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POTENTIOMETRIC SURFACE MAPS OF SELECTED CONFINED AQUIFERS IN SOUTHERN MARYLAND AND MARYLAND'S EASTERN SHORE, 2019

by

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Prepared in cooperation with the
Maryland Power Plant Research Program of the Maryland Department of Natural Resources
and the U.S. Geological Survey

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KEY RESULTS

This report presents potentiometric-surface maps of the Aquia and Magothy aquifers and the Upper Patapsco, Lower Patapsco, and Patuxent aquifer systems using water levels measured during the fall season of 2019. The potentiometric surface maps show water levels ranging from 56 feet above sea level to 163 feet below sea level in the Aquia aquifer, from 87 feet above sea level to 119 feet below sea level in the Magothy aquifer, from 114 feet above sea level to 120 feet below sea level in the Upper Patapsco aquifer system, from 136 feet above sea level to 174 feet below sea level in the Lower Patapsco aquifer system, and from 168 feet above sea level to 184 feet below sea level in the Patuxent aquifer system.

Cones of depression have formed around locations with significant aquifer withdrawals. The Aquia aquifer has depressed water levels around well fields at Lexington Park, Solomons Island, and central Talbot County. Cones of depression have formed in the Magothy aquifer around well fields at Waldorf, Arnold, and Easton. The Upper Patapsco aquifer system has depressed water levels around well fields in the Annapolis-Arnold area, Waldorf, the Lexington Park-Leonardtown area, and at Easton. The Lower Patapsco aquifer system has depressed water levels around well fields at Severndale, Broad Creek, Arnold, and Crofton Meadows as well as in central and western Charles County. Cones of depression have formed in the Patuxent aquifer system around well fields at Dorsey Road, Crofton, Arnold, northwestern Charles County, and at the Chalk Point power plant.

INTRODUCTION

The Maryland Geological Survey (MGS) and U.S. Geological Survey (USGS) have maintained a groundwater-level monitoring network in Maryland since the 1940s to observe changes in groundwater levels through time. Groundwater-level monitoring has been especially critical for Southern Maryland and Maryland's Eastern Shore where groundwater is the primary source of water supply. Many observation wells were added to the network in the early 1970s following the establishment of the Power Plant Research Program (PPRP) of the Maryland Department of Natural Resources in order to monitor groundwater levels at Maryland's power plants. Currently, groundwater is the source of freshwater supply used in the operation of the Calvert Cliffs, Chalk Point, Morgantown, and Panda Brandywine power plants. Water-level data collected from the monitoring network and water-withdrawal data from the confined aquifer systems that supply water for the operation of Maryland's power plants are used by the PPRP to evaluate potential impacts of Maryland's power plants on groundwater resources.

Purpose and Scope

The purpose of this report is to assess the regional effects of groundwater withdrawals on water levels in Southern Maryland and Maryland's Eastern Shore. This report presents potentiometric surface maps for the Aquia and Magothy aquifers and the Upper Patapsco, Lower Patapsco, and Patuxent aquifer systems for the fall season of 2019. The potentiometric surface maps in this report are meant to represent groundwater levels and withdrawal amounts at an instant in time. The water-level measurements were actually made over a period of approximately one month and may reflect short-term variations in water levels throughout the study area, related primarily to short-term changes in groundwater withdrawal rates. Withdrawal amounts are an annual average daily rate calculated from reported monthly pumpage of permitted withdrawals greater than 10,000 gallons per day.

Description of Study Area

The study area includes Anne Arundel, Prince George's, Calvert, Charles and St. Mary's Counties, and portions of Baltimore City, Washington D.C., and Howard, Baltimore, and Harford Counties, all of which are located west of Chesapeake Bay. On Maryland's Eastern Shore, the study area includes Talbot County, and portions of Cecil, Kent, Queen Anne's, Caroline, and Dorchester Counties (fig. 1). Two wells used for these maps are located in Virginia, just across the Potomac River to the south of Charles County.

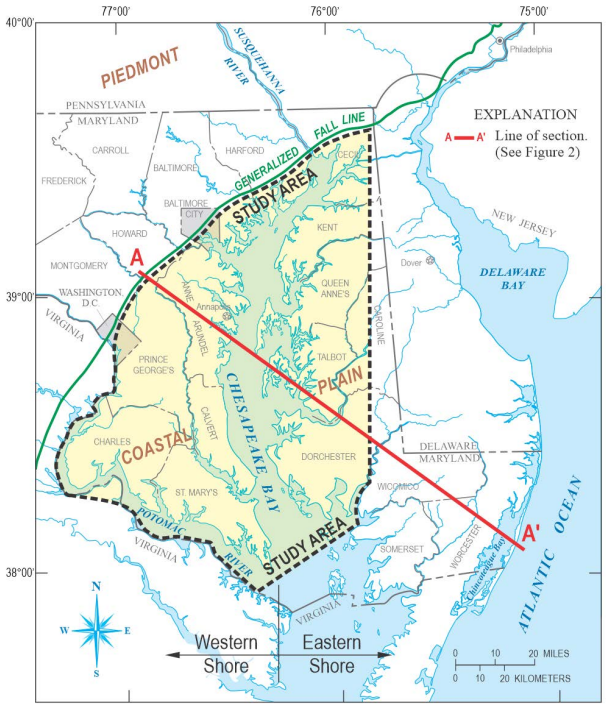

Figure 1. Location of study area in the Atlantic Coastal Plain of Maryland, Washington D.C., and part of Virginia

The Aquia aquifer, Magothy aquifer, and Upper Patapsco, Lower Patapsco, and Patuxent aquifer systems are part of the Atlantic Coastal Plain sediments, which become deeper and thicker towards the southeast (fig. 2; tab. 1). The Paleocene-age Aquia Formation, which comprises the Aquia aquifer, is composed of fine to coarse-grained, greenish-brown sand that

contains layers of silty clay. Cemented layers of shell debris are found throughout the formation. The Aquia's characteristic green color is caused by the presence of glauconitic sand. The Aquia aquifer is the source of water for many self-supplied private residences and some public suppliers in St. Mary's, Calvert, and Talbot Counties, and for extensive irrigation in Queen Anne's and Kent Counties. The late Cretaceous Magothy Formation, which comprises the Magothy aquifer, consists of light gray to white sand and fine gravel interbedded with thin layers of clay. The aquifer's excellent water-bearing characteristics make it a valuable source of water for most users, including public suppliers in Charles, Anne Arundel, Talbot, and Dorchester Counties. The early Cretaceous Patapsco Formation, which is included in the Potomac Group, comprises the Upper and Lower Patapsco aquifer systems and is a complexly layered unit having lenses of tan and gray sand and gravel, interbedded with variegated red, brown, and gray silt and clay. The Upper and Lower Patapsco aquifer systems are generally very productive and widely used, particularly by public suppliers and industries in Anne Arundel, Charles, and St. Mary's Counties. The early Cretaceous Patuxent Formation, which includes the Patuxent aquifer system, is the basal unit of the Potomac Group and is lithologically similar to the Patapsco Formation. The Patuxent aquifer system is also generally very productive and widely used in southern Baltimore County, the central and northern part of Anne Arundel County, northern and extreme southern parts of Prince George's County, and northwestern Charles County, but is not widely used in the rest of Southern Maryland and the Eastern Shore.

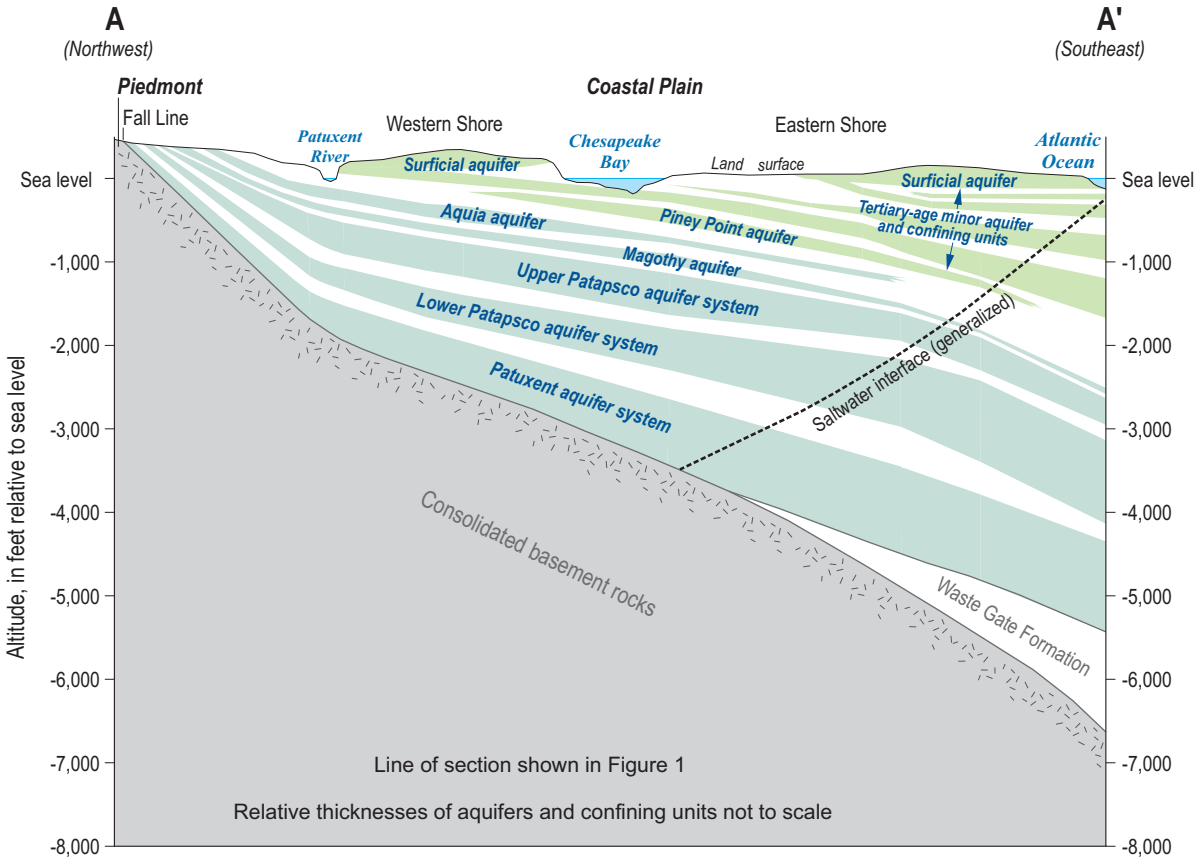

Figure 2. Generalized cross section of the Atlantic Coastal Plain aquifer system. Aquifers shaded in blue are discussed in this report.

Table 1. Generalized stratigraphy and hydrogeology of Southern Maryland and Maryland's Eastern Shore. Aquifers shaded in blue are discussed in this report.

System		Series	Group	Formation	Hydrogeology
Quaternary		Holocene		undifferentiated	*surficial aquifers*
		Pleistocene			
Tertiary	**Neogene**	Pliocene			
		Miocene	Chesapeake	St. Mary's	confining units and minor aquifers
				Choptank	
				Calvert	
	Paleogene	Oligocene		unnamed	*Piney Point aquifer*
		Eocene	Pamunkey	Piney Point	
				Nanjemoy	
				Marlboro	confining unit
		Paleocene		Aquia	*Aquia aquifer*
				Brightseat/ Hornerstown	
Cretaceous		Upper Cretaceous		Severn or Monmouth	confining units and minor aquifers
				Matawan	
				Magothy	*Magothy aquifer*
		Lower Cretaceous	Potomac	Patapsco	confining unit
					Upper Patapsco aquifer system
					confining unit
					Lower Patapsco aquifer system
				Arundel Clay	confining unit
				Patuxent	*Patuxent aquifer system*
				Waste Gate	*"Waste Gate" brine aquifer*
Jurassic, Triassic, Paleozoic to Precambrian					**consolidated basement rocks**

[Modified from Soeder and others, 2007]

Background

In the early 1940s MGS, in cooperation with the USGS, began systematic monitoring of groundwater levels to evaluate the effects of groundwater withdrawals. The monitoring effort was expanded in the early 1970s to evaluate groundwater withdrawals from the Chalk Point coal-fired power plant in southern Prince George's County. In subsequent years, monitoring was further expanded to evaluate groundwater withdrawals from the Calvert Cliffs nuclear power plant in southern Calvert County and the Morgantown coal-fired power plant in southern Charles County, as well as from an increased number of municipal, commercial, domestic, and irrigation wells. The PPRP of the Maryland Department of Natural Resources was established as a result of the Power Plant Siting and Research Act of 1971. This act required the evaluation of the environmental impacts associated with power generation plants in Maryland. Potentiometric surface and water-level difference maps were prepared and published as part of a funding agreement between USGS, MGS, and PPRP in order to supply groundwater data for inclusion in PPRP's periodic Cumulative Environmental Impact Reports. The first potentiometric surface map published as part of this effort was for the Magothy aquifer using groundwater levels from September 1975, followed by a map of the Aquia aquifer using groundwater levels from September 1982. These maps helped evaluate the effects of withdrawals at the Chalk Point plant in southern Prince George's County and the Calvert Cliffs nuclear power plant in southern Calvert County, respectively. To evaluate the effects of withdrawals at the Morgantown power plant in southern Charles County and from additional withdrawal wells at the Chalk Point power plant, potentiometric surface maps were published for the Upper and Lower Patapsco aquifer systems using groundwater levels from September 1990. In 2009, a potentiometric surface map was published using groundwater levels from September 2007 to evaluate the effects of groundwater withdrawals from the Patuxent aquifer system at the Chalk Point power plant. The most recent set of published maps displayed water-level data for 2015 (Staley and others, 2016).

In addition to the maps published for the PPRP reports, Achmad and Hansen (2001) assembled a comprehensive set of potentiometric surface and water-level difference maps for the Piney Point, Aquia, Magothy, Upper Patapsco, Lower Patapsco, and Patuxent aquifers using groundwater level data from 1970 through 1996. This report also includes a compilation of groundwater withdrawals and select hydrographs. Soeder and others (2007) published a similar report for the same set of aquifer systems for the period 1980-2005, which included a model evaluation of the relationship between withdrawals and water levels.

