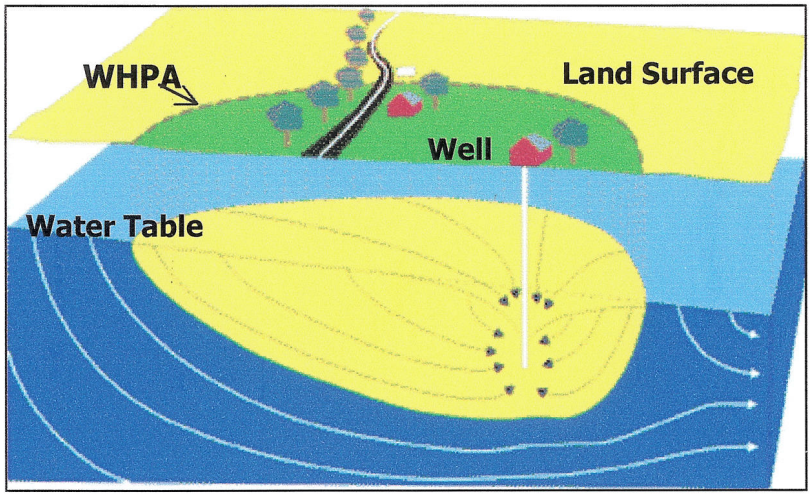
SOURCE WATER ASSESSMENT

FOR THE BARK HILL WATER SYSTEM

CARROLL COUNTY, MD



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MDE

TABLE OF CONTENTS

SUMMARY

The Maryland Department of the Environment's Water Supply Program (WSP) has conducted a Source Water Assessment for the Bark Hill Water System. The major components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are: (1) delineation of an area that contributes water to the source, (2) an inventory of potential sources of contamination, and (3) determining the susceptibility of the water supply to contamination. Recommendations for management of the assessment area conclude this report.

The source of Bark Hill's water supply is an unconfined fractured-rock /carbonate rock aquifer. One well is currently being used to draw the water out of the aquifer. A second well is available as a standby well. The Source Water Assessment Area for Bark Hill's wells was delineated by the Carroll County Bureau of Water Resources Management (now Division of Water Resource Planning) using U.S EPA approved methods specifically designed for each source.

Potential sources of contamination within the assessment area were identified based on site visits, database review, and land use maps. Well information and water quality data were also reviewed. Figures showing land uses and potential contaminant sources within the Source Water Assessment Area and an aerial photograph of the well location are enclosed at the end of the report.

The susceptibility analysis of Bark Hill's water supply is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that Bark Hill's water supply is susceptible to contamination by nitrates but not to other inorganic compounds, and may be susceptible to Radon-222 if the proposed MCL is 300 picoCuries/L. The water supply is not susceptible to volatile organic compounds, synthetic organic compounds, bacteria and protozoans.

INTRODUCTION

The Community of Bark Hill is located about 8 miles west of Westminster in Carroll County (Figure 1). The Bark Hill Water System is owned and operated by the Carroll County Department of Public Works (DPW). The system serves a residential population of 154 and a non-residential population of 850 at the Francis Scott Key High School. Currently, the water is supplied by one well (No.1 also known as K3) with Well No. 2 (also known as K50) serving as a standby well. Well No. 1 is located on a private farm and Well No. 2 is located on the school property (figure 1).

WELL INFORMATION

A review of well data and sanitary surveys of the Bark Hill Water System indicates that Well No. 1 was drilled in 1987 and should be in conformance with the State's well construction regulations which were implemented in 1973. Well No. 2 was drilled in 1969 prior to implementation of the State's well construction standards. Table 1 contains a summary of the well construction data.

PLANT	SOURCE NAME	PERMIT	TOTAL DEPTH	CASING DEPTH	AQUIFER
01	BARK HILL 1 (K3)	CL815034	400'	38'	MARBURG FORMATION
01	BARK HILL 2 (K50)	CL690468	398'	42'	MARBURG FORMATION

Table 1. Bark Hill Well Information

Well Nos. 1 and 2 have a yields of 60 gallons per minute (gpm) and 20 gpm respectively.

