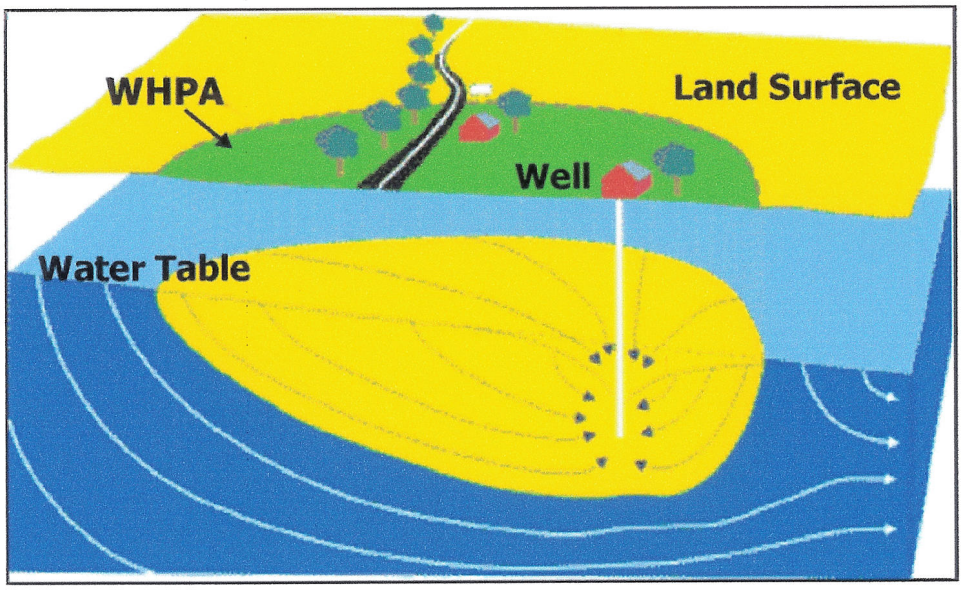
Source Water Assessment
for the Point of Rocks Water System
Frederick County, Maryland



Prepared By
Maryland Department of the Environment
Water Management Administration
Water Supply Program
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MDE

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SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for the Point of Rocks water system. The required components of this report as described in Maryland's Source Water Assessment Program (SWAP) are 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for protecting the drinking water supply conclude this report.

The source of Point of Rocks' water supply is an unconfined fractured-rock aquifer. The Source Water Assessment area was delineated by the WSP using U.S. EPA approved methods specifically designed for this source type.

Point sources of contamination were identified within the assessment area from field inspections, contaminant inventory databases, and previous studies. The Maryland Office of Planning's 2000 digital land use map for Frederick County was used to identify non-point sources of contamination. Well information and water quality data were also reviewed. An aerial photograph and a map showing land use within the Source Water Assessment area are included in the report.

The susceptibility analysis is based on a review of the existing water quality data for the water system, the presence of potential sources of contamination in the WHPA, well integrity, and the inherent vulnerability of the aquifer. It was determined that the Point of Rocks water supply is susceptible to radionuclides and some microbiological contaminants. This water supply is not susceptible to inorganic compounds, volatile organic compounds, or synthetic organic compounds.

INTRODUCTION

The Water Supply Program has conducted a Source Water Assessment for the Point of Rocks water system in Frederick County. The Point of Rocks community is located approximately ten miles southwest of the City of Frederick along the Potomac River and at the foot of Catoctin Mountain. The water system serves a total population of 1058 and has 392 service connections. Point of Rocks currently obtains its water supply from three wells. The water system is owned and operated by the Frederick County Division of Utilities and Solid Waste Management.

WELL INFORMATION

Well information was obtained from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports, and published reports. The Point of Rocks system obtains it water supply from three wells (Table 1). Additional wells have been drilled in the community, but none have met the yield required to put them into production. Two of the production wells are located adjacent to residential properties and the third is located in the community park (Fig. 1). A review of the well completion reports and sanitary surveys of Point of Rocks' water systems indicate that the Misty Hollow (M) and Thomas Drive Wells were installed prior to 1973, when well construction regulations went into effect, and may not meet the current construction standards. The Misty Hollow (M) well was deepened in 1999 but it does not appear that any additional casing or grout was installed based on the construction report. The other wells were drilled after 1973 and should meet construction standards for grouting and casing. A summary of the well information is located in Table 1.

Plant Id	Source Id	Use	Well Name	Permit	Total Depth	Casing Depth	Year Drilled
01	01	Production	Ruritan (1)	FR-81-2912	425	72	1986
02	02	Production	Misty Hollow (M)	FR-69-0376	444[1]	30	1999[1]
03	03	Production	Thomas Drive	FR-72-0029	583	157	1971
02	04	Not In Use	Misty Hollow (N)	FR-94-0328	200	40	1997

Table 1. Point of Rocks well information.

[1]This well was deepened in 1999. The well was originally drilled in 1969 to a depth of 345 feet.

The Point of Rocks water system has an appropriation permit to draw water from the Tomstown Dolomite for an average use of 101,000 gallons per day (gpd) and a maximum of 169,000 gpd in the month of maximum use. The most recent geologic map

(Reinhardt, 1974) describes the bedrock in this area as a limestone facies of the Triassic New Oxford formation. Despite the disagreement in nomenclature, the bedrock is described as limestone, which is the most significant information for the wellhead protection area delineation. Based on the most recent pumpage reports, the average daily use was 67,830 gallons in 1999 and 70,319 gallons in 2000. The months of maximum use for the last two reported years were July 1999 and December 2000 with an average daily use of 89,659 and 76,386 gallons respectively.