METHOD OF ANALYSIS

MGS and USGS personnel measured groundwater levels in the fall season of 2019 (predominantly during the month of September), and these data were used to construct the potentiometric surface maps presented herein. The water-level data were reviewed and approved by the MGS and USGS and stored in the Groundwater Site Inventory (GWSI) database, which is part of the USGS National Water Information System (NWIS) database. Water-level data in the NWIS database are publicly available (U.S. Geological Survey, 2019). Selected water-level data (apps. 1a-1e) were retrieved from GWSI and used in the preparation of the maps in this report (figs. 3-7). Water-withdrawal data included on the maps and described in the text were derived from the Maryland Department of the Environment (MDE) water-withdrawal database, a portion of which were further examined for quality assurance and were exported from the USGS Site-Specific Water-Use Data System (SWUDS) database (Cheryl Dieter, USGS, written commun., 2020). Water-use data are presented on the maps using a series of symbols representing the location and rates of groundwater withdrawals for users who have water appropriation and use permits for average annual rates greater than 10,000 gallons per day. Domestic wells and other small users are not shown on the maps. The 2019 potentiometric surface maps show water-withdrawal data for

2018 (the most recent data available). Permitted users of water greater than 10,000 gallons per day (gal/d) are required to record monthly withdrawal amounts, which are subsequently submitted to MDE (annually for agricultural users and semi-annually for non-agricultural users) and ultimately entered into MDE's database.

In preparing the potentiometric surface maps, groundwater levels were adjusted to feet (ft) related to sea level using the North American Vertical Datum of 1988 (NAVD88) land-surface datum. The data were plotted and manually contoured by visually interpolating between data points. The contours are dashed in areas of sparse data. The maps also include the outcrop and subcrop areas of the aquifers or aquifer systems, and the aquifer boundary if its location is within the area presented. Water levels located in outcrop and subcrop areas are variable due to their unconfined condition and were therefore not contoured for the maps in this report.

POTENTIOMETRIC SURFACE MAPS

Maps are presented for the Aquia and Magothy aquifers, and Upper Patapsco, Lower Patapsco, and Patuxent aquifer systems for Southern Maryland and a portion of Maryland's Eastern Shore using water levels measured in the fall season of 2019. The location and quantity of major groundwater-withdrawal sites in 2018 are presented on the maps to show the relation between pumping centers and water levels.

Aquia Aquifer

The potentiometric surface of the Aquia aquifer during the fall season of 2019 is based on water-level measurements in 85 wells (fig. 3). The highest measured water level on the Western Shore was 56 ft above sea level in the unconfined (outcrop area) portion of the aquifer in the eastern part of Anne Arundel County. In the confined portion of the aquifer, the hydraulic gradient increased southward toward a cone of depression around well fields at Lexington Park and Solomons Island. The Calvert Cliffs nuclear power plant is located along the northern edge of this cone of depression, where the water level was measured at 112 ft below sea level. The lowest measured water level of 163 ft below sea level occurred at the center of a cone of depression at Lexington Park. On the Eastern Shore, water levels in the unconfined (subcrop area) portion of the aquifer in Kent County were as high as 26 ft above sea level. South of that area, water levels were lower and mostly below sea level. A cone of depression occurs in central Talbot County, caused by well fields in St. Michael's, Easton, and Oxford. The lowest measured water level on the Eastern Shore was 72 ft below sea level, occurring in western Dorchester County and is likely caused by the water use across the bay in Calvert and St. Mary's Counties. While the greatest concentration of production wells (primarily for irrigation use) occur in Kent County and northern and central Queen Anne's County, no regional cones of depression have formed because these wells are located in or near the unconfined portions of the aquifer. Pumping effects on water levels are less pronounced in unconfined aquifers due to the larger amount of storage and greater recharge rates. Withdrawals from the Aquia aquifer in the study area have increased from approximately 5 million gallons per day (Mgal/d) in 1982 (Wheeler and Wilde, 1989) to approximately 13.5 Mgal/d in 2018.

Magothy Aquifer

The potentiometric surface of the Magothy aquifer during the fall season of 2019 is based on water-level measurements in 54 wells (fig. 4). The highest measured water level was 87 ft above sea level in the unconfined (outcrop area) portion of the aquifer in the central part of Anne Arundel County. Water levels are lower towards the south. A shallow cone of depression has formed around the Arnold well field caused by downward leakage to the underlying Upper Patapsco aquifer system due to a hydraulic connection between the two aquifers on the Broadneck Peninsula (Mack and Andreasen, 1991). A relatively large cone of depression has developed in the Waldorf area, near the southern extent and downdip boundary of the aquifer, where groundwater levels are as low as 117 ft below sea level. Groundwater withdrawals from the Chalk Point power plant

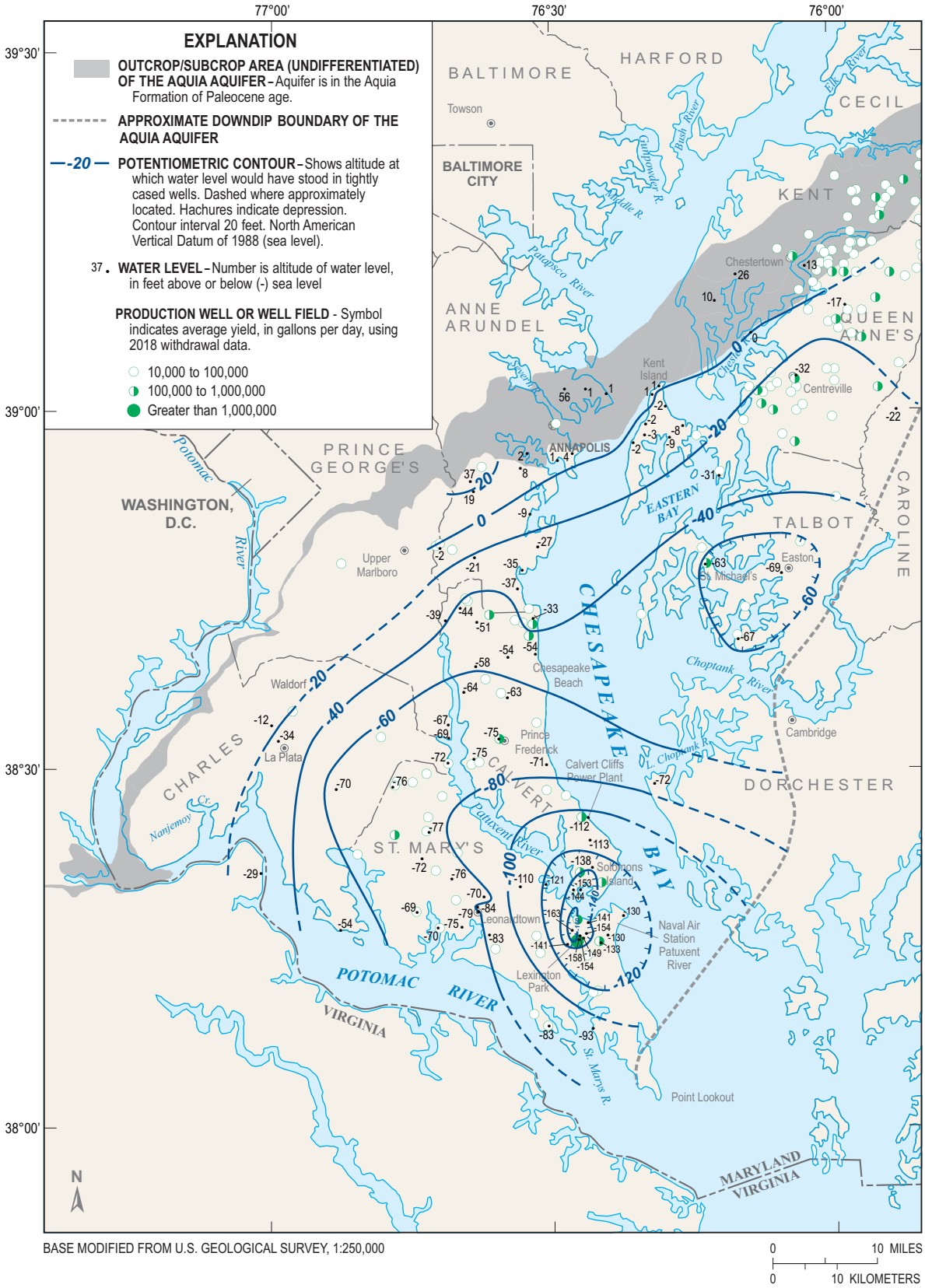

Figure 3. Potentiometric surface of the Aquia aquifer in Southern Maryland and Maryland's Eastern Shore, fall season of 2019.

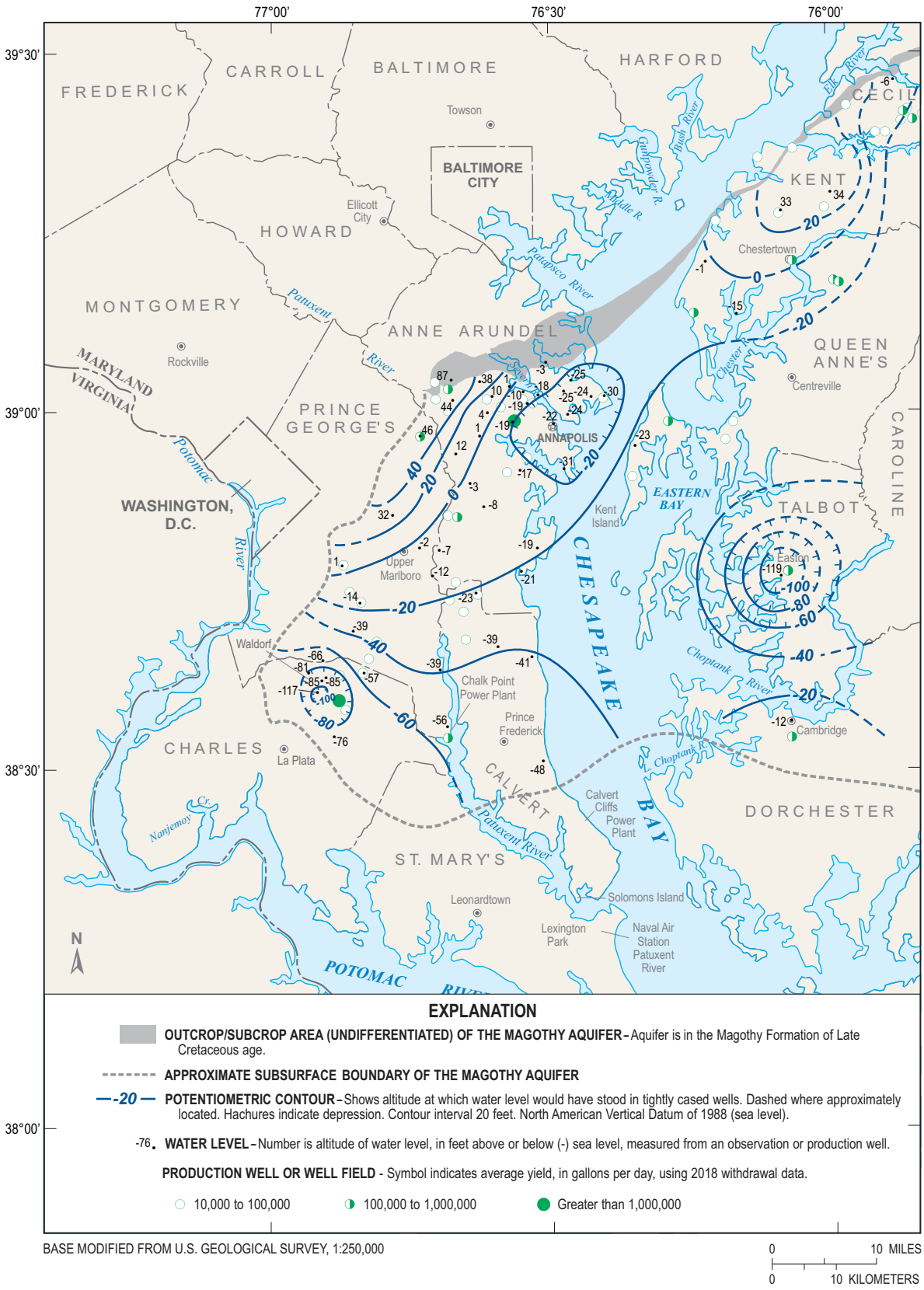

Figure 4. Potentiometric surface of the Magothy aquifer in Southern Maryland and Maryland's Eastern Shore, fall season of 2019.

resulted in a water level of 56 ft below sea level in an observation well at that site. A large cone of depression has developed at Easton on the Eastern Shore, which resulted in a water level of 119 ft below sea level. The groundwater level at Easton is likely highly affected by localized, short-term pumping from the Easton well field. Relatively high groundwater levels in the northwestern portion of Kent County indicate that this is an area of groundwater recharge. Withdrawals from the Magothy aquifer in the study area increased from approximately 7 Mgal/d in 1975 (Wheeler and Wilde, 1989) to approximately 9.5 Mgal/d in 2018.