HYDROGEOLOGY

The Bark Hill area is underlain by the Marburg Formation and narrow belts of the Silver Run Limestone Member. Well completion reports for Bark Hill's wells indicate that the Marburg Formation overlies the Silver Run Limestone Member and that the major water bearing zones are in the limestone. The Marburg Formation consists of blue, green or purple phyllite and phyllitic slate, with interbedded metasiltstone and metagraywacke. The Silver Run Limestone Member consists of blue, thin-bedded finely crystalline schistose limestone and calcareous slate (Meyer and Beall, 1958).

In this type of hydrogeologic setting the aquifer is unconfined and ground water is stored and transmitted in the weathered zone and in voids and fractures in the bedrock. Ground water movement is mainly controlled by fracture orientation and also to some extent by the dissolution of limestone lenses in bedrock.

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment area for the system. The WHPA for the Bark Hill's water supply was delineated by the Carroll County Bureau of Water Resource Management as part of the County Water Resources Ordinance development (R. E. Wright, 1989). Hydrogeologic mapping was the method used for the delineation. This is the methodology recommended for fractured rock aquifers in the EPA approved Maryland's Source Water Assessment Plan (1999).

The WHPA represents the area that contributes ground water to the wells. It is based on "capture areas" as estimated from available field testing data, hydrologic flow systems, and ground water availability estimates, in combination with the hydrogeological characteristics of the aquifer (R. E. Wright, 1989). The area of the WHPA is more than sufficient to cover the annual average recharge needed to supply the wells. The total area of the WHPA is 227 acres.

POTENTIAL SOURCES OF CONTAMINATION

For this assessment MDE Waste and Water Management databases and Carroll County's database were reviewed, staff consulted, and field inspections conducted, to identify potential sources of contamination in around the Bark Hill WHPA. In addition, MDE staff conducted a follow up field survey of the WHPA on September 12, 2000 with Mr. Charles Singer, the Water Superintendent for the Bark Hill Water System. Water quality issues were discussed with Mr. Singer. He did not have any major concerns except for a large herd of cattle grazing around Well No.1 that could cause contamination of the water supply.

The potential contaminant sources that were identified are an underground storage tank (UST), a stormwater management pond and animal waste at two sites (figure 2). It must be noted that the stormwater management pond was installed by the Carroll County and was designed and constructed to prevent contamination of ground water. The pond is lined with synthetic fabric to protect the aquifer from contaminants. The UST is a 10,000 gallon heating oil tank located at Francis Scott Key High School and meets the State's standards for USTs. A large herd of cattle use the field in which Well No. 1 is located for grazing and several cows were observed resting around the wellhead. As a result animal waste was present in the vicinity of this well. Another such site is located on a dairy farm south of the school.

Based on the Maryland Office of Planning 1997 Land Use Map, the land use categories within the WHPA are as shown in table 2. Figure 3 shows the land use in and around the Bark Hill WHPA. It must be noted the land use designated commercial is actually school property.

LAND USE	TOTAL AREA (acres)	PERCENTAGE OF WHPA
Low Density Residential	14.04	6.2
Commercial (School)	42.38	18.6
Cropland	135.84	59.8
Pasture	27.99	12.3
Forest	7.00	3.1

Table 2. Land Use Summary for the Bark Hill WHPA.

A review of the Carroll County Sewer Map (1995) shows that there in no planned sewer service in the WHPA. It must be noted that the school had drainfields for sanitary wastes and discharge of its backwash from the water treatment. These drainfields were located about 1000 feet northeast of Well No. 1. In the early 1990s high chloride levels were detected in the water supply from Well No.1. Investigation of this problem revealed that the source of the chloride was the backwash which was being disposed off through the drainfield and eventually getting into the aquifer and the water supply. This disposal practice has been discontinued since 1996 and the backwash is now being collected in holding tank and hauled off site. The sanitary wastes from the school are collected in a wet well at a newly constructed wastewater treatment plant and also hauled off site. The County is currently waiting for a discharge permit from MDE to begin operation of the wastewater treatment plant.

