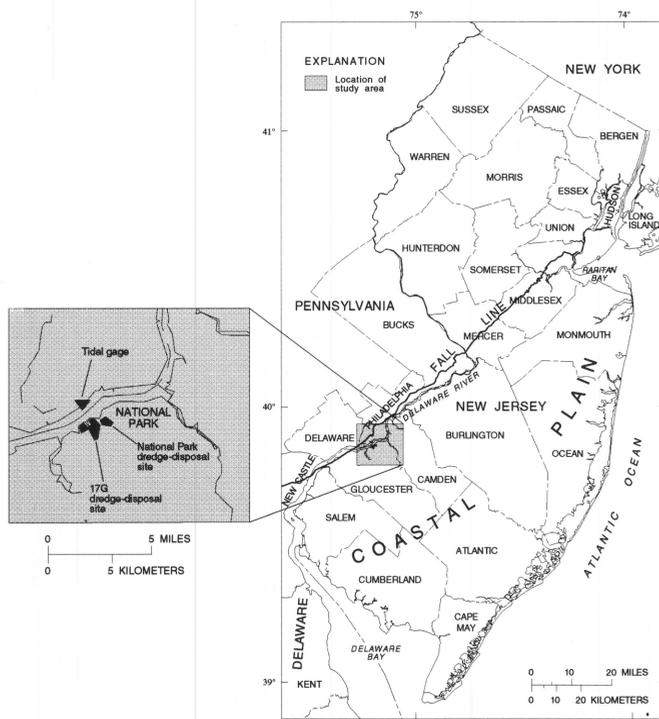


Figure 1. Location of study area.

Potentiometric Surface of the Lower Potomac-Raritan-Magothy Aquifer

Water levels were measured in 51 wells screened in the Lower Potomac-Raritan-Magothy aquifer (sheet 4, fig. 6; table 4). Tidal corrections were applied to 25 wells. The tidally adjusted potentiometric surface near the dredge-disposal sites ranged from 5 ft below to 40 ft below sea level. Water levels were as low as 68 ft below sea level at the eastern edge of the study area (sheet 4, fig. 6; table 4). The general direction of ground-water flow is east (sheet 4, fig. 6).

Water-Level Recorder Data

The U.S. Geological Survey maintains four continuous ground-water-level recorders at observation wells 7-283, 15-296, 15-323, and 15-671 to monitor long-term and seasonal changes in water levels in the Lower Potomac-Raritan-Magothy aquifer (sheet 4, fig. 7). (Data from ADAPS, a computerized water-level data base, are available at the New Jersey District office in West Trenton, N.J.) Data for well 15-296 were obtained before the well was destroyed on April 20, 1996. The water-levels in well 15-323 about 1.25 mi northeast of the dredge-disposal sites rose about 17 ft, from 45 ft below to 28 ft below sea level from 1980 through 1996.

Water levels in wells 7-283, 15-296, and 15-671, which are distant from the two dredge-disposal sites, fluctuate seasonally, but show long-term stability from 1980 through early 1996.

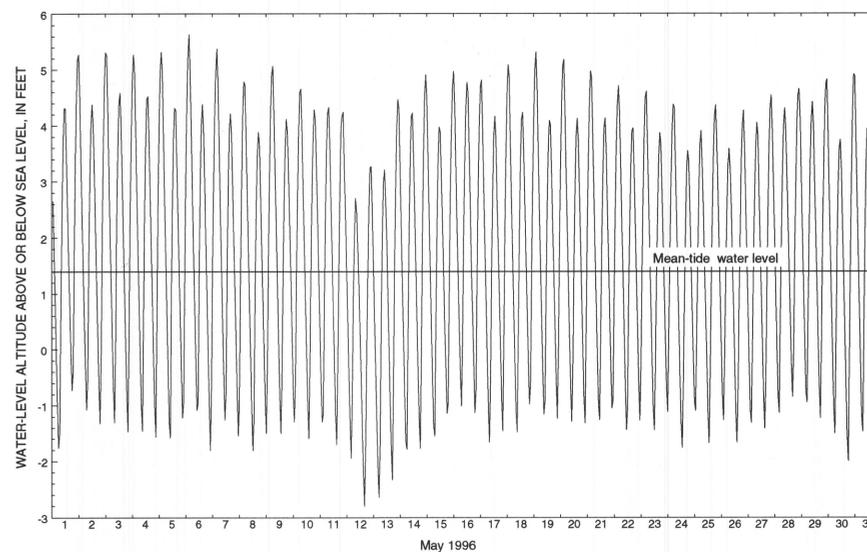


Figure 2. Water-level hydrograph for the tidal gaging station for the Delaware River at Fort Mifflin, Philadelphia, Pa., May 1996.