Upper Patapsco Aquifer System

The potentiometric surface of the Upper Patapsco aquifer system during the fall season of 2019 is based on water-level measurements in 65 wells (fig. 5). The highest measured water level was 114 ft above sea level near the unconfined (outcrop area) portion of the aquifer system in northern Anne Arundel County. From this area, water levels decline to the southeast toward well fields in the Annapolis-Arnold area, where water levels were 50 ft below sea level at the Arnold well field. Relatively large cones of depression have formed in the Waldorf area in central Charles County and the Lexington Park-Leonardtown area in southern St. Mary's County. Groundwater levels were 111 ft below sea level in the center of the Waldorf cone of depression, and 93 ft below sea level at Leonardtown. Water levels at the Chalk Point power plant were between 52 and 60 ft below sea level. The lowest measured water level of 120 ft below sea level is located in a cone of depression formed around Easton, on the Eastern Shore. Total withdrawals from the Upper and Lower Patapsco aquifer systems increased from approximately 29 Mgal/d in 1990 to approximately 37 Mgal/d in 2018. Withdrawals in 2018 from the Upper Patapsco aquifer system totaled approximately 9.5 Mgal/d. Withdrawals reported in 1990 were not differentiated between the Upper and Lower Patapsco aquifer systems.

Lower Patapsco Aquifer System

The potentiometric surface of the Lower Patapsco aquifer system during the fall season of 2019 is based on water-level measurements in 72 wells (fig. 6). The highest measured water level was 136 ft above sea level near the outcrop area of the aquifer system in eastern Washington, D.C. Water levels were lower towards well fields at Severndale, Broad Creek, Arnold, and Crofton Meadows. Measured groundwater levels were 100 ft below sea level at Severndale, 44 ft below sea level at Broad Creek, 77 ft below sea level at Arnold, and 6 ft below sea level at Crofton Meadows. There is a large cone of depression in Charles County that includes Waldorf, La Plata, Indian Head, and the Morgantown power plant. The groundwater levels measured were as low as 174 ft below sea level at Waldorf, 160 ft below sea level near La Plata, 112 ft below sea level at Indian Head, and 102 ft below sea level at the Morgantown power plant. Total withdrawals from the Upper and Lower Patapsco aquifer systems increased from approximately 29 Mgal/d in 1990 to approximately 37 Mgal/d in 2018. Withdrawals in 2018 from the Lower Patapsco aquifer system totaled approximately 27.5 Mgal/d. Withdrawals reported in 1990 were not differentiated between the Upper and Lower Patapsco aquifer systems.

Patuxent Aquifer System

The potentiometric surface of the Patuxent aquifer system during the fall season of 2019 is based on water-level measurements in 62 wells (fig. 7). The highest measured water level was 168 ft above sea level in the outcrop area of the aquifer system in northwestern Prince George's County. Water levels are lower south and east towards well fields at Glen Burnie, Bryans Road, and the Morgantown and Chalk Point power plants. The measured groundwater levels were 184 ft below sea level at Dorsey Road, 86 ft below sea level at Crofton Meadows, 114 ft below sea level at Arnold, 150 ft below sea level near Stump Neck, 38 ft below sea level at the Morgantown power plant, and 78 ft below sea level at the Chalk Point power plant. Relatively

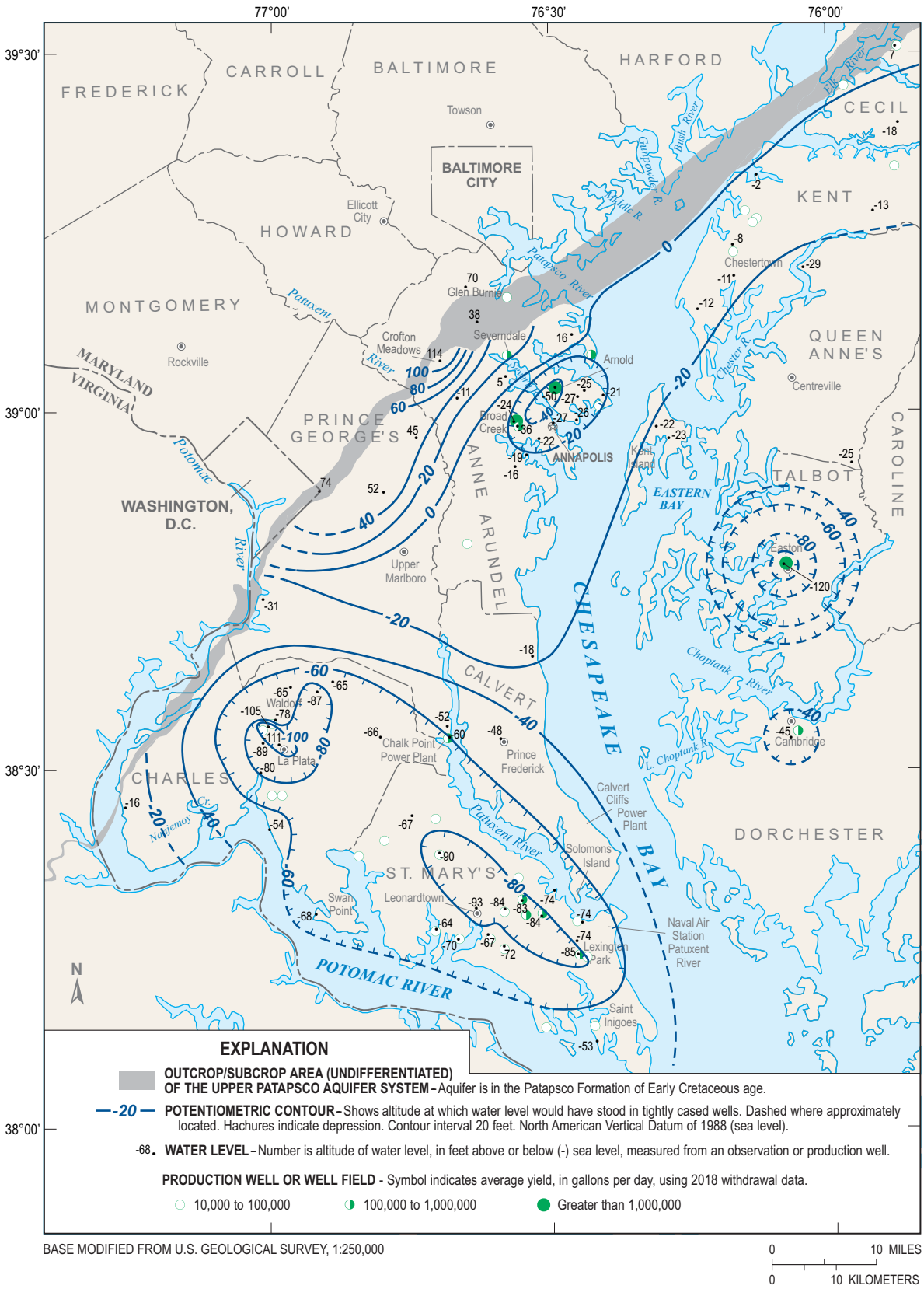

Figure 5. Potentiometric surface of the Upper Patapsco aquifer system in Southern Maryland and Maryland's Eastern Shore, fall season of 2019.

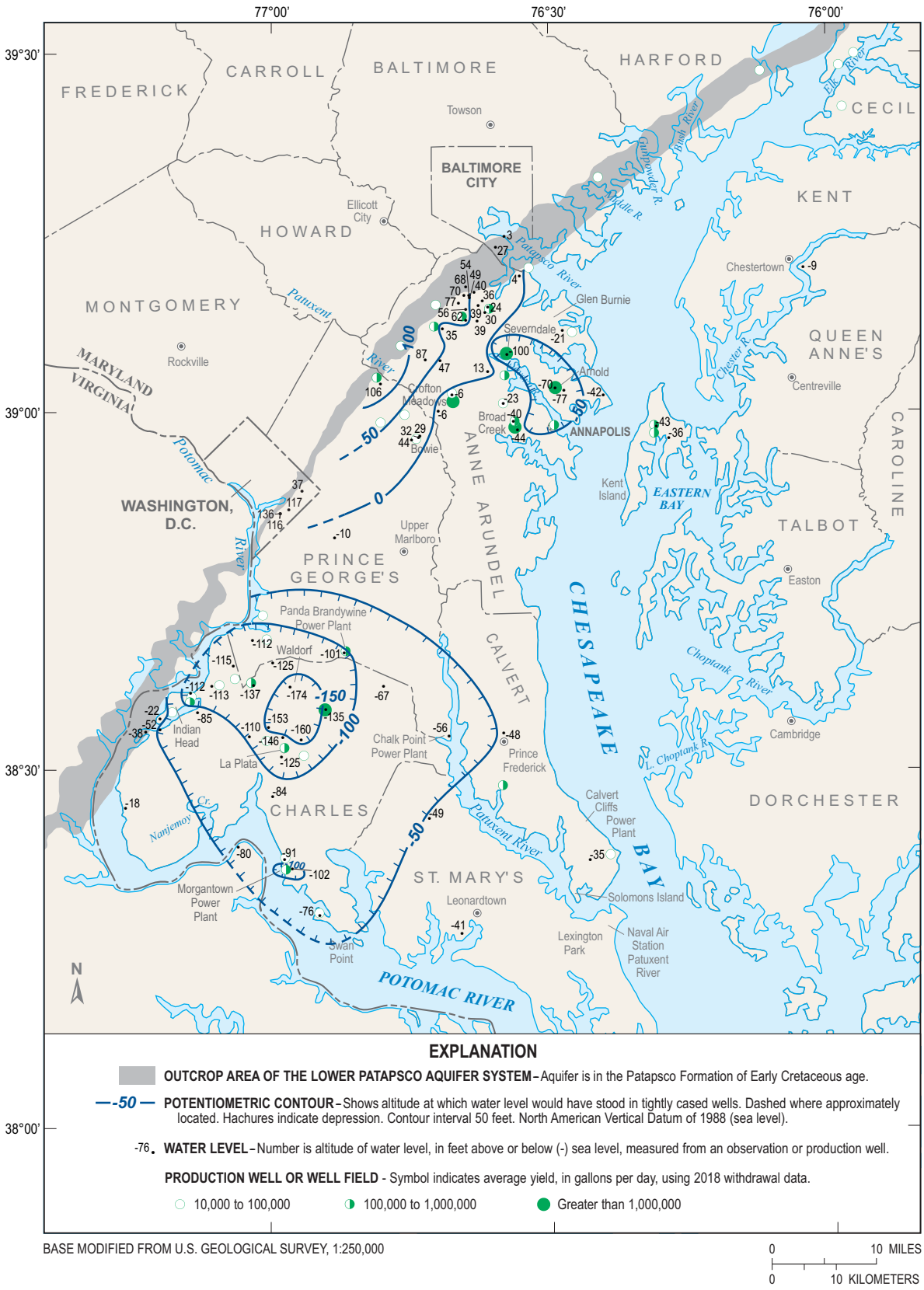

Figure 6. Potentiometric surface of the Lower Patapsco aquifer system in Southern Maryland and Maryland's Eastern Shore, fall season of 2019.

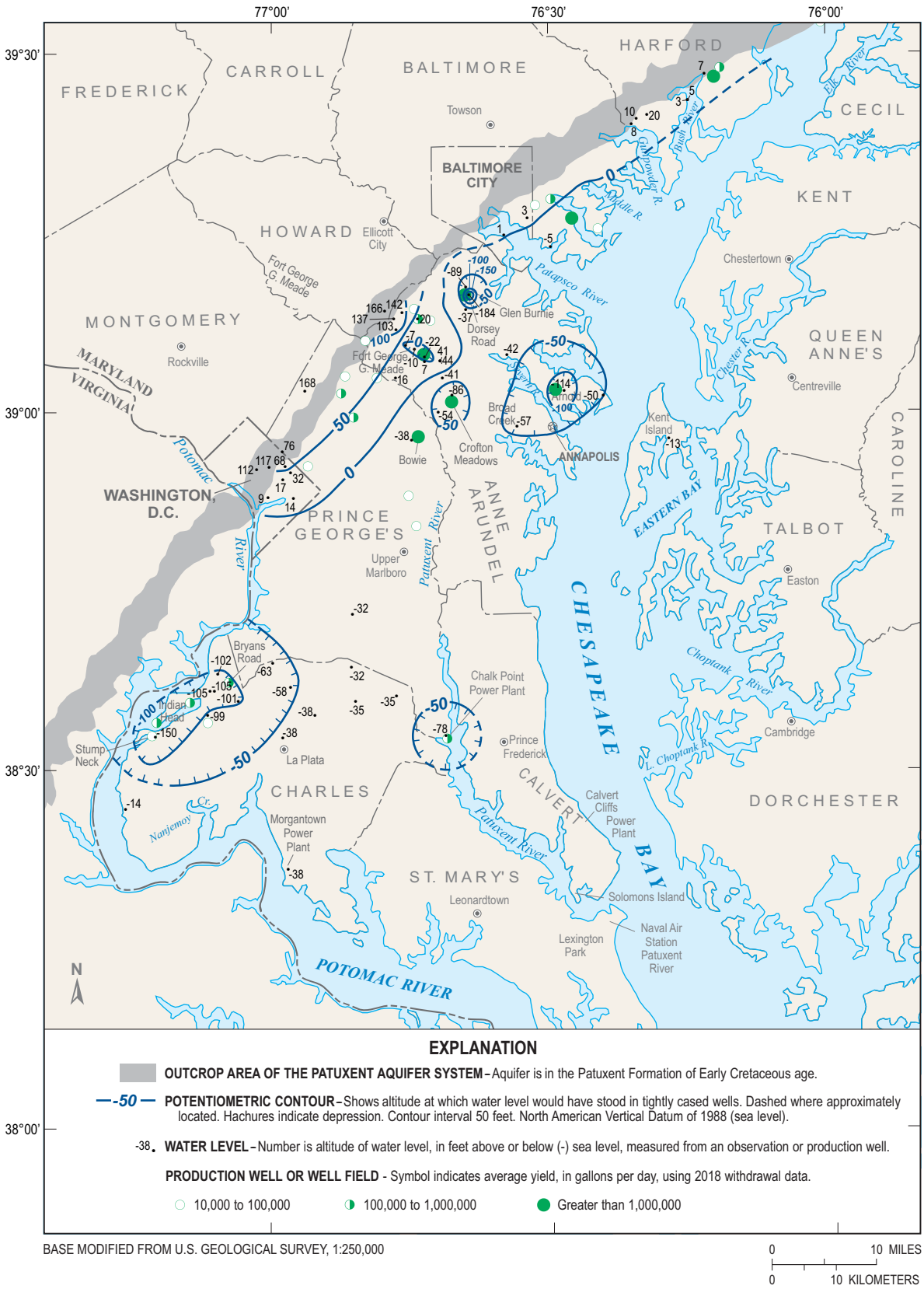

Figure 7. Potentiometric surface of the Patuxent aquifer system in Southern Maryland and Maryland's Eastern Shore, fall season of 2019.

deep cones of depression have formed around the Dorsey Road, Crofton, Arnold, and Bryans Road-Indian Head-Stump Neck well fields, and the Chalk Point power plant. A shallow cone of depression has formed around Crofton Meadows. An additional, less extensive cone of depression has formed around the well field at Fort George G. Meade. The water-use symbol for that well field represents multiple wells and is not centered in the cone of depression. Water levels in western Charles County have declined as rapidly as 10 ft per year beginning in 2007 (Staley, 2015), and exhibit some of the highest rates of decline in the coastal plain of Maryland over that period. Withdrawals from the Patuxent aquifer system in the study area increased from approximately 18 Mgal/d in 2007 to approximately 24.5 Mgal/d in 2018. Changes in Patuxent withdrawals include the start of pumping in Charles County in 2007 and at the Chalk Point power plant in 2009, and the reduction of pumpage in northern Anne Arundel County, the City of Bowie, and the industrial areas of municipal Baltimore over the last three decades.