HYDROGEOLOGY

Point of Rocks lies on the western edge of the Frederick Valley in the Piedmont physiographic province, which is bound by Catoctin Mountain to the west and the low Piedmont ridges to the east. This portion of the Frederick Valley is underlain by a series of sedimentary rocks that form a narrow band on the western edge of the valley. They are composed of undifferentiated limestone conglomerates, sandstones, siltstones and shales of Triassic age (Reinhardt, 1974). Based on driller's reports, the wells penetrate a limestone section within this series. This is an unconfined, fractured-rock aquifer whose primary porosity and permeability are small due to the cementation and consolidation of sediments. Ground water moves principally through secondary porosity, fractures and joint openings, and is recharged by precipitation percolating through soil and saprolite. Due to the low primary porosity, large production wells are not common in consolidated rock aquifers unless significant, water-bearing fractures are encountered. A fracture trace analysis was completed in 1997 by Atlantic Geoscience, Inc. in a well exploration project (Appendix A, Fig. 1). Well N was constructed based on this analysis and initial pump testing showed promise for a production well. However, significant interference with Well M made the use of this well not feasible.

Ground water systems in fractured-rock tend to be localized and flow is within topographic divides towards the nearest perennial stream (Bolton, 1998). The water table is generally in the saprolite, which is characterized by high porosity and thus, the amount of storage often depends on the thickness of the saprolite. Stream valleys tend to follow fracture traces and as a result wells drilled in draws and stream valleys tend to have higher yields than those on hilltops and slopes.

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered the source water assessment area for the system. The source water assessment area for public water systems using wells in fractured-rock aquifers is the watershed drainage area that contributes to the well. The area should be modified to account for geological boundaries, ground water divides, and by annual average recharge needed to supply the well (MD SWAP, 1999).

As noted above, a fracture trace analysis was completed for the area around the Point of Rocks community and the WHPA was delineated using this information, together with pumping data and watershed drainage boundaries. The WHPA is separated into two separate areas, one for the Misty Hollow and Thomas Drive wells (Area 1) and a second for the Ruritan well (Area 2) since an intermittent stream separates the wells and represents a ground water divide. The Area 1 WHPA is based on the fracture traces that intersect the wells and the drainage divide boundaries. The Area 2 WHPA includes the watershed area up gradient of the well. The WHPA should cover an area large enough to supply water at the average appropriated amount using effective recharge. Drought year base flow (effective recharge) in fractured rocks is estimated to be 400 gpd/acre. The recharge area for the wells using an average use of 101,000 gpd and the drought year recharge rate is approximately 250 acres. The monthly operating reports for the water system show that, on average, the Misty Hollow and Thomas Drive wells pump 60% and the Ruritan well pumps 40% of the total water used by the system. The area needed to supply these pumping rates would be 150 acres for the Area 1 WHPA and 100 acres for the Area 2 WHPA. The boundaries of the WHPA were delineated using all of this criteria and are shown in Figure 2. Area 1 is 155 acres and Area 2 is 130 acres.

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, discharge permits, large-scale feeding operations, and CERCLA sites. These sites are generally associated with commercial or industrial facilities that use chemical substances that may, if inappropriately handled, contaminate ground water via a discrete point location. Non-point sources of contamination are associated with certain types of land use practices such as use of pesticides, application of fertilizers or animal wastes, or septic systems that may lead to ground water contamination over a larger area.

Point Sources

A review of MDE contaminant databases revealed several potential point sources of contamination within and near the WHPA (Table 2). Underground storage tanks (UST) were identified in two facilities, and three additional facilities were identified as controlled hazardous substance generators (CHS) (Fig. 3). In addition, the site of a closed solid waste landfill (SWLF) was identified on a property outside of the WHPA boundary.

Underground Storage Tanks (UST's) are a potential source of volatile organic compounds from petroleum products if they leak. Newer tanks are less likely to leak due to new construction standards, however leaks may still be common in underground piping. Because they are located in the subsurface, leaks often go undetected unless a water supply is impacted. It appears that at least three older tanks were removed from the Clay Street site.

Controlled hazardous substance (CHS) generators are those facilities that are registered with MDE and either produce, store, or utilize a hazardous substance on site. Their potential to contaminate ground water depends mostly on how the substances are used and ultimately disposed of.

ID[2]	Type	Facility Name	Address	Comments
1	UST	One Stop Deli	1595 Bowis Dr.	3-8,000 gal gasoline tanks
2	UST	Whistle Stop Deli	3710 Clay St.	2-2,000 gal gasoline + 1-500 gal kerosene, 3 tanks removed
3	CHS	CSX	B&O 44 Station on Clay St.	
4	CHS	Canam Steel	4010 Clay Street	
5	CHS	Builders First Source	4011 Rock Hall Rd	
6	SWLF	Free State	4039 Tuscarora Rd	status = "closed"

Table 2. Potential Contaminant Sources in Point of Rocks WHPA

[2]See Figure 3

Non-Point Sources

The Maryland Office of Planning's 2000 digital land use for Frederick County was used to determine the predominant types of land use in the WHPA (Fig. 4). The land use summary is given in Table 3. The majority of the WHPA is made up of forested land, with smaller proportions residential, agricultural, and commercial areas. The land use immediately around the wells and comprising most of Zone 1 is residential land. Much of the area in Zone 1 that is displayed as cropland either has or will be subdivided into residential properties.

	Area 1 WHPA		Area 2 WHPA	
Land Use Type	Total Acres	Percent of WHPA	Total Acres	Percent of WHPA
Medium Density Residential	88	56.4	27	20.5
Commercial	15	9.8		
Open Urban Land	1	0.6	7	5.2
Cropland	3	1.8		
Pasture	7	4.6		
Forest	42	26.8	99	74.3
Total	156	100	133	100

Table 3. Land Use Summary

Agricultural land (cropland and pasture) is commonly associated with nitrate loading of ground water and also represents a potential source of SOCs depending on fertilizing practices and use of pesticides. Residential areas without sewer service may be a source of nitrate from septic systems. Additionally, residential areas may present a source nitrate and SOCs if fertilizers, pesticides, and herbicides are not used carefully in lawns and gardens. Commercial areas are associated with facilities that may have point sources of contamination as described above.

The Maryland Office of Planning's 1996 digital sewer map of Frederick County shows that the most of the WHPA has existing sewer service or is planned for

service in the near future (Fig. 5). The remaining area, mostly in National Parks Service land on the mountain, is in an area of the county that is not planned for service. Table 4 summarizes the sewer service categories in the WHPA.

