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PRELIMINARY INVESTIGATION OF ELEVATED RADIOACTIVITY IN GROUNDWATER IN CHARLES COUNTY, MARYLAND

by

David C. Andreasen and David W. Bolton

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ABBREVIATIONS USED IN THIS REPORT

commun.	communication
DHMH	Maryland Department of Health and Mental Hygiene
GAPA	gross alpha-particle activity
GBPA	gross beta-particle activity
MDE	Maryland Department of the Environment
MGS	Maryland Geological Survey
MCL	Maximum Contaminant Level
NAD 83	North American Datum of 1983
NED	National Elevation Dataset
NIST	National Institute of Standards and Technology
PDWIS	Public Drinking Water Information System (MDE)
PWS	public water system
PWSID	Public water system identification number
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WSLH	Wisconsin State Laboratory of Hygiene
WTP	water treatment plant

RADIONUCLIDES

Po-210	Polonium-210
Ra-224	Radium-224
Ra-226	Radium-226
Ra-228	Radium-228
Rn-222	Radon-222
U-234	Uranium-234
U-235	Uranium-235
U-238	Uranium-238

UNITS OF MEASUREMENT

ft	feet
gal/d	gallons per day
Mgal/d	million gallons per day
mi	mile
pCi/L	picocuries per liter
µg/L	micrograms per liter
<	less than

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KEY RESULTS

A review of existing data was conducted to evaluate the occurrence and distribution of gross alpha-particle activity, gross beta-particle activity, radium, and polonium in public water (groundwater) systems in Charles County, Maryland. The study was prompted by the exceedances of the U.S. Environmental Protection Agency's Maximum Contaminant Level for gross alpha-particle activity at five public water systems.

- Water samples from wells in five public water systems—Chapel Point Woods, Mt. Carmel Woods, Clifton-on-the-Potomac, Waldorf (St. Paul's Well 9 and St. Charles Well 16), and the Town of Indian Head—all of which are screened in the Upper and Lower Patapsco aquifer systems—exceeded the Maximum Contaminant Level (MCL) of 15 picocuries per liter for gross alpha-particle activity. A water sample from one well at the Brookwood Estates public water system equaled the MCL. The elevated radioactivity (defined as at or above the MCL of 15 picocuries per liter gross alpha-particle activity) tends to occur in the central portion of the county along a line trending approximately north-south.

- The highest gross alpha-particle activity in the Upper Patapsco aquifer system was 122 picocuries per liter at the Chapel Point Woods (main plant) system. The highest gross alpha-particle activity in the Lower Patapsco aquifer system was 53 picocuries per liter from the Waldorf (St. Charles Well 16) system.

- Radium-226, radium-228, and combined radium (Ra-226+Ra-228) concentrations are less than 1.2, 1.7, and 2.5 picocuries per liter, respectively. Combined radium (Ra-226+Ra-228) concentrations are below the Maximum Contaminant Level of 5 picocuries per liter in all six of the public water systems discussed in this report. While there are no analyses for Ra-224 (a known radionuclide in some aquifers in Anne Arundel County, Maryland), the concentrations are likely low since Ra-228 concentrations are low, indicating that another alpha-emitting radionuclide is the source of the elevated gross alpha-particle activity.

- In the Chapel Point Woods and Mt. Carmel Woods public water systems, polonium-210 appears to be the main alpha-emitting radionuclide. At the Chapel Point Woods public water system (main plant Wells 1, 2, and 3 [undifferentiated] and Jude House plant Well 2), polonium-210 concentrations ranged from 6.13 to 46.6 picocuries per liter. All Chapel Point Woods wells are screened in the Upper Patapsco aquifer system. At the Mt. Carmel Woods public water system (Well 1A [Lower Patapsco aquifer system] and Well 3 [Upper Patapsco aquifer system]), polonium-210 concentrations ranged from 2.8 to 26.9 picocuries per liter. The presence of polonium-210 in these systems suggests that polonium may also be the source of elevated gross alpha-particle activity in the other public water systems.

- Elevated radioactivity in the six public water systems occur in aquifer sand layers spanning approximately 900 feet of sediment thickness, which includes both the Upper and Lower Patapsco aquifer systems. Individual sand layers in the Upper and Lower Patapsco aquifer systems are often localized and typically do not extend beyond short distances (less than 1,000 feet) before pinching out. Additionally, since water samples from the public water systems discussed in this report are a composite from multiple well screens tapping discrete sand layers, the existing data do not indicate in which specific stratigraphic horizon the source of the radioactivity is located. Concentrations in groundwater also may vary with time based on pumping intensity and duration.

- There are approximately 57 wells screened in the Upper Patapsco aquifer system and 58 wells screened in the Lower Patapsco aquifer system, within a one-mile radius surrounding the six public water systems identified in this report with elevated radioactivity. Of those wells, 93 are classified as domestic, 14 are public supply wells (from 10 public water systems), five are irrigation, two are test wells, and one is farm supply. Gross alpha-particle activity and combined radium (Ra-226+Ra-228) concentrations in the 14 public supply wells were all below Maximum Contaminant Levels.

- Testing of water wells, in particular domestic wells, for gross alpha- and gross beta-particle activity is recommended to gain better insight into the extent of the radioactivity. Since domestic wells commonly have relatively short, fixed screen lengths they can provide greater definition of radioactivity in specific stratigraphic horizons.

INTRODUCTION

In 1998, water sampled from Wells 1 and 3 supplying groundwater to the Chapel Point Woods public water system (main plant) near La Plata, Maryland, exceeded the U.S. Environmental Protection Agency's (USEPA) Maximum Contaminant Level (MCL) of 15 picocuries per liter (pCi/L) for gross alpha-particle activity (GAPA); repeat samples collected in 1999 were below the MCL for GAPA. In 2003, GAPA in water from the same wells showed a significant increase. Specific radionuclide testing indicated that polonium-210 was the main alpha-particle emitter (Outola and others, 2008). Since the first detection of elevated GAPA at Chapel Point Woods, wells in other public water systems, including Mt. Carmel Woods (2002), Clifton-on-the-Potomac (2005), Waldorf (St. Paul's Well 9 [2002] and St. Charles Well 16 [2014]), and the Town of Indian Head (2008), were found to have GAPA exceeding the MCL. Water in these systems has either been treated, blended, or the wells have been taken out of service so that produced waters are below the MCL. Prior to this report, the data had not been evaluated from a geological perspective to determine if a specific geological interval is responsible for the elevated radioactivity.

PURPOSE AND SCOPE

The purpose of this study is to (1) compile data on radioactivity in public water (groundwater) systems in Charles County, Maryland, primarily using existing radionuclide data from the MDE Public Drinking Water Information System (PDWIS); (2) identify (to the extent possible) the specific aquifer zones in which elevated levels of radioactivity occur; and (3) identify other wells that are screened in correlative aquifer zones in a close proximity to the affected public water systems. In this report, "elevated" radioactivity and "elevated" GAPA are defined as GAPA at or above the MCL. The study is focused primarily on public water systems at Chapel Point Woods, Clifton-on-the-Potomac, Mt. Carmel Woods, and Waldorf (St. Paul's Well 9); public water system wells at Brookwood Estates, the Town of Indian Head, and Waldorf (St. Charles Well 16) are also discussed.

LOCATION OF STUDY AREA

The study area is located in Charles County, Maryland (fig. 1). Charles County is bordered by the Potomac River to the west and south, the Patuxent River to the east, St. Mary's County to the southeast, and Prince George's County to the north. Land use in Charles County is a mix of rural and urban, with the majority of residential and commercial development occurring in the north-central portion of the county along the Route (Rt.) 301 corridor (referred to as the "Waldorf area"). Public water systems discussed in this report are located primarily in the central portion of Charles County, with the exception of the Town of Indian Head system which is located in the western portion of the county.

HYDROGEOLOGIC SETTING

The study area is located entirely within the Maryland Coastal Plain physiographic province. The region is underlain by unconsolidated, marine to fluvial-deltaic sediments (sand, gravel, silt and clay) of Lower Cretaceous to Quaternary age (Andreasen and others, 2013). The Coastal Plain sediments overlie consolidated rocks of Precambrian(?) to Jurassic(?) age. The geologic unit of principal concern in this study is the Lower Cretaceous-age Patapsco Formation, a fluvio-deltaic deposit consisting of a complex series of interstratified gravels, sands, silts, and clays. Patapsco Formation sediments in southern Maryland are dominated by relatively low-energy deposits of floodplain and meandering stream environments. The Patapsco Formation is divided into the Upper and Lower Patapsco aquifer systems (Andreasen and others, 2013). Both aquifer systems consist of multiple water-bearing sands of varying thickness and permeability. While individual sand bodies are typically difficult to correlate over even relatively short distances and may be hydraulically discontinuous, the aquifer systems as a whole behave as distinct integrated hydrologic systems (Drummond, 2007). The altitude of the top of the Upper Patapsco aquifer system ranges from sea level along the western side of Charles County to more than 600 feet (ft) below sea level on the eastern side. The altitude of the top of the Lower Patapsco aquifer

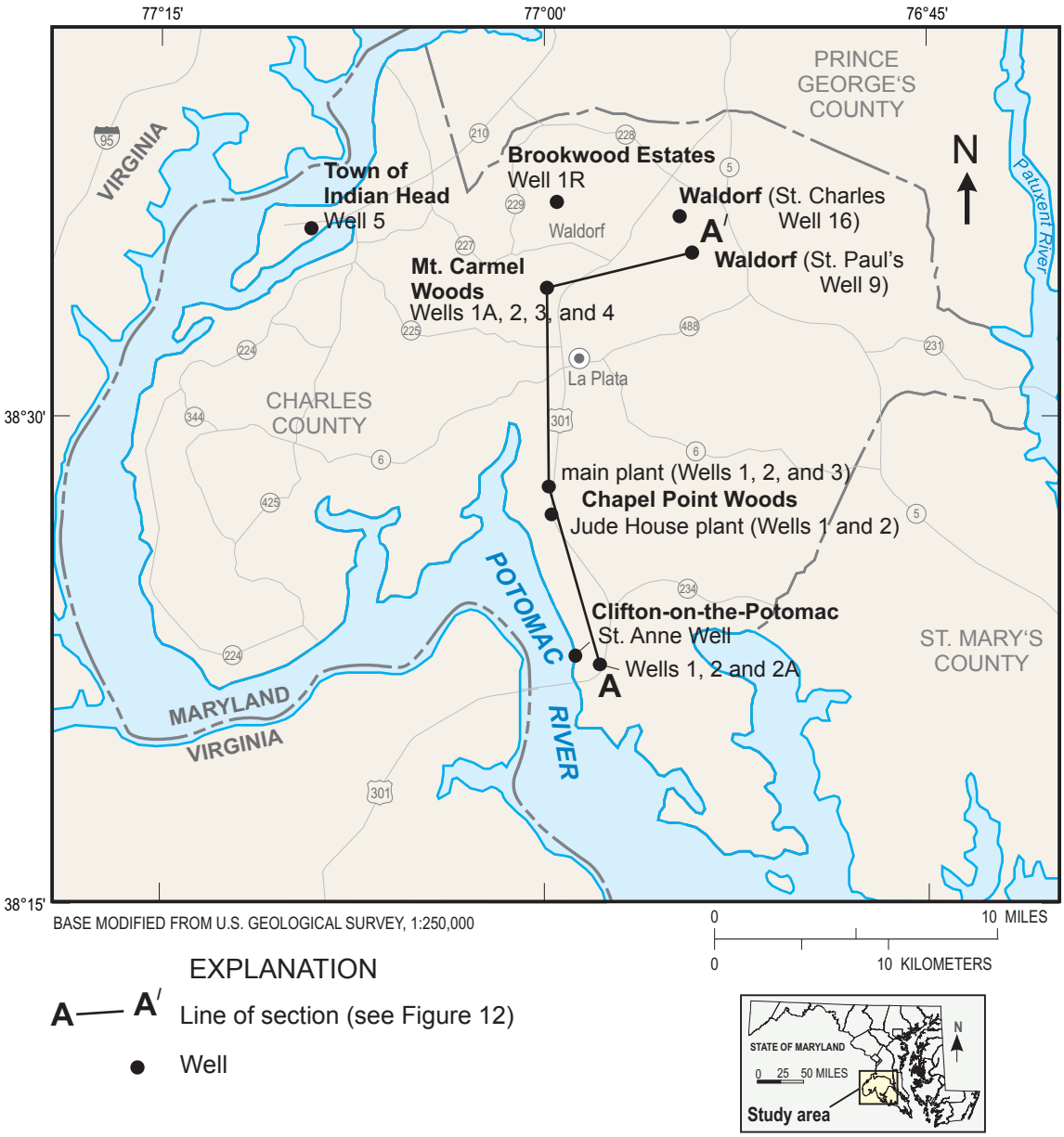

Figure 1. Location of the study area.

system ranges from near sea level along the western side of Charles County to more than 1,200 ft below sea level on the eastern side. Each aquifer system ranges in total thickness from 250 to 300 ft in Charles County (Andreasen and others, 2013).

The Upper and Lower Patapsco aquifer systems supply a large proportion of groundwater in Charles County. In the most recent (2010) estimate of total groundwater use in Charles County, approximately 10 million gallons per day (Mgal/d) were withdrawn (Maupin and others, 2014). Of that amount, approximately 4.8 Mgal/d were withdrawn from the Upper and Lower Patapsco aquifer systems in 2012 by users permitted for more than 10,000 gallons per day (gal/d). The 2012 withdrawal amount is derived from the Site-Specific Water-Use Data system maintained by the U.S. Geological Survey (USGS). As a result of the groundwater withdrawals, water levels have declined significantly in both aquifer systems. Between 1990 and 2013 water levels have declined more than 30 and 80 ft in the Upper and Lower Patapsco aquifer systems, respectively (Staley and others, 2014). Deep cones of depression, with potentiometric-surface altitudes as low as approximately 200 ft below sea level, have formed in central Charles County (Staley and others, 2014). Decades of withdrawals have significantly altered the groundwater-flow regime, resulting in reversals of groundwater-flow directions and accelerated flow rates.

BACKGROUND

Radioactivity in groundwater occurs in a variety of different geologic settings within the United States (Zapecza and Szabo, 1988). Radium, one of the principal sources of radioactivity, is highest in quartz-rich sand aquifers in the Northern Atlantic Coastal Plain where low pH conditions release radium from the sediments (Szabo and dePaul, 1998). Radionuclides can enter the groundwater system by dissolution of minerals or desorption from sediment particle surfaces. In Maryland's Coastal Plain aquifer system, high radium concentrations have been detected in the Magothy and Potomac Group (Patapsco and Patuxent Formations) aquifers in the upper Chesapeake Bay area (Bolton, 2000), and in the Surficial aquifer on the Eastern Shore (Denver and others, 2014). Radium isotopes that have been detected in Maryland Coastal Plain groundwater include radium-224 (Ra-224), radium-226 (Ra-226), and radium-228 (Ra-228) (Bolton and Hayes, 1999; Bolton, 2000).

Radionuclides decay and emit gamma rays and alpha and beta particles at varying rates. Alpha-particle-emitting radionuclides detected in the groundwater and discussed in this report include Ra-224, Ra-226, and polonium-210 (Po-210). Alpha particles cannot penetrate skin, but if radionuclides emitting alpha particles are ingested, the alpha particles can damage cell tissue, which could potentially lead to cancer. Ra-228 emits beta radiation, which can penetrate skin, but must be ingested to cause damage to internal cell tissue. Radium isotopes Ra-224 and Ra-228 are part of the thorium-232 decay series, whereas Ra-226 and Po-210 are part of the uranium-238 (U-239) decay series (fig. 2). The half-lives of Ra-224, Ra-226, and Ra-228 are 3.6 days, 1,600 years, and 5.8 years, respectively. Po-210 has a half-life of approximately 138 days. Exposure to low levels of Po-210 in drinking water, or in food products from animals raised with contaminated water, may have long-term biological effects on humans including possible damage to fetal and placental tissue (Seiler and Wiemels, 2012). The USEPA has established MCLs for radionuclides in drinking water as follows: GAPA, 15 pCi/L; gross beta-particle activity (GBPA), 4 millirems per year; combined radium (Ra-226+Ra-228), 5 pCi/L; and uranium, 30 micrograms per liter (µg/L) (U.S. Environmental Protection Agency, 2000). No individual drinking water standards have been established for Ra-224 and Po-210 by the state or USEPA, although they carry cancer risk upon ingestion nearly equivalent to that of Ra-226 and Ra-228 (U.S. Environmental Protection Agency, 1999).

All of the naturally-occurring radionuclides are Class A human carcinogens (U.S. Environmental Protection Agency, 1999), but some pose greater levels of cancer risk than others. USEPA assigns (cancer) risk coefficients to radionuclides applicable on the basis of water concentrations (U.S. Environmental Protection Agency, 1999). For Po-210, the USEPA has determined an activity level of concern of 1.1 pCi/L on the basis of a lifetime total cancer risk of 1 in 10,000 (U.S. Environmental Protection Agency, 1999). This level is near the lifetime total cancer risk for combined radium (Ra-226+Ra-228) of 5 pCi/L (the MCL). The GAPA MCL of 15 pCi/L is intended to limit risk from ingestion by presuming a "worst-case" scenario of a water sample with 5 pCi/L of Ra-226, 5 pCi/L of progeny of Ra-228, and 5 pCi/L of Po-210, the radionuclide that poses nearly equal dose risk to those of the radionuclides of radium (U.S. Environmental Protection Agency, 1999).

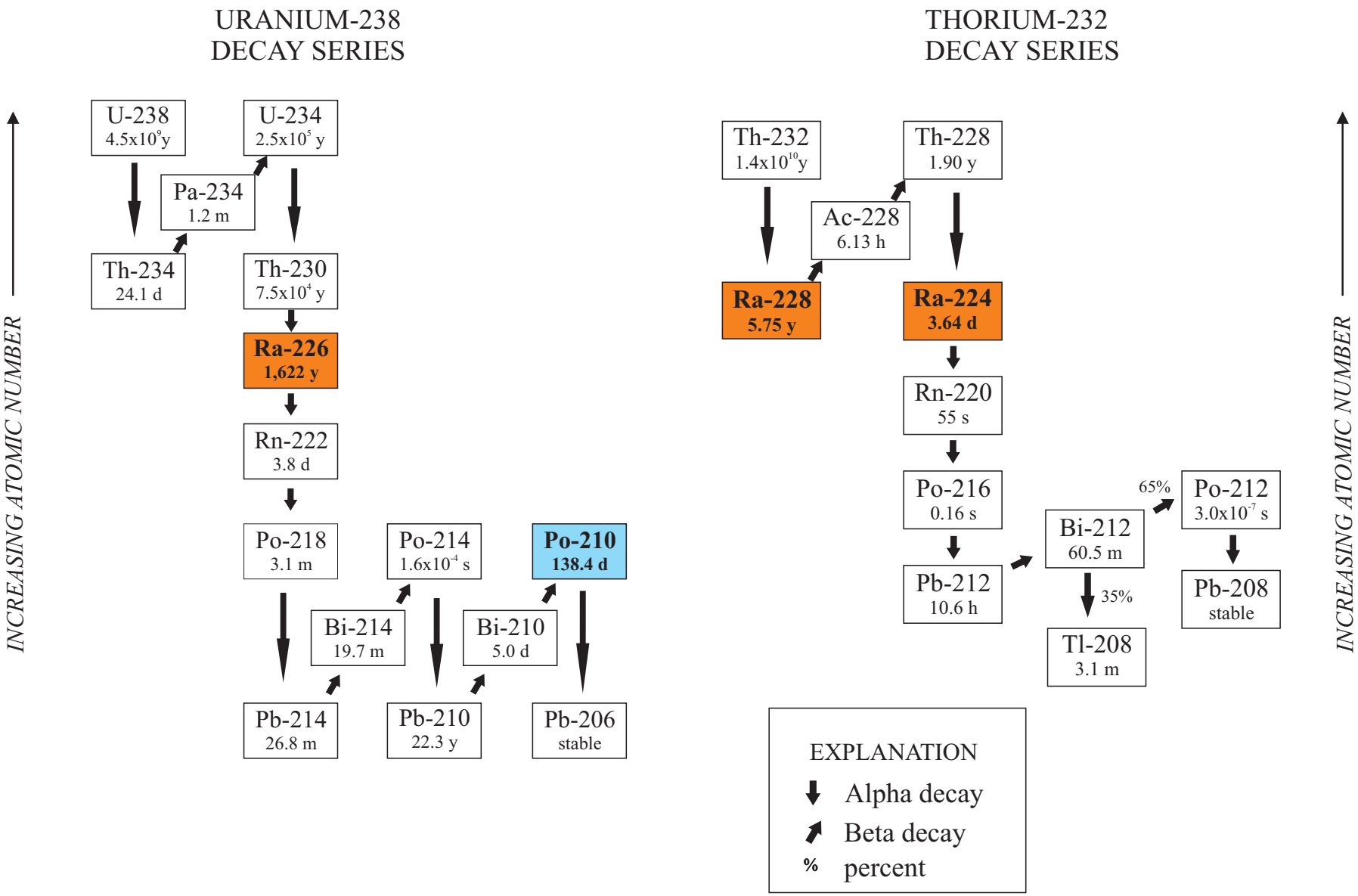

Figure 2. Uranium-238 and thorium-232 radioactive decay series. Isotope half-lives are given in years (y), days (d), hours (h), minutes (m), and seconds (s). Radium isotopes and polonium-210 are shaded. Modified from Aieta and others (1987).

RADIONUCLIDE DATA

The primary source of radionuclide data used in this report is from the MDE's PDWIS (app. A). Maryland Geological Survey (MGS) accepted all data retrieved from PDWIS as stated, and did not attempt to verify the method of analysis or accuracy of values, or identify and correct possible transcription errors; therefore, MGS cannot guarantee the accuracy or completeness of the data. Radionuclide analyses, made by the Maryland DHMH laboratory or a Maryland-certified water-quality laboratory, were performed on water samples collected at a variety of sampling locations within each water plant and include both raw and finished (treated) water. The PDWIS database includes a field indicating the method of analysis; however, for most samples the field is blank. Some samples were collected from individual wells while the majority were a composite from multiple wells. In general, PDWIS does not consistently record which wells were pumping at the time of sampling, the specific sample location (well head, point of entry to the distribution system, or within the distribution system), or whether the analyses were made on finished or raw water. Unless otherwise stated, information regarding which wells were being pumped at the time of sampling, the sample location, and water treatment was unavailable. Water treatment for the public water systems discussed in this report, with the exception of Chapel Point Woods main plant, consists of chlorination only. Chlorination likely does not affect radionuclide concentrations or gross alpha- and beta-particle activity in the sampled water (Nancy Reilman, Maryland Department of the Environment, personal commun., 2014). The Chapel Point Woods main plant system currently utilizes a reverse-osmosis system to reduce radionuclide concentrations.

Prior to 1999, community water systems in Maryland were sampled at various locations in the distribution system, and four quarterly samples (1-quart aliquots) were composited for analysis. In Anne Arundel County, Maryland, Ra-224 (half-life: 3.64 days) was discovered in 1998 after observing large decreases in GAPA when comparing same-sample analyses measured within 3 days and again 30 days after sample collection (Bolton, 2000). In Charles County, the presence of elevated GAPA may not have been detected because a significant portion of Po-210 (the suspected primary source of GAPA, with a half-life of 138 days) may have been lost to radioactive decay as a result of the lag time between sample collection and analyses. State and federal regulations were revised for radionuclides effective December 8, 2003. The new regulations relocated the sample location to the point-of-entry of the water-treatment plant, reduced the holding time for the radionuclide compliance sample to between 3 and 4 days, and eliminated composite sampling. Short-term GAPA refers to samples that were reported as having been analyzed within 72 hours of sample collection, although in reality these samples often exceeded the 72-hr holding time.

