Maryland Department of the Environment

Baltimore, Maryland

Source Water Assessment for the Town of Poolesville Public Water System, Montgomery County, Maryland

October 2006

VIEW Engineering

VEOLIA WATER

Solutions & Technologies

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1 Executive Summary

Maryland Department of the Environment (MDE) contracted with VIEW Engineering to assist with a Source Water Assessment Program for the Town of Poolesville, Montgomery County, Maryland. VIEW Engineering visited the nine existing public water supply wells that serve Poolesville, each of which are community water supply system wells regulated by MDE. After conducting well inspections and surveying each well with Global Positioning Satellite equipment, maps were created to include the source location, land use, delineated wellhead protection area, and potential contaminant sources for each well site. The susceptibility of each well to contamination was then assessed with recommendations provided where appropriate.

While the majority of well sites are not in immediate danger of contamination, Well 2 is has a high susceptibility to contamination due to elevated nitrate and persistent coliform detections, while Well 3 shows past evidence of some anthropogenic impact from low-levels of synthetic chemicals. Naturally-occurring radionuclides (gross alpha and/or radon) are also persistent in most wells and may need to be addressed in the future. In most cases, the risks posed from human influences such as nearby septic systems (public and private), underground storage tanks for petrochemicals, or non-point agricultural influences can be properly managed to minimize impacts to groundwater. Current water quality monitoring practices should be maintained to ensure that these high quality water sources remain viable and their susceptibility to future degradation is minimized. MDE data collection has been an effective means to identify contaminants of concern and ensure that Poolesville's public water supply system continues to comply with relevant regulations.

2 Introduction

The U.S. Environmental Protection Agency (EPA) is authorized by the Safe Drinking Water Act (SDWA) to regulate contaminants that may present health risks present in public drinking water supplies to ensure safe drinking water for all users of public water systems. MDE is the primary agency responsible for implementation of the SDWA in the State of Maryland. The 1996 Amendments to the SDWA reaffirmed the importance of source water protection as the first step in dealing with drinking water quality. A formalized Source Water Assessment Program (SWAP) is mandated by the SDWA and consists of 1) delineating the boundaries of areas providing source water for public systems; 2) inventorying significant potential sources of contamination; and 3) determining the susceptibility of the public water system to such contaminants. The source water assessment report makes recommendations for management of the assessment area and is intended to assist in implementing a Source Water Protection Program (SWPP). Maryland's SWAP Plan was approved by the EPA in Nov. 1999, and is currently being implemented. In November 2004, MDE selected VIEW Engineering to conduct the SWAP study for the Town of Poolesville community public water supplies. The methods, results, and recommendations of this SWAP study follow.

The Source Water Assessment was initiated by a meeting between VIEW Engineering and MDE personnel in Baltimore in December 2004. At that meeting, the MDE explained their expectations and provided the necessary data to begin the project. A follow-up meeting occurred in February 2005 in Poolesville which included personnel from Poolesville, MDE, Montgomery County Department of Environmental Protection, Maryland Rural Water Association, and VIEW Engineering to ensure that each group's expertise and authority could be collectively utilized to offer Poolesville the most effective SWAP program. In addition, it was agreed that once finalized, Poolesville's Draft Wellhead Protection Ordinance would be incorporated by reference into this SWAP study as well as reviewed and adopted as possible at the county level for consistency at all government levels. It should be noted that the aquifer in the Poolesville area is classified as a Sole Source Aquifer by EPA.

After an initial review of the electronic and hard copy records at the MDE office, VIEW Engineering coordinated with Town personnel to arrange for a site survey of each public water supply well, surrounding private wells, and to assist with identification of any potential contaminant sources. VIEW Engineering's staff has worked closely with Town personnel for greater than twenty years on developing Poolesville's water supply and are very familiar with each well and surrounding conditions. An initial reconnaissance occurred on February 16, 2005, to select potential private wells in the area for surveying to create a water table map of the Poolesville area to be able to more accurately delineate the Town's wellhead protection area. During May 4-5, 2005, VIEW Engineering visited each of the Town's nine existing public water supply wells and 18 private wells in order to record water level information and survey these wells with a Global Positioning Satellite (GPS) receiver to obtain accurate horizontal and vertical position at each well. Chesapeake Environmental was contracted to collect copies of MDE sanitary survey and water quality reports for each well and also compared electronic and paper copies of water quality data for quality assurance.

The GPS data, water level data, fracture trace analysis, and geologic mapping were used to generate a wellhead protection area using the GIS as shown in Figures 1 and 2. Potential contaminant sources identified by MDE or VIEW Engineering located within the wellhead protection area were evaluated for contamination susceptibility. Land use data provided by the MDE was used to further characterize each location and the nearby potential risks to water quality.

Water quality analytical data supplied by the MDE were assembled and combined into a relational database for use in assessing each well's susceptibility. These data include all contaminants regulated for community water systems under the Safe Drinking Water Act. Detections in the electronic data were noted and checked against hard copy data results from MDE's files where possible by Chesapeake Environmental. Where applicable, results were compared against the Code of Maryland Regulations, Title 26, Subtitle 4, *Chapter 1-Quality of Drinking Water in Maryland*.

After reviewing the available data and maps, a qualitative rating for the susceptibility of each system to contamination was made along with recommendations to minimize the susceptibility of each water supply to potential contaminant sources. The results and recommendations for the study area and for each public water supply well follow in the subsequent sections of this report.

3 Well Information

Information from each well was collected from MDE sanitary survey records, recorded information from field investigation, well videos, observations from well site inspections, and land use mapping shown in Figure 3. A summary for each well is provided below.

3.1 Well 2

Well Description	Montgomery County Well ID Number	MDE Public Water System Identification Number
Primary Well (not in use)	MO700046	0150002

Address: Wooton Ave. and Left of 19900 Norris Road, Poolesville, MD 20837

Town of Poolesville Well 2, shown in Figure 1, is located in the Horsepen Branch watershed just north of the Poolesville High School and is surrounded by high school property to the south and far west, low-density residential area directly west, medium-density residential area to the east, and a commercial zone to the north as shown in Figure 2. The well is constructed with 8-inch diameter steel casing to a depth of 63 feet below grade with a total depth of 450 feet. The geology of the area is mapped as the New Oxford Formation consisting of red to gray shale, siltstone, and sandstone. Based on a well video conducted by VIEW Engineering personnel, the major water-bearing zone in this well occurs at 224 feet with a sustainable yield of 100 gallons per minute (gpm). Well 2 had been off-line due to the determination that this well was surface water influenced, but has recently been brought back on line with a cartridge filtration system to remove potential water-borne pathogens and chlorination for disinfection.