	Area 1 WHPA		Area 2 WHPA	
Sewer Service Category	**Total Acres**	**Percent of WHPA**	**Total Acres**	**Percent of WHPA**
Existing Service	35	22.7	71	52.9
Planned Service Area	120	77.3		
Not Planned for Service Area			63	47.1
Total	156	100	133	100

Table 4. Sewer Service Summary

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database for Safe Drinking Water Act (SDWA) contaminants. The State's SWAP defines a threshold for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is greater than 50% of a MCL, this assessment will describe the sources of such a contaminant and if possible, locate the specific sources that are the cause of the elevated contaminant level. All data reported is from the finished (treated) water unless otherwise noted. The Point of Rocks water system has three points of entry or plants (one for each well), which have varying treatment as outlined in Table 5.

A review of the monitoring data for Point of Rocks' water indicates that the water supply has met drinking water standards, with one exception. Gross-alpha and Combined Radium results exceed the MCL for these contaminants in one sample from the Thomas Drive well. Inorganic compounds, were not detected above the SWAP threshold level. Radionuclides have been detected in significant concentrations, especially Radon-222, which does not currently have an MCL. No volatile organic compounds or synthetic organic compounds, were detected above 50% of an MCL. The water quality sampling results are summarized in Tables 6.

Plant Id	Treatment	Purpose
01	pH Adjustment	Corrosion Control
01	Hypochlorination, Post	Disinfection
01	Sequestration	Iron Removal
02	Hypochlorination, Post	Disinfection
02	Aeration, Spray	Radon Removal
03	pH Adjustment	Corrosion Control
03	Hypochlorination, Post	Disinfection

Table 5. Treatment Methods

	Plant 01 (Ruritan)		Plant 02 (Misty Hollow)		Plant 03 (Thomas Dr.)	
Contaminant Group	No. of Samples Collected	No. of Samples > 50% of an MCL	No. of Samples Collected	No. of Samples > 50% of an MCL	No. of Samples Collected	No. of Samples > 50% of an MCL
Inorganic Compounds (except Nitrate)	9	0	4	0	5	0
Nitrate	12	0	10	0	9	0
Radiological Contaminants	3	2	3	3	3	3
Volatile Organic Compounds	9	0	5	0	6	0
Synthetic Organic Compounds	9	0	7	0	6	0

Table 6. Summary of Water Quality Samples for Point of Rocks Plants

Inorganic Compounds (IOCs)

Inorganic compounds have not been detected above 50% of an MCL. Nitrate is the most commonly detected inorganic compound but levels in the water supply average only 1.5 ppm in the Ruritan and Misty Hollow wells. Nitrate in the Thomas Drive well is consistently below detection levels.

Radionuclides

A review of the data shows that radionuclides are commonly detected above 50% of an MCL and have been detected above MCL's in the Thomas Drive well (Table 7). Gross alpha and beta radiation are measured as an initial screen and if levels exceed 5 pCi/L, a sample for Radium-226 and Radium-228 is taken. The MCL for Radium 226 and Radium-228 combined is 5 pCi/L and this level was exceeded in September 2000 in a sample collected from the Thomas Drive well. The Frederick Division of Utilities felt that this sample was not representative because the well had been idle for some time before the sample was collected. The well was resampled in January 2002 and Gross alpha was 14.1 pCi/L and combined radium was 3.26 pCi/L. Additional samples collected in February and April 2002 have shown Gross Alpha and Combined Radium levels above or near the MCL's for these contaminants in the Thomas Drive well (Table 7).

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 EPA received many comments in response to their proposed rule, and promulgation may be delayed. Radon-222 results have been reported above 50% of the higher proposed MCL in two of the three wells (Table 7).

Volatile Organic Compounds (VOCs)

A review of the data shows that VOCs have not been detected above 50% of an MCL. Methyl-Tert-Butyl-Ether (MTBE), Chloroform, and Trichloroethane are the only VOC's that have been detected at very low levels.

Synthetic Organic Compounds (SOCs)

The only SOC detected was Di(2-Ethylhexyl)Phthalate for which the highest level reported was 2.2 ppb. This contaminant is commonly found in laboratory blank samples and the method for analyzing this contaminant was just starting to be used in 1995 and had many false positive results.

Microbiological Contaminants

Raw water bacteriological data is available for each of the wells from evaluation for ground water under the direct influence of surface water (GWUDI). This data showed that the wells were not under the direct influence of surface water. The raw water quality was very good with very low turbidity and was free of fecal coliform. Total coliform was not detected in the Ruritan well. Less than 10% of raw water samples collected from the Misty Hollow were positive for total coliform and the concentration was only 1.1 colonies/100 ml. Total coliform was present in 60% of samples collected from the Thomas Drive well and concentrations were fairly low ranging from 1.1 to 16.1 colonies/100 ml.

Plant Id	Contaminant	MCL (pCi/L)	Sample Date	Result (pCi/L) [4]
01	Radon-222	300 or 4000[3]	21-Jun-94	1195
01	Radon-222	300 or 4000[3]	12-Aug-97	700
01	Gross Alpha	15	07-Sep-00	5.0
01	Combined Radium (226 & 228)	5	07-Sep-00	0.7
01	Radium-226	5	07-Sep-00	0.5
01	Radium-228	5	07-Sep-00	0.3
01	Gross Beta	50	07-Sep-00	4.0
02	Radon-222	300 or 4000[3]	12-Aug-97	2190
02	Radon-222	300 or 4000[3]	21-Oct-97	786
02	Gross Alpha	15	07-Sep-00	8.0
02	Combined Radium (226 & 228)	5	07-Sep-00	1.3
02	Radium-226	5	07-Sep-00	1.3
02	Radium-228	5	07-Sep-00	-0.1
02	Gross Beta	50	07-Sep-00	5.0
03	Radon-222	300 or 4000[3]	12-Aug-97	3170
03	Radon-222	300 or 4000[3]	21-Oct-97	1510
03	Gross Alpha	15	07-Sep-00	**21.1**
03	Combined Radium (226 & 228)	5	07-Sep-00	**8.8**
03	Radium-226	5	07-Sep-00	5.6
03	Radium-228	5	07-Sep-00	3.2
03	Gross Alpha (Short Term)	15	07-Sep-00	**23.0**
03	Gross Beta	50	07-Sep-00	9.0
03	Gross Alpha	15	07-Jan-02	14.1
03	Combined Radium (226 & 228)	5	07-Jan-02	3.3
03	Radium-226	5	07-Jan-02	0.0
03	Radium-228	5	07-Jan-02	3.2
03	Gross Beta	50	07-Jan-02	5.4
03	Gross Alpha	15	21-Feb-02	**25.0**
03	Combined Radium (226 & 228)	5	21-Feb-02	**8.8**
03	Radium-226	5	21-Feb-02	5.9
03	Radium-228	5	21-Feb-02	2.9
03	Gross Beta	50	21-Feb-02	13.0
03	Gross Alpha	15	04-Apr-02	15.0
03	Combined Radium (226 & 228)	5	04-Apr-02	4.7
03	Radium-226	5	04-Apr-02	1.8
03	Radium-228	5	04-Apr-02	2.9
03	Gross Alpha (Short Term)	15	04-Apr-02	**25.0**
03	Gross Beta	50	04-Apr-02	15.0
03	Gross Beta (Short Term)	50	04-Apr-02	9.0