Radionuclides included in the PDWIS dataset include Ra-226, Ra-228, combined radium (Ra-226+Ra-228), GAPA, short-term GAPA, GAPA (adjusted), GBPA, short-term GBPA, radon-222, U-234, U-235, U-238, and uranium (combined) (app. A). Radium-224 is not required to be tested, however, the concentrations in the public water systems in Charles County are likely low since Ra-228 concentrations are low. Ra-224:Ra-228 ratios from similar geologic settings range from 1.2 to 2.0, with a typical ratio of near 1 (Focazio and other, 2001). References to GAPA from the PDWIS database include both GAPA and GAPA-adjusted data fields. GAPA-adjusted is GAPA with the uranium activity subtracted; since uranium concentrations are relatively low or below the detection limit in all of the systems sampled in Charles County, GAPA (adjusted) is equal to GAPA (Nancy Reilman, Maryland Department of the Environment, written commun., 2014). The detection limit for radionuclides varies based on total dissolved solids concentrations but is typically less than 1 pCi/L (Nancy Reilman, Maryland Department of the Environment, personal commun., 2015).

For the public water systems discussed in this report the median elapsed time between sample collection and analysis for Ra-226, Ra-228, and combined radium (Ra-226+Ra-228) was 57, 53, and 37 days, respectively. The median elapsed time between sample collection and analysis for GAPA, short-term GAPA, GBPA, and short-term GBPA was 7, 5, 5, and 2 days, respectively. The elapsed time between sample collection and analysis for GAPA and short-term GAPA ranged from 1 to 372 days and 1 to 16 days, respectively. The elapsed time between sample collection and analysis for GBPA and short-term GBPA ranged from 1 to 41 days and 1 to 33 days, respectively. Since the elapsed time between sample collection and analysis of GAPA and GBPA includes both short-term measurements (measured within approximately 72 hours after sampling) and longer-term measurements, GAPA and short-term GAPA, and

GBPA and short-term GBPA were combined for this study.

Analyses of Po-210 concentrations are limited to samples from Chapel Point Woods and Mt. Carmel Woods. Analyses were performed by the National Institute of Standards and Technology (NIST) and the Wisconsin State Laboratory of Hygiene (WSLH) (Arndt, 2010). Po-210 is rare in natural waters. Activities of Po-210 greater than or equal to 5 pCi/L have been reported for less than 100 wells in California, Florida, Louisiana, Nevada, Virginia, and Maryland (Harada and others, 1989; Ruberu and others, 2007; Arndt, 2010; Seiler, 2011). Concentrations above 60 pCi/L were measured in three wells, and concentrations above 15 pCi/L were measured in 13 wells in Lahontan Valley, Nevada (Seiler, 2011); the maximum, a Po-210 concentration greater than 170 pCi/L, was in a domestic well in the same general area. Focazio and others (2001) reported a sample from the Coastal Plain aquifers in Virginia with a Po-210 concentration greater than 4 pCi/L. Arndt (2010) also reports a few high Po-210 concentrations in the Atlantic Coastal Plain. Geochemical and microbiological investigations of Po-210 in Florida groundwater indicate that it can be mobilized in anoxic sulfate-reducing environments (Harada and others, 1989), and data indicate that a similar process could be occurring in the Gulf Coastal Plain and Nevada (Seiler, 2011; Rosen and others, 2012). The study of the occurrence, distribution, and geochemistry of Po-210 has been identified as a considerable data and knowledge gap in the understanding of radionuclide occurrence in drinking water supplies of the Unites States (Rosen and others, 2012).

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PUBLIC WATER SYSTEMS WITH ELEVATED RADIOACTIVITY

This report focuses on six public water (groundwater) systems in Charles County, Maryland with elevated radioactivity. A public water system is defined as any water system (community and non-community) that serves water to at least 25 residents or 15 residential connections per day, for more than 60 days per year. The USEPA MCLs for radionuclides apply to community systems. Currently, non-community water systems such as schools, churches, nursing homes, and factories that serve at least 25 of the same people more than 6 months per year are exempt from USEPA regulations regarding radionuclides. Following reports of elevated radionuclides in Charles County, MDE expanded radionuclide sampling to include 20 non-community systems, all of which had radionuclide concentrations below MCLs. GAPA concentration ranges in those systems in addition to the remaining community systems with GAPA concentrations below the MCL are shown in Figure 3. A summary of radionuclides in public water systems in Charles County in the PDWIS database, as well as Po-210 concentrations analyzed by NIST and WSLH, are given in Table 1.

Public water systems with elevated radioactivity discussed in this report include Chapel Point Woods, Clifton-on-the-Potomac, Mt. Carmel Woods, Waldorf (St. Paul's Well 9 and St. Charles Well 16), Town of Indian Head, and Brookwood Estates. The systems are regulated under the federal and state programs associated with the Safe Drinking Water Act; they are identified in the MDE's PDWIS and MDE source table (hereafter referred to as the "wells database") using a public water system identification number (PWSID) and public water system name (PWS Name), a plant identification number (Plant ID) and name (Plant Name), and a source identification number (Source ID) and name (Source Name) (tab. 2). Individual wells (well permit numbers) were associated with the radionuclide analyses in the PDWIS database by cross-referencing the PWSID, Plant ID, Source ID and Source Name with the MDE wells database. Additional sample-source identification (ex. Well 1) given in the "sample location" field in the PDWIS radionuclide database was also used to determine well-permit numbers. If specific sample sources were not identified in the PDWIS database then it was assumed that the sample was a composite of water from all of the wells (Source IDs) associated with particular PWSID and Plant ID.

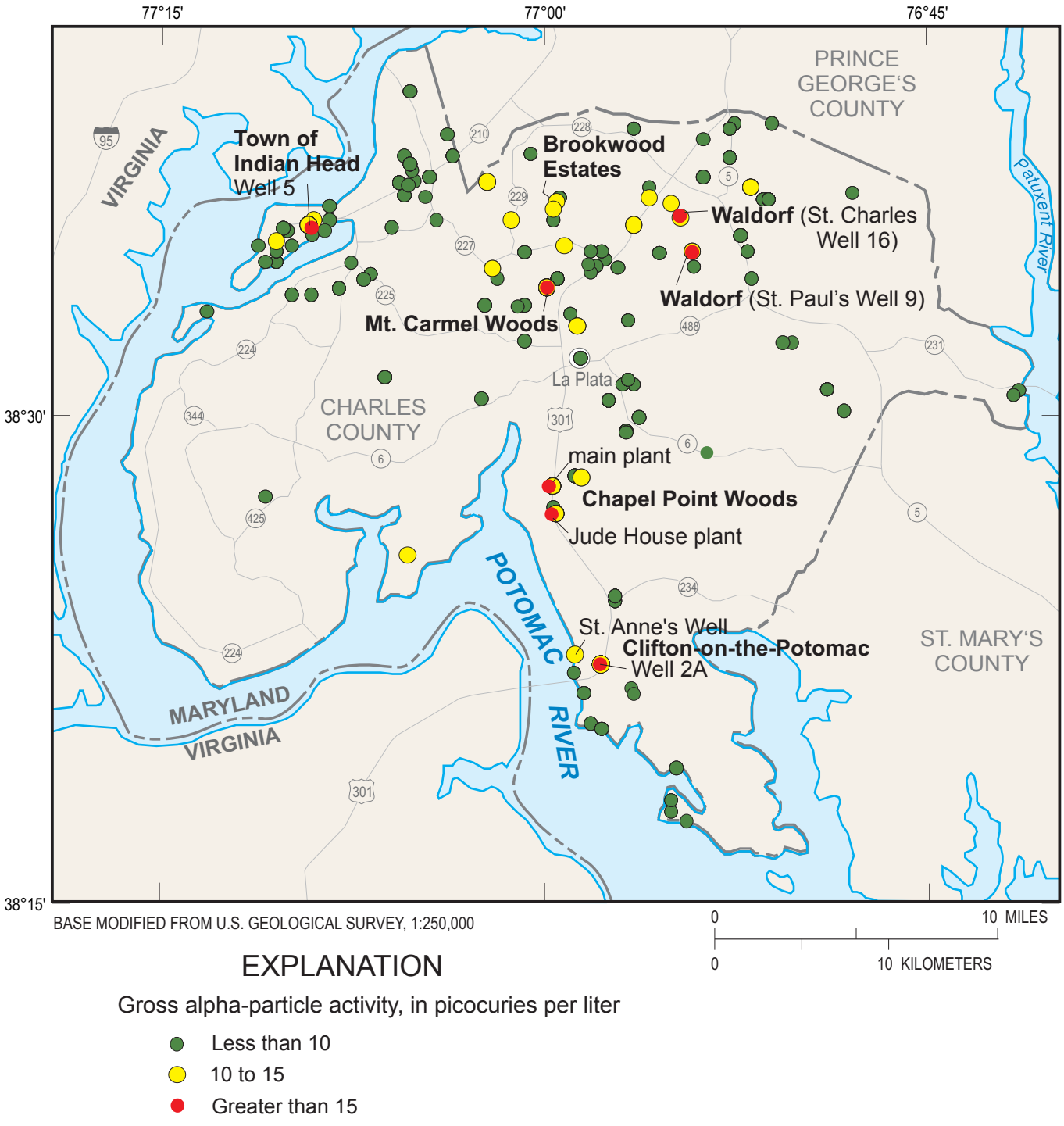

Figure 3. Gross alpha-particle activity in community water systems and selected non-community water systems.

Table 1. Summary of radionuclides in public water systems in Charles County, Maryland from the Maryland Department of the Environment Public Drinking Water Information System

[pCi/L, picocuries per liter; GAPA, gross alpha-particle activity; GBPA, gross beta-particle activity; PDWIS, Public Drinking-Water Information System]

Radionuclide	Total number of samples	Samples above detection limit[1]			
		Number of samples	Range (pCi/L)	Mean (pCi/L)	Median (pCi/L)
GAPA[2]	713	558	0.2 – 122	10	6.0
GBPA[2]	538	408	0.15 – 47	6.2	5.0
Ra-226	325	154	0.06 – 4.0	0.47	0.3
Ra-228	388	73	0.01 – 4.0	1.4	1.3
Combined radium (Ra-226 + Ra-228)	237	124	0.1 – 4.6	1.1	0.6
Combined uranium (U-234, U-235, and U-238)	39	22	0.06 – 6.3	1.3	1.2
Po-210[3]	9	9	2.8 – 46.6	23.1	24.6

[1] Detection limit varies based on total dissolved solids concentration.
[2] Includes samples listed as "short-term GAPA" in the PDWIS database.
[3] Analyses from the National Institute of Standards and Technology (NIST), and the Wisconsin State Laboratory of Hygiene (WSLH).

The occurrence of radionuclides in aquifer systems is complex and often unpredictable. Many factors affect their distribution, including the occurrence and concentration of radionuclides within the original terrestrial sediment source material, accumulation of radionuclides during deposition, and geochemical processes that either reduce or increase mobility of radionuclides in groundwater. In Charles County, elevated radioactivity (GAPA) in public water systems tends to occur in the central part of the county along a line trending roughly north-south. Figure 3 shows GAPA concentrations in public water systems exceeding the MCL of 15 pCi/L, near the MCL (10 to 15 pCi/L), and below 10 pCi/L. Public water systems with concentrations of 10 to 15 pCi/L in the north-central part of the county withdraw water from either the Magothy or Patapsco (undifferentiated) aquifers, with the exception of one system (Pomfret Utilities) which is screened in both the Lower Patapsco and Patuxent aquifer systems. All systems with GAPA concentrations of 10 to less than 15 pCi/L in the south-central part of the county withdraw water from the Patapsco (undifferentiated) aquifer. One system (U.S. Naval Surface Warfare Center) at Indian Head with GAPA concentrations of 10 to 15 pCi/L withdraws water from the Patuxent aquifer. Aquifer assignments are from the MDE PDWIS database. Most public water systems in Charles County do not have elevated radioactivity; of the 58 community water systems (plus the 20 non-transient, non-community systems that were also tested) only 5 had GAPA concentrations above the MCL of 15 pCi/L and 11 had concentrations of 10 to 15 pCi/L.

CHAPEL POINT WOODS

Well-Field Description

The Chapel Point Woods public water system currently consists of two well fields; one located within the Chapel Point Woods community (main plant), and one located approximately 1 mile (mi) to the south at Jude House (fig. 1). The Chapel Point Woods main plant site consists of two production wells screened in the Upper Patapsco aquifer system (Well 1 [CH De 41] and Well 3 [CH De 55]), and a test well (Well 2 [CH De 40]) (app. B). The Upper Patapsco aquifer system is part of the Patapsco Formation (Andreasen and others, 2013). With the exception of the deepest well screen, Well 2 is screened shallower than Wells 1 and 3. Some of the well screens in Well 2 are adjacent to silty or clayey layers (fig. 4); the shallowest well screen is within the zone mapped as the Magothy-Patapsco confining

Table 2. Public water system identification and well-permit numbers.

[Plant and source names are as they appear in the Public Drinking Water Information System (PDWIS) database. PWSID, public water system identification number; PWS, public water system; ID, identification number; WTP, water-treatment plant; COMM CTR, community center; --, no data]

PWSID	PWS name	Plant ID	Plant name	Source ID	Source name	Well - permit number (well number)
0080007	BROOKWOOD ESTATES	02	GENEVIEVE (WELL 1)	02	BROOKWOOD 1R GENEVIEVE DRIVE	CH941043 (CH Be 66)
0080009	CLIFTON-ON-THE-POTOMAC	01	CLIFTON WTP 1 WELL 1	99	CLIFTON (OLD)	CH690013 (--)
0080009	CLIFTON-ON-THE-POTOMAC	01	CLIFTON WTP 1 WELL 1	98	CLIFTON (OLD)	CH690014 (--)
0080009	CLIFTON-ON-THE-POTOMAC	01	CLIFTON WTP 1 WELL 1	01	CLIFTON 1 (OLD)	CH730849 (CH Ee 77)
0080009	CLIFTON-ON-THE-POTOMAC	02	CLIFTON WTP 2 NEW WELL 2A	02	CLIFTON 2 (OLD)	CH730147 (CH Ee 98)
0080009	CLIFTON-ON-THE-POTOMAC	02	CLIFTON WTP 2 NEW WELL 2A	04	CLIFTON 2A (NEW)	CH942198 (CH Ee 92)
0080009	CLIFTON-ON-THE-POTOMAC	03	WTP 3 ST. ANNE"S WELL	03	ST. ANNE'S	CH810761 (CH Ee 91)
0080020	TOWN OF INDIAN HEAD	04	WTP 4 WELL 5	05	WOODLAND VILLAGE 5	CH810992 (CH Bc 72)
0080030	MT. CARMEL WOODS	01	WTP 1 MT. CARMEL WELLS	99	MT. CARMEL WOODS 3	CH730019 (--)
0080030	MT. CARMEL WOODS	01	WTP 1 MT. CARMEL WELLS	02	MT. CARMEL WOODS 2	CH731137 (--)
0080030	MT. CARMEL WOODS	01	WTP 1 MT. CARMEL WELLS	03	MT. CARMEL WOODS 1A	CH880856 (CH Ce 58)
0080030	MT. CARMEL WOODS	01	WTP 1 MT. CARMEL WELLS	04	MT. CARMEL WOODS 4	CH950021 (CH Ce 64)
0080049	WALDORF	04	WTP 4 ST PAUL'S	04	ST. PAUL	CH810738 (CH Bf 147)
0080049	WALDORF	14	WTP 14 WELL 16/ ST. CHARLES WELL	17	ST. CHARLES TOWER/ WELL 16	CH946686 (CH Bf 161)
0080064	CHAPEL POINT WOODS/ JUDE HOUSE/ COMM CTR	01	WTP 1 CHAPEL POINT WELLS 1 2 3	02	CHAPEL POINT 1	CH732073 (CH De 41)
0080064	CHAPEL POINT WOODS/ JUDE HOUSE/ COMM CTR	01	WTP 1 CHAPEL POINT WELLS 1 2 3	03	CHAPEL POINT 3	CH880766 (CH De 55)
0080064	CHAPEL POINT WOODS/ JUDE HOUSE/ COMM CTR	01	WTP 1 CHAPEL POINT WELLS 1 2 3	01	CHAPEL POINT 2 (BACKUP)	CH731804 (CH De 40)
0080064	CHAPEL POINT WOODS/ JUDE HOUSE/ COMM CTR	02	JUDE HOUSE-BEL ALTON COMM CTR	06	JUDE HOUSE WELL 1	CH945204 (CH De 54)
0080064	CHAPEL POINT WOODS/ JUDE HOUSE/ COMM CTR	02	JUDE HOUSE-BEL ALTON COMM CTR	07	JUDE HOUSE WELL 2	CH951343 (CH De 53)

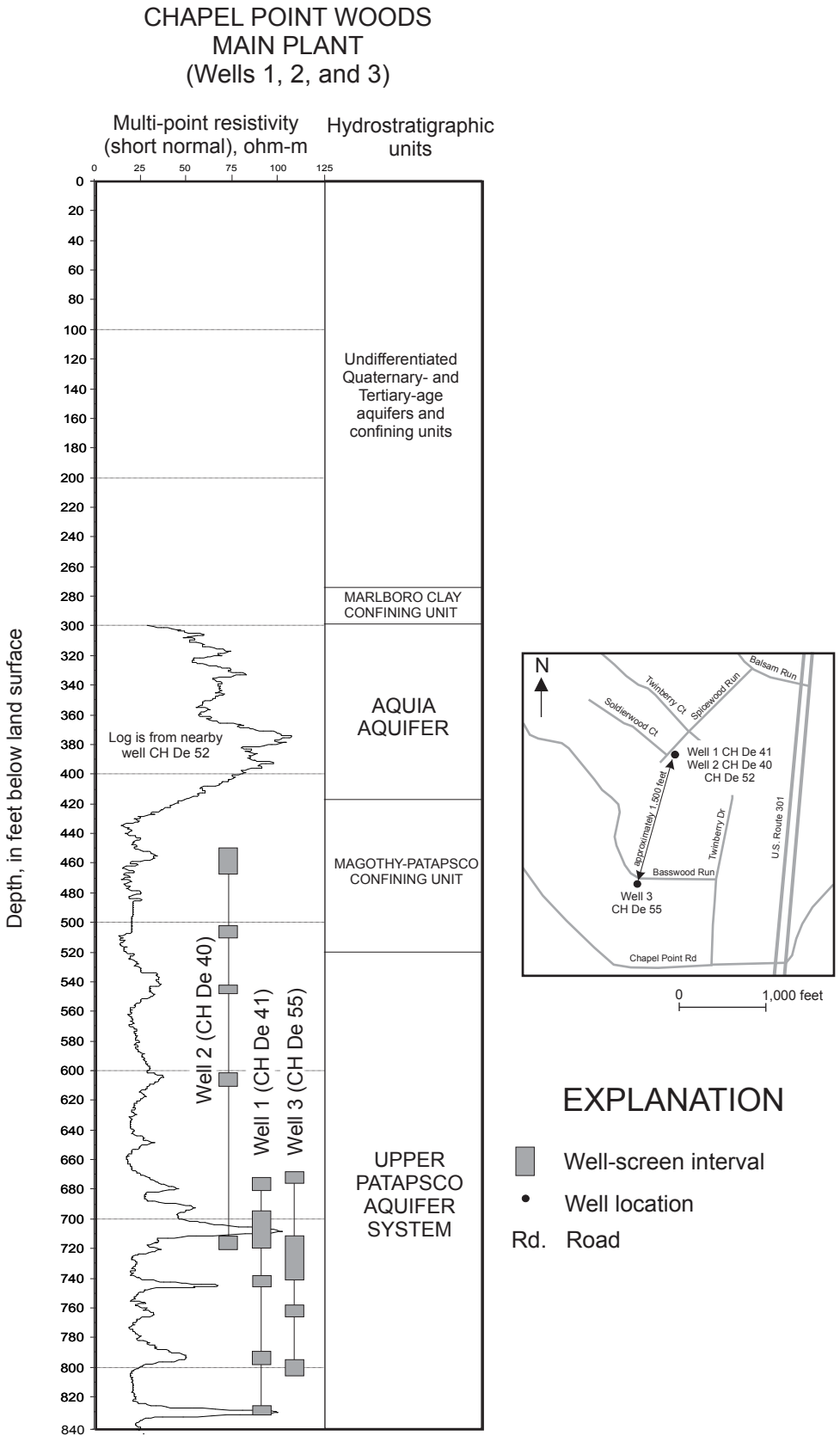

Figure 4. Hydrostratigraphic schematic diagram showing locations of well-screen intervals at Chapel Point Woods main plant (Wells 1, 2, and 3).

unit (Andreasen and others, 2013). The placement of well screens within low permeability silt and clay sediments is reflected by the low specific capacity of the well (0.04 gallons per minute per foot) (app. B). In 2006, a reverse-osmosis system was installed on Chapel Point Woods main plant (Wells 1 and 3) to reduce radionuclide concentrations. Water samples indicated as "finished" were collected after passing through the reverse-osmosis system and after chlorination. The Jude House plant consists of two wells screened in the Upper Patapsco aquifer system (Well 1 [CH De 54] and Well 2 [CH De 53]) (app. B). Wells 1 and 2 are used rarely, only on an emergency basis (Semyon Simanovsky, Charles County Department of Public Works, personal commun., 2015). Wells in both the main plant and the Jude House plant supply water to the same distribution system.

Withdrawals from the Upper Patapsco aquifer system started in 1988 with an average annual withdrawal rate of 0.004 Mgal/d. Between 1989 and 2010, rates fluctuated from 0.008 to 0.036 Mgal/d. In 2012, the average annual withdrawal rate was 0.029 Mgal/d.

Gross Alpha- and Beta-Particle Activity

The first water sample in the PDWIS dataset in which GAPA in the Chapel Point Woods main plant exceeded the MCL of 15 pCi/L was collected in 1998, which is also the first year of reported data in the dataset (app. A). That sample was likely a blend of water from Wells 1, 2 and 3. Samples from the same wells (both composite samples and samples from the individual wells) showed a significant increase in GAPA starting in 2003. The increase is likely attributed to the change in sampling procedure which greatly reduced the time between sample collection and analysis, eliminated composite samples, and moved the sampling location to the point of entry of the water system as opposed to within the distribution system. The highest GAPA in the Chapel Point Woods system was 122 pCi/L in a raw-water sample collected in 2006 from the main plant (composite water from Wells 1, 2, and 3) (tab. 3). The analysis was made 22 days after sample collection. GAPA attributed specifically to Well 1 ranged from 31 to 40.4 pCi/L in two samples; the elapsed time between sample collection and analysis was 2 days for both samples. The two GAPA analyses attributed specifically to Well 2 were both less than 1.5 pCi/L. The analyses did not indicate whether the samples were finished or raw water. GAPA attributed specifically to Well 3 ranged from 2.9 (raw water) to 66.9 (finished or raw water not indicated) pCi/L in five samples. The analyses were made within 16 days of sample collection with the highest value analyzed two days after collection.

GBPA ranged from below detection to 7 pCi/L in 26 samples collected between 1998 and 2012 in the Chapel Point Woods main plant (Wells 1, 2, and 3). The analyses were made within 38 days of sample collection. GBPA in a composite sample from Wells 1 and 2 and in a sample from Well 3 was 5.6 and 6.2 pCi/L, respectively, in 2005. The samples were analyzed 7 days after collection.

The highest GAPA measured in the Chapel Point Woods Jude House plant (Wells 1 and 2) was 46.8 pCi/L sampled in 2014 (tab. 3); the MDE PDWIS does not indicate which wells were pumping at the time of sampling. The analysis was made one day after sample collection. GAPA attributed specifically to Well 1 ranged from 11.7 to 17.2 pCi/L in two samples analyzed within 3 days of collection. GAPA attributed specifically to Well 2 ranged from 5 to 11.4 pCi/L in three samples analyzed within 11 days of collection. In 2013, a packer was installed in Jude House plant Well 1 to isolate the shallowest well screen (Earth Data, Inc., written commun., 2014). Five samples collected over an 8-day period from the well after the packer was installed showed a GAPA ranging from 19.4 to 28 pCi/L, with an average of 24.1 pCi/L.