3.2 Well 3

Well Description	Montgomery County Well ID Number	MDE Public Water System Identification Number
Primary Well	MO730075	0150002

Address: Wooton Ave. (19400 Block) and Kohlhoss Road, Poolesville, MD 20837

Town of Poolesville Well 3, shown in Figure 1, is located in the Dry Seneca Creek Watershed in the central section of Poolesville within an area classified as open/urban land surrounded by a medium-density residential area with a small park immediately adjacent to the east as shown in Figure 3. The well is constructed with 8-inch diameter steel casing to a depth of 82 feet below grade with a total depth of 285 feet. The geology of the area is mapped as the New Oxford Formation consisting of red to maroon shale, siltstone, and sandstone. The major water-bearing zone in this well occurs at 125 feet with a sustainable yield of 60 gpm. A chlorination system is used to treat this water prior to entering into the distribution system.

3.3 Well 4

Well Description	Montgomery County Well ID Number	MDE Public Water System Identification Number
Primary Well	MO731584	0150002

Address: 17500 Block of West Willard Road and Oxley Farm Road

Town of Poolesville Well 4, shown in Figure 1, is located within the Horsepen Branch watershed in the southwest portion of Poolesville's town limits. The area directly surrounding Well 4 is an athletic field surrounded mostly by agricultural cropland to the south, west, and north, and low- to medium density housing to the northeast, and deciduous forest to the east as shown in Figure 3. Well 4 is constructed with an 8-inch diameter steel casing to a depth of 62 feet grouted within a 12-inch borehole with a total drilled depth of 600 feet. Well 4 treated with a chlorination system. The major water-bearing zone is noted to occur near 228 feet below grade and the sustainable yield of this well is 35 gpm.

3.4 Well 5

Well Description	Montgomery County Well ID Number	MDE Public Water System Identification Number
Primary Well	MO732905	0150002

Address: Haller Avenue and Elgin Road

Town of Poolesville Well 5, shown in Figure 1, is located in the northwest portion of Poolesville's town limits and is very near the surface water divide between Broad Run and Dry Seneca Creek. The area directly surrounding Well 5 is classified as low-density residential as shown in Figure 3. Well 5 is constructed with an 8-inch diameter steel casing grouted within a 12-inch borehole to a depth of 104 feet with a total drilled depth of 500. This well is treated with a chlorination system. The major water-bearing zone is noted to occur near 195 feet below grade and the sustainable yield of this well is 100 gpm.

3.5 Well 6

Well Description	Montgomery County Well ID Number	MDE Public Water System Identification Number
Primary Well	MO810765	0150002

Address: 19600 Block Bodmer Avenue and Chiswell Road

Town of Poolesville Well 6, shown in Figure 1, is located in the south-central portion of Poolesville within the Horsepen Branch watershed. Well 6 is located within Halmos Park and is surrounded by residential land use with medium-density residential land to the north and low-density residential land to the south as shown in Figure 3. Well 6 is constructed with an 8-inch diameter steel casing grouted within a 12-inch borehole to a depth of 105 feet with a total drilled depth of 500 feet. Well 6 is treated with a chlorination system. The major water-bearing zone in Well 6 is noted to occur near 350 feet below grade, however the yield of this well decreases significantly once the water level drops below 200 feet. The sustainable yield of this well is 100 gpm while maintaining a pumping water level above 200 feet.

3.6 Well 7

Well Description	Montgomery County Well ID Number	MDE Public Water System Identification Number
Primary Well	MO882384	0150002

Address: 19100 Block Fisher Avenue and Hersperger Lane

Town of Poolesville Well 7, shown in Figure 1, is located in the southeastern portion of Poolesville within the Russell Branch watershed. Well 7 is surrounded by low-density residential land to the north, cropland to the east, evergreen forest to the south, and pasture to the west/southwest as shown in Figure 3. Well 7 is constructed with an 8-inch diameter steel casing grouted within a 12-inch borehole to a depth of 63 feet with a total depth of 700 feet. Well 7 is treated with a chlorination system. The major water-bearing zone in Well 7 is noted to occur near 430 feet below grade with a sustainable yield of 50 gpm.

3.7 Well 8

Well Description	Montgomery County Well ID Number	MDE Public Water System Identification Number
Primary Well	MO930007	0150002

Address: Hillard Street and Halmos Road

Town of Poolesville Well 8, shown in Figure 1 is located in the southern portion of Poolesville within the Horsepen Branch watershed. Well 8 is surrounded by low-density residential land use with cropland to the west and the Poolesville Middle School to the southeast as shown in Figure 3. Well 8 is constructed with an 8-inch diameter steel casing grouted within a 12-inch borehole to a depth of 66 feet with a total drilled depth of 500 feet. Well 8 is treated with a chlorination system. The major water-bearing zone in Well 8 is noted to occur near 217 feet below grade with a sustainable yield of 60 gpm.

3.8 Well 9

Well Description	Montgomery County Well ID Number	MDE Public Water System Identification Number
Primary Well	MO941848	0150002

Address: Fisher Avenue and Budd Road

Town of Poolesville Well 9, shown in Figure 1, is located in the southwest portion of Poolesville within the Russell Branch watershed. Well 9 is surrounded by an area classified as brush with low-density residential land use to the north, evergreen forest to the west, and pasture to the south and east as shown in Figure 3. Well 9 is constructed with an 8-inch diameter steel casing grouted within a 12-inch borehole to a depth of 105 feet with a total drilled depth of 800 feet. Well 9 shares a pump house with Well 10 where the water is treated with a chlorination system. The major water-bearing zones in Well 9 occur at 230, 310 (primary), 435, and 640 feet below grade. The sustainable yield of this well is 180 gpm while not pumping Well 10 and 165 gpm if Well 10 is pumped at 100 gpm.