Non-point sources of contamination are usually associated with land use activities in the area. About 72% of the land use is cropland and pasture. Application of fertilizers and pesticides on cropland could result in potential sources of synthetic organic compounds (SOCs). Wastes generated by livestock grazing in pastures are potential sources of nitrates and microbial pathogens. Application of fertilizers and pesticides for landscaping the school property and maintenance of athletic fields could result in potential sources of nitrate and SOCs. Lawn maintenance and landscaping activities on residential properties could also be potential sources of nitrates and SOCs. Onsite septic systems on residential properties may be potential sources of nitrates and microbial pathogens.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database and system files for Safe Drinking Water Act contaminants. The data described is from finished water unless indicated otherwise. The treatment currently in use in Bark Hill is chlorination for disinfection, ion exchange for both nitrate removal and water softening. Sodium chloride solution is used for the ion exchange process and chlorine gas for disinfection.

In accordance with Maryland's SWAP, data from the water sources and treatment plants were compared with the Maximum Contaminant Levels (MCLs). If the monitoring

data is greater than 50% of the MCL, the written assessment will describe the sources of such a contaminant, and, if possible, locate the specific sources which are the cause of the elevated contaminant level. A review of the monitoring data since 1993 for Bark Hill's finished water indicates that the system's water supply meets drinking water standards. Nitrate was the only contaminant detected above 50% of the MCL. Radon-222 was also detected at a level that may be above 50% of one the proposed MCLs for it. These are discussed in more detail below.

Inorganic Compounds (IOCs)

The only IOC detected above 50% of the MCL was nitrate. The MCL for nitrate is 10 ppm. The nitrate detections above 50% of MCL in Bark Hill's water supply are shown in Table 3.

CONTAM ID	CONTAMINANT NAME	MCL (ppm)	SAMPLE DATE	RESULT (ppm)
1040	NITRATE	10	11-Feb-93	15.1
1040	NITRATE	10	10-Jan-94	5.44
1040	NITRATE	10	07-Feb-94	6.42
1040	NITRATE	10	22-Mar-94	7.22
1040	NITRATE	10	18-Apr-94	9.9
1040	NITRATE	10	09-May-94	9.8
1040	NITRATE	10	20-Jun-94	9.79
1040	NITRATE	10	05-Jul-94	5.74
1040	NITRATE	10	17-Aug-94	10.3
1040	NITRATE	10	22-Aug-94	12.5
1040	NITRATE	10	14-Sep-94	15.5
1040	NITRATE	10	17-Oct-94	6.44
1040	NITRATE	10	14-Nov-94	8.21
1040	NITRATE	10	14-Dec-94	7.26
1040	NITRATE	10	13-Feb-95	9.6
1040	NITRATE	10	16-May-95	8.52
1040	NITRATE	10	06-Jul-95	8.25
1040	NITRATE	10	17-Aug-95	5.82
1040	NITRATE	10	13-Mar-96	6.3
1040	NITRATE	10	18-Apr-97	8.4
1040	NITRATE	10	13-May-97	7.4
1040	NITRATE	10	18-Jun-97	5.3
1040	NITRATE	10	06-Aug-97	5.2
1040	NITRATE	10	22-Oct-98	6.2

Table 3. IOC results above 50% of the MCL for Bark Hill's water supply since 1993.