GBPA ranged from below detection to 6 pCi/L in 17 samples collected between 2012 and 2014 in the Chapel Point Woods Jude House plant (Wells 1 and 2). The analyses were made within 30 days of sample collection with the highest value (6 pCi/L) analyzed 1 day after collection. The highest GBPA attributed to specific wells was 0.67 pCi/L in Well 1 and 1.06 pCi/L in Well 2, both analyzed 3 days after sample collection.

Radium

The highest Ra-226 concentration measured in seven samples collected between 1998 and 2012 in the Chapel Point Woods main plant (Wells 1, 2, and 3) was 0.21 pCi/L. The MDE PDWIS does not indicate which wells were sampled or whether the analyses were on raw-water samples. The highest Ra-226 concentration measured in eight samples collected between 2012 and 2014 in the Chapel Point Woods Jude House plant (Wells 1 and 2) was 1.2 pCi/L. No Ra-228 was detected in the Chapel Point Woods main plant (Wells 1, 2, and 3) in seven

Table 3. Summary of gross alpha-particle activity exceeding the Maximum Contaminant Level in public water systems in Charles County, Maryland

[Ukpt, Upper Patapsco aquifer system; Lkpt, Lower Patapsco aquifer system; GAPA, gross alpha-particle activity; pCi/L, picocuries per liter; <, less than; DL, detection limit; PDWIS, Public Drinking Water System identification number; –, no data]

Well name	Well number (Well-permit number)	GAPA[1] range (number of samples), (pCi/L)	Maximum GAPA (Individual well source not identified) (pCi/L)	Aquifer	Remarks
Chapel Point Woods					
main plant Well 1	CH De 41 (CH732073)	31 - 40.4 (2)	122	Ukpt	
main plant Well 2	CH De 40 (CH731804)	<1.5 (2)		Ukpt	Test well
main plant Well 3	CH De 55 (CH880766)	2.9 - 66.9 (5)		Ukpt	
Jude House plant Well 1	CH De 54 (CH945204)	11.7 - 17.2 (2)	46.8	Ukpt	
Jude House plant Well 2	CH De 53 (CH951343)	5 - 11.4 (3)		Ukpt	
Clifton-on-the-Potomac					
St. Anne's	CH Ee 91 (CH810761)	3.1 – 8 (8)	–	Lkpt	
Well 2A	CH Ee 92 (CH942198)	<DL - 25 (44)		Lkpt	
Mt. Carmel Woods					
Well 1A	CH Ce 58 (CH880856)	0.4 – 6 (6)	21	Lkpt	
Well 2	(CH731137)	1.9 – 31 (3)		Ukpt	
Well 3	(CH730019)	1.9 – 36 (3)		Ukpt	
Well 4	CH Ce 64 (CH950021)	1.9 (1)		Lkpt	
Waldorf St. Paul's					
Well 9	CH Bf 147 (CH810738)	8 - 34.1 (11)	–	Lkpt	Well not in use
Town of Indian Head					
Well 5	CH Bc 72 (CH810992)	8 – 19.8 (24)	–	Lkpt	Well not in use
Waldorf St. Charles					
Well 16	CH Bf 161 (CH46686)	2.1 – 53 (8)	–	Lkpt	
Brookwood Estates[2]					
Well 1R	CH Be 66 (CH941043)	2 – 15 (7)	–	Lkpt	

[1] Includes values listed as "short-term GAPA" in PDWIS database. Does not include data from packer tests.
[2] Brookwood Estates Well 5 did not exceed the Maximum Contaminant Level, but is included because the highest gross alpha-particle activity is at the threshold of 15 pCi/L.

samples collected between 1998 and 2012. In Chapel Point Woods Jude House plant (Wells 1 and 2) Ra-228 was only detected in one out of a total of 10 samples collected between 2012 and 2014. The concentration in that sample was 1.3 pCi/L. Combined radium (Ra-226+Ra-228) concentrations in the Chapel Point Woods main plant (Wells 1, 2, and 3) were all below detection in four samples collected in 2003 and one sample collected in 2012. Combined radium concentrations in the Chapel Point Woods Jude House plant (Wells 1 and 2) ranged from below detection to 2.5 pCi/L in seven samples collected between 2012 and 2014.

Polonium-210

A Po-210 concentration of 46 pCi/L was reported by the NIST in 2004 in water sampled at the entry point of the Chapel Point Woods main plant (tab. 4) (Outola and others, 2008). This analysis marked the first discovery of polonium in groundwater in Maryland. Po-210 was also analyzed in samples collected on two different days in 2012 in the Chapel Point Woods main plant (tab. 4). The samples were collected from the system prior to reverse-osmosis treatment. The water samples may have been chlorinated. Po-210 concentrations were 35.5 and 46.6 pCi/L (tab. 4). In the first sample, the Po-210 analysis was made 42 days after sampling, and in the second sample, the analysis was made 2 days after sampling.

Po-210 was also analyzed in samples collected at the Chapel Point Woods Jude House plant (Wells 1 and 2) in 2012 (tab. 4). The Po-210 concentrations in Wells 1 and 2 were 10.3 and 6.13 pCi/L, respectively (tab. 4). Both samples were analyzed for Po-210 one day after sample collection. An additional raw-water sample collected in 2012 had a reported Po-210 concentration of 9.16 pCi/L. It was not reported whether that sample was from Well 1, Well 2, or from a combination of the two.

CLIFTON-ON-THE-POTOMAC

Well-Field Description

The Clifton-on-the-Potomac public water system currently consists of two wells, one located on the eastern side of the Clifton-on-the-Potomac community near Rt. 301 (Well 2A [CH Ee 92]), and one located approximately 1 mi to the west near the Potomac River (St. Anne's well [CH Ee 91]) (app. B; fig. 1). Both wells are screened in the Lower Patapsco aquifer system. Two previous wells screened in the Aquia aquifer (Wells 1 [CH Ee 77] and 2 [CH Ee 98]) at the same location of Well 2A have been abandoned (most likely after 2000). Well 2A is used only periodically (Semyon Simanovsky, Charles County Department of Public Works, personal commun., 2015).

Withdrawals from the Aquia aquifer started in 1973 with an average annual withdrawal rate of about 0.001 Mgal/d (Wheeler and Wilde, 1989). Withdrawals increased gradually to a high of about 0.051 Mgal/d by 1984, then decreased to an average annual rate of about 0.005 Mgal/d in 2000. The Aquia aquifer was not pumped after 2000. Withdrawals from the Lower Patapsco aquifer system started in 1986 with an annual average rate of about 0.016 Mgal/d and increased to about 0.051 Mgal/d by 1991. From 1987 to 2010 the average annual withdrawal rates fluctuated between 0.042 and 0.052 Mgal/d. In 2012 the average annual withdrawal rate was 0.068 Mgal/d.

Gross Alpha- and Beta-Particle Activity

The first water sample in the PDWIS dataset in which GAPA in the Clifton-on-the-Potomac public water system exceeded the MCL of 15 pCi/L was collected in 2005 (app. A) from Well 2A and analyzed 5 days after collection. GAPA in Well 2A ranged from below detection to 25 pCi/L in 44 samples collected between 2002 and 2014 (tab. 3). The analyses were made within 48 days of sample collection with the highest value analyzed 5 days after collection. The median elapsed time between sample collection and analysis was 8 days. Seventeen samples from Well 2A exceeded the MCL. Well 1 (abandoned well in the Aquia aquifer) showed no detectable GAPA in a sample collected in 1998. The highest GBPA in both Well 1 and Well 2A was 5 pCi/L analyzed within 2 days of sample collection. In 2012, a packer was installed in Well 2A to isolate the deepest well screen (Earth Data, Inc., written commun., 2014). Samples collected from the well after the packer was installed showed a GAPA ranging from 7.8 to 15.6 pCi/L. GAPA in the St. Anne's well ranged from 3.1 to 8 pCi/L in eight samples collected between 1998 and 2014. The analyses were made within 5 days of sample collection with the highest value analyzed 6 days after collection. The highest GBPA attributed to the St. Anne's well was 5 pCi/L from seven samples collected between 1998 and 2014; analyses were made within 5 days of sample collection.

Table 4. Polonium-210 concentrations for the Chapel Point Woods and Mt. Carmel Woods public water systems

[pCi/L, picocuries per liter; +/-, plus or minus; POE, point of entry; Influent RO, water that enters the reverse osmosis unit; NIST, National Institute of Standards and Technology; WSLH, Wisconsin State Laboratory of Hygiene]

Collection date	Analysis date	Polonium-210, pCi/L	Uncertainty, +/- pCi/L	Remarks	Analyzed by
Chapel Point Woods main plant (Wells 1, 2 and 3 undifferentiated)					
Unknown	2/19/2004[1]	46[2]	3	POE	NIST
2/08/2012	3/21/2012	35.5	2.82	Influent RO	WSLH
6/20/2012	6/22/2012	46.6	3.81	Influent RO	WSLH
Chapel Point Woods Jude House plant					
1/5/2012	1/6/2012	10.3	0.55	Jude House Well 1	WSLH
1/5/2012	1/6/2012	6.13	0.43	Jude House Well 2	WSLH
7/12/2012	7/16/2012	9.16	0.85	Wells undifferentiated	WSLH
Mt. Carmel Woods					
3/6/2006	Unknown	2.8	Unknown	Well 1A	WSLH
3/6/2006	Unknown	24.6	Unknown	Well 2	WSLH
3/6/2006	Unknown	26.9	Unknown	Well 3	WSLH

[1] Date sample was received.
[2] Outola and others, 2008.

Radium

The highest Ra-226 concentration measured in 22 samples collected between 2002 and 2014 in Clifton-on-the-Potomac Well 2A was 0.5 pCi/L. The highest Ra-226 concentration measured in five samples collected between 2007 and 2014 in the St. Anne's well was 0.2 pCi/L. No Ra-228 was detected in Well 2A in 11 samples collected between 2002 and 2014. Combined radium (Ra-226+Ra-228) in Well 2A ranged from below detection to 0.1 pCi/L in three samples collected in 2007 to 0.2 pCi/L in one sample collected in 2014. No Ra-228 was detected in the St. Anne's well in six samples collected in 2007 and one sample collected 2014.

Combined radium in the St. Anne's well ranged from below detection to 0.1 pCi/L in three samples collected in 2007, and 0.2 pCi/L in one sample collected in 2014.

MT. CARMEL WOODS

Well-Field Description

The Mt. Carmel Woods public water system currently (2015) consists of two wells (Well 1A [CH Ce 58] and Well 4 [CH Ce 64]) screened in the Lower Patapsco aquifer system (app. B) Currently, Well 1A is the only well currently (2015) in service (Allison Tritt, Maryland Department of the Environment, written commun., 2014). Two earlier wells (Wells 2 and 3), which were taken off-line in 2006 and were presumably located at the same site as the present wells, were part of the system; however, the Charles County Department of Public Utilities could not confirm the well locations and abandonment dates. The MDE PDWIS indicates that both Wells 2 and 3 were screened in the Magothy aquifer; however, the Mt. Carmel Woods system is located just south of the truncation line of the Magothy aquifer (Andreasen and others, 2013). There are no well-construction records for Wells 2 and 3 in the MDE wells database. Wheeler and Wilde (1989), in a report documenting water use in Maryland's Coastal Plain, assigned withdrawals from Mt. Carmel Woods prior to 1980 (Wells 2 and 3) to the Upper Patapsco aquifer system. That designation is retained in this report given the absence of well-screen information.

Wheeler and Wilde (1989) reported that withdrawals from the Upper Patapsco aquifer system started in the 1960's with an average annual withdrawal rate of about 0.008 Mgal/d. Withdrawals increased gradually to about 0.02 Mgal/d by 1989, then decreased to an average annual rate of about 0.005 Mgal/d between 1988 and 2006 as the Lower Patapsco wells began to be utilized. The Upper Patapsco aquifer system was not pumped after 2006. Withdrawals from the Lower Patapsco aquifer system started in 1990.

Between 1991 and 2010 the average annual withdrawal rates fluctuated from 0.008 to 0.013 Mgal/d. In 2012 the average annual withdrawal rate was 0.009 Mgal/d.

Gross Alpha- and Beta-Particle Activity

The first water sample in the PDWIS dataset in which GAPA in the Mt. Carmel Woods public water system exceeded the MCL of 15 pCi/L was collected in 2002 (app. A). The sample, analyzed 1 day after collection, may have been a blend of water from Wells 1A, 2, and 3. GAPA measured in Wells 1A, 2, 3, and 4 (undifferentiated) ranged from 0.6 to 21 pCi/L in 35 samples collected between 1998 and 2006. The analyses were made within 41 days of sample collection with the highest value analyzed 12 days after collection. GAPA attributed specifically to Well 1A ranged from 0.4 to 6 pCi/L in six samples analyzed between 2005 and 2008. The analyses were made within 21 days of sample collection with the highest value (6 pCi/L) analyzed 13 days after collection. GAPA attributed specifically to Well 2 ranged from 1.9 to 31 pCi/L in three samples analyzed between 2005 and 2006. The analyses were made 13 days from sample collection. GAPA attributed specifically to Well 3 ranged from 1.9 to 36 pCi/L in three samples analyzed between 2004 and 2005; all three were analyzed 13 days after sample collection. A GAPA of 1.9 pCi/L attributed specifically to Well 4 was reported in just one analysis for a sample collected in 2006; the sample was analyzed the same day as collection.

GBPA ranged from below detection to 7 pCi/L in 18 samples collected between 2002 and 2012. The median elapsed time between sample collection and analysis was 3 days. The PDWIS does not indicate which wells were pumping at the time of sampling. The highest GBPA attributed to specific wells is 4.7 pCi/L in Well 1A, 6.9 pCi/L in Well 2, 6.8 pCi/L in Well 3, and 1.8 pCi/L in Well 4. Analyses were made 7 days after sample collection in Wells 1A, 2 and 3, and the same day as collection for Well 4.

Radium

The highest Ra-226 concentration measured in 23 samples collected between 1998 and 2012 in the Mt. Carmel Woods public water system was 0.4 pCi/L. The samples were taken from a combination of wells. Ra-226 concentrations in samples derived from specific wells ranged from below detection to 0.38 pCi/L in Well 1A and 0.3 pCi/L in Well 4. No Ra-228 was detected in the Mt. Carmel Woods system in 20 samples collected between 1998 and 2012. Combined radium (Ra-226+Ra-228) ranged from below detection to 1.3 pCi/L in 74 samples collected between 2002 and 2012.

Polonium-210

Po-210 was analyzed in samples collected on the same day in 2006 at Mt. Carmel Woods (Wells 1A, 2, and 3) (tab. 4). The Po-210 concentrations were 2.8, 24.6, and 26.9 pCi/L for Wells 1A, 2, and 3, respectively. The samples were analyzed for Po-210 by the WSLH.

WALDORF (ST. PAUL'S WELL 9)

Well-Field Description

St. Paul's Well 9 (CH Bf 147)—part of the Waldorf public water system—is screened in the Lower Patapsco aquifer. This well had been a major production well supplying water to the Waldorf distribution system, pumping at an annual average rate of approximately 0.5 Mgal/d between 1985 and 2003. The well was taken out of service in 2004, with the exception of a relatively small amount (0.135 Mgal/d) withdrawn in 2007.

Gross Alpha- and Beta-Particle Activity

The first water sample in the PDWIS dataset in which GAPA in the St. Paul's Well 9 exceeded the MCL of 15 pCi/L was in 2002 (app. A). GAPA measured in Well 9 ranged from 8 to 34.1 pCi/L in eleven samples collected between 1998 and 2005 (tab. 3). Analyses were made within 36 days of sample collection, with the highest value analyzed 13 days after sample collection.

GBPA ranged from below detection to 5.3 pCi/L in nine samples collected between 1998 and 2005. The highest value was analyzed 7 days after sample collection.

Radium

The highest Ra-226 concentration measured in six samples collected between 1998 and 2003 in Well 9 was 0.3 pCi/L. Ra-228 was only detected in one out of six samples collected between 1998 and 2003. The concentration in that sample was 1.5 pCi/L. Combined radium (Ra-226+Ra-228) ranged from

below detection to 2.5 pCi/L in five samples collected between 2002 and 2003.

OTHER PUBLIC WATER SYSTEMS

GAPA exceeding the MCL has also been detected in two additional public water systems in Charles County at the Town of Indian Head (Well 5) and the Waldorf system (St. Charles Well 16) (fig. 1; app. A). GAPA equal to the MCL has been detected at the Brookwood Estates public water system (Well 1R) (fig. 1; app. A).

The first water sample in which GAPA in the Town of Indian Head Well 5 (CH Bc 72; CH-81-0992) exceeded the MCL was collected in 2008 (app. A); that sample was analyzed 4 days after collection. GAPA in Well 5, screened in the Lower Patapsco aquifer system, ranged from 8 pCi/L to 19.8 pCi/L in 24 samples collected between 1998 and 2012 (tab. 3). The median time between sample collection and analysis was 8 days, with the highest value (19.8 pCi/L) analyzed 20 days after collection. Well 5 is no longer in service as a result of GAPA exceeding the MCL. GBPA ranged from below detection to 5 pCi/L in 13 samples collected between 1998 and 2010; the median time between sample collection and analysis was less than 5 days, with the highest value (4 pCi/L) analyzed 4 days after collection. Ra-226 concentration ranged from below detection to 0.5 pCi/L in 11 samples collected between 1998 and 2010. Combined radium (Ra-226+Ra-228) concentrations ranged from below detection to 1.9 pCi/L in seven samples collected between 2002 and 2010. Ra-228 concentration ranged from below detection to 1.7 pCi/L in 11 samples collected between 1998 and 2010.

Recent water samples from Waldorf (St. Charles Well 16) (CH Bf 161; CH-94-6686), screened in the Lower Patapsco aquifer system, had GAPA concentrations of 28.1 pCi/L (6/12/2014), 16.5 pCi/L (8/26/2014), and 53 pCi/L (10/8/2014) (app. A); analyses were made 5, 4 and 2 days after sample collection, respectively. GAPA analyzed 35 days after the 6/12/2014 sample collection was also 27.1 pCi/L. These are the first occurrences of GAPA above the MCL since testing began in 2006. Previous samples ranged from 2.1 to 10 pCi/L in four samples collected between 2006 and 2008; analyses were made 2 to 10 days after sample collection. GBPA ranged from below detection to 6 pCi/L in five samples collected between 2006 and 2014; analyses were made 1 to 35 days after sample collection, with the highest value analyzed after 2 days. Ra-226 concentration ranged from below detection to 0.6 pCi/L in five samples collected between 1996 and 2014. Combined radium (Ra-226+Ra-228) concentration ranged from below detection to 0.3 pCi/L in four samples collected between 2008 and 2014. Ra-228 concentrations were all below detection in five samples collected between 1996 and 2014. Well 16 was taken out of service in 2014 (Semyon Simanovsky, Charles County Department of Public Works, personal commun., 2015).

One water sample collected in 2004 from Brookwood Estates Well 1R (CH Be 66; CH-94-1043) equaled the GAPA MCL of 15 pCi/L (app. A). GAPA measured in Well 1R, screened in the Lower Patapsco aquifer system, ranged from 2 to 15 pCi/L in seven water samples collected between 1998 and 2013. GBPA ranged from below detection to 14 pCi/L in eight samples collected between 1996 and 2013. Ra-226 concentration ranged from below detection to 1 pCi/L in seven samples collected between 1996 and 2013. Combined radium (Ra-226+Ra-228) concentrations ranged from below detection to 1 pCi/L in six water samples collected between 2004 and 2013. Ra-228 concentrations were all below detection in all six samples collected between 1996 and 2013.

ELEVATED RADIOACTIVITY RELATED TO HYDROSTRATIGRAPHIC POSITION

To determine which aquifer zones contain elevated radioactivity requires samples that were collected from individual wells. Most samples in the PDWIS dataset, however, are a blend of water from multiple wells. Additionally, because the Upper and Lower Patapsco aquifer systems are relatively thick and have multiple, individual sand layers, production wells are often constructed with multiple, discrete well-screen settings spread over tens to hundreds of feet. Therefore, since water samples collected even from single production wells are a composite of multiple aquifer zones, identifying elevated radioactivity in specific aquifer layers is impossible without specialized packer sampling to isolate individual well screens. If minor variations in water quality also affect the Po-210 occurrence, definition of variability with hydrostratigraphic position is all the more difficult.

The Upper and Lower Patapsco aquifer systems are part of the Patapsco Formation of Early Cretaceous age. The Patapsco Formation is predominantly a fluvial-deltaic deposit. In southern Maryland, Patapsco sands are highly quartzose with a heavy-mineral suite dominated by zircon (Glaser, 1971). Common accessory grains include pyrite, lignite, and muscovite (Drummond, 2007). Clays are typically medium to dark gray, but may also be light greenish gray, light to dark reddish brown, and mottled with gray, brown, yellow, white, pink and purple (Drummond, 2007). The clay mineralogy is essentially a kaolinite-illite assemblage (Glaser, 1969; 1971).

At the Chapel Point Woods main plant, Wells 1 and 3 had GAPA exceeding the MCL attributed specifically to those wells. The hydrostratigraphic position of elevated radioactivity (high GAPA) occurs within a series of sand zones in the Upper Patapsco aquifer system at a depth ranging from approximately 505 to 667 ft below sea level (669 to 832 ft below land surface) (fig. 4). Well 1 is located directly adjacent to a well at the main plant (CH De 52) having resistivity and gamma logs; CH De 52 is not used for water supply. The well screens in Well 1 correlate with the sand layers on the resistivity log for CH De 52. The screened sand layers in Well 3 (located approximately 1,500 ft south of Well 1) do not correlate with sand layers at the Well 1 site (fig. 4). Discontinuous sand layers are a common feature of the fluvial-deltaic environment in which the Patapsco Formation was deposited (Hansen, 1969).

At the Chapel Point Woods Jude House plant, only Well 1 had elevated GAPA exceeding the MCL attributed specifically to that well. Well 1 also had a relatively high Po-210 concentration (10.3 pCi/L) as did Well 2 (Po-210 concentration of 6.13 pCi/L). Wells 1 and 2 are screened in four sand layers in the Upper Patapsco aquifer system; the bottom screens are adjacent to a thin, silty layer that likely doesn't yield much water (fig. 5). All of the screened intervals tend to include zones of higher gamma radiation, indicating the possible presence of thin, interbedded silt or clay layers or a silt-clay matrix within the sandy zones. Silty and clayey layers reflected in gamma-radiation logs have been found to correlate with zones of radioactivity in the groundwater (dePaul and Szabo, 2007). The well screens range in depth from 432 to 629 ft below sea level (598 to 796 ft below land surface). The individual sand layers screened in Jude House plant Wells 1 and 2 do not correlate with sand layers at the Chapel Point Woods main plant located approximately 1 mi to the north-northwest (fig. 1).

In the Clifton-on-the-Potomac public water system, only Well 2A had GAPA exceeding the MCL attributed specifically to that well. Well 2A is screened in three sand layers in the Lower Patapsco aquifer system (fig. 6). The well screens range in depth from 814 to 1,092 ft below sea level (927 to 1,205 ft below land surface). A total of three sand zones in the Lower Patapsco aquifer system are penetrated in Well 2A compared to seven or eight in the St. Anne's well located approximately 1 mi to the west (figs. 1 and 4). The three sand layers in Well 2A may correlate to sand layers at equivalent elevations in the St. Anne's well; however, it is uncertain whether the sands are hydraulically connected. The St. Anne's well had lower radioactivity and intercepted more producing zones than Well 2A, indicating that even if the sand layers were hydraulically connected, radioactivity may have been diluted in the St. Anne's well.