Table 7. Radionuclide Data

[3] Proposed MCL's

[4] A negative number indicates less than the detection limit.

SUSCEPTIBILITY ANALYSIS

The wells serving the Point of Rocks water supply draw water from unconfined fractured-rock carbonate aquifers. Wells in unconfined aquifers are generally vulnerable to any activity on the land surface that occurs within the wellhead protection area. Therefore, continued monitoring of contaminants is essential in assuring a safe drinking water supply. The *susceptibility* of the source to contamination is determined for each group of contaminants based on the following criteria: 1) the presence of potential contaminant sources within the WHPA, 2) water quality data, 3) well integrity, and 4) the aquifer conditions. Table 8 summarizes the susceptibility of Point of Rocks' water supply to each of the groups of contaminants.

In the Piedmont region, if a well is constructed properly with the casing extended to competent rock and with sufficient grout, the saprolite serves as a natural filter and protective barrier. Properly constructed wells with no potential sources of contamination in their WHPA should be well protected from contamination.

Inorganic Compounds

The water supply is **not** susceptible to inorganic compounds based on water quality data and lack of potential contaminant sources within the WHPA. There is some agricultural land and residential areas with septic systems in the WHPA that could present a source of nitrate, but based on water quality data these potential sources are not impacting the water supply.

Radionuclides

The water supply **is** susceptible to radionuclides. The source of radionuclides in ground water is the natural occurrence of uranium in rocks. As uranium decays in the bedrock it eventually forms the daughter products radium and radon. Based on the high levels of gross alpha radiation, Combined Radium 226&228, and Radon-222 detected in the water supply, the aquifer appears to be a source of these contaminants in this area, especially in the Thomas Drive well. Radium and Radon levels in the Point of Rocks water supply are higher than values reported for consolidated sedimentary and carbonate rock aquifers in Maryland (Bolton, 1996). This is likely due to the proximity of Point of Rocks to the crystalline bedrock that forms Catoctin Mountain. The highest reported values in the hard rock areas of Maryland are generally in the crystalline formations. The sediments that make up the aquifer material in Point of Rocks were originally eroded from the crystalline bedrock and thus the proximity to this source material may explain the high radionuclide levels in the Point of Rocks wells.

Volatile Organic Compounds

The water supply is **not** susceptible to contamination by VOC's. Potential sources of VOC's have been identified in the outskirts of the WHPA, however VOC's have not been detected in significant levels.

Synthetic Organic Compounds

The wells are **not** susceptible to synthetic organic compounds. SOCs were not detected in the water supply. A potential source of SOCs in the WHPA may be pesticide use in the agricultural areas. However, these contaminants have not been detected and most of the agricultural land will eventually be residential land.

Microbiological Contaminants

The wells did not have fecal coliform bacteria in their raw water samples and were determined not under direct influence of surface water. Therefore, the wells are **not** susceptible to microbiological contaminants that may be present in surface water, such as *Giardia* and *Cryptosporidium*. Total coliform bacteria, which are ubiquitous in the environment, were detected in the Misty Hollow and Thomas Drive wells and may be indicators of organisms with longer survival rates such as viruses. Without additional data however, it is not possible to determine whether or not the water supply is susceptible to viral contamination. Well construction may be a factor in the positive total coliform results if, for example, the grout seal is not intact or is not completed to the bottom of the casing. The two older wells (constructed prior to 1973) both had total coliform, while the Ruritan well, which was constructed in 1986 was free of coliform bacteria. Therefore the Misty Hollow and Thomas Drive wells **are** susceptible to total coliform.

Contaminant Group	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected Above 50% of MCL?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible?
Nitrate	YES	NO	NO	YES	NO
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Radiological Compounds	YES	YES	NO	YES	YES
Volatile Organic Compounds	YES	NO	NO	YES	NO
Synthetic Organic Compounds	YES	NO	NO	YES	NO
Microbiological Contaminants	YES	YES	YES	YES	YES – Coliform only (see above)

Table 8. Susceptibility Analysis Summary.

MANAGEMENT OF THE SOURCE WATER ASSESSMENT AREA

With the information contained in this report the Frederick County Division of Utilities and Solid Waste Management is in a position to protect the Point of Rocks water supply by staying aware of the area delineated for source water protection and evaluating future development and land planning. Specific management recommendations for consideration are listed below:

Form a Local Planning Team

- The Division of Utilities and Solid Waste Management should continue to work with the County Planning Department and Wellhead Protection committee to implement a County Wellhead Protection Ordinance. The committee should ensure that all interests in the community are represented, such as the water supplier, home association officers, the County Health Department, local businesses, developers, and property owners, and residents within and near the WHPA.
- A management strategy adopted by the Division and the County should be consistent with the level of resources available for implementation. MDE remains available to assist in anyway we can help the process.
- MDE has grant money available for Wellhead Protection projects, such as developing and implementing wellhead protection ordinances, digitizing layers that would be useful for wellhead protection (such as geology), and developing additional protection strategies. An application can be obtained by contacting the water supply program.