As can be seen in the above table, there were four MCL violations between 1993 and 1994. This was due to the malfunction of the nitrate removal system that was installed in 1993 when the water treatment plant was constructed. MDE notified the County to address the violations and consider redesigning the nitrate removal system. Since the redesign of the system in 1995, the nitrate concentrations have

not exceeded the MCL. For the past two years nitrate levels have averaged 2.92 ppm.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of the MCL have been detected in Bark Hill's water supply since 1993. The only VOCs detected since 1993 are the disinfection by-products known as trihalomethanes. Bromodichloromethane was detected at 0.6 ppb (7/15/96) and 2 ppb (11/1/97). Chloroform was detected at 2 ppb ((7/15/96) and 1 ppb (1/11/97). Bromoform was detected at 1 ppb on 11/1/97. Dibromochloromethane was detected at 2 ppb on 11/1/97. Trihalomethanes are not currently regulated for systems serving a population of less than 10,000.

Synthetic Organic Compounds (SOCs)

No SOCs have been detected in Bark Hill's water supply since 1993.

Radionuclides

Radon-222 was detected at 850 picoCuries per liter (pCi/L) on 3/25/97. Currently, there is no MCL for radon-222. EPA has proposed an MCL of 300 pCi/L and an alternate MCL of 4000 pCi/L.

Microbiological Contaminants

A raw water sample was collected and tested for giardia and cryptosporidia from Well No. 1 following about an inch of rainfall to determine whether this well's water supply is ground water under the influence of surface water (GWUDI). The results were negative for the presence of these microrganisms. A raw water sample was collected and tested for bacteria from Well No. 2 on 2/24/00 following 0.8 inches of rainfall, to determine whether this well's water supply is GWUDI. The results were negative for the presence of total and fecal coliform.

SUSCEPTIBILITY ANALYSIS

Bark Hill's wells obtain water from an unconfined aquifer. In general, water supplies in unconfined aquifers are susceptible to contamination from land use activities. Therefore, continued routine monitoring of contaminants is essential in assuring a safe drinking water supply. The criteria that was used to conduct the susceptibility analysis is as follows: (1) available water quality data, (2) presence of potential contamination contaminant sources in the WHPA, (3) aquifer characteristics, (4) well integrity and (5) the likelihood of change to the natural conditions.

Inorganic Compounds (IOCs)

Due to high levels of nitrate in individuals wells in the Bark Hill area, a community water system (Bark Hill Water System) was built in 1993.Nitrate has been detected in Bark Hill's water supply above 50% since 1993 and even exceeded the MCL in 1993 and 1994. Since 1995, when the nitrate treatment system was redesigned, the nitrate concentrations have not exceeded the MCL and for the past two years averaged 2.92 ppm. Sources of nitrate can generally be traced to land use.

Fertilization of cropland and residential properties are non-point sources of nitrate in ground water. Onsite septic systems are also sources of nitrate in ground water. Cropland and residential land make up about 60% and 12 % of the WHPA, respectively (table 2). Well No. 1 is located in a pasture where cattle graze. Animal waste from the cattle is a source of nitrate.

Based on the above analysis, Bark Hill's water supply **is** susceptible to nitrate contamination.

Volatile Organic Compounds (VOCs)

The only VOCs detected were low levels of trihalomethanes which are disinfection by-products. There are no potential sources of VOCs in the WHPA. Therefore, Bark Hill's water supply is **not** susceptible to VOC contamination.

Synthetic Organic Compounds (SOCs)

A large portion of the land use in and around the WHPA can be potential sources of SOC contamination if improper application of pesticides occurs. Sampling data since 1993 indicate that no SOCs have been detected in the water supply. Bark Hill's water supply is therefore **not** susceptible to SOC contamination.

Radionuclides

Radon has been detected in Bark Hill's water supply. The source of radon in ground water can be traced back to the natural occurrence of uranium in rocks. Radon is prevalent in ground water throughout the Piedmont region of Maryland due to radioactive decay of uranium bearing minerals in the bedrock (Bolton, 1996). Bark Hill's water supply may be **susceptible** to radon if an MCL of 300 pCi/L is adopted.

MANAGEMENT OF THE WHPA

Form a Local Planning Team

- The team should represent all the interests in the community. The County Public Works, Health Department, Planning Department, and the Board of Education, residents, farmers, and developers should work to reach a consensus on how to protect the water supply.