SUMMARY AND CONCLUSIONS

Groundwater has been and is expected to continue to be a major source of freshwater supply for Southern Maryland and Maryland's Eastern Shore. The principal confined aquifers in the study area from which groundwater is withdrawn are the Aquia and Magothy aquifers, and Upper Patapsco, Lower Patapsco, and Patuxent aquifer systems. Groundwater withdrawals from these aquifers have increased substantially over the last several decades due to population growth but also from increased use of water for irrigation, especially from the Aquia aquifer on the Eastern Shore. In each aquifer the water levels tend to be higher in wells closer to outcrop areas where most of the aquifer recharge occurs, and lower in the fully confined portions where the larger withdrawals tend to occur.

Table 2. Summary of water levels by aquifer in fall season of 2019.

Aquifer (or aquifer system)	Deepest water-level altitude 2019	
	water level (ft)	Location
Aquia	-163	Lexington Park, St. Mary's Co.
Magothy	-119	Easton, Talbot Co.
Upper Patapsco	-120	Easton, Talbot Co.
Lower Patapsco	-174	Waldorf, Charles Co.
Patuxent	-184	Dorsey Road Well Field, Anne Arundel Co.

Water levels in the Aquia aquifer ranged from 56 ft above sea level to 163 ft below sea level in 2019. Withdrawals from the Aquia aquifer have increased from approximately 5 Mgal/d in 1982 (Wheeler and Wilde, 1989) to approximately 13.5 Mgal/d in 2018. Water levels in the Magothy aquifer ranged from 87 ft above sea level to 119 ft below sea level in 2019. Withdrawals from the Magothy aquifer increased from approximately 7 Mgal/d in 1975 (Wheeler and Wilde, 1989) to approximately 9.5 Mgal/d in 2018. Water levels in the Upper Patapsco aquifer system ranged from 114 ft above sea level to 120 ft below sea level in 2019. Water levels in the Lower Patapsco aquifer system ranged from 136 ft above sea level to 174 ft below sea level in 2019. Total withdrawals from the Upper and Lower Patapsco aquifer systems increased from approximately 29 Mgal/d in 1990 to approximately 37 Mgal/d in 2018. Most of the withdrawals in 2018 were from the Lower Patapsco aquifer system (approximately 27.5 Mgal/d). Withdrawals reported in 1990 were not differentiated between the Upper and Lower Patapsco aquifer systems. Water levels in the Patuxent aquifer system ranged from 168 ft above sea level to 184 ft below sea level in 2019. The withdrawal rates in the Patuxent aquifer system in the study area in 2007 and 2018 were approximately 18 and 24.5 Mgal/d, respectively.

ACKNOWLEDGMENTS

The authors would like to express thanks to all of the USGS and MGS personnel who contributed water-level measurements, and to Cheryl Dieter (USGS), John Smith (MDE), and Robert Peoples (MDE) for providing the water-use data. A special thanks is extended to all of the public-well operators and private domestic well owners who kindly provided access for well measurements. The authors would like to thank Robert Peoples (MDE), Christopher Lewis (USGS), and Sandra Cooper (USGS) for their technical reviews and efforts towards improving the maps and manuscript.

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Appendix 1a. Water-level data for Southern Maryland and Maryland's Eastern Shore wells used in this report (Aquia aquifer).

[Land surface and water-level altitudes are in feet and are measured from the North American Vertical Datum of 1988 (NAVD 88), same as sea level in this report. Latitude and longitude measured relative to the North American Datum of 1983 (NAD 83); USGS, U.S. Geological Survey]

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
AA Cf 98	390150076283003	39.030667	-76.474683	92.62	56.03
AA Cf 122	390149076261702	39.030611	-76.437389	19.20	0.83
AA Cg 25	390127076240301	39.024278	-76.400514	16.53	0.95
AA De 102	385512076331602	38.920028	-76.554194	48.77	8.27
AA De 195	385628076323603	38.940936	-76.542900	36.20	1.58
AA Df 98	385550076292101	38.930778	-76.488778	10.49	1.29
AA Df 103	385623076274401	38.940306	-76.461889	25.69	4.22
AA Ed 45	385406076383901	38.902042	-76.643639	106.42	36.88
AA Ed 49	385249076382101	38.888083	-76.639333	59.19	19.15
AA Ee 67	385124076322001	38.856611	-76.538056	10.36	-9.44
AA Fc 35	384833076415602	38.809528	-76.698750	50.48	-2.47
AA Fd 46	384727076382501	38.795683	-76.636811	138.09	-21.34
AA Fe 46	384840076312801	38.811472	-76.524250	7.64	-27.00
AA Fe 48	384508076334101	38.752444	-76.561194	84.20	-36.92
AA Fe 92	384644076331201	38.778722	-76.552694	8.19	-35.13
CA Ba 13	384231076412501	38.708583	-76.690056	55.07	-39.41
CA Bb 27	384333076394701	38.726111	-76.663389	136.93	-44.47
CA Bb 58	384222076380102	38.706111	-76.633611	109.07	-50.89
CA Bc 44	384243076320201	38.711889	-76.533528	6.77	-32.99
CA Cb 26	383837076381001	38.643528	-76.635611	114.36	-57.66
CA Cb 32	383632076392701	38.609028	-76.656944	94.30	-64.26
CA Cc 18	383940076314801	38.661417	-76.529722	110.5	-54.23
CA Cc 57	383605076344601	38.601194	-76.579694	137.75	-63.28
CA Cc 58	383924076341201	38.656833	-76.579056	121.62	-54.09
CA Db 40	383053076382101	38.515278	-76.639722	22.51	-75.22
CA Db 47	383239076354201	38.543556	-76.594667	139.54	-74.81
CA Dc 29	383025076304701	38.507472	-76.510944	122.27	-71.20
CA Ed 52	382549076260101	38.433250	-76.436944	9.92	-111.58
CA Fd 54	382407076260301	38.402250	-76.434611	128.56	-113.25
CA Fd 70	382155076254502	38.363694	-76.430472	107.67	-137.68
CA Gd 6	381952076270901	38.331944	-76.452139	11.74	-152.61
CA Gd 61	381956076275301	38.332361	-76.464611	17.26	-143.57
CH Ce 41	382225076591002	38.541028	-76.986944	193.43	-34.00
CH Ce 62	383348076595401	38.563167	-76.998167	194.19	-12.17
CH Ch 15	383043076404501	38.510139	-76.680528	8.90	-72.26
CH Df 17	382800076530301	38.473722	-76.884000	160.10	-70.20
CH Ff 59	381639076523201	38.273472	-76.875222	7.15	-54.07
CO Cc 101	385959075525901	38.999835	-75.882714	59.23	-22.95
DO Db 19	382847076190901	38.480194	-76.319389	0.72	-72.11
KE Cb 100	391124076101004	39.189861	-76.168611	64.90	26.26
KE Db 42	390909076122302	39.152944	-76.206306	24.19	9.93
KE Dc 91	390626076083302	39.107333	-76.142171	3.85	-0.12
PG Hf 35	383228076410601	38.541417	-76.684306	10.35	-68.80
PG Hf 42	383348076411303	38.563389	-76.685306	26.89	-66.83
QA Be 17	391203076024303	39.200943	-76.044945	24.21	13.30
QA Cf 78	390845075582302	39.145833	-75.973056	60	-16.88

Appendix 1a (continued)

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
QA Db 32	390201076182703	39.033722	-76.307178	17.21	0.98
QA Db 35	390119076191001	39.022056	-76.319123	6.72	1.03
QA Db 37	390023076174302	39.006501	-76.294955	6.32	-1.50
QA De 27	390251076034401	39.047612	-76.061889	9.42	-32.3
QA Ea 78	385718076211502	38.955113	-76.353845	11.02	-1.74
QA Ea 80	385757076200102	38.965946	-76.333289	7.72	-2.73
QA Eb 113	385748076172001	38.963446	-76.288565	10.57	-9.17
QA Eb 155	385843076155302	38.978724	-76.264399	3.13	-7.97
QA Eb 156	385852076195201	38.981223	-76.330789	11.23	-2.26
QA Fc 7	385429076120201	38.908170	-76.200227	9.27	-31.20
SM Bb 15	382838076470101	38.477556	-76.783222	164.43	-76.34
SM Cc 8	382235076435801	38.377222	-76.732472	127.99	-71.74
SM Cc 16	382449076431202	38.413736	-76.719687	154.13	-77.14
SM Cc 22	382055076404601	38.348737	-76.679129	132.10	-75.97
SM Ce 38	382222076304602	38.339750	-76.512583	15.08	-120.51
SM Ce 43	382012076332901	38.336667	-76.557806	87.13	-110.45
SM Dc 42	381648076421801	38.280128	-76.704687	12.63	-70.23
SM Dc 59	381807076442801	38.302072	-76.740800	40.01	-69.24
SM Dd 39	381834076381301	38.308833	-76.634722	106.57	-83.94
SM Dd 49	381616076364702	38.270250	-76.613944	118.00	-82.84
SM Dd 50	381807076380001	38.302500	-76.632639	98.47	-79.20
SM Dd 68	381654076394502	38.281794	-76.662185	124.08	-74.94
SM Dd 69	381923076372501	38.323861	-76.623250	124.09	-70.05
SM Df 1	381552076265001	38.264722	-76.447139	92.46	-154.28
SM Df 10	381715076261601	38.286791	-76.438007	45.14	-140.98
SM Df 61	381604076271701	38.267889	-76.453528	107.97	-149.45
SM Df 62	381632076275301	38.275806	-76.467389	103.12	-162.81
SM Df 71	381527076283101	38.256972	-76.475278	68.25	-140.93
SM Df 80	381532076250101	38.259028	-76.416556	41.10	-133.29
SM Df 86	381548076272103	38.263250	-76.455639	111.20	-158.23
SM Df 95	381617076263201	38.271444	-76.442000	79.12	-153.59
SM Dg 18	381607076241401	38.269389	-76.403278	17.11	-130.40
SM Dg 19	381747076223901	38.296000	-76.376389	9.14	-129.68
SM Fe 31	380834076303402	38.142917	-76.509278	8.22	-83.44
SM Ff 64	380821076255501	38.139417	-76.431444	9.06	-92.70
TA Cc 50	384707076133202	38.785500	-76.226583	7.22	-62.69
TA Cd 55	384620076052401	38.772061	-76.090498	14.22	-69.46
TA Dc 54	384052076101201	38.681229	-76.169666	4.15	-67.07
VA 54Q-21	382129077005801	38.358055	-77.016111	19.66	-29.14

Appendix 1b. Water-level data for Southern Maryland and Maryland's Eastern Shore wells used in this report (Magothy aquifer).