3.9 Well 10

Well Description	Montgomery County Well ID Number	MDE Public Water System Identification Number
Primary Well	MO941848	0150002

Address: 16820 Budd Road

Town of Poolesville Well 10, shown in Figure 1, is located in the southwest portion of Poolesville within the Russell Branch watershed. Well 10 is surrounded by an area classified as brush with low-density residential land use to the north, evergreen forest to the west, and pasture to the south and east as shown in Figure 3. Well 10 is constructed with an 8-inch diameter steel casing grouted within a 12-inch borehole to a depth of 75 feet with a total drilled depth of 762 feet. Well 10 shares a pump house with Well 9 where the water is treated with a chlorination system. The major water-bearing zones in Well 10 occur at 560 and 600 feet below grade. The sustainable yield of this well is 120 gpm while not pumping Well 9 and 100 gpm if Well 9 is pumped at 165 gpm.

4 Hydrogeology

A reproduction of the Poolesville quadrangle geologic map (Southworth, 1998) is included as Figure 1 of this report and includes the well locations for this study to allow an initial interpretation of well locations with respect to geology. Poolesville's town boundary lies wholly within the Culpeper Basin of the Piedmont Plateau physiographic province of the Appalachian Mountains. Gently undulating plains underlain by sedimentary bedrock (New Oxford Formation) of Triassic-age red to gray shale, siltstone, and sandstone occur in the Culpeper Basin, which is a north-northeast trending half-graben fault (down-faulted) basin. The Culpeper Basin was subsequently filled with sedimentary rocks of the New Oxford formation which lie unconformably on top of the Precambrian and Paleozoic crystalline bedrock that comprises the rest of Montgomery County. Southworth maps the area as being underlain by the Poolesville Member of the Manassas Formation, which correlates to the more regional nomenclature of the New Oxford Formation. Approximately one-half mile northeast of Poolesville is a northeast trending section of the Sam's Creek and Marburg Formations, which consist of grayish to yellow-orange phyllite and metasiltstone, through which the Hyattstown Thrust Fault and several smaller normal faults propagate (Southworth, 1998). Southworth does not map these faults as extending into Poolesville.

Groundwater flow within both the sedimentary and crystalline bedrock occurs primarily through the fractures, faults, joints, and bedding plane partings that exist within the bedrock, which also contribute largely to the aquifer's storage and transmissive capacity. This type of fractured-dominated groundwater flow regime can be quite complex and contaminants can migrate rapidly through these fractures and impact public water supplies. The need to understand and evaluate the susceptibility of groundwater to potential contamination through this SWAP evaluation is critical to protect public health.

5 Wellhead Protection Area

The wellhead protection area delineation methodology used for Poolesville's source water protection program included a combination of hydrogeologic mapping and fracture trace analysis. An initial wellhead protection area map was created using existing fracture trace analysis mapping along with aquifer recharge estimations to delineate the wellhead protection area. A groundwater recharge rate of 610 gallons per day/acre (8.4 inches/year) was used to estimate the recharge areas necessary to balance groundwater withdrawal. On May 4-5, 2005, each of Poolesville's water supply wells and 18 private wells were located with a high-precision GPS unit that provided a vertical resolution of approximately one-inch. A full round of water levels was measured on May 5, 2005, while Wells 3-9 were pumping to assist in delineating the combined capture zones all of the wells. The original wellhead protection map was refined based on the May 5, 2005, water table configuration when each of the active wells were pumping as shown in Figure 2. Figure 2 shows the combined capture zone and directions of groundwater flow when the wells are pumping at typical pumping rates and durations. The total wellhead protection area is 7,464 acres. The water levels were taken near the end of a pumping cycle when the wells were pumped at a combined rate of 562 gpm with individual wells pumped at the following rates and durations: Well 2-not in use, Well 3-72 gpm for 6.9 hours, Well 4-32 gpm for 12.5 hours, Well 5-134 gpm for 12.7 hours, Well 6-99 gpm for 13.2 hours, Well 7-39 gpm for 12.1 hours, Well 8-74 gpm for 13 hours, Well 9-112 gpm for 6.9 hours, and Well 10-not in use. The majority of the groundwater recharge area for the well system is contained within Town's limits with a groundwater divide occurring just south of town. The regional direction of groundwater flow under ambient conditions is generally from north to south toward the Potomac River.

6 Potential Sources of Contamination

Potential sources of contamination are classified as either point or non-point sources. Examples of point sources of contamination are leaking underground storage tanks, landfills, groundwater discharge permits, large-scale feeding operations and Superfund sites. These sites are generally associated with commercial or industrial facilities that use chemical substances that may, if inappropriately handled, contaminate groundwater via discrete point locations. Non-point sources of contamination are associated with certain types of land use practices such as the use of pesticides, application of fertilizers or animal wastes, or septic systems that may lead to groundwater contamination over a larger area. In general, the land use in the Poolesville area has a relatively low potential for point sources of contamination to impact water quality since there is minimal commercial and industrial activity in the area. The area's agricultural land use does pose a potential non-point contaminant threat to the area's groundwater quality via application of fertilizers, herbicides, pesticides, and other related agricultural chemicals due to the relatively thin soil profile that is characteristic of the area.

6.1 Point Sources

A review of MDE contaminant databases as well as the field survey revealed several point sources of contamination in and adjacent to the WHPA. Figure 4 identifies eight Underground or Above Ground Storage Tanks (USTs or ASTs) sites (six in use and two removed), two controlled hazardous substances generators (CHSG), and a groundwater discharger (GWD) within or adjacent to Poolesville's Wellhead Protection Area. Table 2 lists the facilities identified and the associated potential types of contaminants. The contaminants are based on generalized categories and often the potential contaminant depends on the specific chemicals and processes being used or which had been used at the facility. The potential contaminants are not limited to those listed. Potential contaminants are grouped as Volatile Organic Compounds (VOCs), Medical, or Septic. In addition, Poolesville's records were used to map the approximate location of 22 private on-lot septic systems that exist within Town limits and greater than 80 private wells within the mapped wellhead protection area as shown in Figures 4 and 5.

None of the USTs or ASTs listed are known to have leaked, however leaks are still possible in underground tanks and piping systems. Routine testing of these systems and leak detection systems reduce their potential for leaks to be undetected for long periods of time, however USTs are located in the subsurface and therefore leaks can go undetected and create water quality impacts. Most of the potential point-sources of contamination occur along the Fisher Avenue corridor, where most commercial facilities exist, and generally are upgradient from the wells. According to Town personnel, very few (less than five) domestic heating oil USTs are known to exist within Town limits, however no accurate records are kept for domestic USTs. A leaking UST in the area has the greatest potential to adversely impact Poolesville's groundwater supply, therefore it is highly recommended that all USTs in the area be checked regularly to ensure no leaks occur. The medical facility or groundwater discharger are not considered to be significant threats to the area's water supply. The private on-lot septic systems can impact water quality with increased nitrates, bacteria, or improperly disposed household chemicals.