Planning/New Development

- The County developed Performance Standards and Management Criteria for Water Resource Management that were reviewed and approved by MDE. The County has not yet adopted these Performance Standards and is strongly encouraged to do so for protection of the water supply.
- The County Division of Water Resource Planning does plan review of new developments prior to issuance of building permits, to ensure water supply source protection. The County should continue with this plan review process to ensure that new developments do not degrade the quality or quantity of drinking water.

Public Awareness and Outreach

- Pamphlets, flyers and bill stuffers send to local residents, school personnel and farmers will help educate the general public about Wellhead Protection.
  The County has placed signs at the WHPA boundaries as a good way to make the public aware of protecting their source of water supply.
- The County should request the farmer on whose property Well No. 1 is located, to prevent his cattle from grazing adjacent to the well to protect water quality. Construction of a fence around this well should be considered.

Monitoring

- Continue to monitor for all Safe Drinking Water Act contaminants as required by MDE.
- GWUDI testing data for Well No. 1 should be submitted to the WSP so that determination can be made as to whether it is under the influence of surface water and susceptible to bacteria and protozoans.
- Annual sampling of microbiological contaminants is a good check on well integrity.
- Raw water testing of nitrate levels is recommended to mark progress in wellhead protection approaches and also to check the effectiveness of the removal process.

Cooperative Efforts with Other Agencies

- Request the assistance of the University of Maryland Agricultural Extension Service, the Soil Conservation Service to work with the farmers to adopt Best Management Practices (BMP's) for farms located within the WHPA.
- The farmers can also participate in the New Conservation Reserve Program (CREP) applicable to the cropland located within the WHPA. Government funding is available to qualified farmers equal to the cost and financial benefit of farming the area. The Natural Resources Conservation Service is responsible for determining the relative environmental benefits of each acre offered for participation.

Land Acquisition/Easements

- The availability of loans for purchase of and/or easements for the purpose of protecting water supplies is available from MDE. Loans are offered at zero percent interest and zero points.

Contingency Plan

- Comar 26.04.01.22 regulations require all community water systems to prepare and submit for approval a plan for providing a safe and adequate drinking water supply under emergency conditions.

Changes in Use

- Any increase in pumpage or addition of new wells to the system may require revision of the WHPA. The system is required to contact the Water Supply Program when an increase in pumpage is applied for or when new wells are being considered.

Contaminant Source Inventory/Well Inspections

- The County should review the potential sources of contamination within the WHPA and update them if necessary.
- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.

REFERENCES

Bolton, David W., 1996, Network Description and Initial Water-Quality Data from a Statewide Ground-Water Quality Network in Maryland: Maryland Geological Survey Report of Investigations No. 60, 167 p.

Maryland Department of the Environment, Water Supply Program, 199, Maryland's Source Water Assessment Plan, 36 p.

Meyer, G., and Beall, R. M., 1958, The Water Resources of Carroll and Frederick Counties: Department of Geology, Mines and Water Resources Bulletin 22, 355p.

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

R. E. Wright Associates, Inc., 1988, Phase II Report Carroll County Water Resources Study Volumes I and II.

R. E. Wright Associates, Inc., 1989, Recommended Water Resource Management Standards, Criteria, and Administrative Procedures.

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

OTHER SOURCES OF DATA

Water Appropriation and Use Permit CL1969G009
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Carroll County WHP Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles: Union Bridge NE and New Windsor NW
USGS Topographic 7.5 Minute Quadrangles: Littlestown and Emmitsburg
Maryland Office of Planning 1997 Carroll County Land Use Map

FIGURES

Figure 3. Land Use Map of the Bark Hill Wellhead Protection Area

LEGEND

Land Use

- Low Density Residential
- Medium Density Residential
- Commercial
- Cropland
- Pasture
- Forest
- Feeding Operations
- Supply Well
- Wellhead Protection Area

2000 0 2000 Feet

N

Source: Maryland Office of Planning
1997 Carroll County Land Use Map