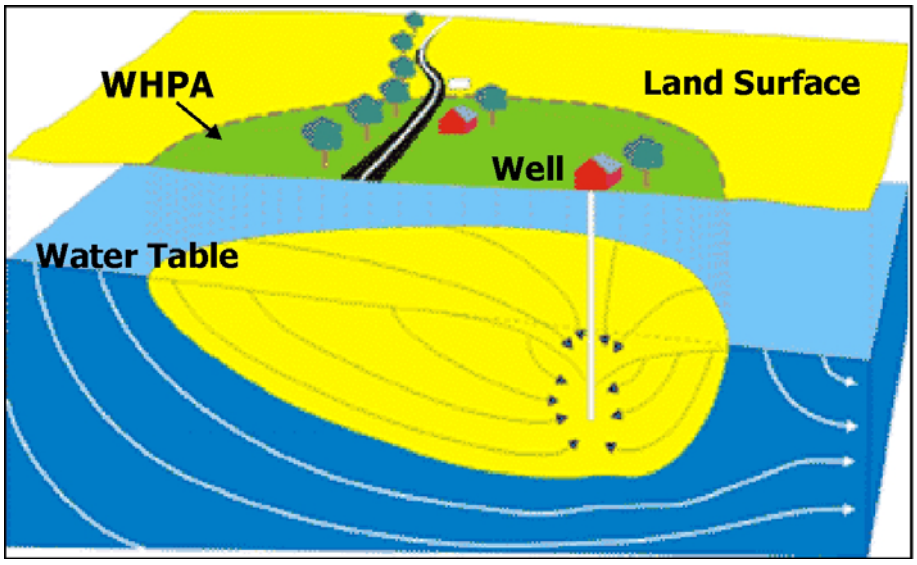
Source Water Assessment

for Emmitsburg

Frederick County, MD



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Water Supply Program
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MDE

WELL INFORMATION

Emmitsburg presently obtains its water supply from three wells (Nos 1, 2, and 3). A fourth well (No. 4) has been drilled but is intended to be hooked up to the water system when construction of the new water treatment plant is completed. All four wells are located within the Turkey Creek watershed west of the Town and downstream of the Rainbow Lake reservoir (Fig 1). A review of the well completion reports and sanitary surveys of Emmitsburg's water system indicate that Well Nos. 1, 2 and 3 were installed prior to the 1973 well construction regulations went into effect. A September 2000 inspection by water supply staff revealed sanitary defects in all three wells. Wells 1 and 2 had unscreened vents and Well 3 lacked a well cap. The Town's water plant operator, Dan Fissel, has since addressed these deficiencies by installing a cap on Well 3 and placing screens in Wells 1 and 2. Mr. Fissel stated he would like to complete further repairs on the Well 3 cap, which has proven difficult to seal due to the construction and age of the well. The condition of the casing in Well 2 was reported as "deteriorated" during pump testing in 1998. Well No. 4 was constructed in 1998, and a review of its permit reveals that it meets well construction standards. Table 1 contains a summary of the well construction data.

PLANT	SOURCE NAME	WELL PERMIT	TOTAL DEPTH	CASING DEPTH	APPROPRIATION PERMIT (*AMT IN GPD*)	AQUIFER
01	WELL 1	FR690288	250	76	FR1975G011 (*168,000*)	CATOCTIN METABASALT
01	WELL 2	FR035425	161	23		
01	WELL 3	FR650432	212	43	FR1976G114 *(72,000)*	CATOCTIN METABASALT
01	WELL 4	FR941117	600	84	FR1997G032 *(40,000)*	CATOCTIN METABASALT

Table 1. Town of Emmitsburg Well Information.

The Town has three ground water appropriation permits issued for a combined 280,000 average gallons per day (gpd) on a yearly basis, and a surface water permit for 168,000 gallons from the Rainbow Lake reservoir. The permits are considered supplemental, meaning that the individual appropriation limits may be exceeded, as long as the total 448,000 average gpd total is not exceeded over the course of the year. These appropriation amounts were arrived at from an extensive review of the Town's water demand and the availability of ground water based on pumping tests of the four wells conducted between 1997 and 1999. Based on the most recent available annual pumpage reports (1999), Wells 1 and 2 averaged 58,000 gpd, and Well 3 average 64,000 gpd.