Additional potential point sources of contamination are the "Beauty Spot" household chemical disposal facility and the road salt storage facilities that are both located on the Poolesville Fleet Refueling Station property. Site visits indicate that both facilities have the potential to release chemicals into nearby stormwater basins that ultimately drain into Dry Seneca Creek. The compounds of concern include numerous organic compounds that could be contained in disposed household chemicals and road salt that could leach into the groundwater system. Section 9 provides additional discussion on recommended approaches to minimize the potential for release of compounds into the groundwater system.

6.2 Non-Point Sources

The Montgomery County land use map was used to determine the predominant types of land use in the WHPA (Figure 3). A large portion of the WHPA is made of cropland (37.7%) followed by deciduous forest (20.4%), pasture (13.3%), low-density residential (11.9%), and a mixture of other land uses as shown in Table 2. Agricultural land (cropland, pasture and feeding operations) is commonly associated with nitrate loading of groundwater. Cropland represents a potential source of synthetic organic compounds (SOCs) depending on fertilizing practices and use of pesticides. In addition, pasture and

Table 1. Potential Contaminant Point Sources within the Poolesville WHPA (see Figure 4 for locations).

Type	Site Name	Address	Status	Potential Contaminants
UST	Poolesville Chevron	17700 Elgin Road	In use	VOCs
UST	Poolesville Getty	20021 Fisher Avenue	In use	VOCs
AST	Poolesville Wastewater Treatment Plant	18901 Fisher Avenue	In use	VOCs
UST	Poolesville Professional Center	20010 Fisher Avenue	In use	Stormwater
UST	Poolesville C.O. GLC - 07305	19816 Fisher Avenue	Removed	VOCs
UST	Poolesville Elementary School	19565 Fisher Avenue	Removed	VOCs
UST/AST	Poolesville Fleet Refueling Station/Beauty Spot	19200 Jerusalem Road	In use	VOCs, household chemicals, road salt
AST	Poolesville Auto	19920 Fisher Avenue	In use	VOCs
CHSG	Hector Asuncion, MD	20010 Fisher Avenue	Active	Medical
CHSG	Leonard Sax, MD	19710-J Fisher Avenue	Active	Medical
GWD	Poolesville Golf Course W.W.T.P.	16601 W. Willard Road	Active	Septic

feeding operations may be potential sources of microbiological pathogens due to animal wastes. Residential areas may be a source of nitrates and SOCs if fertilizers and pesticides are not used carefully for lawns and gardens. Commercial areas are associated with facilities that may have point sources of contamination as described earlier.

The Town of Poolesville has a public sewer system therefore the portion of the wellhead protection area within town limits is generally served by public sewer while the portion of the wellhead protection area outside of town limits has private septic systems within it. As previously noted, approximately 22 private on-lot septic systems exist within Town limits. Poolesville's areal extent is 2,435 acres while the wellhead protection area is

7,464 acres, therefore 5,029 acres of Poolesville's wellhead protection area is not served by public sewer.

Table 2. Types and Percentage of Land Use Within the Poolesville WHPA

Land Use Categories	Total Area (acres)	Percentage of WHPA
Cropland	2814.5	37.7%
Deciduous forest	1524.1	20.4%
Pasture	989.8	13.3%
Low-density residential	890.3	11.9%
Medium-density residential	355.0	4.8%
Open urban land	288.6	3.9%
Evergreen forest	186.0	2.5%
Brush	143.9	1.9%
Institutional	90.2	1.2%
Commercial	76.1	1.0%
Feeding operations	30.2	0.4%
Water	27.7	0.37%
Orchards/vineyards/ horticulture	21.6	0.29%
Agricultural building breeding/training	16.10	0.22%
Mixed forest	9.3	0.12%
Industrial	0.7	0.01%
Total	**7464.0**	**100%**

6.3 Well 2

The most immediate potential for contamination to Well 2 comes from surface runoff, chemicals applied to nearby athletic fields, and from potential leaking domestic or commercial underground storage tanks. This well has had persistent total and fecal coliform detections, suggesting that surface runoff or a leaking sewer line may have impacted this well. An investigation was conducted to determine the source of the coliform, however the results were inconclusive. As previously stated, a new disc filtration system has been installed for treating Well 2's water for surface water influence.

6.4 Well 3

Well 3 is located in a residential area therefore the primary potential sources of contamination are non-point sources, including lawn-care products, surface runoff, and leaking sewer lines. Domestic heating oil tanks or on-lot septic systems could also be potential contaminant sources if they exist nearby.

6.5 Well 4

The surface water runoff from agricultural areas surrounding most of Well 4 has the potential to impact water quality of the well through the misuse or over-application of fertilizers, herbicides, and pesticides. Several private, on-lot septic systems exist close to Well 4 and may act as sources of nitrates, bacteria, or improperly disposed household chemicals. West Willard Road is approximately 100 feet from the well and road salt or other roadway-runoff contaminants could potentially degrade water quality.

6.6 Well 5

The potential contaminant sources near Well 5 may include residential lawn-care products, heating oil tanks, private on-lot septic systems, public sewer lines, or from agricultural land use to the north. In general the land use surrounding Well 5 has a relatively low risk to impacting water quality.

6.7 Well 6

The potential contaminant sources near Well 6 may include residential lawn-care products, heating oil tanks, private on-lot septic systems, or public sewer lines. In general the land use surrounding Well 6 has a relatively low risk to impacting water quality.

6.8 Well 7

The potential contaminant sources near Well 7 may include residential lawn-care products, heating oil tanks, private on-lot septic systems, public sewer lines, and the proximity of Fisher Avenue could cause road runoff.

6.9 Well 8

The potential contaminant sources near Well 8 may include residential lawn-care products, heating oil tanks, private on-lot septic systems, agricultural impacts, or public sewer lines.

6.10 Well 9

The potential contaminant sources near Well 9 may include residential lawn-care products, heating oil tanks, private on-lot septic systems, or public sewer lines.

6.11 Well 10

The potential contaminant sources near Well 10 may include agricultural runoff, heating oil tanks, private on-lot septic systems, or public sewer lines. A sawmill and wood finishing shop is located on the property containing the well (approximately 500 feet east) and may store paints, thinners, lacquers, stains and other related wood-finishing products.