In the Mt. Carmel Woods public water system, only Wells 2 and 3 had GAPA exceeding the MCL and relatively high Po-210 concentrations attributed specifically to those wells (tabs. 2 and 3). There are no recorded well-construction records for Wells 2 and 3 in the MDE wells database; however, a report on groundwater use in Maryland's Coastal Plain province by Wheeler and Wilde (1989) assigns the wells to the Upper Patapsco aquifer system. The

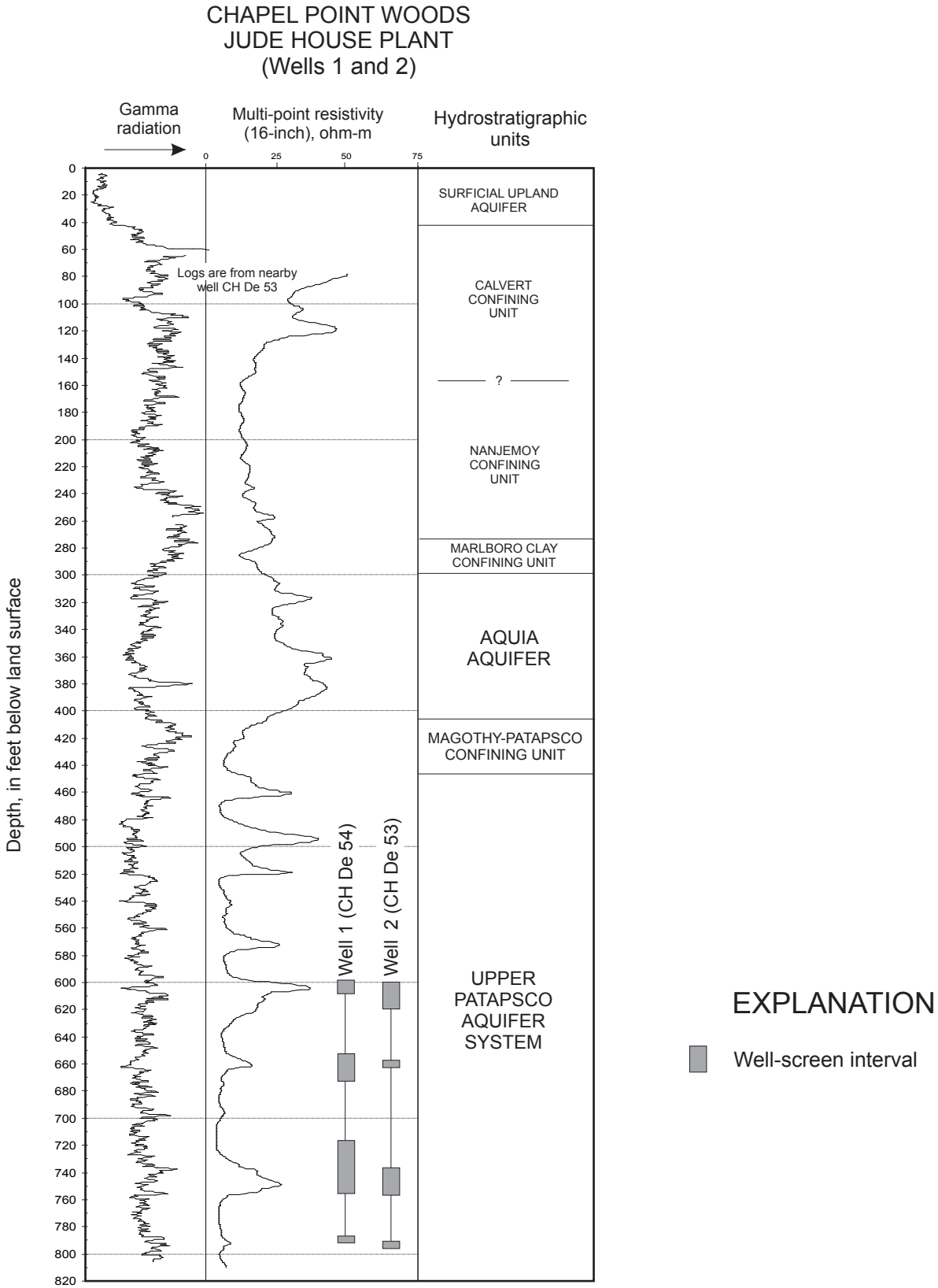

Figure 5. Hydrostratigraphic schematic diagram showing locations of well-screen intervals at Chapel Point Woods Jude House plant (Wells 1 and 2).

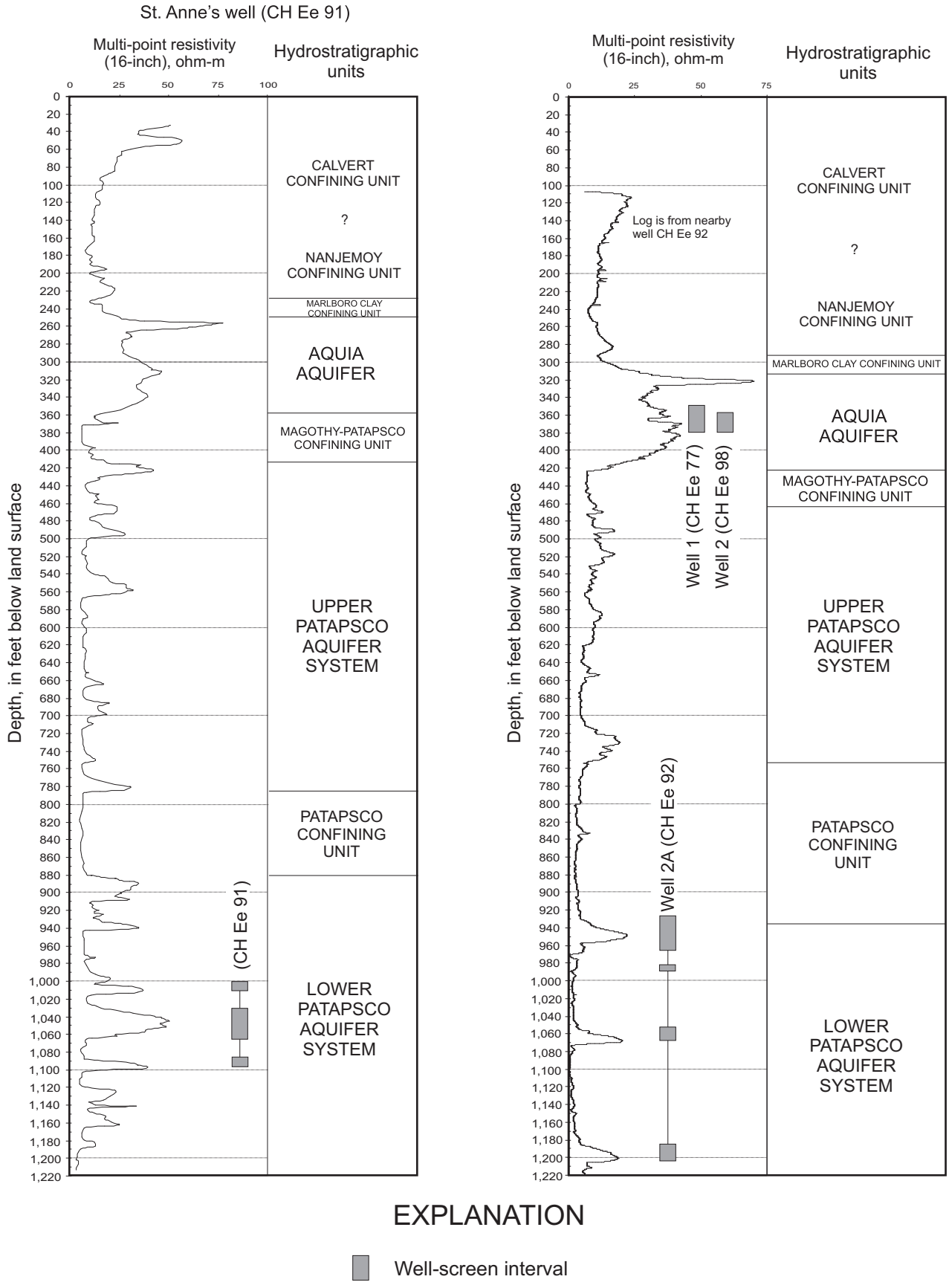

Figure 6. Hydrostratigraphic schematic diagram showing locations of well-screen intervals at Clifton-on-the-Potomac.

Upper Patapsco aquifer system at Mt. Carmel Woods occurs at approximately 300 to 600 ft below sea level (490 to 790 ft below land surface) (fig. 7). The two current wells (Wells 1A and 4), screened in the Lower Patapsco aquifer system, had maximum GAPA levels of 6 and 1.9 pCi/L, respectively. The Po-210 concentration in Well 1A is relatively low at 2.8 pCi/L (tab. 4). The well screen in Well 1A extends below the sand layer at 1,227 to 1,255 ft and includes approximately 25 ft of an underlying clay layer. The screened sand layer appears to become increasingly silty upwards based on the gamma-radiation log.

Waldorf St. Paul's Well 9 is screened in five sand layers within the Lower Patapsco aquifer system (fig. 8). The well screens range in depth from 867 to 1,225 ft below sea level (934 to 1,312 ft below land surface). All of the screened intervals tend to include zones of higher gamma radiation, indicating the possible presence of thin interbedded silt or clay layers or a silt-clay matrix within the sandy zones.

In the Town of Indian Head public water system, only Well 5 had GAPA exceeding the MCL attributed specifically to that well. Well 5 is screened in three sand layers in the Lower Patapsco aquifer system (fig. 9). The well screens range in depth from 190 to 313 ft below sea level (224 to 347 ft below land surface). The shallowest and deepest well screens include zones of higher gamma radiation, indicating the possible presence of thin, interbedded silt or clay layers or a silt-clay matrix within the sandy zones. The screened sand layers in Well 5 do not correlate with sand layers in the Town of Indian Head Well 6R, located approximately 1,000 ft to the southwest.

Brookwood Estates Well 1R is screened in five sand layers within the Lower Patapsco aquifer system (fig. 10). The well screens range in depth from 736 to 938 ft below sea level (951 to 1,153 ft below land surface). With the possible exception of the well screen at 1,101 to 1,109 ft, all of the screened intervals tend to include zones of higher gamma radiation, indicating the possible presence of thin, interbedded silt or clay layers or a silt-clay matrix within the sandy zones.

Waldorf St. Charles Well 16 is screened in eight sand layers within the Lower Patapsco aquifer system (fig. 11). The well screens range in depth from 734 to 1,112 ft below sea level (934 to 1,312 ft below land surface). With the possible exception of the deepest well screen, all of the screened intervals tend to include zones of higher gamma radiation, indicating the possible presence of thin, interbedded silt or clay layers or a silt-clay matrix within the sandy zones.

Screened intervals in the Upper and Lower Patapsco aquifer systems at the Clifton-on-the-Potomac, Chapel Point Woods main plant, Mt. Carmel Woods, and Waldorf (St. Paul's Well 9) public water systems with GAPA above the MCL are shown on a hydrogeologic cross section (fig. 12). The cross section, extending from south to north approximately along strike of the surface of both aquifers, illustrates the thick interval and broad lateral extent of aquifer material from which water containing elevated radioactivity was withdrawn. Elevated radioactivity occurs in water from two aquifer systems with approximately 900 ft of total sediment thickness, and therefore is not unique to specific stratigraphic horizons.

In addition to spatial variability within the aquifer system, radionuclide concentrations can also vary over time. In 2012, a long-term (30-day), constant-rate aquifer test of Clifton-on-the-Potomac Well 2A showed an increase in GAPA from about 9 pCi/L at the start of the test to 22 pCi/L after 21 days of pumping; this was followed by a decrease to 7.5 pCi/L near the end of the test (Earth Data, Inc., written commun., 2014). During the test, the deepest well screen was isolated by means of a packer. The decrease in GAPA after 21 days of pumping corresponded to expansion of the cone of depression to an apparent low-permeability boundary, resulting in an increased rate of drawdown observed in the pumped well; perhaps the water entering the well from a different part of the aquifer contained a different level of radioactivity. However, GAPA analysis contains inherent uncertainty that makes use of GAPA values less than ideal for evaluating temporal trends; even minor modifications of analytical techniques result in a large increase in uncertainty (Eaton and others, 2011).

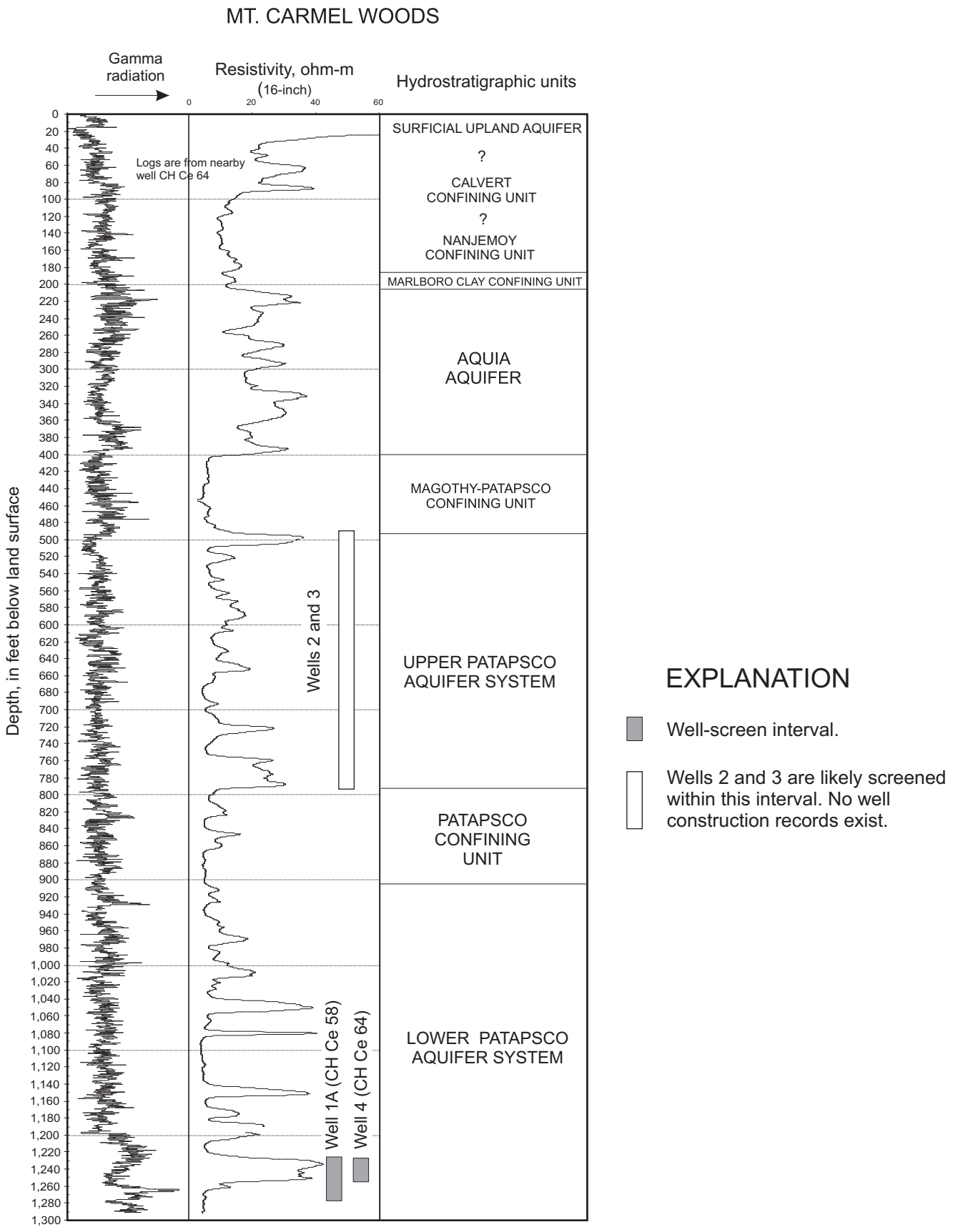

Figure 7. Hydrostratigraphic schematic diagram showing locations of well-screen intervals at Mt. Carmel Woods.

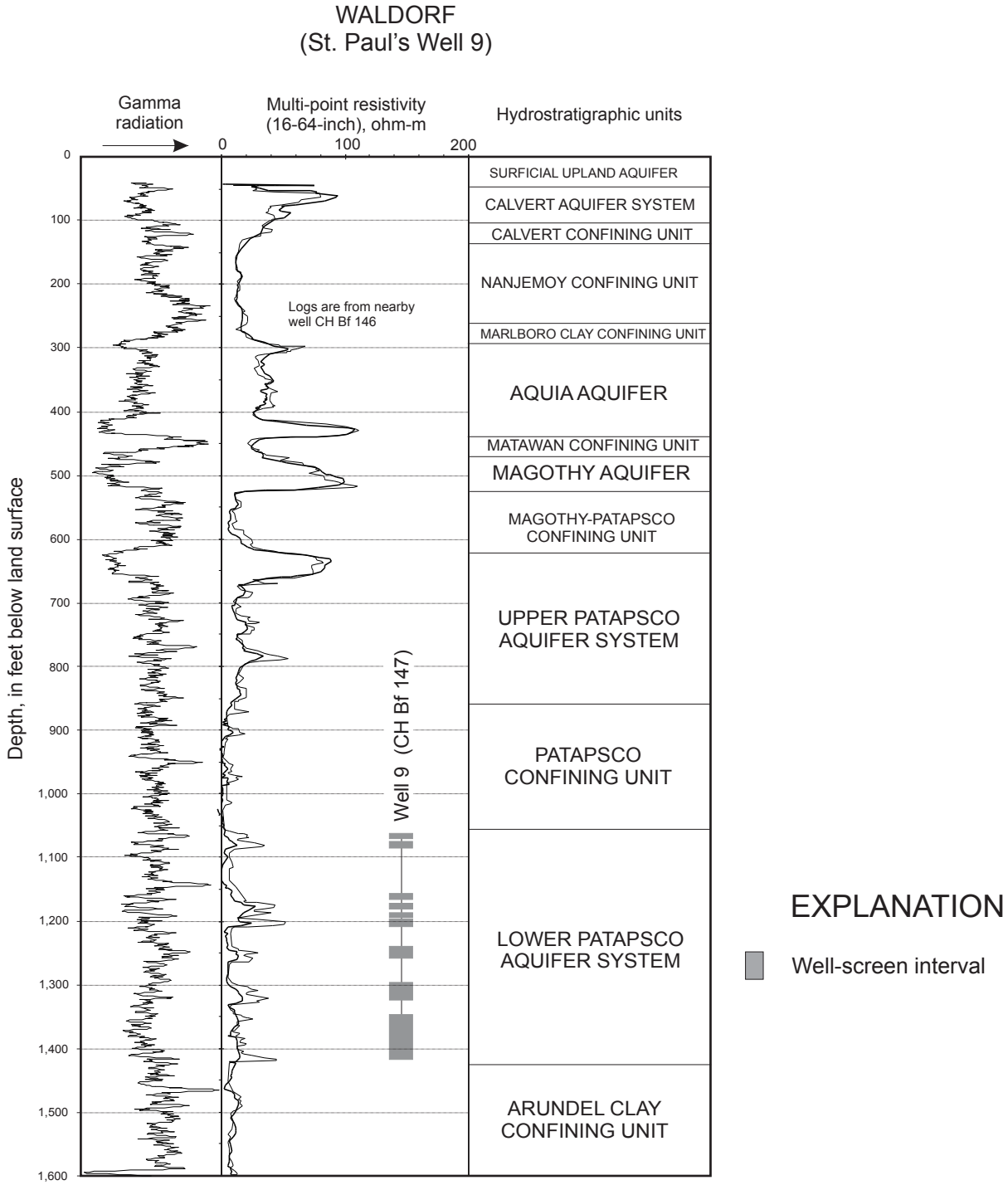

Figure 8. Hydrostratigraphic schematic diagram showing locations of well-screen intervals at Waldorf (St. Paul's Well 9).

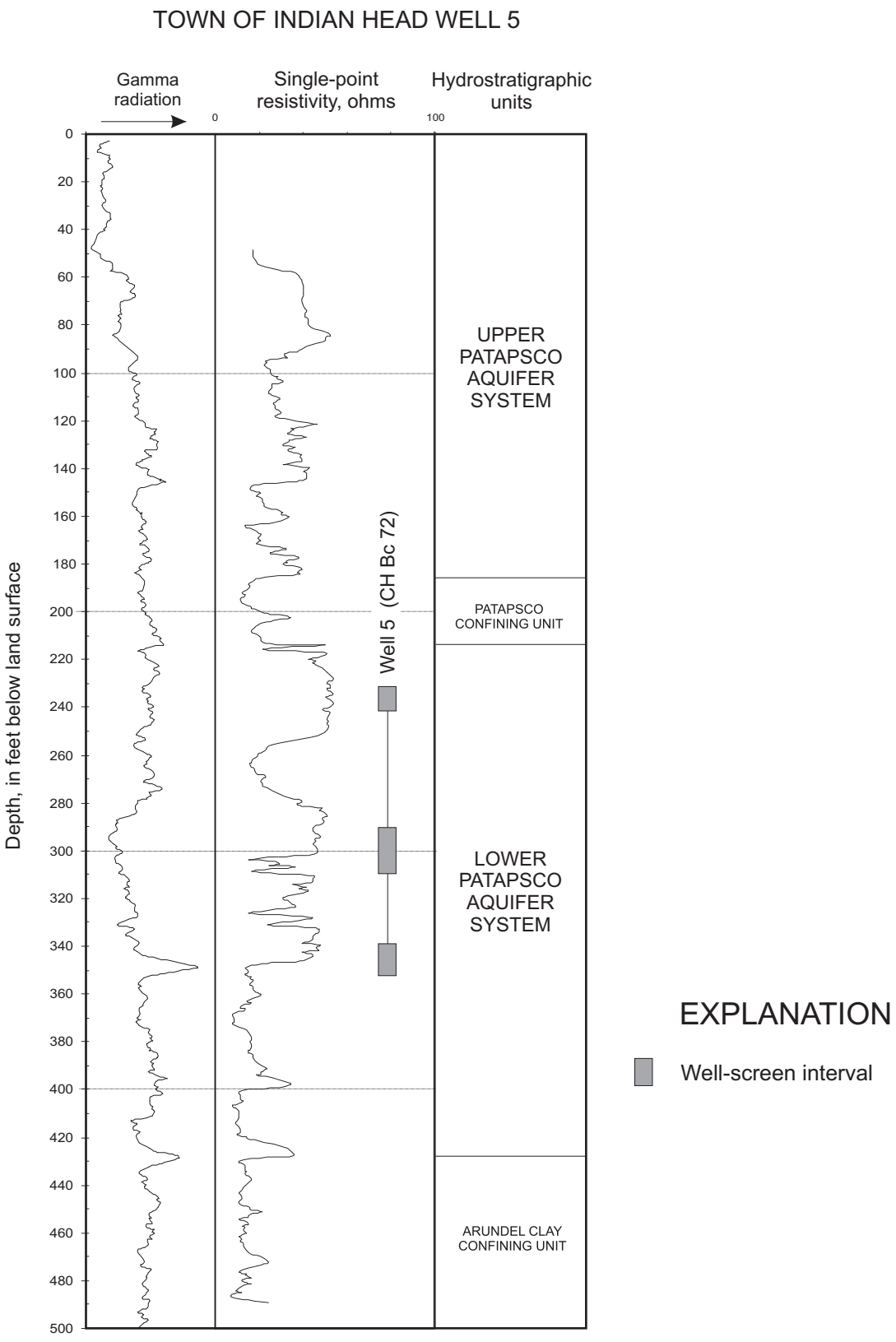

Figure 9. Hydrostratigraphic schematic diagram showing locations of well-screen intervals at Town of Indian Head Well 5.