Table 1. Measured and tide-corrected water levels for 38 wells in the tidally influenced zone of the Potomac-Raritan-Magothy aquifer system (USGS, U.S. Geological Survey; <, less than)

New Jersey well number	Pennsylvania well number	Aquifer	USGS 7.5-minute quadrangle	Altitude ² (feet)	Time	Date	Measured tide level		Distance from closest bank of Delaware River (feet)	Water-level adjustment	Water-level altitude corrected for tidal effect (feet)		
							High tide ³	Low tide ³					
7-47		Lower	Camden	-13.4	1420	5/22	4.36	0900	-1.44	1100	<50	1.15	-12.25
7-221		Lower	Philadelphia	-25.07	1700	5/20	5.18	0200	-1.32	2200	<50	-0.85	-25.92
7-517		Lower	Camden	-29.29	0938	5/29	4.83	2300	-1.22	1700	1400	0	-29.89
*15-97		Middle	Bridgetown	-1.16	0822	5/22	4.36	0300	-1.44	1100	2640	0	-1.16
15-310		Lower	Woodbury	-4.29	1103	5/28	4.66	2200	-1.13	0400	2640	0	-4.29
15-311		Lower	Woodbury	-7.15	1044	5/28	4.66	2200	-1.13	0400	1200	-0.26	-7.41
15-320		Lower	Woodbury	-35.99	1024	5/20	5.18	0300	-1.32	2200	2100	-0.02	-36.01
15-321		Lower	Woodbury	-44.36	1117	5/20	5.18	0300	-1.32	2200	600	-0.02	-44.38
15-323		Lower	Woodbury	-25.98	1056	5/20	5.18	0300	-1.32	2200	500	0.73	-25.23
15-327		Lower	Woodbury	-43.84	1539	5/20	5.18	0300	-1.32	2200	2640	0	-43.84
15-434		Lower	Woodbury	-41.09	1600	5/20	5.18	0300	-1.32	2200	2250	-0.13	-41.22
15-680		Lower	Bridgetown	-5.66	0926	5/20	5.18	0300	-1.39	2200	250	2.62	-3.04
15-681		Middle	Bridgetown	-0.21	0922	5/20	5.18	0300	-1.39	2200	250	2.13	1.92
15-682		Middle	Bridgetown	-1.38	0943	5/20	5.18	0300	-1.39	2200	400	1.82	3.20
15-711		Lower	Bridgetown	-5.18	0952	5/20	5.18	0300	-1.39	2200	400	1.67	-3.51
15-770		Lower	Woodbury	-19.35	0925	5/20	5.18	0300	-1.32	2200	1250	0.83	-18.52
15-771		Middle	Woodbury	-1.78	0755	5/20	5.18	0300	-1.32	2200	1250	1.3	-0.48
15-772		Lower	Woodbury	-20.58	1115	5/21	4.85	0400	-1.26	1100	1600	-0.06	-20.64
15-774		Middle	Woodbury	1.69	1119	5/21	4.85	0400	-1.26	1100	1600	-0.2	1.43
15-775		Lower	Woodbury	-16.75	0845	5/21	4.85	0400	-1.26	1100	400	1.61	-15.14
15-776		Middle	Woodbury	-7.8	0826	5/21	4.85	0400	-1.26	1100	400	2	1.22
15-778		Lower	Woodbury	-21.88	1018	5/21	4.85	0400	-1.26	1100	150	2.69	-19.19
15-780		Middle	Woodbury	-4.69	1027	5/21	4.85	0400	-1.26	1100	150	1.84	-2.85
15-1120		Middle	Woodbury	3.40	0932	5/24	4.38	0500	-1.76	0300	500	0.77	4.17
15-1121		Middle	Woodbury	2	0906	5/24	4.38	0500	-1.76	0300	1500	0.65	0.85
15-1122		Middle	Woodbury	-1.49	0920	5/24	4.38	0500	-1.76	0300	2000	0.44	-1.05
15-1177		Lower	Woodbury	-20.8	1239	5/21	4.85	0400	-1.26	1100	500	-0.5	-20.30
*P101-03	PH-19	Lower	Philadelphia	-8.68	1000	6/04	5.28	0300	-1.83	2200	<50	2.4	-6.28
*P101-07	PH-2	Lower	Philadelphia	-9.7	1100	6/04	5.28	0300	-1.83	2200	1500	-0.39	-10.09
*P101-08	PH-3	Lower	Philadelphia	-7.77	0939	6/04	5.28	0300	-1.83	2200	1375	0.91	-6.86
*P101-09	PH-4	Lower	Philadelphia	-9.7	0930	6/04	5.28	0300	-1.83	2200	1375	0.91	-8.79
*P101-10	PH-5	Lower	Philadelphia	-7.88	1300	6/04	5.28	0300	-1.83	2200	1375	-1.37	-9.25
*P101-11	PH-20	Lower	Philadelphia	-9.84	1300	6/04	5.28	0300	-1.83	2200	200	-2.03	-11.87
*P101-12	PH-27	Lower	Philadelphia	-15.15	1000	6/04	5.28	0300	-1.83	2200	<50	2.4	-12.75
*P101-14	PH-750	Lower	Philadelphia	-5.63	1029	6/04	5.28	0300	-1.83	2200	1350	0.15	-5.78
*P101-19	PH-861	Middle	Philadelphia	-7.78	0857	4/19	5.01	0200	-1.21	2100	2000	-0.1	-7.88
*P101-20	PH-862	Middle	Philadelphia	-8.22	0930	4/19	5.01	0200	-1.21	2100	1500	-0.48	-8.70
*P101-21	PH-863	Middle	Philadelphia	-8.15	1052	4/19	5.01	0200	-1.21	2100	2000	-0.63	-8.78