7 Water Quality Data

A review of water quality data provided by MDE personnel for each well was conducted to determine if any detected constituent occurs at levels of concern. If the average concentration of a particular constituent was greater than 50% of the associated MCL then potential sources of the contaminant are further discussed so that appropriate measures can be taken if necessary. Tables 3-11 contain a summary of detected parameters for each well.

7.1 Well 2

Water quality analytical data for Well 2 are available from March 1989 through March 2004. Nitrate concentrations averaged 4.9 mg/L and ranged from 3.5 mg/L to 6.6 mg/L, both of which are below the Maryland standard of 10 mg/L, however the average is very near 50% of the standard. Gross alpha, a measure of natural radionuclides occurring in groundwater, had an average of 9 pCi/L and ranged from 2 pCi/L to 18 pCi/L. The MCL for gross alpha is 15 pCi/L, therefore the average is greater than 50% of the MCL with only one exceedance. Total and fecal coliform bacteria have been detected in this well during GWUDI testing. The water quality data provided by MDE does not include GWUDI data, but rather results of samples collected from distribution system, therefore bacterial quality of individual wells cannot be assessed. It is worth noting that the system wide coliform testing results from 93 samples collected from January 1997 through October 2004, include only three total coliform detections and no fecal coliform detections. No other contaminants were consistently detected at levels greater than 50% of the MCL. Table 3 summarizes the constituents detected at concentrations greater than 50% of the associated MCL for Well 2.

Table 3. Summary of contaminants exceeding 50% of the MCL for Well 2.

Contaminant	Date	MCL	Result
Coliform (colonies/100 mL)*	12/09/98	<1	1.1, 1.1
Coliform (colonies/100 mL)*	04/04/00	<1	1, 1
Coliform (colonies/100 mL)*	06/22/00	<1	23.1, 2.2
Coliform (colonies/100 mL)*	06/23/00	<1	3.6, -1.1
Coliform (colonies/100 mL)*	06/26/00	<1	1.1, -1.1
Coliform (colonies/100 mL)*	07/13/00	<1	2.2, -1.1

Contaminant	Date	MCL	Result
Coliform (colonies/100 mL)*	07/17/00	<1	170, 80
Coliform (colonies/100 mL)*	07/18/00	<1	6.9, 2
Coliform (colonies/100 mL)*	07/26/00	<1	6.9, 1.1
Coliform (colonies/100 mL)*	07/26/00	<1	5.1, -1.1
Coliform (colonies/100 mL)*	06/22/01	<1	3.6, 1.1
Coliform (colonies/100 mL)*	06/25/01	<1	23, 6.9
Coliform (colonies/100 mL)*	06/26/01	<1	23, 5.1
Coliform (colonies/100 mL)*	06/27/01	<1	80, 3.6
Coliform (colonies/100 mL)*	06/28/01	<1	50, 2
Coliform (colonies/100 mL)*	06/29/01	<1	240, 2
Coliform (colonies/100 mL)*	07/02/01	<1	30, 8
Coliform (colonies/100 mL)*	07/03/01	<1	16.1, 3.6
Coliform (colonies/100 mL)*	07/05/01	<1	500, 23
Coliform (colonies/100 mL)*	07/09/01	<1	8, -1.1
Coliform (colonies/100 mL)*	09/05/02	<1	201, 21
Coliform (colonies/100 mL)*	02/24/03	<1	18, -1
Coliform (colonies/100 mL)*	02/25/03	<1	21, -1
Coliform (colonies/100 mL)*	04/08/03	<1	200, 3
Coliform (colonies/100 mL)*	04/09/03	<1	200, 4
Gross alpha	3/27/00	15	11
Gross alpha	2/24/03	15	9
Gross alpha	4/8/03	15	10
Gross alpha	8/27/03	15	18
Gross alpha (Short-term)	8/27/03	15	27
Nitrate	9/30/96	10	5
Nitrate	9/22/99	10	5.7
Nitrate	7/10/01	10	5.1
Nitrate	3/11/02	10	6.3
Nitrate	7/16/02	10	5.3
Nitrate	3/5/03	10	5.7
Nitrate	6/10/03	10	5.8
Nitrate	9/30/03	10	6.6
Nitrate	12/9/03	10	5.5
Radon-222	2/12/97	300	820

Note: *Total and fecal coliform results from GWUDI monitoring

7.2 Well 3

Water quality data for Well 3 are available from March 1989 through October 2004. Nitrate concentrations averaged 5.3 mg/L and ranged from 4.2 mg/L to 6.8 mg/L, both of which are below the MCL of 10 mg/L, however the average is greater than 50% of the

MCL. Gross alpha was detected once at a level of 11 pCi/L, which is greater than 50% of the MCL for gross alpha. It is worth noting that several other compounds were detected in Well 3 between 1989 and 1993 at low concentrations well below their respective MCLs including 1,1,1-trichloroethane, trichloroethene, and 1,1-dichloroethene, which are common industrial degreasing compounds. Chlordane, a now-banned insecticide was detected at 0.12 ug/L in September 1996, which is below the MCL of 2 ug/L. The detected low concentrations of these compounds in an area that is largely residential with minimal industrial activity does reveal how vulnerable water supplies can be to impacts from surface land use. Table 4 summarizes the constituents detected at concentrations greater than 50% of the associated MCL for Well 3.

Table 4. Summary of contaminants exceeding 50% of MCL for Well 3.

Contaminant	Date	MCL	Result
Gross alpha (pC/L)	06/06/00	15	11
Nitrate (mg/L)	09/30/96	10	5.3
Nitrate (mg/L)	07/19/00	10	5.3
Nitrate (mg/L)	07/10/01	10	6.3
Nitrate (mg/L)	03/11/02	10	5.9
Nitrate (mg/L)	07/16/02	10	5.2
Nitrate (mg/L)	11/12/02	10	5.7
Nitrate (mg/L)	03/05/03	10	6.2
Nitrate (mg/L)	06/10/03	10	6.3
Nitrate (mg/L)	09/30/03	10	6.6
Nitrate (mg/L)	12/09/03	10	6.8
Nitrate (mg/L)	03/09/04	10	5.7
Nitrate (mg/L)	06/08/04	10	6.3