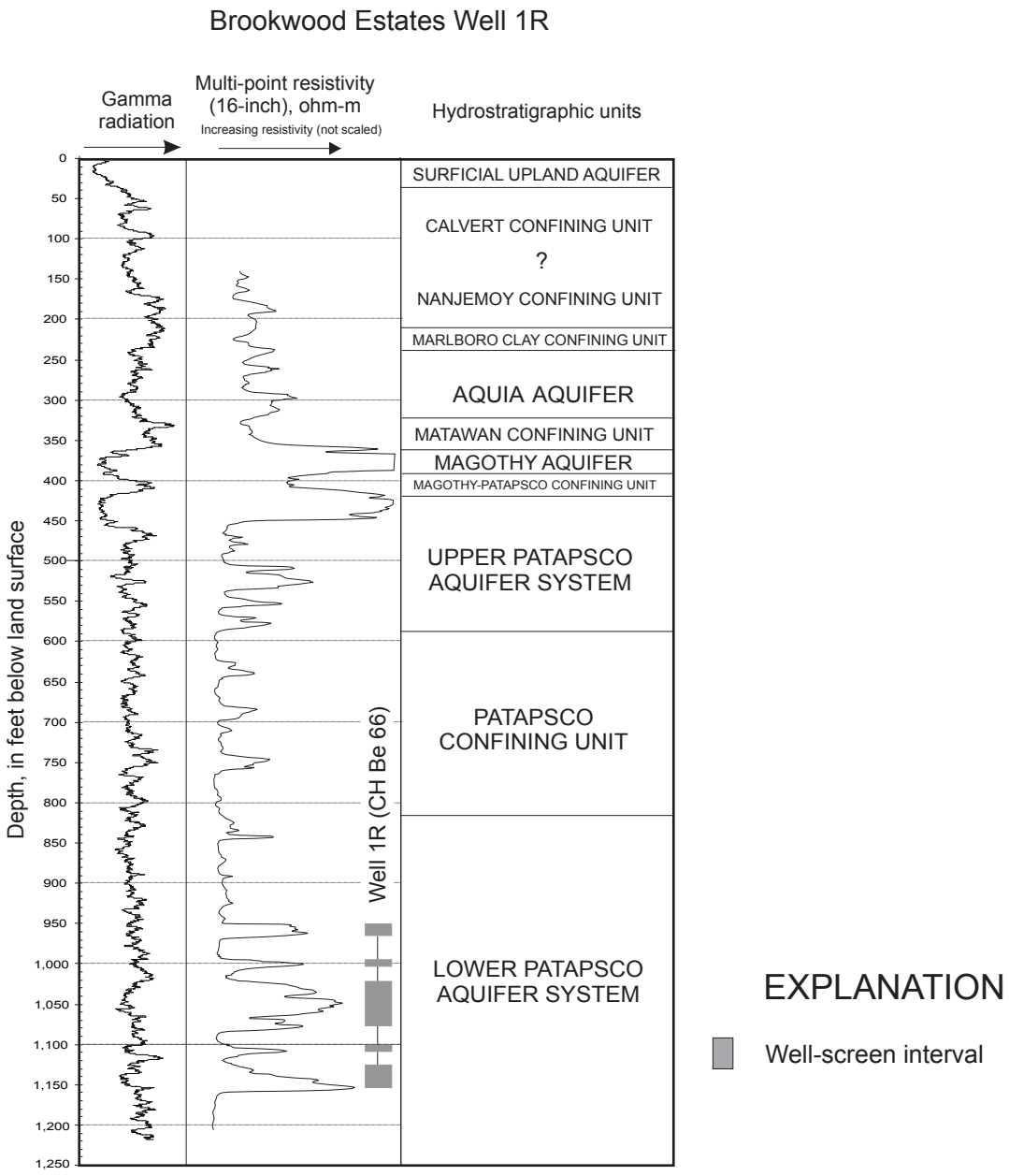

Figure 10. Hydrostratigraphic schematic diagram showing locations of well-screen intervals at Brookwood Estates Well 1R.

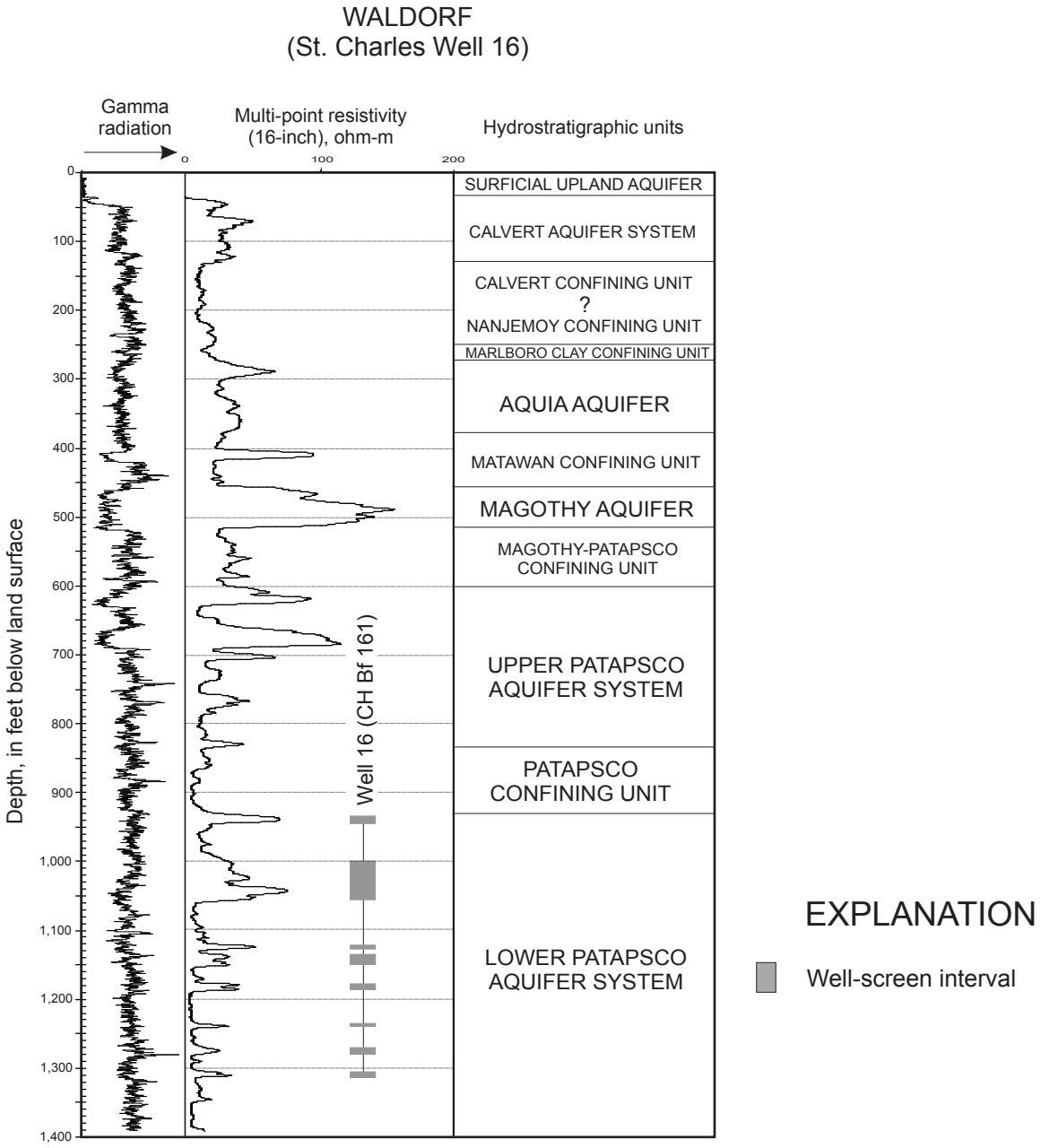

Figure 11. Hydrostratigraphic schematic diagram showing locations of well-screen intervals at Waldorf (St. Charles Well 16).

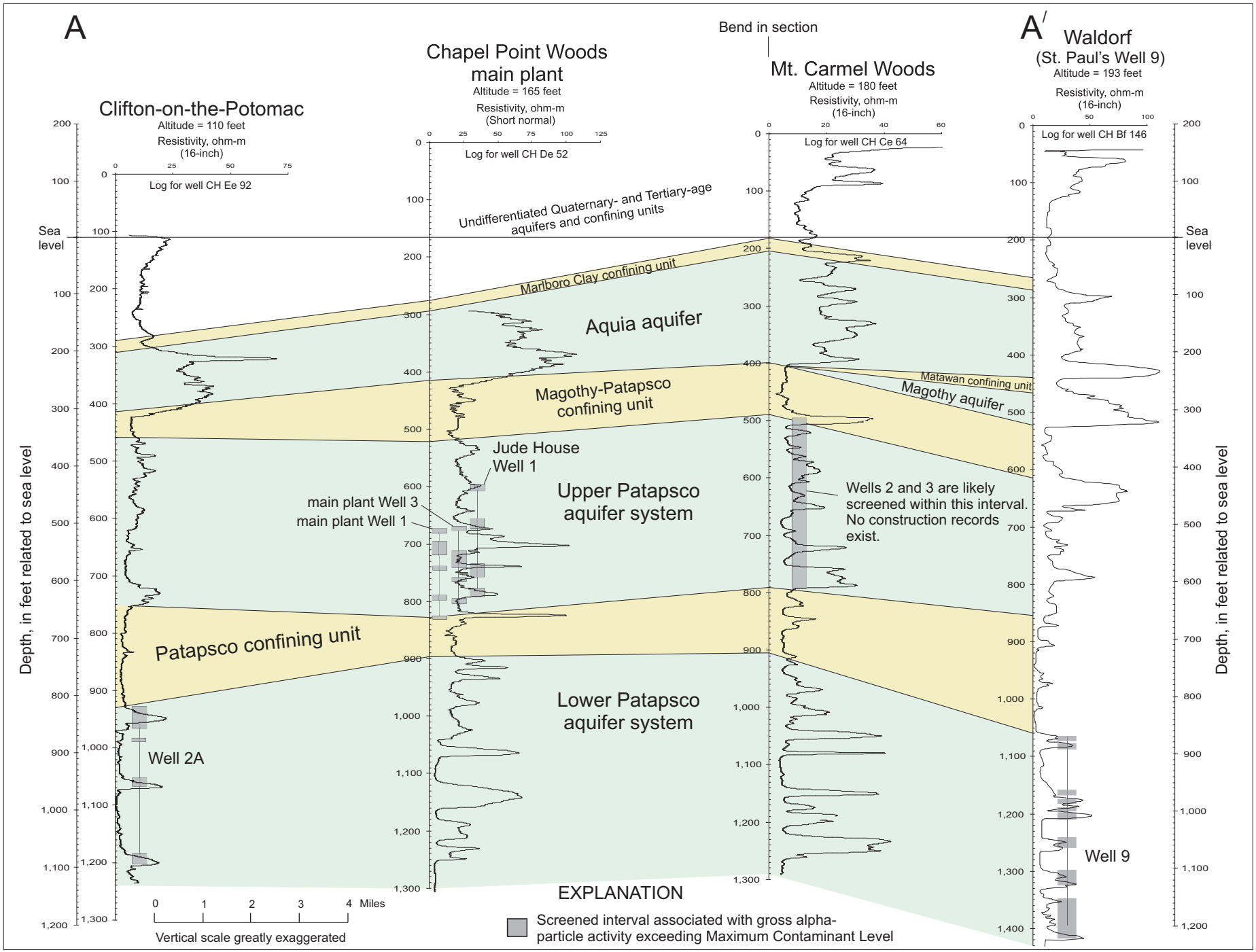

Figure 12. Hydrogeologic cross section A-A′ from Clifton-on-the-Potomac to Waldorf (St. Paul's Well 9) public water systems. See Figure 1 for location of line of section.

WELLS ADJACENT TO PUBLIC WATER SYSTEMS WITH ELEVATED RADIOACTIVITY

Wells screened in the Upper and Lower Patapsco aquifer systems that are in close proximity (1-mi radius) of the public water systems with elevated radioactivity were identified. Identifying wells nearest to the known areas of elevated radioactivity will help guide future sampling to better map the distribution of radioactivity. To identify these wells, well-screen depths contained in the MDE's wells database were compared to aquifer depths for the Upper and Lower Patapsco aquifer systems. To make the comparison, the following steps were taken:

1) Well-screen records were retrieved on July 18, 2014 from the MDE wells database. The retrieval includes wells completed between 1949 and 2014; records for wells drilled from late 2012 to 2014 may not be fully represented in the dataset due to lag in time for entry of data (John Boris, Maryland Department of the Environment, personal commun., 2014). A total of 15,771 well records were retrieved from the MDE wells database.
2) Three hundred and five wells noted as abandoned were removed from the dataset.
3) Well locations were plotted in ESRI's ArcMap geographic information system (GIS) using latitude and longitude coordinates from the wells database. The locational accuracy varies from relatively high for wells completed after about 2011 when global positioning system (GPS) measurements were required to relatively low for earlier wells approximately located using the 10,000-ft Maryland State Plane grid coordinates.
4) Four hundred three wells with erroneous coordinates that plotted outside of the Charles County boundary were removed. Since well coordinates are approximate, wells that plotted outside of Charles County but within several miles of the boundary were retained.
5) Top and bottom surfaces (GIS rasters) of the Upper and Lower Patapsco aquifer systems contained in the Maryland Coastal Plain Aquifer Information System (Andreasen and others, 2013) were re-referenced from elevation relative to sea level to depth below land surface by subtracting land-surface altitudes from aquifer-layer altitudes. The land-surface altitudes were derived from the USGS National Elevation Dataset (NED) and regridded as a mean value at a resolution of 2,500 by 2,500 ft. The aquifer-layer rasters also represent mean values at the same resolution.
6) Raster values for aquifer-layer depths below land surface for each well location were extracted.
7) Well-screen depth contained in the MDE wells database was compared to aquifer-layer depth and wells that fully or partially penetrate the Upper and Lower Patapsco aquifer systems were extracted. The MDE wells database provides fields for entry of a maximum of three well-screen intervals; therefore, the intervals of any additional well screens in wells with more than three well screens are unknown. All well-screen intervals are recorded on paper well-completion reports; however, accessing that information for this analysis was unrealistic given the large number of wells involved.

This analysis provides only a rough approximation of wells that may be screened in the two aquifers because of the averaging of land surface and aquifer depth over a relatively large area (2,500 by 2,500 ft), uncertainty of well locations, and possibly incomplete well-screen depth information. Additionally, not all wells drilled between late 2012 and 2014 are included in the MDE wells database retrieval used in the analysis due to lag in time for data entry.

This process resulted in the identification of 57 wells screened in the Upper Patapsco aquifer system and 58 wells screened in the Lower Patapsco aquifer system within a 1-mi radius surrounding the public water systems with elevated radioactivity. Of those wells, 93 are classified as domestic, 14 are public supply wells (from 10 public water systems), five are irrigation, two are test wells, and one is farm supply.

Wells screened in the Upper Patapsco aquifer system and located within 1 mi of the Chapel Point Woods and Mt. Carmel Woods public water systems are shown in Figure 13. Eleven wells were identified that are screened in the Upper Patapsco aquifer system surrounding the Chapel Point Woods (main

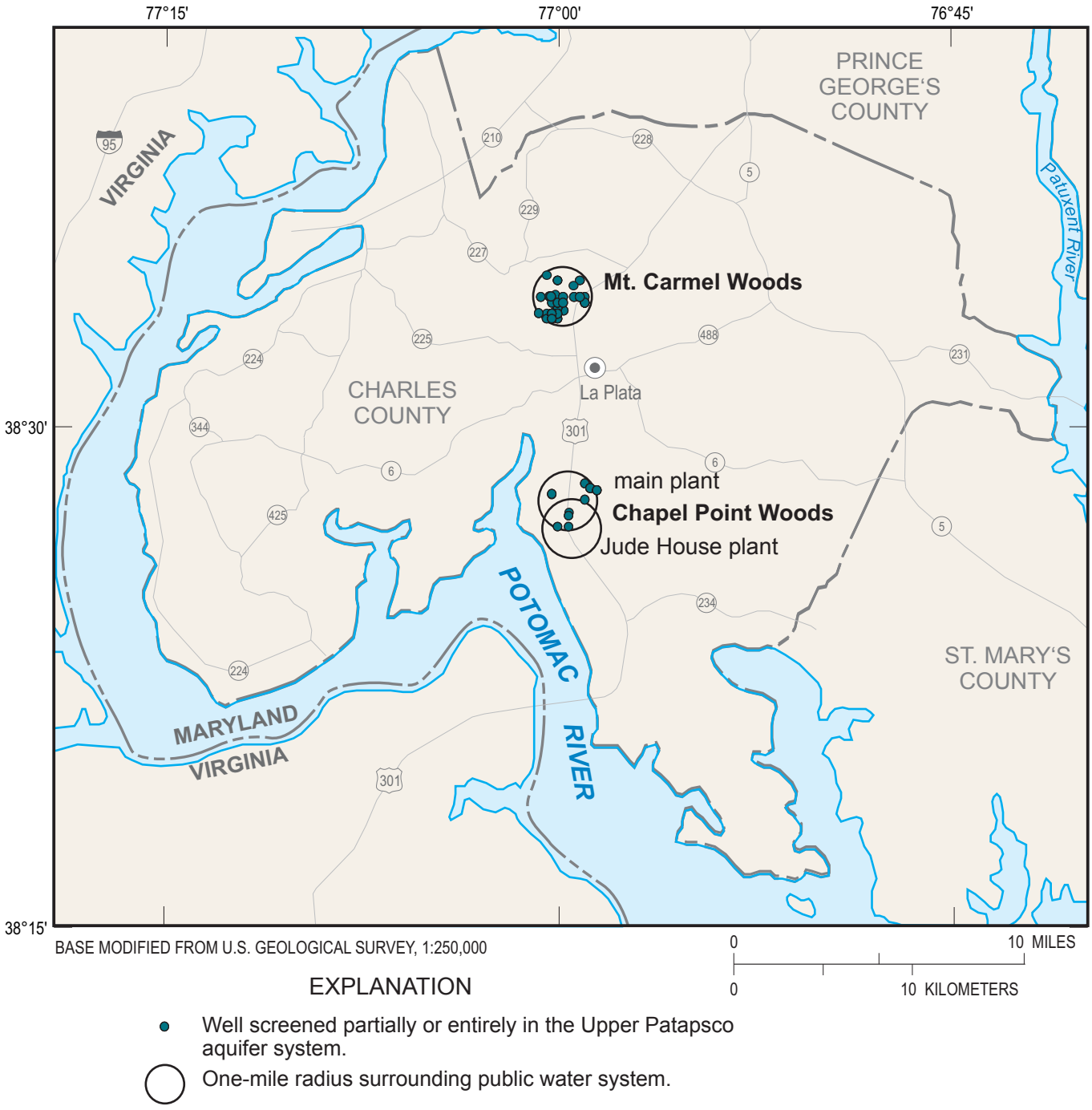

Figure 13. Wells screened in the Upper Patapsco aquifer system that are located within one mile of public water systems with elevated radioactivity.

plant and Jude House plant) public water system. Five of these wells are classified as public supply wells (from two public water systems), three are domestic, one is irrigation, one is farm supply, and one is a test well. The wells were completed between 1959 and 2008, with a median completion date of 1986. Radionuclides (GAPA, GBPA, and combined radium (Ra-226+Ra-228) analyzed by MDE in the public water system wells (Bel Alton and Thunderbird Motel) have been detected but were below the MCLs.

Forty-six wells were identified that are screened in the Upper Patapsco aquifer system surrounding the Mt. Carmel Woods public water system (fig. 13). Forty-three of these wells are classified as domestic, two are public supply wells (from two public water systems), and one is irrigation. The wells were completed between 1974 and 2013, with a median completion date of 1993. Radionuclides (GAPA, GBPA, and combined radium (Ra-226+Ra-228) analyzed by MDE in the public water system wells (Turkey Hill Water Company and College of Southern Maryland) have been detected but were below the MCLs.

Wells screened in the Lower Patapsco aquifer system and located within 1 mi of the Clifton-on-the-Potomac, Mt. Carmel Woods, Town of Indian Head Well 5, and Brookwood Estates public water systems are shown in Figure 14. There are no wells screened in the Lower Patapsco aquifer system within 1 mi of Waldorf (St. Paul's Well 9 or St. Charles Well 16). There is one domestic well screened in the Lower Patapsco aquifer system surrounding the Brookwood Estates system; that well was completed in 1992.

Two wells are screened in the Lower Patapsco aquifer system surrounding the Clifton-on-the-Potomac public water system; the wells, part of the public water system located at the Morgantown Power Plant, were completed between 2000 and 2002. Radionuclides (GAPA and combined radium (Ra-226+Ra-228) in these wells reported are below detection; GBPA has been as high as 5 pCi/L.

Thirty-four wells were indentified that are screened in the Lower Patapsco aquifer system surrounding the Town of Indian Head Well 5 (fig. 14). Twenty-six of these are classified as domestic wells, six are public supplies (from four public water systems), one is a test well, and one is irrigation. The wells were completed between 1918 and 2011, with a median completion date of 1986. Radionuclides (GAPA, GBPA, and combined radium (Ra-226+Ra-228) reported in PDWIS in the public supply wells (Town of Indian Head - three wells; U.S. Naval Surface Warfare Center - one well; Potomac Heights - one well; and Indian Head Teates Supply - one well) have been detected but were below the MCLs.

Twenty-one wells were identified that are screened in the Lower Patapsco aquifer system surrounding the Mt. Carmel Woods public water system (fig. 14). Twenty of the wells are classified as domestic and one is irrigation. The wells were completed between 1989 and 2008, with a median completion date of 1999.

To gain better insight as to the extent of elevated radioactivity in Charles County, it is recommended that the domestic wells in particular be sampled and analyzed for GAPA and GBPA. The distribution of radionuclides in Coastal Plain aquifers is best evaluated by collecting samples from domestic wells, which commonly have relatively short, fixed screen lengths defining radioactivity in specific stratigraphic horizons; this approach was used in New Jersey (Szabo and dePaul, 1998).

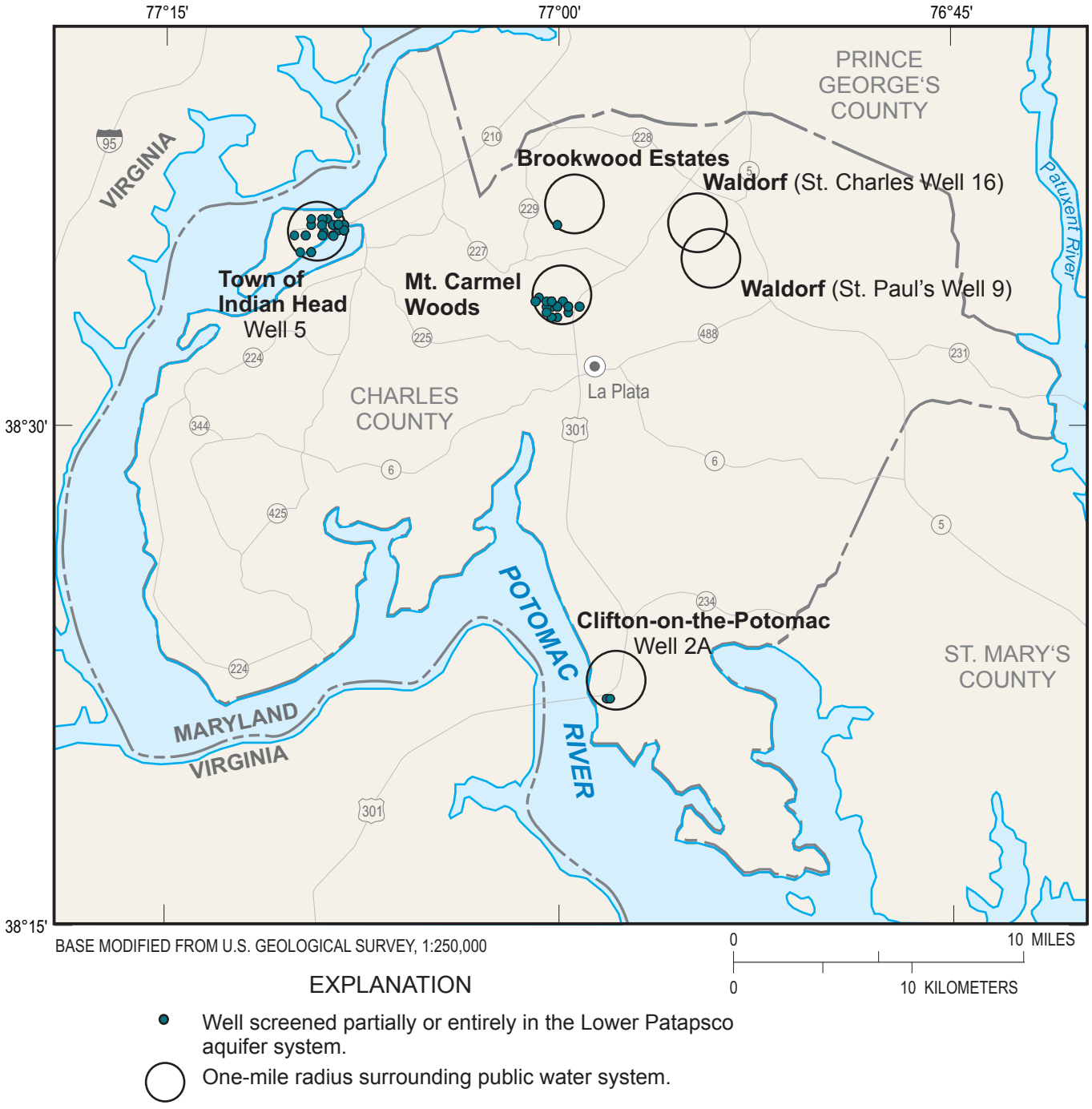

Figure 14. Wells screened in the Lower Patapsco aquifer system that are located within one mile of public-water systems with elevated radioactivity.