¹ Pennsylvania well numbers were changed to include the letter "P" in front of a numbered county code and sequence number.
² Datum is sea level.
³ Rounded to nearest 0.01 foot.
* Well not shown on figure 5.
+ Water-level altitudes provided by Curtis Schreffler of the U.S. Geological Survey, Malvern, Pa.
Water-level altitudes provided by Ray Scheinfeld, Roy F. Weston, Inc.

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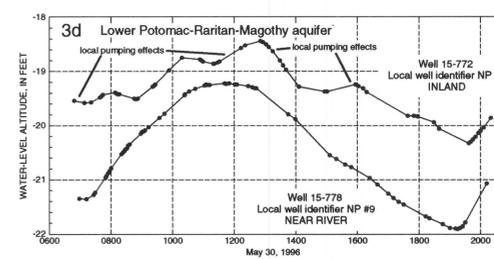
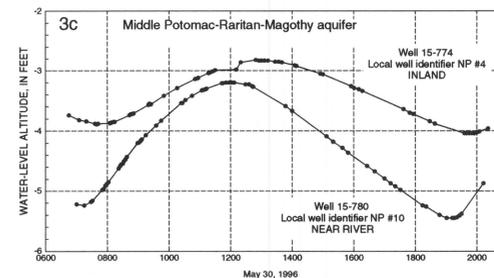
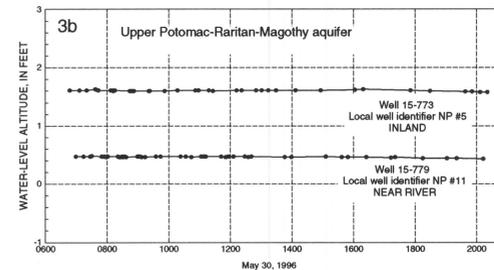
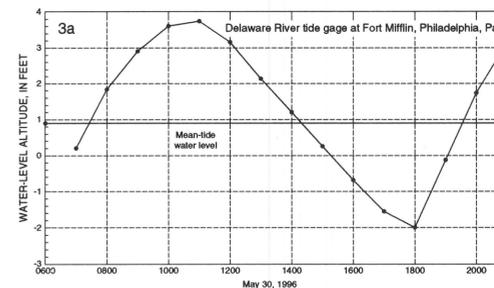


Figure 3. Hydrographs of Delaware River tide stage and water levels in observation wells showing the effects of tide.

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