7.3 Well 4

Water quality data for Well 4 are available from June 1991 through October 2004. During this period the average nitrate level has been 5.1 mg/L and has ranged from 4.1 to 7.2 mg/L. The average nitrate concentration is slightly greater than 50% of the MCL of 10 mg/L, however has not exceeded the MCL. Gross alpha has been detected consistently with an average concentration of 15.3 pCi/L with a range from 7 to 24 pCi/L. The gross alpha MCL is 15 pCi/L, therefore average concentrations and nearly half of the samples collected exceed the MCL. It should be noted that radon-222 was detected at a concentration of 2500 pCi/L. There is currently no MCL for radon-222, however EPA has proposed an MCL of 300 pCi/L or an alternate of 4000 pCi/L for community water systems if the State has a program to address the more significant risk from radon in indoor air. The health effects of radon round at levels in groundwater are negligible compared to breathing radon. Since an MCL has not been finalized, this report considers the lowest proposed MCL of 300 pCi/L, in an effort to be more conservative and protective of human health. No other constituents of concern were detected consistently at significant concentrations. Table 5 summarizes the constituents detected at concentrations greater than 50% of the associated MCL for Well 4.

Table 5. Summary of contaminants exceeding 50% of MCL for Well 4.

Contaminant	Date	MCL	Result
Gross alpha (pCi/L)	09/20/00	15	10
Gross alpha (pCi/L)	09/20/00	15	24
Gross alpha (pCi/L)	03/11/02	15	24
Gross alpha (pCi/L)	03/11/02	15	20.5
Gross alpha (pCi/L)	04/09/02	15	12
Gross alpha (pCi/L)	04/09/02	15	19.8
Gross alpha (pCi/L)	07/25/02	15	18
Gross alpha (pCi/L)	11/06/02	15	10
Nitrate (mg/L)	06/13/95	10	5.4
Nitrate (mg/L)	07/10/01	10	6.3
Nitrate (mg/L)	03/11/02	10	7.1
Nitrate (mg/L)	05/30/02	10	5.7
Nitrate (mg/L)	07/16/02	10	7.2
Nitrate (mg/L)	11/12/02	10	6
Nitrate (mg/L)	03/05/03	10	5
Nitrate (mg/L)	06/10/03	10	6
Radon-222	09/20/00	300	2500

7.4 Well 5

Water quality data for Well 5 are available from December 1993 through October 2004. During this period the average nitrate level has been 4.4 mg/L and have ranged from 2.9 to 8.3 mg/L. A very low concentration of 2,4-TP (Silvex), a residue from a banned pesticide, was detected in December 2000. The detected concentration, 1.05 ug/L, was much lower than the MCL of 50 ug/L, and is therefore not of great concern, but does provide a reminder of how application of chemicals to the land surface can impact groundwater quality. No other constituents of concern were detected consistently at significant concentrations. Table 6 summarizes the constituents detected at concentrations greater than 50% of the associated MCL for Well 5.

Table 6. Summary of contaminants exceeding 50% of MCL for Well 5.

Contaminant	Date	MCL	Result
Gross alpha (pCi/L)	03/29/00	15	12
Gross alpha (pCi/L)	10/06/04	15	9
Nitrate (mg/L)	12/22/93	10	5.2
Nitrate (mg/L)	10/21/96	10	5.1
Nitrate (mg/L)	03/11/02	10	6.6
Nitrate (mg/L)	07/16/02	10	5.1
Nitrate (mg/L)	11/12/02	10	5.3
Nitrate (mg/L)	03/05/03	10	5.7
Nitrate (mg/L)	06/10/03	10	8.3
Nitrate (mg/L)	03/09/04	10	5.6
Radon-222	02/12/97	300	405

7.5 Well 6

Water quality data for Well 6 are available from December 1993 through June 2004. During this period the average nitrate level has been 2.3 mg/L and has ranged from 1.4 to 4 mg/L. Gross alpha was detected once in June 2000 at the MCL of 15 pCi/L, however the average concentration is less than 50% of the MCL. Radon was detected at 1565 pCi/L in March 1997, which is above the proposed MCL of 300 pCi/L. No other constituents of concern were detected consistently at significant concentrations. Table 7 summarizes the constituents detected at concentrations greater than 50% of the associated MCL for Well 6.

Table 7. Summary of contaminants exceeding 50% of MCL for Well 6.

Contaminant	Date	MCL	Result
Gross alpha (pCi/L)	06/26/00	15	15
Gross alpha (pCi/L, short term)	06/26/00	15	8.32
Radon-222	03/24/97	300	1565
Radon-222	06/26/00	300	815

7.6 Well 7

Water quality data for Well 7 are available from December 1993 through October 2004. During this period the average nitrate level has been 0.66 mg/L and has ranged from 0.2 to 2.4 mg/L. Gross alpha was detected in June 2000 at a concentration of 35 pCi/L and again in February 2005 at 34 pCi/L, which is more than double the MCL of 15 pCi/L. Radon was detected at 1540 pCi/L in March 1997 and at 2585 pCi/L in June 2000, which is above the proposed MCL of 300 pCi/L. Alpha emitter testing is currently being conducted on Well 7 to determine the radionuclide source for future treatment. No other constituents of concern were detected consistently at significant concentrations. Table 8 summarizes the constituents detected at concentrations greater than 50% of the associated MCL for Well 7.

Table 8. Summary of contaminants exceeding 50% of MCL for Well 7.

Contaminant	Date	MCL	Result
Gross alpha (pCi/L)	06/20/00	15	35
Gross alpha (pCi/L)	02/08/05	15	34
Gross alpha (pCi/L, short term)	06/20/00	15	14.1
Combined radium (226 & 228)	06/20/00	5	5.083
Radium-228	06/20/00	5	4.72
Radon-222	03/24/97	300	1540
Radon-222	06/20/00	300	2585

7.7 Well 8

Water quality data for Well 8 are available from April 1994 through June 2004. During this period the average nitrate level has been 2.5 mg/L and has ranged from 1.2 to 4.1 mg/L, with a favorable decreasing trend occurring with more recent samples. The average gross alpha concentration is 15.2 pCi/L, which is just above the MCL of 15 pCi/L, with exceedances occurring during April 1994 (17 pCi/L) and February 2003 (18 pCi/L). Barium was detected slightly above 50% of the MCL once in October 1999 and lead was detected once slightly above the MCL, however these concentrations have not persisted and are considered to be anomalous. No other constituents of concern were detected consistently at significant concentrations. Table 9 summarizes the constituents detected at concentrations greater than 50% of the associated MCL for Well 8.