SUMMARY AND CONCLUSIONS

A review of existing water-quality data was conducted to determine the occurrence and distribution of radionuclides in groundwater from public water systems in Charles County, Maryland. The primary source of radionuclide analyses used in the study was the MDE PDWIS database, along with Po-210 analyses from the NIST, and the WSLH. Data were evaluated "as is"; they were not reviewed for accuracy, completeness, or transcription errors.

Five public water systems with a groundwater source in Charles County, Maryland—Chapel Point Woods, Clifton-on-the-Potomac, Mt. Carmel Woods, Waldorf (St. Paul's Well 9 and St. Charles Well 16), and the Town of Indian Head—had water with GAPA exceeding the USEPA MCL of 15 pCi/L. The Brookwood Estates public water system had one GAPA that equaled the MCL. At Chapel Point Woods, two wells at the main plant (Wells 1 and 3) and one well at the Jude House plant (Well 1) exceeded the GAPA MCL. All wells in Chapel Point Woods are screened in the Upper Patapsco aquifer system. A reverse osmosis treatment system was installed at the main plant in 2006. At Clifton-on-the-Potomac, one well (Well 2A) screened in the Lower Patapsco aquifer system exceeded the GAPA MCL. At Mt. Carmel Woods, two wells (Wells 2 and 3) screened in the Upper Patapsco aquifer system exceeded the GAPA MCL. Wells 2 and 3 at Mt. Carmel Woods have been abandoned. The GAPA MCL was also exceeded in the Waldorf St. Paul's Well 9, Town of Indian Head Well 5, and Waldorf St. Charles Well 16, all of which are screened in the Lower Patapsco aquifer system. The St. Paul's well was taken out of service in 2006 and the Town of Indian Head well is not in use.

GAPA ranged from below detection in Chapel Point Woods main plant Well 2 to 66.9 pCi/L in the Chapel Point Woods main plant Well 3. The highest GAPA in the six public water systems discussed in this report occurred at the Chapel Point Woods main plant at 122 pCi/L in 2006. The highest GAPA in the Upper Patapsco aquifer system occurred in the Chapel Point Woods main plant at 122 pCi/L. The highest GAPA in the Lower Patapsco aquifer system occurred in the Waldorf St. Charles Well 16 at 53 pCi/L. The mean and median of GAPA above the detection limit from all public water systems in Charles County reported in the PDWIS database were 10 and 6.0 pCi/L, respectively

The highest GBPA in the Upper Patapsco aquifer system was 7 pCi/L in the Chapel Point Woods main plant (Wells 1, 2, and 3) and highest GBPA in the Lower Patapsco aquifer system was 14 pCi/L in Brookwood Estates Well 1R. The mean and median of GBPA above detection limits in analyses from all public water systems in Charles County reported in the PDWIS database were 6.2 and 5.0 pCi/L, respectively

Combined radium (Ra-226+Ra-228) concentrations were relatively low and were below the MCL of 5 pCi/L in all six of the public water systems discussed in this report. Ra-226, Ra-228, and combined radium (Ra-226+Ra-228) concentrations were less than 1.2, 1.7, and 2.5 pCi/L, respectively. Ra-224 was not included in the PDWIS dataset; however, Ra-224 concentrations are likely low since Ra-228 concentrations are low. The relatively low radium concentrations indicate that another radionuclide, presumably Po-210, is the source of the elevated radioactivity. Mean and median Ra-226, Ra-228, and combined radium (Ra-226+Ra-228) above detection limits in analyses from all public water systems in Charles County reported in the PDWIS database were 0.47 and 0.3, 1.4 and 1.3, and 1.1 and 0.6 pCi/L, respectively

The maximum Po-210 concentration in the Chapel Point Woods main plant (Wells 1, 2, and 3, undifferentiated) was 46.6 pCi/L in 2012. The maximum Po-210 concentration in the Chapel Point Jude House plant (Well 1) was 10.3 pCi/L in 2012. All of the Chapel Point Woods wells are screened in the Upper Patapsco aquifer system. At the Mt. Carmel Woods public water system, Po-210 concentrations ranged from 2.8 to 26.9 pCi/L in Well 1A (Lower Patapsco aquifer system) and Well 3 (Upper Patapsco aquifer system), respectively.

The waters with elevated radioactivity in the six public water systems discussed in this report occur in aquifer-sand layers ranging over approximately 900 ft of total sediment thickness spanning both the Upper and Lower Patapsco aquifer systems, and therefore, are not unique to specific stratigraphic levels within these systems. Individual sand layers in the Upper and Lower Patapsco aquifer systems are often localized and discontinuous and do not extend even relatively short distances (less than 1,000 ft). Since water samples from the public water systems discussed in this report are a composite from multiple well screens tapping discrete sand layers, it is difficult to determine precisely where the high radiation is sourced within the thick aquifer systems. The occurrence of elevated radioactivity in the water

is difficult to determine because radionuclide concentrations in individual sand layers are unknown; sand layers are predominantly discontinuous even over relatively short distances, and concentrations of radioactivity in the sampled water may vary with time, perhaps in association with variation in pumping. Geographically, elevated radioactivity in Charles County tends to occur in the central part of the county along a line roughly trending north-south.

Fifty-seven wells that are screened in the Upper Patapsco aquifer system and 58 wells screened in the Lower Patapsco aquifer system were identified within a 1-mi radius surrounding the six public water systems with elevated radioactivity. Of those wells, 93 are classified as domestic, 14 are public supply wells, five are irrigation, two are test wells, and one is farm supply. Radionuclide concentrations in the 14 public water systems were all below the MCLs. Since domestic wells commonly have relatively short, fixed screen lengths it is recommended that they be sampled and analyzed for GAPA and GPBA to provide greater definition of the presence of radioactivity in specific

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APPENDIX A

RADIONUCLIDE ANALYSES FROM THE CHAPEL POINT WOODS, CLIFTON-ON-THE-POTOMAC, MT. CARMEL WOODS, WALDORF (ST. PAUL'S WELL 9 AND ST. CHARLES WELL 16), TOWN OF INDIAN HEAD (WELL 5), AND BROOKWOOD ESTATES (WELL 1R) PUBLIC WATER SYSTEMS

Data in this appendix were compiled from the Maryland Department of the Environment's Public Drinking Water Information System (PDWIS). The Maryland Geological Survey (MGS) accepted all data retrieved from PDWIS as stated and did not attempt to verify the method of analysis, accuracy of values, or possible errors of transcription; therefore, MGS cannot guarantee the accuracy or completeness of the data. Source identification and well-permit numbers were added to the dataset for this report.

U.S. ENVIRONMENTAL PROTECTION AGENCY ANALYTICAL METHODS LISTED IN PDWIS:

Method	Constituent
200.8	Uranium
600	Radon
900	GAPA and GPBA
903.1	Ra-226
904.0	Ra-228

ABBREVIATIONS USED IN APPENDIX A:

General:

d	day
m	month
MGS	Maryland Geological Survey
PDWIS	Public Drinking Water Information System
y	year
--	no data available

Sample location:

POE	point of entry
raw	raw (untreated) water
RO	reverse osmosis
WTP	water-treatment plant

Radionuclides:

Combined uranium	U-234 + U-235 + U-238
GAPA	gross alpha-particle activity
GAPA, adjusted	GAPA minus uranium
GAPA (short-term)	"short-term" (either GAPA or GBPA) refers to analyses made within 72 hours of sampling; however, in practice, the PDWIS database contains GAPA (short-term) and GBPA (short-term) analyses made well after the 72-hour period.
GBPA	gross beta-particle activity
GBPA (short-term)	See GAPA (short-term)

Results:

BDL	below detection limit (detection limit not specified)
pCi/L	picocuries per liter
<	less than

Finish type:

F	finished (treated) water
R	raw (untreated) water

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Combined radium (Ra-226 + Ra-228)	<2.5	--	24-Jun-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Combined radium (Ra-226 + Ra-228)	0.2	--	28-Sep-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Combined radium (Ra-226 + Ra-228)	<2.3	--	21-Oct-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Sample tap	Combined radium (Ra-226 + Ra-228)	<1	F	10-Apr-07	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	POE	Combined radium (Ra-226 + Ra-228)	0.3	F	22-Apr-11	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Well 1 POE tap	Combined radium (Ra-226 + Ra-228)	1	F	21-Oct-13	26-Nov-13	36	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Combined uranium	<1	--	28-Sep-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	POE	GAPA	2	F	02-Feb-98	02-Feb-98	0	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	GAPA	3	--	19-Feb-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	GAPA	2	--	24-Jun-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	GAPA	15	--	28-Sep-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	GAPA	4	--	21-Oct-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Sample tap	GAPA	3	F	10-Apr-07	12-Apr-07	2	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Well 1 POE tap	GAPA	2.6	F	21-Oct-13	23-Oct-13	2	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	GBPA	<3	R	12-Dec-96	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	POE	GBPA	<2	F	02-Feb-98	02-Feb-98	0	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	GBPA	<3	--	19-Feb-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	GBPA	3	--	24-Jun-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	GBPA	14	--	28-Sep-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	GBPA	3	--	21-Oct-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Sample tap	GBPA	<3	F	10-Apr-07	12-Apr-07	2	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Well 1 POE tap	GBPA	<4	F	21-Oct-13	23-Oct-13	2	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Ra-226	<0.7	R	12-Dec-96	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Ra-226	<1	--	19-Feb-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Ra-226	<1	--	24-Jun-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Ra-226	0.2	--	28-Sep-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Ra-226	<0.8	--	21-Oct-04	--	--	02	CH941043

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Sample tap	Ra-226	<0.2	F	10-Apr-07	14-Aug-07	126	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Well 1 POE tap	Ra-226	1	F	21-Oct-13	26-Nov-13	36	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Ra-228	<2	R	12-Dec-96	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Ra-228	<1.5	--	24-Jun-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Ra-228	<0.8	--	28-Sep-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Ra-228	<1.5	--	21-Oct-04	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Sample tap	Ra-228	<0.8	F	10-Apr-07	14-Aug-07	126	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	Well 1 POE tap	Ra-228	<0.8	F	21-Oct-13	25-Nov-13	35	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	--	Rn-222	97.4	R	12-Dec-96	--	--	02	CH941043
0080007	Brookwood Estates	02	Genevieve Drive (Well 1R)	POE well	Rn-222	210	F	02-Feb-98	03-Feb-98	1	02	CH941043
0080009	Clifton-on-the-Potomac	01	Well 1	Well 1	GAPA	<1	F	11-Mar-98	12-Mar-98	1	01	CH730849
0080009	Clifton-on-the-Potomac	01	Well 1	Well 1	GBPA	5	F	11-Mar-98	12-Mar-98	1	01	CH730849
0080009	Clifton-on-the-Potomac	01	Well 1	POE	Rn-222	160	F	19-Mar-98	19-Mar-98	0	01	CH730849
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Combined radium (Ra-226 + Ra-228)	<2.5	--	27-Aug-02	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Plant	Combined radium (Ra-226 + Ra-228)	0.2	--	26-May-05	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Outside tap	Combined radium (Ra-226 + Ra-228)	0.2	--	20-Mar-06	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Combined radium (Ra-226 + Ra-228)	0.4	--	20-Jun-06	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE	Combined radium (Ra-226 + Ra-228)	<2.5	--	14-Sep-06	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Combined radium (Ra-226 + Ra-228)	0.5	F	18-Dec-06	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Combined radium (Ra-226 + Ra-228)	<1	F	22-May-07	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Combined radium (Ra-226 + Ra-228)	0.1	F	12-Jul-07	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Combined radium (Ra-226 + Ra-228)	0.2	F	11-Dec-07	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Combined radium (Ra-226 + Ra-228)	BDL	F	25-Sep-13	18-Oct-13	23	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Plant	Combined uranium	1.2	--	26-May-05	27-Jul-05	62	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Outside tap	Combined uranium	6.3	--	20-Mar-06	21-Jun-06	93	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Combined uranium	<0.7	--	20-Jun-06	18-Sep-06	90	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE	Combined uranium	0.7	--	14-Sep-06	31-Jan-07	139	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Combined uranium	0.7	F	18-Dec-06	09-Mar-07	81	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Combined uranium	<1	F	15-Mar-07	07-Jun-07	84	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Combined uranium	<0.8	F	12-Jul-07	14-Jan-08	186	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	10	--	27-Aug-02	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	7	--	29-Oct-02	30-Oct-02	1	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Plant	GAPA	12	--	26-May-05	--	--	02;04	CH942198

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080009	Clifton-on-the-Potomac	02	Well 2a	Outside tap	GAPA	14	--	20-Mar-06	24-Apr-06	35	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GAPA	16	--	20-Jun-06	23-Jun-06	3	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE	GAPA	18	--	14-Sep-06	19-Sep-06	5	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	23	F	18-Dec-06	19-Jan-07	32	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GAPA	16	F	15-Mar-07	19-Mar-07	4	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GAPA	14	F	22-May-07	25-May-07	3	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GAPA	16	F	12-Jul-07	13-Aug-07	32	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GAPA	8	F	11-Dec-07	13-Dec-07	2	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Raw	GAPA	14.1	R	23-Apr-09	29-Apr-09	6	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Clifton 2A	GAPA	12.7	F	27-Jul-11	30-Jul-11	3	04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Clifton 2A raw	GAPA	11	R	05-Jan-12	19-Jan-12	14	04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	11	F	17-Jan-12	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	18	F	19-Apr-12	27-Apr-12	8	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	8.2	F	18-Jul-12	25-Jul-12	7	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Water	GAPA	9.5	F	20-Sep-12	01-Oct-12	11	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	11.1	F	26-Sep-12	01-Oct-12	5	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	7.7	F	27-Sep-12	01-Oct-12	4	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	11.8	F	01-Oct-12	01-Oct-12	0	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Well 2A	GAPA	8.9	F	03-Oct-12	17-Oct-12	14	04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Well 2A	GAPA	9	F	04-Oct-12	17-Oct-12	13	04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	8.5	F	16-Oct-12	25-Oct-12	9	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	12.6	F	16-Oct-12	25-Oct-12	9	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	12.3	F	16-Oct-12	25-Oct-12	9	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Well 2A	GAPA	15.7	F	16-Oct-12	03-Dec-12	48	04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	13.7	F	17-Oct-12	29-Oct-12	12	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	15.4	F	18-Oct-12	29-Oct-12	11	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	13	F	23-Oct-12	01-Nov-12	9	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	22	F	24-Oct-12	01-Nov-12	8	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	17.2	F	25-Oct-12	01-Nov-12	7	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	12.8	F	09-Jan-13	18-Jan-13	9	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE - Clifton 2A	GAPA	11.3	F	27-Jun-13	08-Jul-13	11	04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE - Clifton 2A	GAPA	2.5	F	11-Jul-13	17-Jul-13	6	04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA	3.5	F	29-Oct-13	15-Nov-13	17	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE	GAPA	8.9	F	05-Mar-14	14-Mar-14	9	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE - Clifton 2A	GAPA	<1.4	F	07-Apr-14	23-Apr-14	16	04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Plant	GAPA (short term)	17	--	26-May-05	31-May-05	5	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Outside tap	GAPA (short term)	17	--	20-Mar-06	23-Mar-06	3	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE	GAPA (short term)	25	--	14-Sep-06	19-Sep-06	5	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GAPA (short term)	23	F	18-Dec-06	20-Dec-06	2	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GAPA (short term)	19	F	12-Jul-07	17-Jul-07	5	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Outside tap	GAPA, adjusted	11.7	--	20-Mar-06	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GAPA, adjusted	19	F	12-Jul-07	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GBPA	3	--	27-Aug-02	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GBPA	<3	--	29-Oct-02	30-Oct-02	1	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Plant	GBPA	<3	--	26-May-05	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Outside tap	GBPA	<3	--	20-Mar-06	24-Apr-06	35	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GBPA	<3	--	20-Jun-06	23-Jun-06	3	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE	GBPA	<3	--	14-Sep-06	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GBPA	<3	F	18-Dec-06	19-Jan-07	32	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GBPA	<3	F	15-Mar-07	19-Mar-07	4	02;04	CH942198

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GBPA	<3	F	22-May-07	25-May-07	3	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GBPA	3	F	12-Jul-07	13-Aug-07	32	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GBPA	5	F	11-Dec-07	13-Dec-07	2	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Plant	GBPA (short term)	<3	--	26-May-05	31-May-05	5	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Outside tap	GBPA (short term)	3	--	20-Mar-06	23-Mar-06	3	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	GBPA (short term)	<3	F	18-Dec-06	20-Dec-06	2	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	GBPA (short term)	<3	F	12-Jul-07	17-Jul-07	5	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE	GBPA (short term)	<3	--	14-Sep-06	--	--	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Ra-226	<1	--	27-Aug-02	21-Jan-03	147	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Plant	Ra-226	0.2	--	26-May-05	27-Jul-05	62	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Outside tap	Ra-226	0.2	--	20-Mar-06	21-Jun-06	93	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-226	0.4	--	20-Jun-06	18-Sep-06	90	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE	Ra-226	<1	--	14-Sep-06	31-Jan-07	139	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Ra-226	0.5	F	18-Dec-06	09-Mar-07	81	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-226	<0.2	F	15-Mar-07	07-Jun-07	84	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-226	<0.1	F	22-May-07	14-Aug-07	84	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-226	0.1	F	12-Jul-07	14-Jan-08	186	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-226	0.2	F	11-Dec-07	07-Mar-08	87	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Ra-226	<0.4	F	25-Sep-13	11-Oct-13	16	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Ra-228	<1.5	--	27-Aug-02	17-Apr-03	233	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Plant	Ra-228	<1	--	26-May-05	27-Jul-05	62	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Outside tap	Ra-228	<1	--	20-Mar-06	21-Jun-06	93	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-228	<0.8	--	20-Jun-06	18-Sep-06	90	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	POE	Ra-228	<1.5	--	14-Sep-06	31-Jan-07	139	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Ra-228	<0.9	F	18-Dec-06	09-Mar-07	81	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-228	<0.8	F	15-Mar-07	07-Jun-07	84	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-228	<0.9	F	22-May-07	14-Aug-07	84	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-228	<1	F	12-Jul-07	14-Jan-08	186	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	Sample tap	Ra-228	<0.8	F	11-Dec-07	07-Mar-08	87	02;04	CH942198
0080009	Clifton-on-the-Potomac	02	Well 2a	--	Ra-228	<0.47	F	25-Sep-13	18-Oct-13	23	02;04	CH942198
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Combined radium (Ra-226 + Ra-228)	<1.1	F	22-May-07	--	--	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Combined radium (Ra-226 + Ra-228)	<1.2	F	12-Jul-07	--	--	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Combined radium (Ra-226 + Ra-228)	0.1	F	11-Dec-07	--	--	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	POE tap	Combined radium (Ra-226 + Ra-228)	0.2	F	29-Apr-14	20-May-14	21	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	--	GAPA	4	F	11-Mar-98	12-Mar-98	1	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	--	GAPA	6		27-Aug-02	--	--	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	GAPA	7	F	15-Mar-07	19-Mar-07	4	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	GAPA	6	F	22-May-07	25-May-07	3	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	GAPA	8	F	12-Jul-07	17-Jul-07	5	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	GAPA	6	F	11-Dec-07	13-Dec-07	2	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Raw	GAPA	3.1	R	23-Apr-09	29-Apr-09	6	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	POE tap	GAPA	3.4	F	29-Apr-14	30-Apr-14	1	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	--	GBPA	2	F	11-Mar-98	12-Mar-98	1	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	--	GBPA	4	--	27-Aug-02	--	--	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	GBPA	5	F	15-Mar-07	19-Mar-07	4	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	GBPA	4	F	22-May-07	25-May-07	3	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	GBPA	5	F	12-Jul-07	17-Jul-07	5	03	CH810761

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	GBPA	3	F	11-Dec-07	13-Dec-07	2	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	POE tap	GBPA	<4	F	29-Apr-14	30-Apr-14	1	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Ra-226	<0.1	F	15-Mar-07	07-Jun-07	84	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Ra-226	<0.2	F	22-May-07	14-Aug-07	84	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Ra-226	<0.2	F	12-Jul-07	14-Jan-08	186	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Ra-226	0.1	F	11-Dec-07	07-Mar-08	87	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	POE tap	Ra-226	0.2	F	29-Apr-14	21-May-14	22	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Ra-228	<1	F	15-Mar-07	07-Jun-07	84	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Ra-228	<0.9	F	22-May-07	14-Aug-07	84	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Ra-228	<1	F	12-Jul-07	14-Jan-08	186	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	Sample tap	Ra-228	<0.9	F	11-Dec-07	07-Mar-08	87	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	POE tap	Ra-228	<0.8	F	29-Apr-14	20-May-14	21	03	CH810761
0080009	Clifton-on-the-Potomac	03	St. Anne's Well	POE	Rn-222	200	F	19-Mar-98	19-Mar-98	0	03	CH810761
0080020	Town of Indian Head	04	Well 5	--	Combined radium (Ra-226 + Ra-228)	<2.5	--	28-Oct-02	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	Sample tap	Combined radium (Ra-226 + Ra-228)	<1.5	F	03-Apr-08	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Combined radium (Ra-226 + Ra-228)	1.9	F	27-Apr-09	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Combined radium (Ra-226 + Ra-228)	0.1	F	31-Aug-09	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5 tap	Combined radium (Ra-226 + Ra-228)	0.2	F	28-Apr-10	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE tap	Combined radium (Ra-226 + Ra-228)	0.5	F	16-Jul-10	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP tap	Combined radium (Ra-226 + Ra-228)	0.4	F	09-Nov-10	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE	Combined uranium	0.312	F	11-Feb-98	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE	GAPA	8	F	11-Feb-98	12-Feb-98	1	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	GAPA	13	--	28-Oct-02	29-Oct-02	1	05	CH810992
0080020	Town of Indian Head	04	Well 5	Sample tap	GAPA	15	F	03-Apr-08	02-May-08	29	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GAPA	12	F	30-Mar-09	03-Apr-09	4	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GAPA	15.8	F	27-Apr-09	04-May-09	7	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GAPA	10	F	31-Aug-09	03-Sep-09	3	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GAPA	10.9	F	17-Nov-09	23-Nov-09	6	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5 tap	GAPA	12.4	F	28-Apr-10	03-May-10	5	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE tap	GAPA	11.7	F	16-Jul-10	09-Aug-10	24	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP tap	GAPA	13.7	F	09-Nov-10	23-Nov-10	14	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5	GAPA	14.9	F	19-Jan-11	27-Jan-11	8	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5	GAPA	14.3	F	26-Jan-11	03-Feb-11	8	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5	GAPA	9.8	F	02-Feb-11	10-Feb-11	8	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5	GAPA	10.9	F	15-Jun-11	19-Jul-11	34	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5	GAPA	15	F	07-Sep-11	15-Sep-11	8	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5	GAPA	12.6	F	16-Nov-11	29-Nov-11	13	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5	GAPA	13.6	--	21-Mar-12	30-Mar-12	9	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	GAPA	13	F	27-Jun-12	30-Aug-12	64	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5	GAPA	13.7	F	28-Sep-12	28-Sep-12	0	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	GAPA	19.8	F	19-Dec-12	08-Jan-13	20	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	GAPA	14	--	09-Feb-05	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	Sample tap	GAPA (short term)	16	F	03-Apr-08	07-Apr-08	4	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GAPA (short term)	16	F	30-Mar-09	--	--	05	CH810992