Public Awareness and Outreach

- The Consumer Confidence Report should list that this report is available to the general public through their county library, by contacting the Division or MDE.
- Conduct educational outreach to the facilities and residents of the community focusing on activities that may present potential contaminant sources. Important topics include: (a) compliance with MDE and federal guidelines for gasoline and heating oil UST's, (b) monitoring well installation and maintenance of UST's, (c) appropriate use and application of fertilizers and pesticides, and (d) hazardous material disposal and storage.
- Road signs at the WHPA boundary are an effective way of keeping the relationship of land use and water quality in the public eye, and help in the event of spill notification and response.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.
- Annual raw water bacteriological samples are a good test for well integrity. Also, other indicators, such as coliphage, may be useful for determining the susceptibility to viral contamination.

Land Acquisition/Easements

- Loans are available for the purchase of property or easements for protection of the water supply. Eligible property must lie within the designated WHPA. Loans are currently offered at zero percent interest and zero points. Contact the Water Supply Program for more information.

Contingency Plan

- COMAR 26.04.01.22 requires all community water systems to prepare and submit for approval a plan for providing a safe and adequate drinking water supply under emergency conditions. Point of Rocks' Contingency Plan was submitted to MDE for a review and approved in November 2001.
- Develop a spill response plan in concert with the Fire Department and other emergency response personnel.

Contaminant Source Inventory Updates/ Inspections

- The Division should conduct their own field survey of the source water assessment area to ensure that there are no additional potential sources of contamination.
- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.

Changes in Use

- The Division is required to notify MDE if new wells are to be put into service. Drilling a new well outside the current WHPA would modify the area; therefore the Water Supply Program should be notified if a new well is being proposed.

REFERENCES

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Committee on Health Risks of Exposure to Radon, 1999, Health Effects of Exposure to Radon: BEIR VI, (http://www.epa.gov/iaq/radon/beirvi1.html).

Duigon, M.T., and J.R. Dine, 1987, Water Resources of Frederick County, Maryland, MGS Bulletin 33, 101 pp.

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Nutter, L.J. and E.G. Otton, 1969, Ground Water Occurrence in the Maryland Piedmont: Maryland Geological Survey Report of Investigations No. 10, 56 pp

Reinhardt, J. (1974), Geologic Map of the Frederick Valley, from Maryland Geological Survey Report of Investigations No. 23 (Plate 1).

U.S. Environmental Protection Agency, 1991, Delineation of Wellhead Protection Areas in Fractured Rocks: Office of Ground Water and Drinking Water, EPA/570/9-91-009, 144 pp.

OTHER SOURCES OF DATA

Water Appropriation and Use Permit FR1968G001
Public Water Supply Sanitary Survey Inspection Reports
MDE Water Supply Program Oracle® Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles for Point of Rocks
USGS Topographic 7.5 Minute Quadrangles for Point of Rocks
Maryland Office of Planning 2000 Frederick County Digital Land Use Map
Maryland Office of Planning 1996 Frederick County Digital Sewer Map

FIGURES

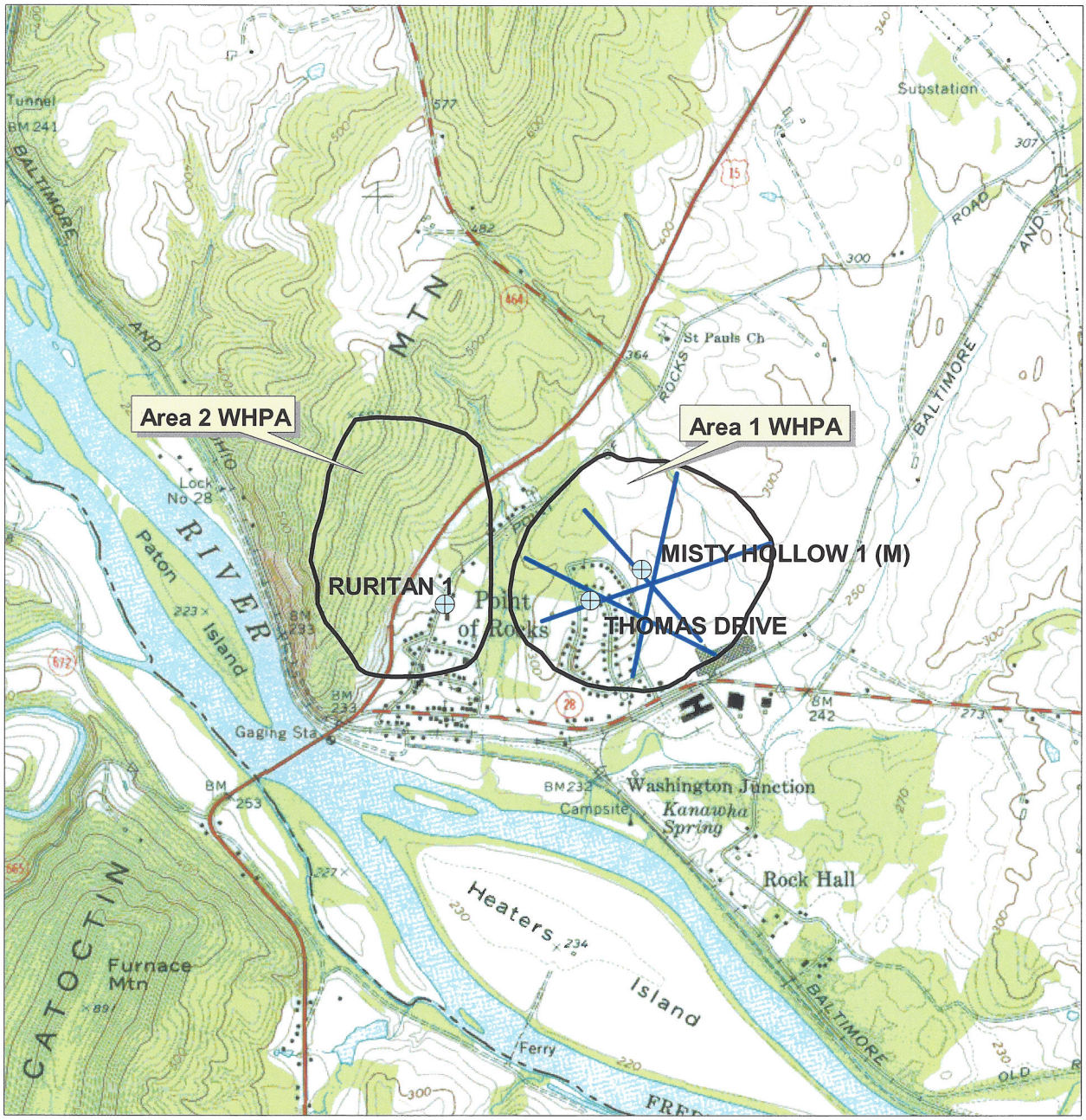


Figure 2. Point of Rocks Wellhead Protection Area (WHPA).