[Land surface and water-level altitudes are in feet and are measured from the North American Vertical Datum of 1988 (NAVD 88), same as sea level in this report. Latitude and longitude measured relative to the North American Datum of 1983 (NAD 83); USGS, U.S. Geological Survey]

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
AA Cc 95	390247076403501	39.046389	-76.676333	130.33	87.18
AA Cc 117	390103076402603	39.017694	-76.673889	133.36	44.26
AA Cd 12	390124076361202	39.023500	-76.603083	98.03	10.41
AA Cd 78	390238076373301	39.044139	-76.625639	128.04	37.70
AA Cd 143	390000076364001	38.999917	-76.611222	102.21	3.60
AA Ce 103	390214076342201	39.037278	-76.572556	58.40	0.95
AA Ce 130	390148076325202	39.030222	-76.547389	1.88	-10.45
AA Ce 133	390410076302401	39.070250	-76.506361	14.34	-3.29
AA Ce 138	390049076322702	39.013611	-76.540722	68.20	-18.50
AA Ce 151	390132076311401	39.025611	-76.520611	83.20	-18.46
AA Cf 99	390150076283002	39.030667	-76.474683	92.90	-25.24
AA Cf 104	390242076274501	39.045222	-76.462333	25.97	-24.97
AA Cf 152	390121076253301	39.022578	-76.426258	24.64	-23.62
AA Cg 7	390123076241102	39.023167	-76.402737	16.20	-29.95
AA Dc 20	385637076400802	38.943722	-76.668194	91.39	11.68
AA Dd 42	385808076373502	38.969000	-76.626076	104.68	0.99
AA De 1	385915076340401	38.987750	-76.567528	12.93	-19.31
AA De 103	385512076331603	38.920028	-76.554139	48.87	-16.72
AA Df 79	385905076293601	38.984861	-76.493250	4.36	-21.54
AA Df 82	385953076280201	38.998222	-76.467639	86.97	-23.89
AA Df 84	385518076282701	38.921778	-76.474472	6.50	-30.80
AA Ed 39	385210076371002	38.869558	-76.619130	175.67	-8.40
AA Ed 65	385406076383902	38.902119	-76.643617	108.83	-2.75
AA Fc 34	384833076415601	38.809472	-76.698722	50.18	-6.63
AA Fe 47	384843076312601	38.812361	-76.523861	5.52	-19.24
AA Fe 93	384644076331202	38.778667	-76.552722	7.22	-21.15
CA Bb 10	384028076354201	38.674194	-76.594222	186.00	-39.24
CA Bb 23	384458076375501	38.749278	-76.632972	145.96	-22.74
CA Cc 56	383934076320001	38.659778	-76.533639	95.30	-40.67
CA Dc 35	383050076305501	38.514194	-76.514417	90.76	-48.23
CE De 64	392746075524901	39.462889	-75.880361	16	-5.54
CH Be 43	383819076555501	38.637778	-76.931389	216.03	-80.62
CH Bf 98	383739076543001	38.627722	-76.907972	215.62	-85.36
CH Bf 124	383750076540801	38.632194	-76.900444	207.02	-84.67
CH Bf 133	383640076545901	38.611000	-76.915917	222.73	-117.49
CH Bf 135	383814076500301	38.637528	-76.832722	207.03	-57.42
CH Bf 143	383918076522201	38.655444	-76.905806	205.83	-65.57
CH Cf 39	383259076531001	38.549678	-76.886294	138.82	-75.64
DO Ce 15	383408076042402	38.569056	-76.072889	5.23	-11.73
KE Bc 184	391650076050401	39.280665	-76.084114	81.23	32.69
KE Be 43	391823075594701	39.306722	-75.995056	64.21	33.60
KE Cb 106	391238076131001	39.210667	-76.219500	30	-0.89
KE Dc 32	390758076095801	39.132888	-76.165784	4.21	-15.05
PG Cf 33	385806076435303	38.968333	-76.731750	114.62	46.22
PG De 21	385130076465501	38.858833	-76.781611	94.89	31.52
PG Ed 50	384715076522001	38.787778	-76.871667	240.11	1.08

Appendix 1b (continued)

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
PG Ef 34	384623076424001	38.773167	-76.711139	38.32	-12.23
PG Ef 40	384847076440401	38.813167	-76.733806	79.03	-2.32
PG Fd 32	384148076510901	38.696783	-76.852193	225	-39.34
PG Fd 39	384410076502501	38.735444	-76.839806	232.66	-13.94
PG Gf 35	383832076414701	38.642139	-76.696861	34.05	-38.96
PG Hf 41	383348076411302	38.563389	-76.685389	27.43	-55.54
QA Ea 27	385718076205501	38.954002	-76.348011	17.49	-22.72
TA Cd 56	384617076052501	38.771505	-76.089942	14.22	-119.25

Appendix 1c. Water-level data for Southern Maryland and Maryland's Eastern Shore wells used in this report (Upper Patapsco aquifer system).

[Land surface and water-level altitudes are in feet and are measured from the North American Vertical Datum of 1988 (NAVD 88), same as sea level in this report. Latitude and longitude measured relative to the North American Datum of 1983 (NAD 83); USGS, U.S. Geological Survey]

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
AA Ad 108	391032076385906	39.175889	-76.649056	77.52	70.44
AA Bd 159	390737076374402	39.127083	-76.629083	74.69	38.25
AA Bf 100	390629076273601	39.108364	-76.459517	44.9	16.47
AA Cc 43	390422076414501	39.072725	-76.695953	175.3	114.17
AA Cc 116	390103076402602	39.017694	-76.673889	133.57	-10.61
AA Ce 120	390303076344301	39.050889	-76.578444	161.00	4.96
AA Cf 118	390207076292802	39.035278	-76.490278	119.76	-50.25
AA Cf 128	390149076261703	39.030389	-76.437738	13.20	-25.48
AA Cf 134	390121076270501	39.021889	-76.449889	23.20	-27.40
AA Cg 24	390123076241603	39.023167	-76.404125	11.88	-20.66
AA De 95	385853076333001	38.981722	-76.557778	72.41	-35.84
AA De 128	385530076334701	38.924889	-76.562611	27.51	-15.74
AA De 199	385753076310801	38.964303	-76.519386	37.05	-22.36
AA De 219	385915076335303	38.987611	-76.564408	119.21	-23.99
AA De 230	385627076322901	38.940764	-76.541389	35.37	-19.31
AA Df 19	385921076270701	38.989556	-76.451944	15.04	-26.30
AA Df 99	385905076293604	38.984861	-76.493250	4.36	-27.29
CA Cc 55	383934076320201	38.659972	-76.532861	104	-18.08
CA Db 96	383244076354201	38.545889	-76.589639	151.56	-48.33
CE Ce 56	393026075523101	39.507611	-75.874917	37.22	6.84
CE Ee 29	392403075521801	39.401472	-75.871528	74.20	-18.26
CH Be 60	383706076575604	38.617778	-76.963889	212.02	-64.66
CH Bf 157	383637076545803	38.610917	-76.916000	224.23	-86.93
CH Bf 158	383732076531902	38.625639	-76.888194	192.23	-65.05
CH Cd 31	383222077004401	38.539565	-77.011919	129.19	-89.18
CH Cd 54	383346077000901	38.562806	-77.002472	179.18	-105.21
CH Ce 16	383217076590201	38.537642	-76.983231	186.65	-111.23
CH Ce 50	383420076592501	38.572322	-76.989578	201.37	-78.47
CH Cg 24	383254076481401	38.548778	-76.803389	171.04	-66.38
CH Da 21	382659077152401	38.449528	-77.256667	89.20	-16.47
CH Dd 33	382607077002601	38.419278	-77.000222	98.98	-53.80
CH Dd 38	382925077010101	38.499203	-77.016678	76.4	-79.85
CH Fe 5	381803076550801	38.301333	-76.917806	11.16	-67.94
DO Ce 84	383243076042801	38.545397	-76.074107	15.23	-45.24
KE Ac 20	392007076075501	39.334917	-76.131500	6.19	-2.03
KE Be 171	391643075550901	39.278722	-75.917996	40.62	-12.85
KE Cb 36	391400076101401	39.233167	-76.170611	39.20	-7.72
KE Cb 103	391124076101005	39.189861	-76.168361	64.81	-10.72
KE Db 40	390837076140401	39.143778	-76.234167	14.19	-11.74
PG Cf 31	385757076442001	38.965750	-76.738861	146.22	45.41
PG De 33	385323076471802	38.889444	-76.797861	102.83	52.47
PG Fb 36	384423077004501	38.739778	-77.012167	77.19	-31.09
PG Hf 40	383348076411301	38.563500	-76.685333	27.11	-51.69
PG Hf 44	383250076405304	38.547344	-76.681074	9.58	-59.53
QA Be 16	391203076024302	39.200943	-76.044945	24.21	-29.25
QA Eb 111	385751076171601	38.964279	-76.287454	13.26	-23.38

Appendix 1c (continued)

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
QA Eb 167	385850076183601	38.980668	-76.309678	14.23	-21.53
QA Ef 29	385534075573601	38.927336	-75.960772	60.92	-25.30
SM Bc 41	382621076445301	38.439111	-76.747889	159.14	-66.81
SM Cc 31	382312076415901	38.386667	-76.699722	82.48	-90.05
SM Dc 64	381559076400201	38.266667	-76.666667	32.08	-70.33
SM Dc 65	381647076421801	38.279722	-76.705000	15.53	-64.07
SM Dd 78	381827076350402	38.307500	-76.584167	129.08	-84.28
SM Dd 79	381834076381303	38.308833	-76.634722	112	-93.11
SM Dd 81	381509076351401	38.256111	-76.584722	113	-72.36
SM Dd 83	381621076364701	38.272500	-76.613056	119.06	-67.26
SM De 52	381753076310001	38.298056	-76.518056	109.11	-84.13
SM De 59	381914076331002	38.320000	-76.552778	150	-83.42
SM Df 84	381548076272102	38.263111	-76.456056	107.50	-73.85
SM Df 88	381955076293901	38.333139	-76.496306	19.16	-73.79
SM Df 100	381721076264801	38.289167	-76.446528	20.14	-74.17
SM Ef 94	381440076271701	38.244444	-76.454722	79.09	-85.48
SM Ff 36	380724076251901	38.122611	-76.421667	5.06	-53.36
TA Cd 57	384709076050301	38.785949	-76.083831	11.23	-120.13
WE Cc 3	385327076544801	38.890833	-76.913472	88.7	-74.06

Appendix 1d. Water-level data for Southern Maryland and Maryland's Eastern Shore wells used in this report (Lower Patapsco aquifer system).

[Land surface and water-level altitudes are in feet and are measured from the North American Vertical Datum of 1988 (NAVD 88), same as sea level in this report. Latitude and longitude measured relative to the North American Datum of 1983 (NAD 83); USGS, U.S. Geological Survey]

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
4S2E-7	391456076345002	39.248947	-76.580686	7.02	3.48
5S2E-26	391349076354401	39.230378	-76.595711	68.74	26.58
AA Ad 102	391032076385904	39.175861	-76.649167	75.93	67.75
AA Ad 109	391006076380101	39.168000	-76.634056	34.99	39.95
AA Ae 47	391124076331201	39.190056	-76.553194	35.45	4.05
AA Bc 215	390700076412601	39.116889	-76.690722	123.24	34.63
AA Bd 37	390848076363601	39.147222	-76.609444	37.40	24.12
AA Bd 56	390950076384001	39.163917	-76.644139	60.81	53.73
AA Bd 91	390950076391101	39.163917	-76.652722	81.85	70.02
AA Bd 101	390855076373402	39.149000	-76.626556	54.21	38.92
AA Bd 152	390821076365401	39.139639	-76.615028	52.49	30.07
AA Bd 155	390938076383701	39.161167	-76.643139	56.71	49.10
AA Bd 156	390922076371001	39.155833	-76.619083	68.19	36.15
AA Bd 157	390737076374401	39.127111	-76.629139	74.96	38.95
AA Bd 158	390744076390001	39.129194	-76.649722	107.47	61.66
AA Bd 160	390908076394402	39.152556	-76.661833	87.22	76.55
AA Bd 181	390839076385702	39.144219	-76.649408	176.7	56.04
AA Bf 99	390654076283601	39.114861	-76.476972	39.19	-21.21
AA Cc 40	390423076432001	39.073500	-76.722111	136.17	87.30
AA Cc 82	390422076414505	39.072897	-76.696006	177.96	47.07
AA Cc 89	390010076415703	39.001861	-76.699444	51.99	-6.20
AA Cc 137	390126076402901	39.024278	-76.674278	114.57	-5.99
AA Cd 128	390327076363701	39.057461	-76.610711	109.22	12.87
AA Ce 94	390450076343503	39.080665	-76.576075	89.20	-99.72
AA Ce 136	390043076345401	39.012961	-76.582711	59.4	-22.70
AA Cf 137	390205076292702	39.034556	-76.490111	123.50	-70.01
AA Cf 167	390154076282802	39.031544	-76.474381	105.89	-77.32
AA Cg 23	390123076241602	39.023167	-76.404125	11.77	-42.36
AA De 206	385833076332801	38.976167	-76.557222	80.95	-44.20
AA De 232	385915076335304	38.987500	-76.564722	118.21	-39.98
AC Aa 2	385157076580301	38.865944	-76.967583	125.59	116.93
AC Aa 6	385138076585901	38.860667	-76.983139	142.55	135.79
AC Aa 7	385138076585902	38.860667	-76.983139	142.55	115.51
CA Db 99	383311076350301	38.553056	-76.584167	159.14	-48.15
CA Fd 85	382236076255401	38.376472	-76.431972	105.98	-34.65
CH Bc 24	383633077083001	38.609639	-77.141278	71.17	-111.61
CH Bc 81	383709077061002	38.619194	-77.102694	155.63	-113.08
CH Bd 33	383844077040701	38.647028	-77.065583	179.19	-115.23
CH Bd 51	383715077014901	38.620556	-77.029583	184.19	-137.42
CH Be 58	383706076575602	38.617833	-76.964000	211.72	-173.86
CH Be 72	383903076594301	38.650833	-76.995278	109.23	-124.92
CH Bf 146	383508076540701	38.585889	-76.900833	192.03	-134.62
CH Bg 17	383706076475401	38.618452	-76.798024	199.16	-66.73
CH Cb 7	383422077114601	38.572861	-77.195722	35.18	-21.58
CH Cb 28	383315077131401	38.554444	-77.220222	4.18	-38.33
CH Cb 38	383328077114201	38.557898	-77.194702	3.19	-52.42

Appendix 1d (continued)

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
CH Cc 31	383455077074401	38.582083	-77.128361	34.19	-85.06
CH Cd 42	383256077015301	38.548942	-77.036122	187.62	-109.55
CH Cd 53	383340077000901	38.560944	-77.002778	159.18	-153.35
CH Ce 35	383111076584801	38.520189	-76.979736	172.37	-124.57
CH Ce 37	383236076563901	38.543454	-76.943862	184.18	-159.78
CH Ce 56	383251076583901	38.547306	-76.977139	195.69	-145.82
CH Da 20	382654077152701	38.448222	-77.256472	89.20	-18.13
CH De 52	382752076593601	38.464722	-76.995278	165	-84.00
CH Ee 70	382154076574801	38.364139	-76.960278	21.99	-102.22
CH Ee 78	382240076582801	38.376528	-76.973944	74.16	-90.77
CH Ff 60	381806076545401	38.298861	-76.911917	11.15	-76.39
PG Be 14	390226076481001	39.040969	-76.802311	149.7	106.38
PG Cf 32	385806076435302	38.968417	-76.731694	114.62	28.68
PG Cf 76	385757076440402	38.965833	-76.734861	126.83	31.59
PG Cf 80	385816076434502	38.962667	-76.747444	149.22	43.77
PG Ed 34	384933076530001	38.825806	-76.884472	269.21	-9.52
PG Fb 57	384056077015501	38.682339	-77.031643	169.16	-111.91
PG Gd 6	383958076520601	38.666333	-76.868167	216.24	-101.25
PG Hf 32	383250076405303	38.549533	-76.681406	9.58	-56.07
QA Be 15	391203076024301	39.200943	-76.044945	24.21	-9.31
QA Eb 112	385751076171602	38.964279	-76.287454	13.15	-35.76
QA Eb 182	385850076183501	38.980668	-76.309400	13.23	-42.55
SM Bc 39	382605076430201	38.434750	-76.716778	161.54	-49.48
SM Dd 72	381626076393401	38.274000	-76.659611	109.99	-41.15
VA 54R-2	382341077032401	38.394722	-77.056667	69.19	-80.12
WE Cb 12	385332076564102	38.892250	-76.944778	60.59	37.24

Appendix 1e. Water-level data for Southern Maryland and Maryland's Eastern Shore wells used in this report (Patuxent aquifer system).