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080020	Town of Indian Head	04	Well 5	WTP	GAPA, adjusted	16	F	30-Mar-09	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE	GBPA	<3	F	11-Feb-98	12-Feb-98	1	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	GBPA	3	--	28-Oct-02	29-Oct-02	1	05	CH810992
0080020	Town of Indian Head	04	Well 5	Sample tap	GBPA	3	F	03-Apr-08	02-May-08	29	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GBPA	4	F	30-Mar-09	03-Apr-09	4	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GBPA	3.3	F	27-Apr-09	04-May-09	7	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GBPA	3	F	31-Aug-09	03-Sep-09	3	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GBPA	3	F	17-Nov-09	23-Nov-09	6	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5 tap	GBPA	2.7	F	28-Apr-10	03-May-10	5	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE tap	GBPA	3.6	F	16-Jul-10	09-Aug-10	24	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP tap	GBPA	<4	F	09-Nov-10	23-Nov-10	14	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	GBPA	4	--	09-Feb-05	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	Sample tap	GBPA (short term)	4	F	03-Apr-08	07-Apr-08	4	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	GBPA (short term)	5	F	30-Mar-09	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	Ra-226	<1	--	28-Oct-02	16-Jan-03	80	05	CH810992
0080020	Town of Indian Head	04	Well 5	Sample tap	Ra-226	<0.7	F	03-Apr-08	09-Jun-08	67	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Ra-226	0.2	F	30-Mar-09	05-May-09	36	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Ra-226	0.2	F	27-Apr-09	02-Jun-09	36	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Ra-226	0.1	F	31-Aug-09	23-Nov-09	84	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Ra-226	<0.2	F	17-Nov-09	07-Jan-10	51	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5 tap	Ra-226	0.2	F	28-Apr-10	28-Jun-10	61	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE tap	Ra-226	0.5	F	16-Jul-10	30-Aug-10	45	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP tap	Ra-226	0.4	F	09-Nov-10	21-Dec-10	42	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE	Ra-226	0.095	F	11-Feb-98	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	Ra-226	<0.8	--	09-Feb-05	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	Ra-228	<1.5	--	28-Oct-02	17-Apr-03	171	05	CH810992
0080020	Town of Indian Head	04	Well 5	Sample tap	Ra-228	<0.8	F	03-Apr-08	27-May-08	54	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Ra-228	<0.7	F	30-Mar-09	04-May-09	35	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Ra-228	1.7	F	27-Apr-09	02-Jun-09	36	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Ra-228	<0.9	F	31-Aug-09	23-Nov-09	84	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	Ra-228	1	F	17-Nov-09	07-Jan-10	51	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5 tap	Ra-228	<0.9	F	28-Apr-10	28-Jun-10	61	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE tap	Ra-228	<0.8	F	16-Jul-10	30-Aug-10	45	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP tap	Ra-228	0.8	F	09-Nov-10	20-Dec-10	41	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE	Ra-228	0.24	F	11-Feb-98	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	--	Ra-228	<1.5	--	09-Feb-05	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	Well 5 POE	Rn-222	250	F	11-Feb-98	11-Feb-98	0	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE	U-234	0.052	F	11-Feb-98	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	POE	U-235	0.11	F	11-Feb-98	--	--	05	CH810992
0080020	Town of Indian Head	04	Well 5	Sample tap	U-238	<1	F	03-Apr-08	15-Apr-08	12	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	U-238	<1	F	30-Mar-09	21-Apr-09	22	05	CH810992
0080020	Town of Indian Head	04	Well 5	WTP	U-238	<0.001	F	27-Apr-09	19-May-09	22	05	CH810992
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Combined radium (Ra-226 + Ra-228)	0.2	--	30-Oct-02	06-Dec-02	37	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Combined radium (Ra-226 + Ra-228)	<1.1	--	12-Jun-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Combined radium (Ra-226 + Ra-228)	<0.9	--	21-Jul-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Combined radium (Ra-226 + Ra-228)	<2.5	--	30-Oct-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Plant	Combined radium (Ra-226 + Ra-228)	0.2	--	24-May-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Combined radium (Ra-226 + Ra-228)	0.2	--	19-Sep-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	American Holly Court	Combined radium (Ra-226 + Ra-228)	0.2	--	15-Nov-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Combined radium (Ra-226 + Ra-228)	<1.1	--	04-Mar-06	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Combined radium (Ra-226 + Ra-228)	<2.5	--	13-Jun-06	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Combined radium (Ra-226 + Ra-228)	1.3	--	31-Aug-06	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	Combined radium (Ra-226 + Ra-228)	<1	F	19-Dec-06	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	Combined radium (Ra-226 + Ra-228)	<1.2	F	31-May-07	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	Combined radium (Ra-226 + Ra-228)	0.2	F	23-Aug-07	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Kitchen sink	Combined radium (Ra-226 + Ra-228)	0.2	F	04-Dec-07	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Combined radium (Ra-226 + Ra-228)	<1.2	F	09-Feb-12	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Combined uranium	0.076	F	20-Aug-98	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Combined uranium	1.3	--	30-Oct-02	14-Dec-02	45	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Combined uranium	<0.6	--	10-Mar-03	12-May-03	63	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Combined uranium	1.8	--	12-Jun-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Combined uranium	<0.7	--	21-Jul-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Combined uranium	2.2	--	09-Mar-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Plant	Combined uranium	<0.9	--	24-May-05	27-Jul-05	64	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Combined uranium	<1.2	--	19-Sep-05	19-Dec-05	91	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	American Holly Court	Combined uranium	2.3	--	15-Nov-05	17-Jan-06	63	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Combined uranium	1.2	--	04-Mar-06	21-Jun-06	109	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	Combined uranium	0.13	--	17-Apr-06	--	--	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	Combined uranium	0.12	--	17-Apr-06	--	--	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	GAPA	5	F	20-Aug-98	21-Aug-98	1	02;03;04;99	CH731137; CH880856; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA	18	--	30-Oct-02	31-Oct-02	1	02;03;04;99	CH731137; CH880856; CH950021; CH730019

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA	16	--	10-Mar-03	13-Mar-03	3	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA	15	--	12-Jun-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA	12	--	21-Jul-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA	10	--	30-Oct-03	31-Oct-03	1	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA	20	--	09-Mar-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Plant	GAPA	16	--	24-May-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	GAPA	1.9	--	31-Aug-05	13-Sep-05	13	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 2	GAPA	29.7	--	31-Aug-05	13-Sep-05	13	02	CH731137
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 3	GAPA	24.5	--	31-Aug-05	13-Sep-05	13	99	CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	GAPA	14	--	19-Sep-05	24-Oct-05	35	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	American Holly Court	GAPA	20	--	15-Nov-05	17-Nov-05	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	GAPA	15	--	04-Mar-06	14-Apr-06	41	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	GAPA	6	--	06-Mar-06	19-Mar-06	13	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 2	GAPA	31	--	06-Mar-06	19-Mar-06	13	02	CH731137
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 3	GAPA	36	--	06-Mar-06	19-Mar-06	13	99	CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	GAPA	1.8	--	17-Apr-06	08-May-06	21	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	GAPA	4	--	17-Apr-06	08-May-06	21	03	CH880856

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	GAPA	3	--	13-Jun-06	15-Jun-06	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Blended sample POE	GAPA	2.1	--	09-Aug-06	17-Aug-06	8	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 4	GAPA	1.9	--	30-Aug-06	30-Aug-06	0	04	CH950021
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	GAPA	7	--	31-Aug-06	06-Sep-06	6	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA	0.6	--	29-Nov-06	07-Dec-06	8	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	GAPA	3	F	19-Dec-06	21-Dec-06	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sink	GAPA	5	F	26-Mar-07	28-Mar-07	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	GAPA	5	F	31-May-07	04-Jun-07	4	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	GAPA	4	F	23-Aug-07	27-Aug-07	4	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Kitchen sink	GAPA	3	F	04-Dec-07	06-Dec-07	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	GAPA	0.829	F	15-Jan-08	15-Jan-08	0	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA	2	F	23-Apr-09	29-Apr-09	6	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	GAPA	3.5	F	09-Feb-12	11-Feb-12	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA (short term)	18	--	21-Jul-03	22-Jul-03	1	02;03;04;99	CH731137; CH880856; CH950021; CH730019

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Plant	GAPA (short term)	18	--	24-May-05	26-May-05	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	GAPA (short term)	17	--	19-Sep-05	21-Sep-05	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	American Holly Court	GAPA (short term)	4	--	15-Nov-05	17-Nov-05	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	GAPA (short term)	21	--	04-Mar-06	16-Mar-06	12	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	GAPA (short term)	0.4	--	06-Mar-06	19-Mar-06	13	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 2	GAPA (short term)	1.9	--	06-Mar-06	19-Mar-06	13	02	CH731137
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 3	GAPA (short term)	1.9	--	06-Mar-06	19-Mar-06	13	99	CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA, adjusted	16.7	--	30-Oct-02	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA, adjusted	16	--	10-Mar-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA, adjusted	13.2	--	12-Jun-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GAPA, adjusted	17.8	--	09-Mar-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Plant	GAPA, adjusted	18	--	24-May-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	GAPA, adjusted	17	--	19-Sep-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	American Holly Court	GAPA, adjusted	17.7	--	15-Nov-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	GAPA, adjusted	19.8	--	04-Mar-06	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	GBPA	2	F	20-Aug-98	21-Aug-98	1	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GBPA	4	--	30-Oct-02	31-Oct-02	1	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GBPA	3	--	10-Mar-03	13-Mar-03	3	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GBPA	<3	--	12-Jun-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GBPA	3	--	21-Jul-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GBPA	<3	--	30-Oct-03	31-Oct-03	1	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GBPA	7	--	09-Mar-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Plant	GBPA	<3	--	24-May-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	GBPA	4.7	--	31-Aug-05	07-Sep-05	7	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 2	GBPA	6.9	--	31-Aug-05	07-Sep-05	7	02	CH731137
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 3	GBPA	6.8	--	31-Aug-05	07-Sep-05	7	99	CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	GBPA	<3	--	19-Sep-05	24-Oct-05	35	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	GBPA	<3	--	04-Mar-06	14-Apr-06	41	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	GBPA	1.3	--	17-Apr-06	08-May-06	21	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	GBPA	0.6	--	17-Apr-06	08-May-06	21	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	GBPA	<3	--	13-Jun-06	15-Jun-06	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 4	GBPA	1.8	--	30-Aug-06	30-Aug-06	0	04	CH950021
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	GBPA	4	--	31-Aug-06	06-Sep-06	6	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	GBPA	<3	F	19-Dec-06	21-Dec-06	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sink	GBPA	<3	F	26-Mar-07	28-Mar-07	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	GBPA	<3	F	31-May-07	04-Jun-07	4	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	GBPA	3	F	23-Aug-07	27-Aug-07	4	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Kitchen sink	GBPA	3	F	04-Dec-07	06-Dec-07	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	GBPA	<4	F	09-Feb-12	11-Feb-12	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	GBPA (short term)	4	--	21-Jul-03	22-Jul-03	1	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Plant	GBPA (short term)	4	--	24-May-05	26-May-05	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	GBPA (short term)	<3	--	19-Sep-05	21-Sep-05	2	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	GBPA (short term)	4	--	04-Mar-06	16-Mar-06	12	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Ra-226	0.101	F	20-Aug-98	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-226	0.2	--	30-Oct-02	06-Dec-02	37	02;03;04;99	CH731137; CH880856; CH950021; CH730019

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-226	0.4	--	10-Mar-03	15-May-03	66	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-226	<0.2	--	12-Jun-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-226	0.1	--	21-Jul-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-226	<1	--	30-Oct-03	17-Dec-03	48	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-226	<0.8	--	09-Mar-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Plant	Ra-226	0.2	--	24-May-05	27-Jul-05	64	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Ra-226	0.2	--	19-Sep-05	19-Dec-05	91	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	American Holly Court	Ra-226	0.2	--	15-Nov-05	10-Feb-06	87	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Ra-226	<0.2	--	04-Mar-06	21-Jun-06	109	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	Ra-226	<0.1	--	17-Apr-06	19-Apr-06	2	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	Ra-226	<0.1	--	17-Apr-06	19-Apr-06	2	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Ra-226	<1	--	13-Jun-06	05-Sep-06	84	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 4	Ra-226	0.3	--	30-Aug-06	30-Aug-06	0	04	CH950021
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Ra-226	0.4	--	31-Aug-06	20-Oct-06	50	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	Ra-226	<0.2	F	19-Dec-06	30-Apr-07	132	02;03;04;99	CH731137; CH880856; CH950021; CH730019

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sink	Ra-226	0.1	F	26-Mar-07	07-Jun-07	73	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	Ra-226	0.3	F	31-May-07	14-Aug-07	75	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	Ra-226	0.2	F	23-Aug-07	14-Jan-08	144	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Kitchen sink	Ra-226	0.2	F	04-Dec-07	07-Mar-08	94	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	Ra-226	0.38	F	15-Jan-08	15-Jan-08	0	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Ra-226	0.4	F	09-Feb-12	29-Feb-12	20	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Ra-228	0.01	F	20-Aug-98	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-228	<0.9	--	30-Oct-02	06-Dec-02	37	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-228	<0.9	--	10-Mar-03	15-May-03	66	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-228	<0.9	--	12-Jun-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-228	<0.8	--	21-Jul-03	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-228	<1.5	--	30-Oct-03	21-Nov-03	22	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	--	Ra-228	<0.9	--	09-Mar-05	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Plant	Ra-228	<0.9	--	24-May-05	27-Jul-05	64	02;03;04;99	CH731137; CH880856; CH950021; CH730019

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Ra-228	<0.9	--	19-Sep-05	19-Dec-05	91	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	American Holly Court	Ra-228	<0.9	--	15-Nov-05	10-Feb-06	87	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Ra-228	<0.9	--	04-Mar-06	21-Jun-06	109	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Ra-228	<1.5	--	13-Jun-06	05-Sep-06	84	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 4	Ra-228	<0.8	--	30-Aug-06	30-Aug-06	0	04	CH950021
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Outside tap	Ra-228	0.9	--	31-Aug-06	20-Oct-06	50	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	Ra-228	<0.8	F	19-Dec-06	30-Apr-07	132	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sink	Ra-228	<1	F	26-Mar-07	07-Jun-07	73	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	Ra-228	<0.9	F	31-May-07	14-Aug-07	75	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Sample tap	Ra-228	<0.9	F	23-Aug-07	14-Jan-08	144	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Kitchen sink	Ra-228	<0.9	F	04-Dec-07	07-Mar-08	94	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Ra-228	<0.8	F	09-Feb-12	29-Feb-12	20	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	Rn-222	230	F	20-Aug-98	20-Aug-98	0	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	Rn-222	294	F	15-Jan-08	15-Jan-08	0	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	U-234	0.07	--	17-Apr-06	25-Apr-06	8	03	CH880856

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	U-234	0.048	F	20-Aug-98	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	Well 1A	U-235	0.01	--	17-Apr-06	25-Apr-06	8	03	CH880856
0080030	Mt. Carmel Woods	01	Mt. Carmel Woods wells	POE	U-235	0.009	F	20-Aug-98	--	--	02;03;04;99	CH731137; CH880856; CH950021; CH730019
0080049	Waldorf	04	St. Paul's	--	Combined radium (Ra-226 + Ra-228)	2.5	--	16-Oct-02	05-Dec-02	50	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Combined radium (Ra-226 + Ra-228)	<1.2	--	19-Dec-02	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul pumphouse	Combined radium (Ra-226 + Ra-228)	<1.2	--	10-Mar-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Combined radium (Ra-226 + Ra-228)	<2.5	--	12-Jun-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Combined radium (Ra-226 + Ra-228)	<1	--	22-Jul-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul's	Combined uranium	0.056	F	29-Oct-98	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Combined uranium	1.5	--	16-Oct-02	14-Nov-02	29	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Combined uranium	1.9	--	19-Dec-02	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul pumphouse	Combined uranium	1.9	--	10-Mar-03	12-May-03	63	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Combined uranium	2.1	--	22-Jul-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul's	GAPA	8	F	29-Oct-98	29-Oct-98	0	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GAPA	16	--	16-Oct-02	17-Oct-02	1	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GAPA	14	--	19-Dec-02	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul pumphouse	GAPA	14	--	10-Mar-03	15-Apr-03	36	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GAPA	14	--	12-Jun-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GAPA	17	--	22-Jul-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul's	GAPA	34.1	--	31-Aug-05	13-Sep-05	13	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GAPA (short term)	17	--	19-Dec-02	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul pumphouse	GAPA (short term)	17	--	10-Mar-03	13-Mar-03	3	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GAPA (short term)	17	--	22-Jul-03	23-Jul-03	1	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GAPA, adjusted	14.5	--	16-Oct-02	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul's	GBPA	<2	F	29-Oct-98	29-Oct-98	0	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GBPA	3	--	16-Oct-02	17-Oct-02	1	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GBPA	<3	--	19-Dec-02	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul pumphouse	GBPA	<3	--	10-Mar-03	15-Apr-03	36	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GBPA	<3	--	12-Jun-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GBPA	<3	--	22-Jul-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul's	GBPA	5.3	--	31-Aug-05	07-Sep-05	7	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul pumphouse	GBPA (short term)	<3	--	10-Mar-03	13-Mar-03	3	04	CH810738
0080049	Waldorf	04	St. Paul's	--	GBPA (short term)	3	--	22-Jul-03	23-Jul-03	1	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul's	Ra-226	0.14	F	29-Oct-98	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Ra-226	1	--	16-Oct-02	05-Dec-02	50	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Ra-226	0.3	--	19-Dec-02	--	--	04	CH810738

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080049	Waldorf	04	St. Paul's	St. Paul's	Ra-226	0.3	--	10-Mar-03	15-May-03	66	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Ra-226	<1	--	12-Jun-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Ra-226	0.2	--	22-Jul-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul's	Ra-228	<0.03	F	29-Oct-98	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Ra-228	1.5	--	16-Oct-02	05-Dec-02	50	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Ra-228	<0.9	--	19-Dec-02	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul pumphouse	Ra-228	<0.9	--	10-Mar-03	15-May-03	66	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Ra-228	<1.5	--	12-Jun-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	--	Ra-228	<0.8	--	22-Jul-03	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul's	U-234	0.031	F	29-Oct-98	--	--	04	CH810738
0080049	Waldorf	04	St. Paul's	St. Paul's	U-235	0.007	F	29-Oct-98	--	--	04	CH810738
0080049	Waldorf	14	St. Charles Well 16	Sample tap	Combined radium (Ra-226 + Ra-228)	0.1	F	07-Feb-08	--	--	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Outside faucet	Combined radium (Ra-226 + Ra-228)	<1.1	F	26-Aug-08	--	--	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	WTP	Combined radium (Ra-226 + Ra-228)	0.3	F	06-Oct-08	--	--	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	POE tap	Combined radium (Ra-226 + Ra-228)	BDL	F	12-Jun-14	22-Jul-14	40	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	POE tap	Combined uranium	<0.67	F	12-Jun-14	26-Jun-14	14	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	raw	GAPA	2.1	R	16-Feb-06	23-Feb-06	7	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Sample tap	GAPA	3	F	07-Feb-08	11-Feb-08	4	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Outside faucet	GAPA	10	F	26-Aug-08	28-Aug-08	2	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	WTP	GAPA	3	F	06-Oct-08	07-Oct-08	1	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	POE tap	GAPA	27.1	F	12-Jun-14	17-Jul-14	35	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Well 16 POE	GAPA	16.5	F	26-Aug-14	30-Aug-14	4	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Well 16	GAPA	53	R	08-Oct-14	10-Oct-14	2	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	POE tap	GAPA (short term)	28.1	F	12-Jun-14	17-Jun-14	5	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	raw	GBPA	<1.8	R	16-Feb-06	23-Feb-06	7	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Sample tap	GBPA	2	F	07-Feb-08	11-Feb-08	4	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Outside faucet	GBPA	6	F	26-Aug-08	28-Aug-08	2	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	WTP	GBPA	2	F	06-Oct-08	07-Oct-08	1	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	POE tap	GBPA	<4	F	12-Jun-14	17-Jul-14	35	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	POE tap	GBPA (short term)	<4	F	12-Jun-14	13-Jun-14	1	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	raw	Ra-226	0.6	R	16-Feb-06	27-Feb-06	11	17	CH946686

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080049	Waldorf	14	St. Charles Well 16	Sample tap	Ra-226	0.1	F	07-Feb-08	14-Apr-08	67	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Outside faucet	Ra-226	<0.1	F	26-Aug-08	07-Oct-08	42	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	WTP	Ra-226	0.3	F	06-Oct-08	23-Nov-08	48	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	POE tap	Ra-226	<1	F	12-Jun-14	22-Jul-14	40	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	raw	Ra-228	<0.8	R	16-Feb-06	27-Feb-06	11	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Sample tap	Ra-228	<0.8	F	07-Feb-08	14-Apr-08	67	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	Outside faucet	Ra-228	<1	F	26-Aug-08	24-Sep-08	29	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	WTP	Ra-228	<1	F	06-Oct-08	21-Nov-08	46	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	POE tap	Ra-228	<1	F	12-Jun-14	30-Jun-14	18	17	CH946686
0080049	Waldorf	14	St. Charles Well 16	raw	Rn-222	352	R	16-Feb-06	20-Feb-06	4	17	CH946686
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Combined radium (Ra-226 + Ra-228)	<1.2	--	10-Mar-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Combined radium (Ra-226 + Ra-228)	<1.1	--	12-Jun-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Combined radium (Ra-226 + Ra-228)	<1	--	21-Jul-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Combined radium (Ra-226 + Ra-228)	<1.2	--	30-Oct-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	POE tap	Combined radium (Ra-226 + Ra-228)	<0.8	F	03-Apr-12	04-May-12	31	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Combined uranium	0.084	F	12-Nov-98	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Combined uranium	<0.7	--	10-Mar-03	12-May-03	63	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Combined uranium	<1	--	12-Jun-03	21-Jul-03	39	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Combined uranium	<1	--	21-Jul-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Combined uranium	<1	--	30-Oct-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	20	F	12-Nov-98	12-Nov-98	0	01;02;03	CH731804; CH732073; CH880766