Table 9. Summary of contaminants exceeding 50% of the MCL for Well 8.

Contaminant	Date	MCL	Result
Barium (mg/L)	10/07/99	2	1.01
Gross alpha (pCi/L)	04/19/94	15	17
Gross alpha (pCi/L)	10/06/99	15	10
Gross alpha (pCi/L)	02/24/03	15	18
Gross alpha (pCi/L)	04/08/03	15	15
Gross alpha (pCi/L)	04/08/03	15	16
Gross alpha (pCi/L)	11/05/03	15	14
Gross alpha (pCi/L)	04/08/03	15	16
Lead (mg/L)	04/14/99	0.015	0.016
Radon-222 (pCi/L)	04/19/94	300	1800

7.8 Well 9

Water quality data for Well 9 are only available from samples collected at the end of the 72-hour pumping test in June 2001. Results from the pumping test samples indicate that no coliform were detected and the nitrate level was 0.9 mg/L. Gross alpha was detected at 12.7 pCi/L, which is below the MCL of 15 pCi/L and radon was detected at 1,630 pCi/L, which is above the proposed MCL of 300 pCi/L. Alpha emitter testing is currently being conducted on Well 9 to determine the radionuclide source for future treatment. No other constituents of concern were detected consistently at significant concentrations. Table 10 summarizes the constituents detected at concentrations greater than 50% of the associated MCL for Well 9.

Table 10. Summary of contaminants exceeding 50% of the MCL for Well 9.

Contaminant	Date	MCL	Result
Gross alpha (pCi/L)	06/13/01	15	12.7
Gross alpha (pCi/L)	02/08/05	15	20
Radon-222 (pCi/L)	06/7/01	300	1,630

7.9 Well 10

Water quality data for Well 10 are only available from samples collected at the end of the 72-hour pumping test in June 2001. Results from the pumping test samples indicate that no coliform were detected and the nitrate level was 1.0 mg/L. Radon was detected at 2,709 pCi/L, which is above the proposed MCL of 300 pCi/L. Alpha emitter testing is currently being conducted on Well 10 to determine the radionuclide source for future treatment. No other constituents of concern were detected consistently at significant concentrations. Table 11 summarizes the constituents detected at concentrations greater than 50% of the associated MCL for Well 10.

Table 11. Summary of contaminants exceeding 50% of the MCL for Well 10.

Contaminant	Date	MCL	Result
Radon-222 (pCi/L)	06/13/01	300	2,709

8 Susceptibility Analysis

Each of the nine community water supply wells in Poolesville were assessed for their susceptibility to contamination. The factors considered for ranking each source's susceptibility to contamination include the number and type of potential contaminant sources, the proximity of contaminant sources to each well, contaminant concentrations, duration of contaminant detection, surrounding land use, the depth of water-bearing zones, and well construction. This information was then used to determine contamination susceptibility using a low, medium, high ranking system. Table 12 summarizes the susceptibility analysis rankings with additional discussion for each well below.

Table 12. Summary of Susceptibility Analyses for Town of Poolesville Public Water Supplies

PWSID	Location Name	Well Name	Susceptibility	Reason
0150002	Well 2	MO700046	High	Land use, presence of nitrate and coliform
0150002	Well 3	MO730075	Moderate	Nitrate concentrations, past VOC and SOCs detections
0150002	Well 4	MO731584	Moderate	Nitrate concentrations
0150002	Well 5	MO732905	Low	
0150002	Well 6	MO810765	Low	
0150002	Well 7	MO882384	Low	
0150002	Well 8	MO930007	Low	
0150002	Well 7	MO882384	Low	
0150002	Well 8	MO930007	Low	
0150002	Well 9	MO941848	Low	
0150002	Well 10	MO941848	Low	

8.1 Well 2

The two greatest causes for concern at Well 2 are the potential for fuel releases from ASTs or USTs, or septic and lawn care product application influences. Nitrate concentrations have not exceeded the MCL, however appear slightly elevated, and coliform detections have occurred in this well during GWUDI testing. Continued review of the results from state-mandated monitoring is advised and a filtration treatment system for this well is expected to be installed to ensure this well provides safe, and reliable water quality. The contamination risk to Well 2 is high for inorganic compounds, microbiological contaminants, and radionuclides given its surrounding land use, elevated nitrate concentrations, persistent coliform detections, and geologic setting. Well 2 is moderately susceptible to VOC and SOC contamination given the surrounding land use and nearby potential sources from ASTs or USTs, and agricultural chemicals, respectively. Overall, Well 2 has a high susceptibility to contamination.

8.2 Well 3

The contamination risk to Well 3 from IOCs, VOCs, and SOCs is moderate based on nitrate concentrations above 50% of the MCL, and past low-level detections of VOCs and SOCs, while considering that VOCs and SOCs have not been detected recently. The contamination risk from radionuclides is high given past concentrations of gross alpha above the MCL combined with the area's geologic setting which is known to produce radionuclide concentrations above current or proposed MCLs. The contamination risk from microbiological contaminants is low since no historic detections of coliform have occurred. Overall, Well 3 has a moderate susceptibility to contamination.

8.3 Well 4

The contamination risk to Well 4 from IOCs is moderate based on water quality analysis results indicate that agricultural activity or on-lot septic systems in the area may have elevated nitrate concentrations in the vicinity of Well 4, however the MCL has not been exceeded and the concentrations appear relatively stable. Well 4's susceptibility to contamination from SOCs is moderate since given the surround agricultural land use. The contamination risk from radionuclides is high since concentrations are above the current or proposed MCLs and the geologic setting is known to produce radionuclide concentrations above current or proposed MCLs. Well 4's susceptibility to VOC and microbiological contamination is low since no nearby sources exist. Overall, Well 4 has a moderate susceptibility to contamination.

8.4 Well 5

Well 5 has a low susceptibility to IOC, VOC, SOC, and microbiological contamination as indicated by relatively low impact residential land use surrounding the well, low nitrate concentrations, adequate well construction, deep water-bearing zone, and the lack of any other anthropogenic constituents of concern in groundwater. Well 5 does have a high susceptibility to radionuclide contamination since concentrations are above the current or proposed MCLs and the geologic setting is known to produce radionuclide concentrations above current or proposed MCLs. Overall, Well 5 has a low susceptibility to contamination.