[Land surface and water-level altitudes are in feet and are measured from the North American Vertical Datum of 1988 (NAVD 88), same as sea level in this report. Latitude and longitude measured relative to the North American Datum of 1983 (NAD 83); USGS, U.S. Geological Survey]

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
2S5E-1	391617076322001	39.271583	-76.538472	27.39	2.80
4S2E-6	391456076345001	39.248933	-76.580756	6.88	1.20
AA Ad 90	391032076385902	39.176000	-76.649222	77.06	-88.84
AA Bb 67	390538076453001	39.094639	-76.757306	132.26	-6.78
AA Bb 87	390826076454802	39.140556	-76.763333	268.55	141.58
AA Bb 88	390756076464201	39.132222	-76.778333	174.11	136.76
AA Bb 90	390657076462601	39.115833	-76.773889	162.76	103.15
AA Bc 163	390524076442501	39.089972	-76.741056	134.37	-9.61
AA Bc 240	390752076441001	39.131500	-76.735444	259.25	20.32
AA Bd 57	390952076384102	39.164722	-76.644417	69.21	-184.08
AA Bd 182	390839076385703	39.144264	-76.649339	178.06	-36.73
AA Cb 1	390303076463201	39.050111	-76.775750	128.35	15.95
AA Cc 80	390422076414503	39.072897	-76.696006	177.99	41.32
AA Cc 81	390422076414504	39.072897	-76.696006	177.98	43.98
AA Cc 102	390004076420001	39.001361	-76.699472	53.18	-54.47
AA Cc 113	390256076413101	39.049008	-76.691806	150.73	-40.56
AA Cc 119	390437076432302	39.077667	-76.723361	138.25	-22.42
AA Cc 124	390419076432301	39.072014	-76.722833	126.87	7.43
AA Cc 135	390126076403001	39.024306	-76.674333	114.04	-86.21
AA Ce 117	390450076343402	39.080889	-76.576000	85.20	-41.56
AA Cf 166	390154076282801	39.031558	-76.474467	105.93	-114.47
AA Cg 22	390123076241601	39.023167	-76.404125	11.81	-50.44
AA De 203	385854076333202	38.981361	-76.558772	92.59	-57.21
BA Gf 11	391356076293501	39.232167	-76.492556	12.72	-5.42
CH Bc 75	383645077062401	38.613028	-77.105944	123.77	-104.70
CH Bc 77	383644077055501	38.612111	-77.099333	95.82	-105.38
CH Bc 78	383809077053401	38.636056	-77.092389	20.13	-102.30
CH Bd 52	383553077032401	38.598333	-77.056111	46.68	-100.73
CH Be 57	383706076575601	38.617778	-76.963889	211.48	-57.95
CH Be 73	383903076594302	38.650833	-76.995278	106	-62.60
CH Bf 166	383846076512001	38.646250	-76.855611	211	-32.35
CH Bf 167	383556076505201	38.598972	-76.847833	182	-34.58
CH Bg 18	383621076462801	38.605744	-76.774492	187.16	-34.83
CH Cb 45	383255077121201	38.548583	-77.203222	126	-150.18
CH Cc 34	383441077063901	38.578444	-77.110722	41.01	-99.07
CH Ce 57	383250076584001	38.547250	-76.977611	192.68	-37.68
CH Ce 66	383445076551301	38.578806	-76.919861	179	-37.90
CH Da 18	382654077152501	38.448333	-77.223111	89.11	-14.17
CH Ee 96	382151076580901	38.364342	-76.967453	22.16	-38.01
HA De 181	392606076145801	39.435109	-76.249122	11.34	4.58
HA De 183	392606076145803	39.435109	-76.249122	11.65	2.92
HA De 197	392819076130901	39.472054	-76.218844	18.21	7.13
HA Ec 11	392435076203301	39.409830	-76.342181	10.88	10.01
HA Ec 46	392408076210101	39.402330	-76.349959	22.35	7.85
HA Ed 47	392455076192101	39.415386	-76.322180	89.68	20.30
HO Df 60	390830076473902	39.141667	-76.794167	210.68	166.44

Appendix 1e (continued)

Well number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Land surface altitude	Water-level altitude 2019
PG Bc 16	390151076561501	39.031075	-76.937206	188.29	167.93
PG Cf 66	385745076445201	38.962750	-76.747167	149.29	-38.00
PG Fd 62	384309076511401	38.719556	-76.853278	227.85	-32.42
PG Hf 43	383300076411601	38.550033	-76.687386	44.17	-77.87
QA Eb 110	385751076171603	38.964279	-76.287454	13.21	-12.63
WE Ca 35	385429076583601	38.908111	-76.976667	150.05	16.85
WE Ca 36	385460076574801	38.916639	-76.963194	42.71	31.56
WE Cb 8	385252076572801	38.881194	-76.957778	58.79	14.15
WE Ba 10	385534076582101	38.926222	-76.972611	74.43	68.20
WE Ba 11	385649076584201	38.946889	-76.978444	87.43	75.66
WE Ca 35	385429076583601	38.908111	-76.976667	150.05	16.85
WE Ca 36	385460076574801	38.916639	-76.963194	42.71	31.56
WE Cb 8	385252076572801	38.881194	-76.957778	58.79	14.15
WW Bc 8	385519077012601	38.922028	-77.024139	123.39	112.34
WW Bc 9	385527077000701	38.924389	-77.002139	133.6	117.40
WW Cc 38	385257077001101	38.882472	-77.003131	60.61	8.92

Appendix 2a. Water-use data from 2018 (Aquia aquifer).

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
AA1948G001	384329076322601	38.724840	-76.540234	0.04226
AA1950G002	390214076262401	39.037333	-76.439682	0.00711
AA1960G008	384847076421801	38.813170	-76.704689	0.04489
AA1971G020	384835076310901	38.809838	-76.518846	0.00407
AA1973G013	384857076415301	38.815948	-76.697744	0.01874
AA1976G014	384827076403701	38.807615	-76.676632	0.06430
AA1986G045	384907076414001	38.818726	-76.694133	0.00826
AA2001G019	385857076292301	38.982612	-76.489405	0.02988
AA2008G001	390030076394301	39.008333	-76.661944	0.00006
CA1953G102	383047076305102	38.513178	-76.513842	0.00675
CA1959G002	383355076314001	38.565399	-76.527454	0.05046
CA1959G003	384420076391001	38.739090	-76.652606	0.01254
CA1959G101	383526076365402	38.590695	-76.614838	0.00760
CA1960G002	382033076245101	38.342624	-76.413839	0.53409
CA1962G201	382749076283402	38.463734	-76.475785	0.01527
CA1966G005	384410076385701	38.736228	-76.648852	0.01305
CA1969G010	382600076265401	38.433457	-76.448007	0.43100
CA1970G005	383317076351401	38.554844	-76.586902	0.00429
CA1970G007	383029076383601	38.508178	-76.643016	0.05337
CA1972G003	384111076322701	38.686508	-76.540512	0.42178
CA1973G013	384230076335501	38.708451	-76.564958	0.01782
CA1973G014	382331076242401	38.392068	-76.406339	0.00006
CA1974G005	383237076353901	38.543733	-76.593847	0.25716
CA1974G102	383336076311502	38.560122	-76.520510	0.00943
CA1976G005	383040076374501	38.511111	-76.629167	0.01388
CA1978G004	384220076330501	38.705674	-76.551068	0.06692
CA1984G003	382123076270901	38.356513	-76.452174	0.34472
CA1986G007	382819076303901	38.472068	-76.510509	0.04383
CA1988G009	384210076320201	38.702896	-76.533567	0.13684
CA1990G008	384311076394801	38.719839	-76.663019	0.00291
CA1993G048	382004076282401	38.334569	-76.473008	0.04922
CA1994G004	383922076320301	38.656231	-76.533844	0.00334
CA1995G030	383734076370601	38.626231	-76.618015	0.01422
CA1996G026	384300076363901	38.716784	-76.610516	0.33126
CA1999G018	383625076352601	38.607065	-76.590236	0.04012
CA2002G001	383704076362801	38.617898	-76.607459	0.00885
CH1955G006	383249076481501	38.547066	-76.803857	0.02500
CH1965G007	383458076574101	38.582897	-76.961084	0.01500
CH1972G006	382952076562601	38.497900	-76.940250	0.00800
CH1980G020	383049076402901	38.513734	-76.674406	0.01647
CH2002G025	382307076563801	38.385278	-76.943889	0.00055
CO1987G004	390021075531603	39.005946	-75.887436	0.00392
KE1959G003	391436076020901	39.243443	-76.035500	0.01603
KE1970G004	391238076035301	39.213443	-76.064390	0.23729
KE1975G002	391809075531201	39.302611	-75.886328	0.03181
KE1980G001	391740075545401	39.294555	-75.914662	0.33488

Appendix 2a (continued)

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
KE1987G013	391707075482101	39.285389	-75.805491	0.03167
KE1991G007	391258076035201	39.216221	-76.064113	0.09714
KE1992G021	392115075495801	39.354278	-75.832437	0.01404
KE1992G124	391449075482201	39.246944	-75.806111	0.00808
KE1993G003	391746075480701	39.296222	-75.801602	0.02996
KE1993G005	391926075493501	39.324000	-75.826047	0.10034
KE1993G006	391905075483101	39.318167	-75.808269	0.07392
KE1993G007	392114075481701	39.354000	-75.804102	0.09629
KE1993G010	391821075570101	39.305944	-75.949942	0.01294
KE1993G011	391721075570201	39.289277	-75.950220	0.01404
KE1994G008	391915075484401	39.320945	-75.811880	0.00267
KE1994G013	392203075460801	39.367500	-75.768889	0.00481
KE1995G001	391757075491101	39.299278	-75.819380	0.07319
KE1997G006	391329076053401	39.224832	-76.092447	0.01594
KE1998G006	391458075483601	39.249555	-75.809657	0.03600
KE1999G002	391907075515501	39.318722	-75.864938	0.11461
KE1999G003	391811075572701	39.303166	-75.957164	0.01223
KE1999G014	391748075504001	39.296778	-75.844104	0.00855
KE1999G022	392232075464601	39.375667	-75.779101	0.05707
KE2001G004	392123075473801	39.356500	-75.793546	0.00032
KE2001G017	391611075543001	39.269832	-75.907995	0.15764
KE2002G021	391740075535101	39.294555	-75.897162	0.02671
KE2003G001	391550075501601	39.263782	-75.837690	0.08230
KE2007G005	391111076045701	39.186389	-76.082500	0.01000
KE2007G006	392016075501101	39.337778	-75.836389	0.02767
KE2008G010	391001076031601	39.166879	-76.054438	0.05247
KE2008G011	391458075471901	39.249444	-75.788611	0.00881
KE2010G001	391708075491101	39.285556	-75.819722	0.03235
KE2011G002	392016075490801	39.337778	-75.818889	0.04749
KE2011G003	391552075550801	39.264444	-75.918889	0.01901
KE2012G001	391557075463901	39.265833	-75.777500	0.01230
KE2012G003	391553075555901	39.264722	-75.933056	0.00630
KE2012G008	391719075504001	39.288611	-75.844444	0.02328
KE2012G009	391748075494801	39.296667	-75.830000	0.00868
KE2012G011	391840075534901	39.311111	-75.896944	0.05352
KE2012G019	391523075552101	39.256389	-75.922500	0.00753
KE2012G020	391857075500001	39.315833	-75.833333	0.00603
KE2013G001	391641075542901	39.278056	-75.908056	0.05302
KE2013G004	391604075575301	39.267778	-75.964722	0.01553
KE2013G006	391718075493601	39.288333	-75.826667	0.03045
KE2013G007	391711075541601	39.286389	-75.904444	0.02961
KE2013G014	391454075574201	39.248333	-75.961667	0.01063
KE2014G001	391932075591901	39.325556	-75.988611	0.08932
KE2014G002	--	39.179366	-76.182284	0.00024
KE2014G003	--	39.192009	-76.147115	0.05270
KE2014G004	--	39.293621	-75.980223	0.06084

Appendix 2a (continued)