HYDROGEOLOGY

Emmitsburg's wells draw water from the Catoctin Metabasalt Formation. The Turkey Creek watershed, in which the wells are located, is underlain by this fractured

rock aquifer, a dense green schistose rock which is believed to be a series of metamorphosed lava flows (Meyer and Beall, 1958). The primary porosity and permeability are small due to the dense nature of the metabasalt. Ground water moves principally through joint openings and is recharged by precipitation percolating through soil and saprolite. A fracture trace analysis has not been completed in the vicinity of Emmitsburg's wells, however fractures were inferred to be oriented north-south to northeast-southwest from topographic observations and pumping tests conducted in support of the water appropriation permit renewal.

SOURCE WATER ASSESSMENT AREA DELINEATION

The source water assessment area (SWAA) 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). The Turkey Creek watershed upstream of the wells has been delineated as the source water assessment area (Fig. 2). The availability of ground water for the wells was calculated based on this drainage basin when appropriation amounts were issued and therefore it is the appropriate area to use. The flow model developed during pumping tests conducted on wells 1 and 2 show that pumping during dry conditions may cause 0-15 feet of drawdown in the nearest domestic supply wells, therefore the eastern boundary of the SWAA is extended approximately 1000 feet downstream of the wells.

Maryland's SWAP also states that where feasible, a fracture trace analysis can be used to delineate the most vulnerable areas around the well. Fracture traces are surface expressions of vertical, closely spaced joints and fractures in the bedrock below. Highly developed fracture systems in bedrock aquifers readily transmit water; thus fracture trace analysis is commonly used to locate high yield wells in fractured bedrock aquifers. A well intercepting a fracture, or fracture zone, will demonstrate a drawdown pattern that is greatest along the trace of the fracture(s). Although Emmitsburg's wells are located along fractures, separate source water assessment zones have not been delineated due to the complexity of the aquifer. Previous studies have shown that the orientation of fractures controlling ground water flow to the wells is not obvious. Furthermore, well exploration has shown that the saprolite in the Catoctin formation is very thick in places, and therefore may have a large influence on ground water storage and time of travel to the wells.

POTENTIAL SOURCES OF CONTAMINATION

No point sources of contamination were identified in the Emmitsburg SWAA. Based on the Maryland Office of Planning's 1997 digital land use map of Frederick County, the land use within Emmitsburg's SWAA is completely forested (Fig.3). The digital sewer service map shows that the entire SWAA is in an area that is not planned for service.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database for Safe Drinking Water Act contaminants. All data reported is from the finished (treated) water, unless otherwise noted. The treatment currently in use in Emmitsburg includes disinfection, coagulation, rapid sand filtration and sedimentation.

The State's SWAP defines a threshold level for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is greater than 50% of a MCL, the written 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. A review of the monitoring data since 1990 for Emmitsburg's water indicates that no contaminants exceeded the 50% threshold.

Inorganic Compounds (IOCS)

IOCs are analyzed annually from the Emmitsburg water plant. Data is available since 1995. IOCs have not been detected above 50% of the MCL.

Radionuclides

There is currently no MCL for Radon-222, however EPA has proposed a MCL of 300 pCi/L or an alternate of 4000 pCi/L. Although Radon-222 has been detected in Emmitsburg water supply, it has not exceeded the 50% MCL threshold level. The highest level of radon in Emmitsburg's finished water is 145 pCi/L. Since this is a combined result for all sources, it is not clear what the level of radon is in the wells. However, it is likely that the wells have a higher level than the surface supply because it is a common contaminant found in ground water in the Blue Ridge due to naturally occurring elements in the bedrock that decay to form radon.

Microbiological Contaminants

The Town sampled raw (untreated) water from all 3 wells to test for "Ground Water Under the Direct Influence of Surface Water" (GWUDI) in 1995 and 1996. The wells were free of fecal coliform and turbidity levels were consistently less than 1 NTU (Table 2). The wells were determined not influenced by surface water. Wells 2 and 3 both had total coliform bacteria present in several samples. Total coliforms are a group of bacteria that are ubiquitous in the environment. The coliform group is used as an indicator of contamination, but is not as specific as the fecal coliform group, which is used to indicate the presence of human or mammal waste. All bacteriological samples from finished water have been free of coliform.