8.5 Well 6

Well 6 has a low susceptibility to IOC, VOC, SOC, and microbiological contamination as indicated by relatively low impact residential land use surrounding the well, low nitrate levels, adequate well construction, deep water-bearing zones, and the lack of any other anthropogenic constituents of concern in groundwater. Well 6 does have a high susceptibility to radionuclide contamination since concentrations are above the current or proposed MCLs. Overall, Well 6 has a low susceptibility to contamination.

8.6 Well 7

Well 7 has a low susceptibility to IOC, VOC, SOC, and microbiological contamination as indicated by relatively low impact residential land use surrounding the well, low nitrate levels, adequate well construction, deep water-bearing zones, and the lack of any other anthropogenic constituents of concern in groundwater. Well 7 does have a high susceptibility to radionuclide contamination since concentrations are above the current or proposed MCLs and the geologic setting is known to produce radionuclide concentrations above current or proposed MCLs. Overall, Well 7 has a low susceptibility to contamination.

8.7 Well 8

Well 8 has a low susceptibility to IOC, VOC, SOC, and microbiological contamination as indicated by relatively low impact residential land use surrounding the well, low nitrate levels, adequate well construction, deep water-bearing zone, and the lack of any other anthropogenic constituents of concern in groundwater. Well 8 does have a high susceptibility to radionuclide contamination since concentrations are above the current or proposed MCLs and the geologic setting is known to produce radionuclide concentrations above current or proposed MCLs. Overall, Well 8 has a low susceptibility to contamination.

8.8 Well 9

Well 9 has a low susceptibility to IOC, VOC, SOC, and microbiological contamination as indicated by relatively low impact residential land use surrounding the well, low nitrate levels, adequate well construction, deep water-bearing zones, and the lack of any other anthropogenic constituents of concern in groundwater. Well 9 does have a high susceptibility to radionuclide contamination since concentrations are above the current or proposed MCLs and the geologic setting is known to produce radionuclide concentrations above current or proposed MCLs. Overall, Well 9 has a low susceptibility to contamination.

8.9 Well 10

Well 10 has a low susceptibility to IOC, VOC, SOC, and microbiological contamination as indicated by relatively low impact residential land use surrounding the well, low nitrate levels, adequate well construction, deep water-bearing zones, and the lack of any other anthropogenic constituents of concern in groundwater. Well 10 does have a high susceptibility to radionuclide contamination since concentrations are above the current or proposed MCLs and the geologic setting is known to produce radionuclide concentrations above current or proposed MCLs. Overall, Well 10 has a low susceptibility to contamination.

9 Recommendations for Management of the Wellhead Protection Area

Poolesville is located in the portion of western Montgomery County which comprises a mixture of land uses, each of which may have its own potential adverse impact on groundwater quality. The predominantly fractured bedrock aquifers throughout the area coupled with thin soil profiles can result in rapid transport of contaminants from the surface into the fractures that ultimately transmit groundwater toward public or private supply wells. The aquifer supplying Poolesville has been designated as a Sole Source Aquifer by EPA since it is the only viable water resource in the area. Poolesville is generally an agricultural and residential area with some local commercial operations, however generally lacks any industrial land use. The Town's wells are mostly located on the periphery of the town limits where land use transitions from residential to agricultural land use. Residential land use is generally considered to be low-impact to groundwater quality, however misuse or over-application of household chemicals, lawn-care products, or leaking underground heating oil tanks can have a cumulative affect on water quality. In addition, an increase in impervious surfaces due to increased development can degrade stormwater quality, which may impact groundwater quality and reduce groundwater recharge. Poolesville is mostly served by public sewer (with the exception of 22 private on-lot septic systems), which is much more protective of groundwater quality than on-lot septic systems, however leaking sewer lines can provide a source of sewage contamination to the aquifer. Many of the Town's wells are located near agricultural land uses, which may result in nitrate or bacterial loading to the aquifer, however periodic water quality monitoring of Town's wells should allow detection of impact from most any typical land use in the area.

The most significant potential threats to degraded water quality in Poolesville are from a combination of surface runoff (road salt), agricultural land use, leaking sewer lines, domestic chemical misuse, and releases from above ground or underground storage tanks. Fortunately these potential impacts are generally minimized given a combination of proper well construction, sewer line studies, storage tanks with leak detection systems, proper storm water management, minimal use and proper storage of road salt, public education, and use of agricultural best management practices in the area. Naturally-occuring radionuclides (gross alpha, radium 226 and 228, and radon-222) are also persistent in most wells and may need to be addressed in the future.

The "Beauty Spot" household chemical disposal facility and road salt storage facility located at the Poolesville Fleet Refueling station are two point sources of particular concern since runoff from each facility goes to a stormwater basin that feeds into Dry Seneca Creek. This area is located in the upper reaches of the delineated wellhead protection area, and may ultimately provide recharge to Poolesville's wellfield. Sampling of water from the outfall of the facility's stormwater basin for VOCs, sodium, and chloride indicated the presence of elevated sodium and chloride, however fortunately no VOCs were detected. It is recommended that Poolesville personnel work closely with the facility's management to minimize the potential for surface release of stormwater runoff that may contain road salt and disposed household chemicals. The road salt storage facilities should be covered more effectively so no runoff can occur. The household chemical disposal facility should have secondary containment to minimize spills and runoff. A further recommended step to prevent improper chemical disposal would be periodic inspection of the facility to ensure no prohibited chemicals are being disposed, no spills occur, and adequate spill response materials are available in the event of a spill. In addition, periodic (annual or more frequent) water quality testing of the stormwater basin outfall water for sodium, chloride, and VOCs should occur to ensure that water released to the environment meets all applicable standards.

Continued regular water quality testing of wells is recommended as well as public education and awareness programs (e.g. wellhead protection signs at the edges of Town) for all residents and visitors to the area. Other recommendations that may be taken by Town personnel, commissioners, and planners for protecting Poolesville's valuable groundwater resources include:

1) Creation of zoning ordinances that promote groundwater protection (e.g. stormwater management BMPs, use of public sewer, and chemical storage and disposal),

2) Regular private septic system inspections and pump outs,

3) Regular checks on UST and AST systems within Town, and

4) Inventory of chemicals used and stored at commercial facilities within Town.

10 References

Southworth, Scott, 1998. *Geologic Map of the Poolesville Quadrangle, Frederick and Montgomery Counties, Maryland, and Loudoun County, Virginia.* U.S. Geological Survey Map GQ-1761.