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
KE2014G005	--	39.274338	-75.951829	0.00013
KE2014G008	--	39.355932	-75.814348	0.02900
KE2015G001	--	39.320843	-75.887370	0.04034
KE2015G002	--	39.332299	-75.803448	0.03324
KE2016G003	--	39.283533	-75.947404	0.00014
KE2017G003	--	39.307144	-75.901375	0.01303
KE2017G004	--	39.172355	-76.156793	0.00610
PG1996G005	384719076522501	38.788725	-76.873305	0.02209
QA1956G001	385719076035201	38.955391	-76.064110	0.23611
QA1961G005	390155076012901	39.032056	-76.024387	0.00147
QA1962G001	385913076170901	38.987057	-76.285510	0.00641
QA1963G002	390650075590501	39.114000	-75.984386	0.02797
QA1963G004	391403075552301	39.234277	-75.922718	0.01524
QA1965G004	385453076085801	38.914836	-76.149114	0.00372
QA1967G002	390235076034801	39.043167	-76.063000	0.36736
QA1969G003	385849076070101	38.980390	-76.116613	0.00751
QA1976G003	385444076120801	38.912336	-76.201616	0.00699
QA1979G010	385910076092001	38.986224	-76.155226	0.03420
QA1980G013	385454076115501	38.915114	-76.198283	0.05955
QA1982G002	385903076165601	38.984279	-76.281899	0.00897
QA1983G005	385824076174701	38.973446	-76.296066	0.00058
QA1986G013	385753076141201	38.964835	-76.236341	0.00264
QA1990G003	391248075452701	39.213445	-75.757988	0.01644
QA1990G012	385443076085801	38.912058	-76.149114	0.00012
QA1990G040	391123075524001	39.189833	-75.877438	0.00789
QA1991G001	391100075460701	39.183167	-75.768266	0.08558
QA1991G009	385924075573001	38.990113	-75.957994	0.00008
QA1991G013	390306076062001	39.051778	-76.105224	0.01134
QA1991G016	390028076072501	39.008158	-76.123412	0.26519
QA1992G007	391340075500601	39.227888	-75.834658	0.04101
QA1992G008	390720076000801	39.122333	-76.001886	0.01434
QA1992G011	391346076001601	39.229554	-76.004110	0.00039
QA1992G012	391316075593801	39.221221	-75.993554	0.06202
QA1992G013	391227076000401	39.207610	-76.000776	0.07549
QA1992G014	391326076005401	39.223998	-76.014666	0.02986
QA1992G015	391207076000401	39.202054	-76.000776	0.02269
QA1992G016	391306076002901	39.218443	-76.007721	0.01539
QA1992G019	--	38.892998	-76.145906	0.00493
QA1992G020	391209075460601	39.202611	-75.767989	0.01233
QA1992G026	391126075570701	39.190666	-75.951607	0.02130
QA1992G027	391138076012101	39.193999	-76.022166	0.06384
QA1992G032	391039076014701	39.177610	-76.029388	0.01045
QA1992G033	391019076012201	39.172055	-76.022444	0.01618
QA1992G044	385753076142502	38.964835	-76.239953	0.07036
QA1993G002	390559075563401	39.099834	-75.942439	0.16294
QA1993G010	390138076074901	39.027334	-76.129948	0.18200

Appendix 2a (continued)

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
QA1993G011	385957076033701	38.999279	-76.059944	0.07160
QA1993G012	390157076062101	39.032612	-76.105224	0.08298
QA1993G013	390128076071201	39.024556	-76.119669	0.05418
QA1993G034	391126075582301	39.190666	-75.972719	0.12154
QA1994G005	390730075591801	39.125111	-75.987997	0.19496
QA1995G001	385958076060901	38.999557	-76.102168	0.10063
QA1995G011	390648075550401	39.113445	-75.917439	0.00003
QA1996G018	391325075575601	39.223721	-75.965219	0.04236
QA1997G003	390046076032401	39.012890	-76.056333	0.00032
QA1997G011	391419075483601	39.238722	-75.809657	0.03214
QA1997G040	391241075495401	39.211500	-75.831325	0.04742
QA1997G042	391308075464301	39.219000	-75.778267	0.05007
QA1998G005	390915075535901	39.154278	-75.899383	0.00151
QA1998G011	391142075503302	39.195111	-75.842158	0.03747
QA1998G017	390916075550201	39.154555	-75.916883	0.33151
QA1998G035	391354075574301	39.231776	-75.961608	0.01933
QA1998G039	390105076010401	39.018168	-76.017442	0.00395
QA1998G040	390026076025901	39.007335	-76.049388	0.03940
QA1999G015	391255075571901	39.215388	-75.954941	0.09192
QA1999G018	390818075563201	39.138444	-75.941884	0.06169
QA1999G019	390158076084001	39.032890	-76.144115	0.06378
QA1999G039	390156076033601	39.032334	-76.059666	0.05339
QA2000G002	390323076002401	39.056501	-76.006330	0.02236
QA2000G003	390935075541101	39.159833	-75.902716	0.00155
QA2000G023	390223075593501	39.039834	-75.992718	0.02258
QA2000G036	390348075523501	39.063446	-75.876048	0.01793
QA2000G037	390323075593401	39.056501	-75.992441	0.04357
QA2001G007	390216076054201	39.037890	-76.094668	0.02107
QA2002G026	385759076050801	38.966502	-76.085222	0.02877
QA2002G035	390151075545601	39.030946	-75.915215	0.20372
QA2002G036	391348075461701	39.230111	-75.771044	0.02989
QA2004G001	390848075583801	39.146777	-75.976886	0.00179
QA2004G019	390126076041401	39.024001	-76.070222	0.02775
QA2005G025	391104075514901	39.184444	-75.863611	0.03589
QA2006G016	391356075583301	39.232222	-75.975833	0.00022
QA2006G017	391336075583401	39.226667	-75.976111	0.00135
QA2007G028	385926075594901	38.990556	-75.996944	0.01085
QA2008G010	390821076021401	39.139167	-76.037222	0.02724
QA2008G013	391351075494001	39.230833	-75.827778	0.03797
QA2008G020	390620075573601	39.105556	-75.960000	0.04765
QA2008G021	390405076023001	39.068056	-76.041667	0.00447
QA2008G024	390734075480401	39.126111	-75.801111	0.02836
QA2008G027	391059076004301	39.183003	-76.011887	0.00397
QA2008G030	391422075515901	39.239349	-75.866337	0.00192
QA2009G003	391355075573001	39.231944	-75.958333	0.04419
QA2009G006	391218076005401	39.205000	-76.015000	0.09077

Appendix 2a (continued)

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
QA2009G010	390744075480401	39.128889	-75.801111	0.00152
QA2010G005	390819075580001	39.138611	-75.966667	0.08438
QA2010G006	391207075582201	39.201944	-75.972778	0.03534
QA2012G002	390929075592801	39.158056	-75.991111	0.00000
QA2012G006	391354075562601	39.231667	-75.940556	0.07112
QA2012G007	390949076001801	39.163611	-76.005000	0.00300
QA2013G009	391205075543301	39.201389	-75.909167	0.02119
QA2013G011	391128075593901	39.191111	-75.994167	0.13493
QA2013G015	391125075533101	39.190278	-75.891944	0.10297
QA2016G005	--	39.140044	-75.819351	0.00787
QA2017G002	--	39.118636	-75.940808	0.00597
SM1932G001	380841076253401	38.144849	-76.425784	0.00102
SM1946G001	381537076272401	38.260403	-76.456341	1.34483
SM1950G002	380853076312501	38.148183	-76.523288	0.00021
SM1965G002	381640076422601	38.277906	-76.706909	0.01700
SM1966G006	382902076463501	38.484012	-76.776078	0.06017
SM1967G009	381559076363501	38.266516	-76.609404	0.00048
SM1969G001	381129076252001	38.191515	-76.421895	0.08960
SM1970G010	380833076303501	38.142627	-76.509399	0.02488
SM1971G004	382305076400601	38.384848	-76.668018	0.01056
SM1972G004	381809076443101	38.302628	-76.741633	0.01350
SM1973G003	381536076250601	38.260125	-76.418006	0.14005
SM1974G018	381726076272301	38.290680	-76.456063	0.55617
SM1974G025	382941076432601	38.494845	-76.723575	0.04010
SM1974G035	382454076432701	38.415125	-76.723854	0.01248
SM1976G003	382435076464801	38.409847	-76.779689	0.11912
SM1976G014	381608076314701	38.269015	-76.529400	0.08998
SM1976G025	382015076305501	38.337625	-76.514954	0.00418
SM1979G010	380952076311202	38.164572	-76.519677	0.00227
SM1981G018	382842076464701	38.478457	-76.779411	0.04659
SM1983G016	381429076312201	38.244293	-76.522455	0.04383
SM1983G022	383001076463401	38.500400	-76.775800	0.00104
SM1985G051	382802076414601	38.467346	-76.695796	0.00400
SM1986G016	382901076445401	38.483734	-76.748021	0.02995
SM1986G060	381500076361101	38.250127	-76.602737	0.03134
SM1988G002	380932076320201	38.159016	-76.533567	0.01391
SM1989G010	382603076431401	38.434291	-76.720242	0.02680
SM1991G021	381447076251901	38.246514	-76.421618	0.00977
SM1992G010	382256076504701	38.382348	-76.846080	0.02006
SM1995G009	381428076262202	38.241236	-76.439118	0.02457
SM1995G042	381957076400701	38.332626	-76.668296	0.00003
SM1997G002	382136076422501	38.360126	-76.706631	0.01159
SM1998G025	381908076402001	38.319016	-76.671907	0.01796
SM2005G002	381120076254601	38.188889	-76.429444	0.01219
TA1969G002	384559076083901	38.766506	-76.143833	0.00709
TA1970G002	384113076101001	38.687063	-76.169111	0.05531

Appendix 2a (continued)

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
TA1971G002	384839076135301	38.808172	-76.231059	0.04103
TA1973G101	384855076032102	38.815393	-76.055497	0.01250
TA1979G004	384710076132801	38.786228	-76.224114	0.21233
TA1981G101	384320076054401	38.722339	-76.095220	0.00003
TA1982G008	384256076202801	38.715674	-76.340783	0.06756
TA1986G009	384331076091801	38.725562	-76.154913	0.04704
TA1989G002	385451076032901	38.914280	-76.057720	0.00128
TA1991G019	385240075593001	38.877892	-75.991328	0.02306
TA2003G015	384439076065901	38.744283	-76.116054	0.00529

Appendix 2b. Water-use data from 2018 (Magothy aquifer).

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
AA1949G004	390114076241801	39.020667	-76.404681	0.02500
AA1954G001	390108076364601	39.018999	-76.612465	0.08100
AA1960G021	390028076351701	39.007889	-76.587742	0.01600
AA1963G029	390107076325801	39.018722	-76.549130	0.04700
AA1965G032	385125076410201	38.857058	-76.683577	0.06500
AA1966G028	390047076315401	39.013167	-76.531351	0.04200
AA1966G048	390009076405901	39.002610	-76.682745	0.01200
AA1968G011	385204076372701	38.867892	-76.623852	0.00900
AA1972G009	385918076334901	38.988445	-76.563296	1.56600
AA1978G018	385839076345301	38.977612	-76.581075	0.00100
AA1987G051	390026076265101	39.007334	-76.447182	0.00400
AA1989G029	385523076372501	38.923056	-76.623611	0.02189
AA1990G024	385630076323401	38.941779	-76.542461	0.00100
AA1990G045	385501076344101	38.917057	-76.577740	0.01400
AA1992G022	384549076401302	38.763727	-76.669964	0.03800
AA1997G030	385910076402201	38.986222	-76.672466	0.00100
AA2003G005	390158076405901	39.032888	-76.682745	0.31100
AA2003G033	385613076404701	38.936944	-76.679722	0.00600
AA2005G015	385116076395801	38.854444	-76.666111	0.12800
AA2006G023	390433076255701	39.075833	-76.432500	0.00700
AA2010G005	390109076421501	39.019167	-76.704167	0.02300
AA2012G001	--	39.043432	-76.705828	0.05397
CA1970G004	384449076375401	38.747061	-76.631351	0.01900
CA1972G001	384102076391101	38.684007	-76.652740	0.01200
CA1972G002	384420076405101	38.739005	-76.680520	0.02000
CA1979G004	384322076394801	38.722778	-76.663333	0.00800
CA1989G008	384302076392201	38.717222	-76.656111	0.00500
CA1998G124	384033076410501	38.675951	-76.684408	0.00100
CA2002G010	384321076392301	38.722617	-76.656074	0.01500
CE1972G004	392414075520301	39.404001	-75.867161	0.07600
CE1973G008	392316075544901	39.387891	-75.913274	0.04000
CE1979G011	392536075575801	39.426781	-75.965778	0.08100
CE1987G075	392352075480101	39.397890	-75.799936	0.03500
CE1988G061	392503075514901	39.417613	-75.863272	0.46800
CE1998G014	392316075534501	39.387778	-75.895833	0.04900
CE2000G001	392513075512401	39.420391	-75.856327	0.03200
CE2007G024	392443075494101	39.411944	-75.828056	0.06900
CE2009G002	392502075482501	39.417222	-75.806944	0.08400
CE2012G001	392424075504501	39.406667	-75.845833	0.14300
CE2015G002	--	39.409118	-75.925181	0.00661
CE2016G001	--	39.409373	-75.830036	0.00657
CH1955G001	383537076520101	38.593731	-76.866637	0.00600
CH1962G003	383736076530401	38.626785	-76.884138	0.00700
CH1963G002	383806076523801	38.635118	-76.876915	0.01800
CH1963G008	383508076520101	38.585675	-76.866637	0.01300
CH1968G008	383647076512301	38.613175	-76.856081	0.00600

Appendix 2b (continued)

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
CH1970G009	383557076523901	38.599286	-76.877193	2.99300
CH1971G004	383438076540701	38.577342	-76.901638	0.00600
CH1977G033	383815076500701	38.637618	-76.834970	0.07700
DO1971G105	383246076042401	38.546230	-76.072996	0.11400
KE1967G001	392114076073501	39.353999	-76.126061	0.01100
KE1971G004	390816076143101	39.137888	-76.241621	0.17800
KE1974G003	391600076120601	39.266776	-76.201341	0.01200
KE1979G002	392152076034501	39.367334	-76.062170	0.03300
KE1979G105	391636076051901	39.276776	-76.088281	0.06900
KE1986G004	391516076013001	39.254444	-76.025000	0.00200
KE1988G004	391703076002601	39.284277	-76.006889	0.03300
KE1991G011	392145075502302	39.362612	-75.839382	0.00100
KE1992G011	391238076035302	39.210665	-76.064390	0.33958
KE1996G004	391906076074901	39.318443	-76.129950	0.00400
PG1956G007	384402076501901	38.736504	-76.838304	0.01900
PG1961G008	385801076435701	38.967055	-76.732191	0.17400
PG1962G007	383248076410701	38.546788	-76.684963	0.52200
PG1963G006	383925076492901	38.657062	-76.824414	0.02000
PG1975G008	384222076483801	38.706228	-76.810247	0.00400
PG1979G002	384719076521201	38.788725	-76.869694	0.01500
PG1990G023	384054076483901	38.681506	-76.810247	0.04300
PG1994G007	384501076513501	38.750393	-76.859416	0.01500
PG2000G003	384015076571601	38.670950	-76.954140	0.00600
QA1984G016	385814076172201	38.970668	-76.289121	0.00900
QA1985G009	385438076211201	38.910670	-76.353010	0.01300
QA1989G026	385911076102301	38.986501	-76.172727	0.01400
QA1994G007	385742076111501	38.961780	-76.187172	0.07600
QA1999G008	391047075584901	39.179833	-75.979942	0.15426
QA2013G006	391058075592701	39.182778	-75.990833	0.15800
TA1971G005	384637076043801	38.777060	-76.076886	0.55300

Appendix 2c. Water-use data from 2018 (Upper Patapsco aquifer system).