Volatile Organic Compounds (VOCS)

The Emmitsburg water supply has not detected any VOCs above 50% of the MCL. Annual VOCs samples were reviewed for the years 1990 – 2000.

Synthetic Organic Compounds (IOCS)

Seven sets of samples collected between 1995 and 2000 were reviewed for SOCs. No contaminants were detected above 50% of the MCL.

Sample Location	Sample Type	Sample Date	Total Coliform (MPN/100 ml)*	Fecal Coliform (MPN/100 ml)	Temp. (°C)	pH	Turbidity (NTU)
Well 1	Dry Weather	12/20/95	<1.1	<1.1	13	6.7	0.17
Well 2	Dry Weather	10/14/96	4.6	<1.1	14	7.3	0.052
Well 2	Dry Weather	10/16/96	1.1	<1.1	n/a	6.9	n/a
Well 2	Wet Weather	1/22/96	2.6	<1.1	11	6.6	0.25
Well 2	Wet Weather	1/23/96	4.6	<1.1	10.8	6.8	0.18
Well 2	Wet Weather	1/24/96	2.6	<1.1	12	6.8	0.22
Well 2	Wet Weather	1/25/96	<1.1	<1.1	11	6.7	0.25
Well 2	Wet Weather	3/12/96	<1.1	<1.1	10.9	6.5	0.04
Well 2	Wet Weather	3/13/96	<1.1	<1.1	13.2	6.9	0.045
Well 2	Wet Weather	3/14/96	<1.1	<1.1	11.6	6.8	0.05
Well 2	Wet Weather	12/16/96	<1.1	<1.1	10.8	6.7	0.08
Well 2	Wet Weather	12/17/96	2.6	<1.1	11.1	6.7	0.08
Well 2	Wet Weather	12/18/96	2.6	<1.1	11.6	7.0	0.1
Well 2	Wet Weather	12/19/96	<1.1	<1.1	11.6	7.2	0.095
Well 3	Dry Weather	10/14/96	4.6	<1.1	14.5	7.1	0.038
Well 3	Dry Weather	10/16/96	1.1	<1.1	n/a	6.9	n/a
Well 3	Wet Weather	1/22/96	2.6	<1.1	13	7.0	0.2
Well 3	Wet Weather	1/23/96	4.6	<1.1	12.7	6.7	0.2
Well 3	Wet Weather	1/24/96	8.0	<1.1	14	6.99	0.19
Well 3	Wet Weather	1/25/96	8.0	<1.1	13	6.9	0.78
Well 3	Wet Weather	3/12/96	<1.1	<1.1	13.7	6.3	0.1
Well 3	Wet Weather	3/13/96	<1.1	<1.1	13.6	6.6	0.055
Well 3	Wet Weather	3/14/96	<1.1	<1.1	14.3	6.6	0.048
Well 3	Wet Weather	3/15/96	<1.1	<1.1	14.6	7.1	0.065
Well 3	Wet Weather	12/2/96	<1.1	<1.1	11.2	6.8	0.09
Well 3	Wet Weather	12/3/96	2.6	<1.1	11.8	6.9	0.095
Well 3	Wet Weather	12/4/96	<1.1	<1.1	12.2	6.9	0.08
Well 3	Wet Weather	12/5/96	<1.1	<1.1	11.4	7.0	0.09

Table 2. Raw water GWUDI Testing Data for Emmitsburg Wells.
***MPN = Most Probable Number**

SUSCEPTIBILITY ANALYSIS

Emmitsburg's wells draw water from an unconfined fractured rock aquifer, and therefore can be vulnerable to any activity on the land surface that occurs within the SWAA. In order to determine *susceptibility* to each group of contaminants the following criteria were considered: 1) the presence of potential contaminant sources within the SWAA, 2) water quality data and 3) the well and aquifer conditions. Based on the protected nature of the forested watershed in which the wells are located, the lack of potential contaminants in the SWAA, and the water quality data, the wells are considered not susceptible to the inorganic, volatile organic, and synthetic organic compound groups. Based on the review of raw water GWUDI data, the wells are not susceptible to protozoa. However, the GWUDI data together with the structural condition of the wells indicate that the wells may be susceptible to viruses.

Inorganic Compounds

The wells are **not** susceptible to inorganic compounds. The only IOCs that have been detected were well below 50% of the MCL. There are no potential contaminant sources identified in the SWAA for this group of compounds.