Legend

- Wells
- Fracture Trace
- Wellhead Protection Area

N

1000 0 1000 2000 Feet

Base Map: USGS Topgraphic 7.5 Minute Quad for Point of Rocks

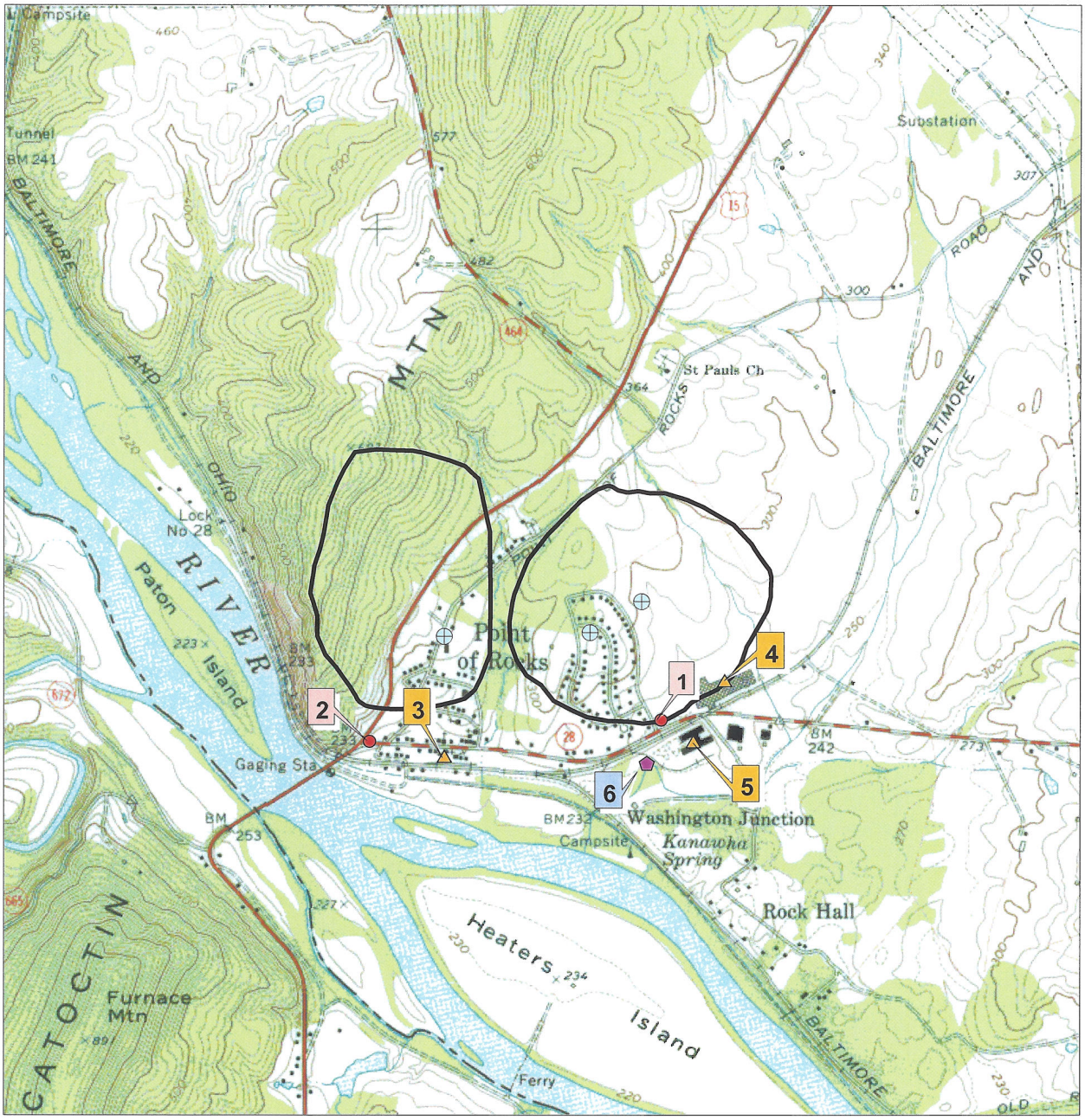


Figure 3. Point of Rocks WHPA with Potential Contaminant Sources.

Legend

Potential Contaminant Sources
(See Table 2 in text)