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
AA1953G108	390450076343506	39.080665	-76.576075	0.14500
AA1966G027	390035076244401	39.009834	-76.411903	0.01100
AA1968G006	385849076332401	38.980389	-76.556352	0.50400
AA1970G041	385927076274201	38.990945	-76.461349	0.00900
AA1971G034	390452076253201	39.081222	-76.425237	0.24700
AA1972G309	385918076334903	38.988445	-76.559130	1.01300
AA1982G036	390205076292201	39.034833	-76.489128	2.87400
AA1985G025	390355076354101	39.065388	-76.594409	0.00300
AA1989G041	384906076385601	38.818448	-76.648575	0.04500
AA1989G094	390941076343601	39.161498	-76.576354	0.02700
AA1999G041	385125076410202	38.857058	-76.683577	0.00500
AA2002G017	390801076293201	39.133721	-76.491906	0.00600
AA2011G008	390715076383701	39.120833	-76.643611	0.00400
AA2015G002	--	38.949861	-76.481250	0.00276
AA2017G003	--	39.016144	-76.529769	0.00158
CE1968G007	393116075475401	39.521224	-75.797714	0.00866
CE1974G017	392715075581001	39.454282	-75.969112	0.02197
CE1976G005	393030075522201	39.508447	-75.872440	0.01800
CE1989G083	392917075470501	39.488168	-75.784380	0.02200
CH1959G006	--	38.363422	-76.982255	0.00789
CH1965G011	383021076571601	38.507344	-76.954139	0.00800
CH1966G108	383359076594702	38.566509	-76.996086	0.01000
CH1967G002	382942076563801	38.495122	-76.943583	0.00700
CH1968G001	383329077005001	38.558176	-77.013586	0.02100
CH1969G003	383508076593401	38.585675	-76.992474	0.00900
CH1969G005	383409077014001	38.569286	-77.027475	0.00400
CH1970G001	383419076592201	38.572064	-76.989141	0.00700
CH1970G103	383150076583101	38.530677	-76.974974	0.00200
CH1971G002	383458077003701	38.582897	-77.009975	0.00400
CH1973G001	383607076593401	38.602063	-76.992474	0.00400
CH1974G007	383428076552201	38.574564	-76.922472	0.00400
CH1974G010	382803076584401	38.467623	-76.978585	0.01500
CH1975G001	383329077020501	38.558176	-77.034420	0.00600
CH1975G004	382137076561401	38.360404	-76.936638	0.00100
CH1976G011	382803076594701	38.467623	-76.996085	0.02400
CH1977G055	--	38.492372	-77.156917	0.00001
CH2014G005	383400077075701	38.566667	-77.132500	0.00900
DO1971G205	383316076034601	38.554563	-76.062440	0.68800
KE1971G003	392027075524501	39.340945	-75.878828	0.03900
KE1979G104	391321076101302	39.222609	-76.169951	0.04464
KE2008G014	391649076085401	39.280278	-76.148333	0.02500
KE2008G015	391609076073801	39.269167	-76.127222	0.04100
KE2008G020	391549076080401	39.263611	-76.134444	0.02300
PG1966G006	384720076590901	38.789003	-76.985531	0.00600
PG1984G001	383248076410702	38.546788	-76.684963	0.42300
PG1987G003	385553076491402	38.931500	-76.820249	0.00300

Appendix 2c (continued)

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
PG1989G001	383303076413001	38.550955	-76.691352	0.00500
PG1996G017	385513076433301	38.920390	-76.725523	0.00200
PG2002G005	385612076442301	38.936778	-76.739413	0.00100
PG2003G002	384640076545604	38.777892	-76.915251	0.00700
QA1985G024	385913076172101	38.987057	-76.288844	0.20500
SM1965G102	381641076422601	38.278056	-76.707222	0.01300
SM1966G009	380333076195901	38.059293	-76.332725	0.01200
SM1969G117	381601076395501	38.266944	-76.665278	0.06600
SM1970G210	380834076304601	38.142778	-76.512778	0.02400
SM1972G001	382256076503401	38.382348	-76.842469	0.06300
SM1976G103	382416076475001	38.404444	-76.797222	0.07000
SM1989G074	381428076262201	38.240958	-76.439118	0.03200
SM1989G110	382604076422301	38.434444	-76.706389	0.02100
SM1990G165	381928076372401	38.324444	-76.623333	0.00600
SM1998G021	381806076310801	38.301792	-76.518566	0.30100
SM2000G004	381817076350701	38.304848	-76.584958	0.05300
SM2001G009	380841076253402	38.144849	-76.425784	0.01500
SM2001G012	381726076272302	38.290680	-76.456063	0.03700
SM2003G016	381439076271101	38.244167	-76.453056	0.48200
SM2004G002	382624076445401	38.440000	-76.748333	0.00600
SM2004G014	381510076350701	38.252778	-76.585278	0.01800
SM2005G004	382306076415901	38.385000	-76.699722	0.03100
SM2005G014	381600076363501	38.266667	-76.609722	0.01800
SM2007G006	381917076331301	38.321389	-76.553611	0.13600
SM2007G007	381758076324801	38.299444	-76.546667	0.26100
SM2008G001	382106076333701	38.351667	-76.560278	0.01300
TA1971G205	384716076045101	38.787893	-76.080220	1.17900

Appendix 2d. Water-use data from 2018 (Lower Patapsco aquifer system).

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
AA1932G003	385857076293601	38.982612	-76.493016	0.38200
AA1953G008	390455076343801	39.082054	-76.576909	6.75500
AA1969G016	390714076422601	39.120664	-76.706913	0.31500
AA1970G013	390642076273801	39.111777	-76.460238	0.01800
AA1972G105	390058076402101	39.016221	-76.672189	5.27200
AA1972G209	385918076334902	38.988445	-76.563296	0.82400
AA1981G025	390803076392801	39.134275	-76.657467	0.22500
AA1982G031	390306076345101	39.051777	-76.580520	0.12500
AA1982G037	390842076363101	39.145109	-76.608299	0.25000
AA1984G070	391209076321501	39.202608	-76.537186	0.01200
AA1986G070	385849076333701	38.980112	-76.562185	2.69600
AA1987G069	390205076292202	39.034833	-76.489128	4.45200
AA1987G070	390047076350502	39.013166	-76.584131	0.01000
AA1989G059	390714076383801	39.120665	-76.643578	0.00700
AA1990G056	391200076350101	39.200108	-76.583298	0.00600
AA2004G016	390904076421301	39.151111	-76.703611	0.09200
AA2012G005	390139076403301	39.027500	-76.675833	0.02400
AA2015G007	--	39.095226	-76.630954	0.00208
AA2018G001	--	39.093690	-76.766217	0.01085
BA2012G004	391942076244601	39.328333	-76.412778	0.05100
CA1973G114	382302076234601	38.383889	-76.396111	0.08600
CA1974G205	382851076351501	38.480833	-76.587500	0.22700
CE1960G013	392844075583401	39.479005	-75.975779	0.00808
CE1961G007	393603075473601	39.600945	-75.792992	0.49822
CE1962G003	392943075565101	39.495394	-75.947166	0.00605
CE1969G014	392527075582401	39.424281	-75.973000	0.02639
CE1977G025	393548075545001	39.596667	-75.913889	0.00359
CE1992G073	--	39.557092	-75.790308	0.01285
CH1953G010	383716077052701	38.621229	-77.090533	0.01200
CH1954G003	383746077034601	38.629562	-77.062477	0.01400
CH1955G003	383756077050201	38.632340	-77.083588	0.00200
CH1955G008	383617077082301	38.604841	-77.139423	0.06900
CH1957G003	383547077083601	38.596508	-77.143034	0.16300
CH1967G011	382147076581901	38.363182	-76.971639	0.37900
CH1968G002	383358077095101	38.566231	-77.163868	0.00800
CH1968G009	383448077075801	38.580119	-77.132478	0.00600
CH1970G003	383200076583101	38.533454	-76.974974	0.86800
CH1971G005	383458077102901	38.582897	-77.174424	0.06600
CH1971G105	383319077130001	38.555398	-77.216369	0.00300
CH1972G002	381810076544601	38.302906	-76.912471	0.05400
CH1975G002	383121076562601	38.522621	-76.940250	0.01000
CH1983G012	383508076540705	38.585675	-76.901638	2.38300
CH1983G014	382247076585701	38.379848	-76.982195	0.05200
CH1988G025	383230077003701	38.541787	-77.009975	0.00100
CH1989G032	383726077020601	38.624007	-77.034420	0.11100
HA2014G005	--	39.475945	-76.119045	0.01854

Appendix 2d (continued)

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
PG1955G011	384114077002501	38.684561	-77.006642	0.02200
PG1957G003	385911076481001	38.986499	-76.802470	0.01200
PG1961G108	385751076442301	38.964278	-76.739413	0.02100
PG1977G008	385950076453801	38.997332	-76.760247	0.01000
PG1988G008	384303077005001	38.717615	-77.013587	0.01000
PG1993G003	384004076520001	38.667895	-76.866360	0.18300
QA1997G050	385854076185001	38.981779	-76.313567	0.35300
QA2010G007	385816076185001	38.971111	-76.313889	0.26200

Appendix 2e. Water-use data from 2018 (Patuxent aquifer system).

Water Use Permit number	USGS site identification number	Latitude (decimal degrees)	Longitude (decimal degrees)	Average Daily Use (million gallons per day)
AA1947G003	390606076495101	39.101775	-76.830528	0.02204
AA1962G030	391149076334401	39.197053	-76.561909	0.00033
AA1963G008	390844076443301	39.145664	-76.742193	0.07902
AA1969G019	390952076390301	39.164553	-76.650523	3.40502
AA1969G021	390456076433001	39.082331	-76.724691	2.90685
AA1970G046	390754076440801	39.131775	-76.735248	0.26000
AA1972G005	390058076403401	39.016221	-76.675800	4.94908
AA1973G025	390744076425201	39.128997	-76.714136	0.05830
AA2005G020	390156076292100	39.032222	-76.489167	2.41249
AA2011G009	391111076322801	39.186389	-76.541111	0.00005
BA1969G020	391615076273401	39.270941	-76.459128	1.72986
BA1970G006	391525076244901	39.257053	-76.413293	0.03431
BA2014G006	--	39.289898	-76.525366	0.03656
CE1954G006	393243076003801	39.542615	-76.010225	0.01404
CE1957G003	393635075522901	39.609835	-75.874385	0.02998
CE1958G005	393911075474501	39.653167	-75.795492	0.14265
CE1961G002	393318075531101	39.555114	-75.886052	0.04872
CE1966G025	393657075550201	39.615946	-75.916887	0.01211
CE1970G003	393617075542501	39.604835	-75.906331	0.01213
CE1987G009	393606075521701	39.604557	-75.871051	0.01410
CE1988G087	393420075582901	39.572337	-75.974390	0.08130
CE2001G026	393555075493001	39.598611	-75.825000	0.08948
CE2006G005	393432076001001	39.575556	-76.002778	0.08678
CE2013G001	393605075502101	39.601389	-75.839167	0.09951
CH1957G103	383548077083501	38.596667	-77.143056	0.10652
CH1968G004	383438077015301	38.577342	-77.031087	0.00517
CH1971G205	383408077121001	38.569008	-77.202480	0.66463
CH1971G305	383300077123401	38.550000	-77.209444	0.03313
CH1995G123	383728077042802	38.624562	-77.074144	0.39480
CH1998G008	383409077064201	38.569286	-77.111367	0.04330
HA1969G003	392801076121101	39.467054	-76.202732	3.80991
HA1977G123	392407076200502	39.402053	-76.334403	0.00484
HA1989G078	392850076113201	39.480666	-76.191898	0.14405
PG1958G003	390258076483501	39.049554	-76.809416	0.04156
PG1958G103	390258076483502	39.049554	-76.809416	0.10400
PG1961G208	385801076441001	38.967055	-76.735802	1.35341
PG1962G107	383248076410703	38.546667	-76.685278	0.26400
PG1990G012	390139076522301	39.027610	-76.872751	0.45065
PG1994G006	390308076515801	39.052331	-76.865806	0.01071
PG1998G006	385036076442401	38.843447	-76.739690	0.01490
PG1998G023	385941076510801	38.994832	-76.851916	0.18847
PG1999G015	385534076555901	38.926223	-76.932752	0.01184
PG2002G004	390109076461601	39.019277	-76.770803	0.00093
PG2002G009	385305076451401	38.884835	-76.753580	0.08517

A message to Maryland's citizens

The Maryland Department of Natural Resources (DNR) seeks to balance the preservation and enhancement of the living and physical resources of the state with prudent extraction and utilization policies that benefit the citizens of Maryland. This publication provides information that will increase your understanding of how DNR strives to reach that goal through the earth science assessments conducted by the Maryland Geological Survey.

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