Radionuclides

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 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 has been detected in Emmitsburg's water supply, but below 50% of the lower proposed level of 300 pCi/L. 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 of crystalline rock aquifers, such as the Catoctin Metabasalt, due to radioactive decay of uranium bearing minerals in the bedrock (Bolton, 1996). The EPA also has information on proposed regulations for radon in indoor air and drinking water on their web site (http://www.epa.gov/OGWDW/radon.html). Currently, it appears that Emmitsburg's water supply is **not** susceptible to radon.

Volatile Organic Compounds

The wells are **not** susceptible to volatile organic compounds. VOCs have not been detected in the wells and no potential contaminant sources were identified within the SWAA.

Synthetic Organic Compounds

The wells are **not** susceptible to synthetic organic compounds. SOCs were not detected in the wells and no potential contaminant sources were identified within the SWAA.

Microbiological Contaminants

The consistent presence of total coliform bacteria in Wells 2 and 3 indicate that they are susceptible to viral contamination. Total coliform bacteria are a broad class of organisms found in the digestive tracts of human and animals, but may also occur in the natural environment. The presence of these organisms in well water indicate that ground water moves through the soil and saprolite fast enough to allow for organisms with relatively long survival rates, such as viruses, to reach the wells. The age of the wells and the condition of the casing may also create routes for coliform bacteria to enter the wells. The fecal coliform bacteria group is used as an indicator for pathogens because they are associated with fresh feces from mammals or humans. The absence of fecal coliform in the wells and their low turbidity indicate that they are **not** susceptible to pathogenic protozoa, such as *Giardia* and *Cryptosporidium*.

MANAGEMENT OF THE SWAA

With the information contained in this report the Town of Emmitsburg is in a position to protect its 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

- Emmitsburg should form a local planning team to begin to implement a source water protection plan. The team should represent all the interests in the community, such as the water supplier, home association officers, the County Health Department, local planning agencies, local business, developers, and property owners, and residents within and near the SWAA. The team should work to reach a consensus on how to protect the water supply.

- A management strategy adopted by Emmitsburg should be consistent with the level of resources available for implementation. By consulting with other jurisdictions involved in this process, the Town can benefit from lessons learned by others. There are at least two other nearby municipalities actively involved in wellhead protection (Walkersville and Middletown). MDE remains available to assist in anyway we can help the process.

- MDE has grant money available for Wellhead Protection projects. The Town may want to consider having a fracture trace analysis or other study that would delineate the 1 year time of travel area (Zone 1) for the wells. This would allow the Town to know the most critical areas for wellhead protection.

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 town office or MDE.

- Road signs at the SWAA boundaries is 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.

Planning/ New Development

- Review the State's model wellhead protection zoning ordinances for potential adoption. Compare the source water protection boundaries with the Town limits to determine how to coordinate with Frederick County Department of Planning. MDE recommends water supply owners to encourage the County to adopt a wellhead protection ordinance.

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

- Emmitsburg should have a Contingency Plan for its water system. 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.

- Develop a spill response plan in concert with the Fire Department and other emergency response personnel.

Changes in Use

- Emmitsburg should notify MDE if new wells are to be put into service. Drilling a new well outside the current SWAA would modify the area, therefore Emmitsburg should contact the Water Supply Program if a new well is being proposed.

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 pp.

MDE, Water Supply Program, 1999, Maryland's Source Water Assessment Plan (SWAP), 36 p.

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

Smith Technology Corporation, 1997, Long-term aquifer testing of water supply wells 1, 2, and 3 in support of application numbers FR76G114 and FR75G011 prepared for the Town of Emmitsburg, 31 pp.

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 No. FR1975G011, FR1976G114, FR1997G032
Public Water Supply Inspection Reports
MDE Water Supply Program Oracle® Database
MDE Waste Management Sites Database
Department of Natural Resources Digital Orthophoto Quarter Quadrangles for Emmitsburg NW and Blue Ridge Summit NE and SW
USGS Topographic 7.5 Minute Quadrangles Emmitsburg and Blue Ridge Summit
Maryland Office of Planning 1997 Frederick County Digital Land Use Map
Maryland Office of Planning 1996 Frederick County Digital Sewer Map

Figure 1. Location Map

Figure 3. Land Use Map of Emmitsburg Source Water Assessment Area