Wells

WHPA

CHS

UST

SWLF

N

1000 0 1000 2000 Feet

Base Map: USGS Topgraphic 7.5 Minute Quad for Point of Rocks

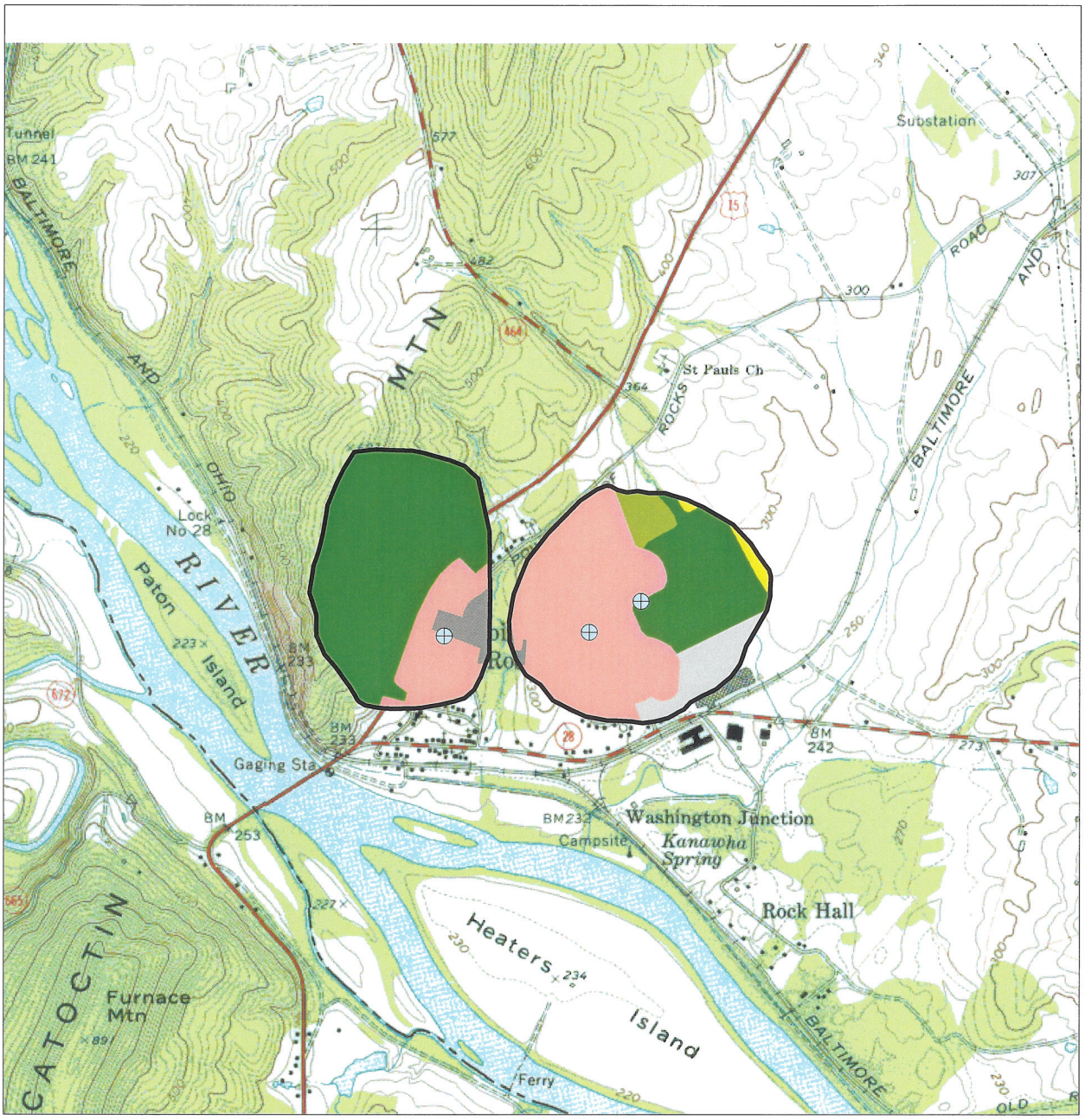


Figure 4. Land Use in the Point of Rocks WHPA.

Legend

Frederick County 2000 Land Use

- Medium Density Residential
- Commercial
- Open Urban Land
- Cropland
- Pasture
- Forest