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	8	F	03-Feb-99	09-Feb-99	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	43	--	10-Mar-03	15-Apr-03	36	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	43	--	12-Jun-03	22-Jul-03	40	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	51	--	21-Jul-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 1	GAPA	31	--	18-Aug-03	20-Aug-03	2	02	CH732073
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 2	GAPA	<1.5	--	18-Aug-03	20-Aug-03	2	01	CH731804
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 3	GAPA	66.9	--	18-Aug-03	20-Aug-03	2	03	CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 1	GAPA	40.4	--	28-Aug-03	30-Aug-03	2	02	CH732073
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 2	GAPA	1.3	--	28-Aug-03	30-Aug-03	2	01	CH731804
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 3	GAPA	20.3	--	28-Aug-03	30-Aug-03	2	03	CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Wells 1 + 2	GAPA	54.4	--	23-Sep-03	25-Sep-03	2	01;02	CH732073; CH731804
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	33	--	30-Oct-03	01-Dec-03	32	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	WTP	GAPA	46.1	--	11-Dec-03	14-Dec-03	3	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	46.2	--	30-Mar-04	02-Apr-04	3	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	26	--	19-May-04	27-May-04	8	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	70.4	--	21-Sep-04	23-Sep-04	2	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	60.4	--	09-Nov-04	16-Nov-04	7	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Wells 1 + 2	GAPA	44.7	--	19-Jan-05	26-Jan-05	7	01;02	CH732073; CH731804

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	44.7	--	19-Jan-05	26-Jan-05	7	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	WTP	GAPA	56.7	--	28-Apr-05	06-May-05	8	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Wells 1 + 2	GAPA	52.3	--	31-Aug-05	13-Sep-05	13	01;02	CH732073; CH731804
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 3	GAPA	18.3	--	31-Aug-05	13-Sep-05	13	03	CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Wells 1 +2 POE	GAPA	46.1	--	20-Oct-05	07-Nov-05	18	01;02	CH732073; CH731804
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	WTP	GAPA	50.4	--	22-Feb-06	29-Mar-06	35	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GAPA	0.9	--	31-May-06	23-Jun-06	23	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GAPA	1.4	--	31-May-06	23-Jun-06	23	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GAPA	0.8	--	31-May-06	23-Jun-06	23	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GAPA	1.3	--	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GAPA	0.4	--	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GAPA	1.1	--	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Before complete treatment	GAPA	66	R	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Before treatment	GAPA	122	--	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Influent	GAPA	61	R	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended sample POE	GAPA	4.9	F	09-Aug-06	17-Aug-06	8	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	3	F	29-Nov-06	05-Dec-06	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended water	GAPA	5.4	F	19-Jul-07	25-Sep-07	68	01;02;03	CH731804; CH732073; CH880766

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended water	GAPA	3.7	F	11-Oct-07	13-Oct-07	2	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended water	GAPA	3.3	F	21-Nov-07	27-Nov-07	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended water	GAPA	5.5	F	12-Dec-07	18-Dec-07	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	4.7	F	16-Apr-08	23-Apr-08	7	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	4.6	F	14-May-08	19-May-08	5	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	5.5	F	11-Jun-08	14-Jun-08	3	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	0.3	F	05-Mar-09	10-Mar-09	5	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	BDL	F	23-Apr-09	29-Apr-09	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	1.3	F	01-Oct-09	07-Oct-09	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	BDL	F	07-Jan-10	14-Jan-10	7	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	BDL	F	14-Jan-10	14-Jan-10	0	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	POE	GAPA	2	F	23-Nov-10	03-Dec-10	10	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	3.7	F	15-Dec-11	22-Dec-11	7	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended RO effluent	GAPA	<1.12	F	05-Jan-12	29-Jan-12	24	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	POE tap	GAPA	11.5	F	03-Apr-12	04-Apr-12	1	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	POE	GAPA	18.4	F	20-Jun-12	29-Jun-12	9	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Public drinking entry point	GAPA	18.4	F	06-Jul-12	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	7.71	F	28-Aug-12	--	--	01;02;03	CH731804; CH732073; CH880766

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	9.19	F	19-Sep-12	30-Sep-12	11	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended	GAPA	6.2	F	30-Sep-12	07-Oct-13	372	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	52	R	04-Oct-12	10-Oct-12	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	8.4	F	11-Oct-12	11-Oct-12	0	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	9.3	R	15-Oct-12	15-Oct-12	0	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	9.19	F	05-Nov-12	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	8.2	F	08-Nov-12	15-Nov-12	7	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended	GAPA	6.6	F	18-Dec-12	01-Jan-13	14	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended RO	GAPA	19.8	F	03-Jan-13	18-Jan-13	15	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	4.9	F	07-Feb-13	12-Feb-13	5	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	31	R	07-Feb-13	12-Feb-13	5	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA	21	F	07-Feb-13	15-Feb-13	8	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Concentrate	GAPA	21	R	07-Feb-13	15-Feb-13	8	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended RO effluent	GAPA	33	F	07-Mar-13	12-Mar-13	5	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Concentrate	GAPA	27	R	07-Mar-13	13-Mar-13	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended RO effluent	GAPA	1.3	F	28-Mar-13	03-Apr-13	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Concentrate RO	GAPA	18.5	R	28-Mar-13	08-Apr-13	11	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended	GAPA	3.6	F	11-Apr-13	19-Apr-13	8	01;02;03	CH731804; CH732073; CH880766

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended	GAPA	0.2	F	02-May-13	31-May-13	29	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended	GAPA	8.5	F	06-Jun-13	14-Jun-13	8	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended	GAPA	6	F	11-Jul-13	17-Jul-13	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended	GAPA	10.8	F	26-Aug-13	04-Sep-13	9	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended POE	GAPA	6	F	28-Oct-13	05-Nov-13	8	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended	GAPA	3.6	F	05-Nov-13	09-Nov-13	4	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	POE	GAPA	4.9	F	02-Dec-13	09-Dec-13	7	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 1 POE	GAPA	3.7	F	06-Jan-14	08-Jan-14	2	02	CH732073
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 3	GAPA	5	F	11-Feb-14	15-Feb-14	4	03	CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 1	GAPA	17.4	F	25-Feb-14	10-Mar-14	13	02	CH732073
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 1	GAPA	1.6	F	25-Mar-14	16-Apr-14	22	02	CH732073
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 3 raw	GAPA	2.9	R	27-Mar-14	12-Apr-14	16	03	CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 1	GAPA	0.6	F	07-Apr-14	23-Apr-14	16	02	CH732073
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA (short term)	54	--	10-Mar-03	13-Mar-03	3	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA (short term)	65	--	12-Jun-03	16-Jun-03	4	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA (short term)	64	--	21-Jul-03	22-Jul-03	1	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA (short term)	37	--	30-Oct-03	31-Oct-03	1	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA, adjusted	19.8	F	12-Nov-98	--	--	01;02;03	CH731804; CH732073; CH880766

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA, adjusted	43	--	10-Mar-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GAPA, adjusted	43	--	12-Jun-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA	<2	F	12-Nov-98	12-Nov-98	0	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA	4	F	03-Feb-99	09-Feb-99	6	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA	5	--	10-Mar-03	15-Apr-03	36	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA	4	--	12-Jun-03	22-Jul-03	40	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA	7	--	21-Jul-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA	4	--	30-Oct-03	01-Dec-03	32	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Wells 1 + 2	GBPA	5.6	--	31-Aug-05	07-Sep-05	7	01;02	CH732073; CH731804
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Well 3	GBPA	6.2	--	31-Aug-05	07-Sep-05	7	03	CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GBPA	0.9	--	31-May-06	23-Jun-06	23	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GBPA	0.7	--	31-May-06	23-Jun-06	23	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GBPA	1	--	31-May-06	23-Jun-06	23	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GBPA	0.7	--	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GBPA	0.6	--	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	After treatment	GBPA	0.9	--	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Before complete treatment	GBPA	5.4	R	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Before treatment	GBPA	6.9	--	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766

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Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Influent	GBPA	3.5	R	01-Jun-06	23-Jun-06	22	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	Blended RO effluent	GBPA	<0.01	F	05-Jan-12	29-Jan-12	24	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	POE tap	GBPA	<4	F	03-Apr-12	04-Apr-12	1	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA	0.78	F	28-Aug-12	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA	0.31	F	19-Sep-12	30-Sep-12	11	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA	0.31	F	05-Nov-12	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA (short term)	6	--	10-Mar-03	13-Mar-03	3	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA (short term)	6	--	12-Jun-03	16-Jun-03	4	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA (short term)	8	--	21-Jul-03	22-Jul-03	1	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	GBPA (short term)	6	--	30-Oct-03	31-Oct-03	1	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-226	0.211	F	12-Nov-98	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-226	0.11	F	03-Feb-99	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-226	0.3	--	10-Mar-03	15-May-03	66	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-226	0.2	--	12-Jun-03	22-Jul-03	40	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-226	0.1	--	21-Jul-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-226	<0.3	--	30-Oct-03	29-Jan-04	91	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	POE tap	Ra-226	<0.2	F	03-Apr-12	04-May-12	31	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-228	0.09	F	12-Nov-98	--	--	01;02;03	CH731804; CH732073; CH880766

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-228	<0.3	F	03-Feb-99	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-228	<0.9	--	10-Mar-03	15-May-03	66	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-228	<0.9	--	12-Jun-03	22-Jul-03	40	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-228	<0.9	--	21-Jul-03	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	Ra-228	<0.9	--	30-Oct-03	28-Jan-04	90	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	POE tap	Ra-228	<0.8	F	03-Apr-12	04-May-12	31	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	POE	Rn-222	230	F	12-Nov-98	12-Nov-98	0	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	U-234	0.061	F	12-Nov-98	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	01	Chapel Point Wells 1 2 3 (main plant)	--	U-235	0.005	F	12-Nov-98	--	--	01;02;03	CH731804; CH732073; CH880766
0080064	Chapel Point Woods	02	Jude House plant	Well 1 raw	Combined radium (Ra-226 + Ra-228)	<1.2	F	01-Feb-12	--	--	06	CH945204
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Combined radium (Ra-226 + Ra-228)	0.1	--	03-Apr-12	04-May-12	31	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Combined radium (Ra-226 + Ra-228)	2.5	F	04-Mar-13	08-Apr-13	35	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Combined radium (Ra-226 + Ra-228)	BDL	F	22-Apr-13	29-May-13	37	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Combined radium (Ra-226 + Ra-228)	0.8	F	31-Jul-13	21-Sep-13	52	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Combined radium (Ra-226 + Ra-228)	0.4	F	01-Oct-13	08-Nov-13	38	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Combined radium (Ra-226 + Ra-228)	BDL	F	05-Mar-14	22-Apr-14	48	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Combined uranium	<0.00007	--	03-Apr-12	13-Apr-12	10	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw tap	Combined uranium	<0.001	F	03-Oct-12	18-Oct-12	15	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Combined uranium	<0.001	F	22-Apr-13	22-May-13	30	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Combined uranium	<0.67	F	05-Mar-14	18-Mar-14	13	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Well 1 raw	GAPA	17.2	R	05-Jan-12	08-Jan-12	3	06	CH945204
0080064	Chapel Point Woods	02	Jude House plant	Well 2 raw	GAPA	11.4	R	05-Jan-12	08-Jan-12	3	07	CH951343

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	02	Jude House plant	Well 1 raw	GAPA	11.7	F	01-Feb-12	03-Feb-12	2	06	CH945204
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GAPA	37.6	--	03-Apr-12	04-Apr-12	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	--	GAPA	6.84	F	28-Jun-12	28-Jun-12	0	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw sample tap	GAPA	14.1	F	12-Jul-12	16-Jul-12	4	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	raw	GAPA	15.9	F	12-Jul-12	11-Aug-12	30	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Public drinking entry point	GAPA	15.9	F	16-Jul-12	16-Jul-12	0	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	--	GAPA	8.6	F	28-Sep-12	28-Sep-12	0	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw tap	GAPA	17.4	F	03-Oct-12	09-Oct-12	6	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	--	GAPA	8.4	F	15-Oct-12	15-Oct-12	0	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	--	GAPA	5.1	F	09-Jan-13	18-Jan-13	9	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	--	GAPA	0.6	F	09-Jan-13	18-Jan-13	9	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	--	GAPA	28	R	31-Jan-13	11-Feb-13	11	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GAPA	6.6	F	04-Mar-13	05-Mar-13	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GAPA	33.5	F	22-Apr-13	22-May-13	30	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Well 2 POE	GAPA	5.7	F	27-Jun-13	08-Jul-13	11	07	CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE	GAPA	5.4	F	11-Jul-13	17-Jul-13	6	06;07	CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GAPA	5.8	F	31-Jul-13	08-Aug-13	8	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GAPA	13.5	F	01-Oct-13	02-Oct-13	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Well 2 POE	GAPA	5	F	19-Dec-13	30-Dec-13	11	07	CH951343
0080064	Chapel Point Woods	02	Jude House plant	raw	GAPA	3.1	F	05-Mar-14	14-Mar-14	9	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GAPA	39.8	F	05-Mar-14	09-Apr-14	35	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE	GAPA	0.8	F	07-Apr-14	23-Apr-14	16	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GAPA	<2	F	29-Apr-14	30-Apr-14	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw tap	GAPA (short term)	11.6	F	03-Oct-12	19-Oct-12	16	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GAPA (short term)	38.6	F	22-Apr-13	23-Apr-13	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GAPA (short term)	46.8	F	05-Mar-14	06-Mar-14	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Well 1 raw	GBPA	0.67	R	05-Jan-12	08-Jan-12	3	06	CH945204

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	02	Jude House plant	Well 2 raw	GBPA	1.06	R	05-Jan-12	08-Jan-12	3	07	CH951343
0080064	Chapel Point Woods	02	Jude House plant	Well 1 raw	GBPA	<4	F	01-Feb-12	03-Feb-12	2	06	CH945204
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GBPA	<4	--	03-Apr-12	04-Apr-12	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw sample tap	GBPA	<4	F	12-Jul-12	16-Jul-12	4	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	raw	GBPA	2.27	F	12-Jul-12	11-Aug-12	30	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Public drinking entry point	GBPA	2.27	F	16-Jul-12	16-Jul-12	0	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw tap	GBPA	5.3	F	03-Oct-12	09-Oct-12	6	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GBPA	<4	F	04-Mar-13	05-Mar-13	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GBPA	<4	F	22-Apr-13	22-May-13	30	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GBPA	<4	F	31-Jul-13	08-Aug-13	8	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GBPA	6	F	01-Oct-13	02-Oct-13	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GBPA	<4	F	05-Mar-14	09-Apr-14	35	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GBPA	<4	F	29-Apr-14	30-Apr-14	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw tap	GBPA (short term)	4.2	F	03-Oct-12	05-Nov-12	33	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GBPA (short term)	<4	F	22-Apr-13	23-Apr-13	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	GBPA (short term)	<4	F	05-Mar-14	06-Mar-14	1	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Well 1 raw	Ra-226	<0.2	F	01-Feb-12	28-Feb-12	27	06	CH945204
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-226	0.1	--	03-Apr-12	04-May-12	31	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw sample tap	Ra-226	<1	F	12-Jul-12	08-Aug-12	27	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw tap	Ra-226	0.2	F	03-Oct-12	19-Nov-12	47	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-226	1.2	F	04-Mar-13	08-Apr-13	35	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-226	<0.2	F	22-Apr-13	29-May-13	37	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-226	0.8	F	31-Jul-13	21-Sep-13	52	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-226	0.4	F	01-Oct-13	08-Nov-13	38	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-226	<1	F	05-Mar-14	26-Mar-14	21	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Well 1 raw	Ra-228	<1	F	01-Feb-12	28-Feb-12	27	06	CH945204
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-228	<0.8	--	03-Apr-12	04-May-12	31	06;07	CH945204; CH951343

Appendix A.--Continued

Public water system identification number	Public water system name	Plant identification number	Plant name	Sample location	Radionuclide	Result, pCi/L	Finish type	Sample date, day-month-year	Analysis date, day-month-year	Time between sample collection and analysis, days	Source identification number	Well-permit numbers
0080064	Chapel Point Woods	02	Jude House plant	Raw sample tap	Ra-228	0.9	F	12-Jul-12	10-Aug-12	29	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Raw tap	Ra-228	<0.9	F	03-Oct-12	19-Nov-12	47	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-228	1.3	F	04-Mar-13	08-Apr-13	35	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-228	<0.8	F	22-Apr-13	29-May-13	37	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-228	<0.9	F	31-Jul-13	19-Sep-13	50	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-228	<0.8	F	01-Oct-13	07-Nov-13	37	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-228	<0.8	F	05-Mar-14	22-Apr-14	48	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	POE tap	Ra-228	<0.9	F	29-Apr-14	20-May-14	21	06;07	CH945204; CH951343
0080064	Chapel Point Woods	02	Jude House plant	Well 1 raw	Rn-222	413	R	01-Feb-12	02-Feb-12	1	06	CH945204

APPENDIX B.
WELL-CONSTRUCTION RECORDS FOR PUBLIC SUPPLY WELLS FROM SIX PUBLIC WATER SYSTEMS, CHARLES COUNTY, MARYLAND

[GPS, global positioning system; NAD 83, North American Datum of 1983; lat., latitude; long., longitude; Co., company; Inc., incorporated; --, no data]

Well name	Well number	GPS coordinates, NAD 83		Land surface elevation (feet)	Well-permit number	Year completed	Driller	Total depth drilled (feet)	Diameter (inches)	
		Lat.	Long.						Casing [1]	Screen
Chapel Point Woods										
main plant Well 1	CH De 41	38.46466	76.99525	165	CH732073	1978	Shannahan Well Co.	901	6, 4	4
main plant Well 2	CH De 40	38.46466	76.99525	165	CH731804	1978	Shannahan Well Co.	762	6, 4	4
main plant Well 3	CH De 55	38.46082	76.99664	164	CH880766	1989	Shannahan Well Co.	818	6, 4	4
Jude House plant Well 1	CH De 54	38.45093	76.99117	166	CH945204	2003	A.C. Schultes of Maryland, Inc.	797	6	6
Jude House plant Well 2	CH De 53	38.45069	76.99120	167	CH951343	2010	A.C. Schultes of Maryland, Inc.	801	8	6
Clifton-on-the-Potomac										
St. Anne's	CH Ee 91	38.37691	76.98116	68	CH810761	1984	Layne-Atlantic Co.	1,214	12, 6	6
Well 1	CH Ee 77	38.37373	76.96200	113	CH730849	1975	Patuxent Pump and Well, Inc.	380	6	4
Well 2	CH Ee 98	38.37373	76.96200	113	CH730147	1973	Patuxent Pump and Well, Inc.	380	6	5
Well 2A	CH Ee 92	38.37373	76.96200	113	CH942198	1998	A.C. Schultes of Maryland, Inc.	1,215	8	6
Mt. Carmel Woods										
Well 1A	CH Ce 58	38.56719	76.99657	185	CH880856	1989	Delmarva Drilling Co.	1,316	6	6
Well 2	--	--	--	--	CH731137	--	--	400	--	--
Well 3	--	--	--	--	CH730019	--	--	--	--	--
Well 4	CH Ce 64	38.56716	76.99678	186	CH950021	2006	A.C. Schultes of Maryland, Inc.	1,261	6	6

[1] First number indicates diameter of top casing, second number indicates diameter of middle (or bottom) casing, and third number indicates diameter of bottom casing.

Appendix B.—Continued

Well name	Well number	GPS coordinates, NAD 83		Land surface elevation (feet)	Well-permit number	Year completed	Driller	Total depth drilled (feet)	Diameter (inches)	
		Lat.	Long.						Casing	Screen
Waldorf St. Paul's										
Well 9	CH Bf 147	38.58583	76.90100	193	CH810738	1984	Sydnor Hydrodynamics, Inc.	1,440	20, 12	12
Town of Indian Head										
Well 5	CH Bc 72	38.59705	77.15313	34	CH810992	1984	Sydnor Hydrodynamics, Inc.	498	20,12, 6	6
Brookwood Estates										
Well 1R	CH Be 66	38.60955	76.99141	215	CH941043	1996	A.C. Schultes of Maryland, Inc.	1,233	8, 6	6
Waldorf St. Charles										
Well 16	CH Bf 161	38.60335	76.90853	200	CH946686	2006	A.C. Schultes of Maryland, Inc.	1,322	18, 8	8

Appendix B.—Continued

Well name	Screen position (feet below land surface)	Aquifer	Water level (feet below land surface)		Date measured (month/ day/ year)	Yield (gallons per minute)	Hours pumped	Specific capacity (gallons per minute per foot)	Remarks
			Static	Pumping					
Chapel Point Woods									
main plant Well 1	673-681, 695-720, 738-745, 790-797, 826-832	Upper Patapsco aquifer system	162	218	9/3/1978	41	12	0.7	
main plant Well 2	450-468, 503-511, 542-547, 602-611, 712-720	Upper Patapsco aquifer system	164	415	8/22/1978	10	2	0.04	Test well
main plant Well 3	669-676, 732-741, 758-766, 795-806	Upper Patapsco aquifer system	198	312	10/10/1989	50	4	0.44	
Jude House plant Well 1	598-608, 653-673, 737-757, 787-792	Upper Patapsco aquifer system	214	387	3/7/2003	80	24	0.46	
Jude House plant Well 2	600-620, 658-663, 737-757, 791-796	Upper Patapsco aquifer system	285	432	10/20/2010	100	24	0.68	
Clifton-on-the-Potomac									
St. Anne's	1,000-1,010, 1,033-1,066, 1,084-1,096	Lower Patapsco aquifer system	103	295	1/25/1984	317	24	1.7	
Well 1	350-380	Aquia aquifer	108	334	11/28/1975	50	24	0.22	Abandoned
Well 2	358-380	Aquia aquifer	120	210	5/15/1973	25	6	0.28	Abandoned
Well 2A	927-967, 983-988, 1,053-1,068, 1,185-1,205	Lower Patapsco aquifer system	175	353	10/26/1998	170	24	0.96	
Mt. Carmel Woods									
Well 1A	1,225-1,278	Lower Patapsco aquifer system	243	373	11/28/1989	60	24	0.5	
Well 2	--	Undetermined	--	--	--	--	--	--	Only construction record is total depth of 400 feet.
Well 3	--	Undetermined	--	--	--	--	--	--	No construction record.
Well 4	1,226-1,256	Lower Patapsco aquifer system	3	474	8/30/2006	76	8	0.16	

Appendix B.—Continued

Well name	Screen position (feet below land surface)	Aquifer	Water level (feet below land surface)		Date measured (month/ day/ year)	Yield (gallons per minute)	Hours pumped	Specific capacity (gallons per minute per foot)	Remarks
			Static	Pumping					
Waldorf St. Paul's									
Well 9	1,060-1,070, 1,074-1,084, 1,162-1,167, 1,171-1,181, 1,185-1,190, 1,196-1,206, 1,245-1,250, 1,253-1,263, 1,299-1,329, 1,343-1,418	Lower Patapsco aquifer system	207	317	2/29/1984	510	24	4.6	Well not in use
Town of Indian Head									
Well 5	224-254, 284-304, 334-347	Lower Patapsco aquifer system	99	156	10/18/1984	160	24	2.8	Well not in use
Brookwood Estates									
Well 1R	951-965, 995-1,003, 1,022-1,078, 1,101-1,109, 1,135-1,153	Lower Patapsco aquifer system	337	385	12/12/1996	325	24	6.8	
Waldorf St. Charles									
Well 16	934-942, 1,000-1,054, 1,121-1,126, 1,135-1,150, 1,178-1,186, 1,236-1,240, 1,270-1,280, 1,305-1,312	Lower Patapsco aquifer system	346	532	3/17/2006	577	24	3.1	

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.

MARYLAND DEPARTMENT OF NATURAL RESOURCES
Resource Assessment Service
Tawes State Office Building
580 Taylor Avenue
Annapolis, Maryland 21401
Toll free in Maryland: 1-877-620-8DNR
Out of State call: 1-410-260-8021
TTY users: Call via the Maryland Relay
Internet Address: www.dnr.Maryland.gov

MARYLAND GEOLOGICAL SURVEY
2300 St. Paul Street
Baltimore, Maryland 21218
Telephone Contact Information: 410-554-5500
Internet Address: www.mgs.md.gov

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