- Wells
- WHPA

N

1000 0 1000 2000 Feet

Base Map: USGS Topographic 7.5 Minute Quad for Point of Rocks

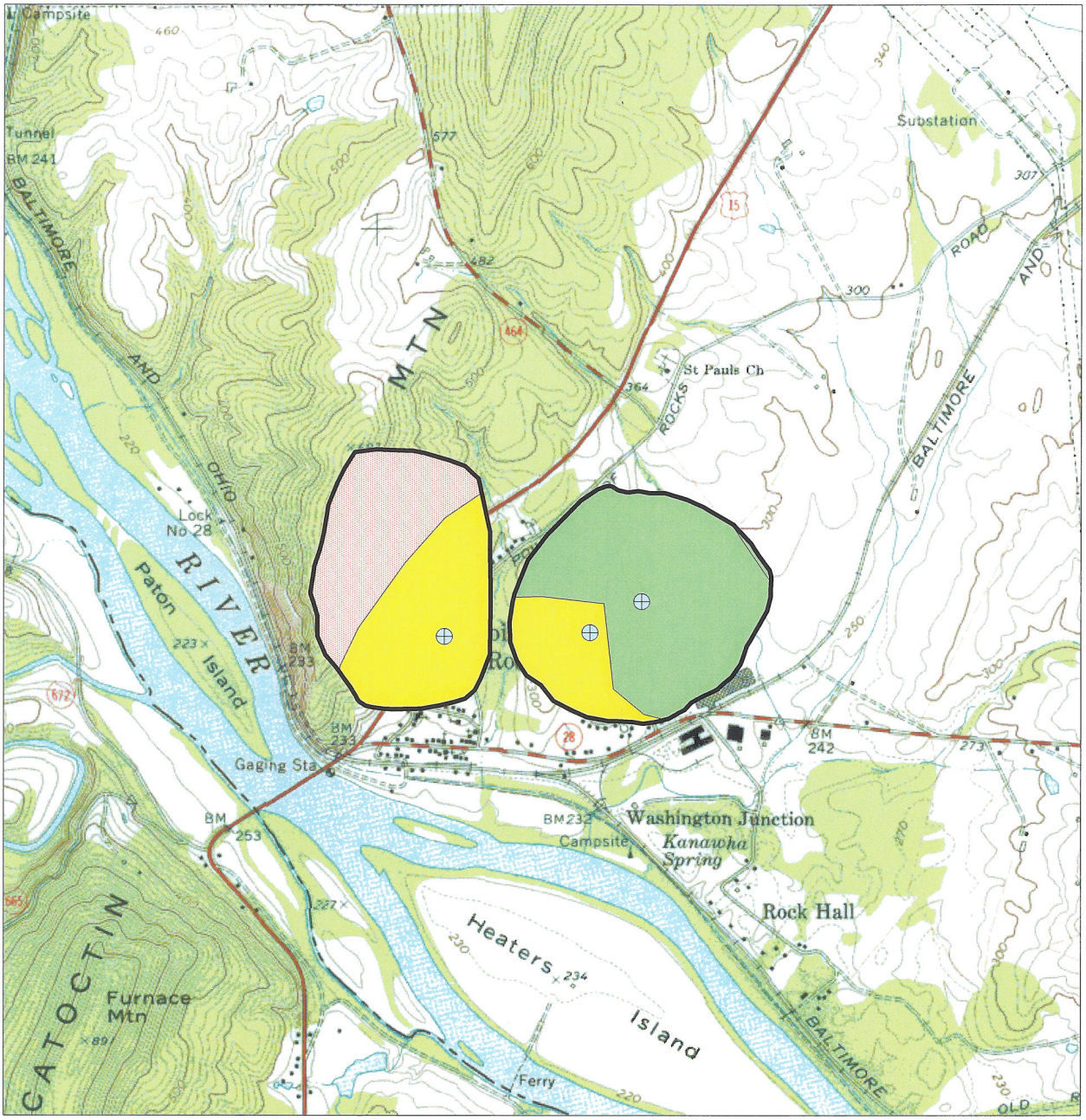


Figure 5. Sewer Service Areas in the Point of Rocks WHPA.

Legend

Frederick County Sewer Service Areas

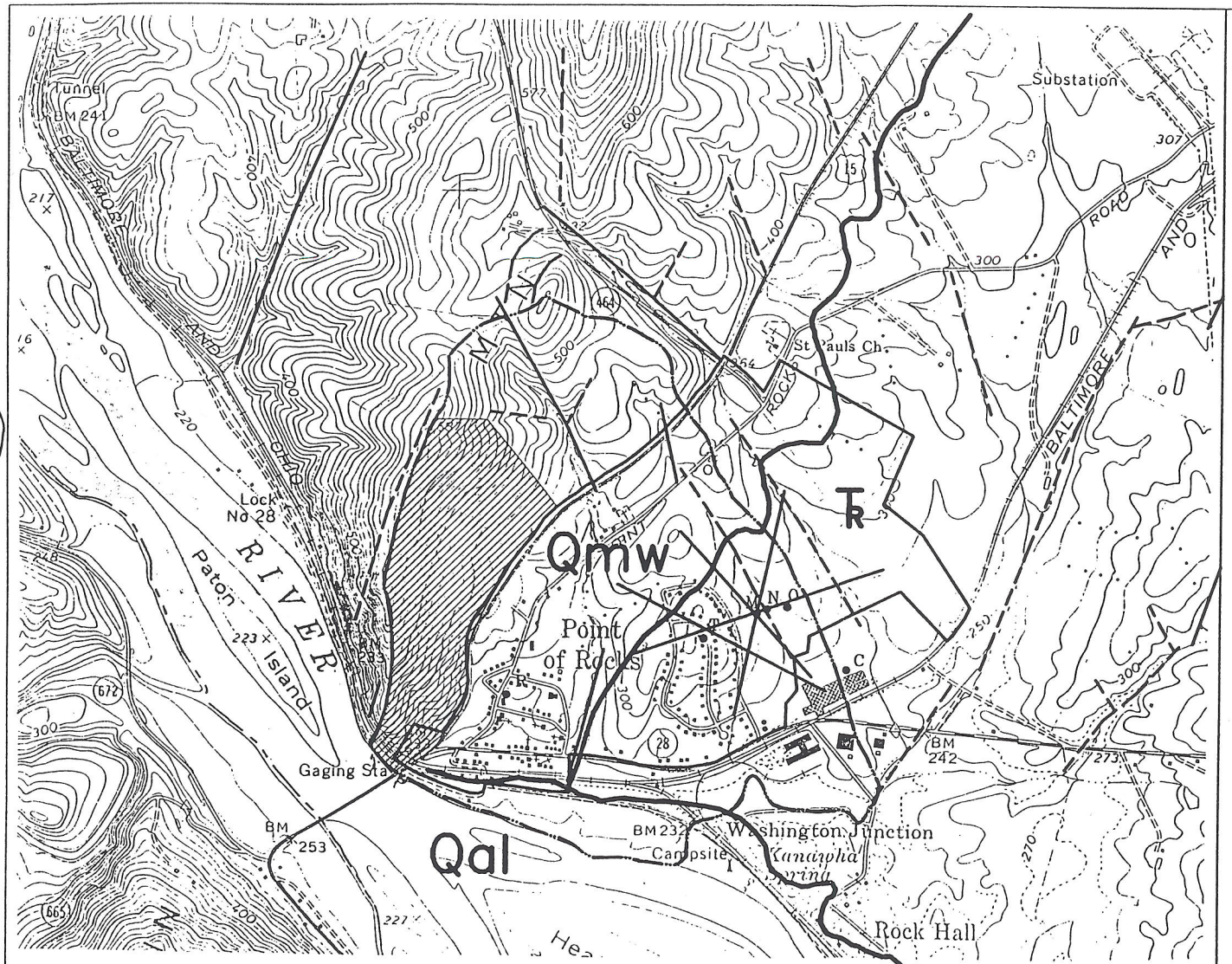
- Wells
- WHPA
- Existing Service
- 3 Year Planned Service
- Not Planned for Service

N

1000 0 1000 2000 Feet

Base Map: USGS Topographic 7.5 Minute Quad for Point of Rocks

APPENDIX



(181)

NOTES:

1. *Base map from USGS 7.5-minute topographic quadrangle map for Point of Rocks, MD (photoinspected 1981)*
2. *This figure is integral to a written report and should only be used in that context. This figure is solely intended to facilitate regulatory review, and is not intended to be used for boundary verification or survey control purposes.*
3. *The production wells at Point of Rocks are owned and operated by the Frederick County Bureau of Water and Sewer.*
4. *The service area, as shown, includes all proposed portions of the Potomac village subdivision.*
5. *Geology from Reinhardt, 1974, Geologic Map of the Frederick Valley, Maryland.*

PV1, LLC
POTOMAC VILLAGE PUD

FIGURE 1. HYDROGEOLOGIC BASE MAP

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