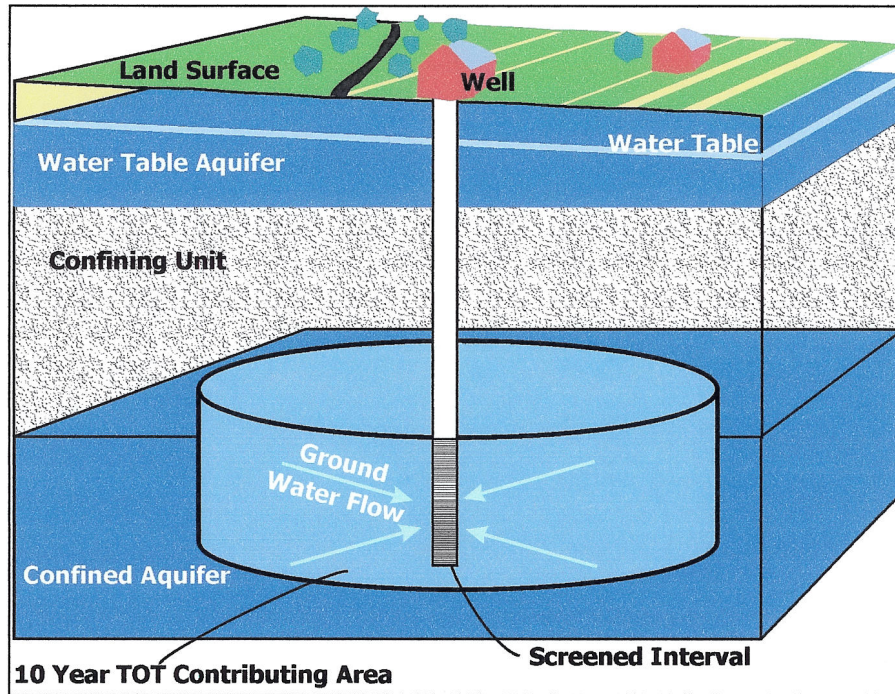


# SOURCE WATER ASSESSMENT

## FOR CRYSTAL BEACH MANOR

### CECIL COUNTY, MD



Prepared By  
Water Management Administration  
Water Supply Program  
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*Robert L. Ehrlich*  
Governor

*Kendl P. Philbrick*  
Secretary

*Michael S. Steele*  
Lt. Governor

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## SUMMARY

The Maryland Department of the Environment's (MDE) Water Supply Program (WSP) has conducted a Source Water Assessment for the Crystal Beach Manor 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) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for management of the assessment area conclude this report.

The source of Crystal Beach Manor's water supply is a Coastal Plain confined aquifer- the Potomac. Two wells are currently being used to pump the water out of this aquifer. The source water assessment area was delineated by the Water Supply Program using methods approved by the U. S. EPA.

Potential sources of contamination within the assessment area were identified based on MDE site visits, and a review of MDE's databases. Well information and water quality data were also reviewed. A map showing the source water assessment area and potential contaminant sources is enclosed.

The susceptibility analysis for Crystal Beach Manor'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 Crystal Beach Manor's water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifer. It may be susceptible to radon-222 if the lower EPA proposed MCL for this contaminant is implemented.

## INTRODUCTION

The Maryland Department of the Environment's (MDE) Water Supply Program (WSP) has conducted a Source Water Assessment for the Crystal Beach Manor Water System. Crystal Beach Manor is located approximately 13 miles south of Elkton in Cecil County. The system is owned by T & C Utility Corporation and operated by Miller Environmental, Inc. and serves a population of 500. Currently, the water is being pumped from two wells (Nos. 1 & 2) and treated at one plant located in the vicinity of the wells. An older plant that treated water from two older wells, was demolished and the abandoned in 1998.

## 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. A review of the well data and sanitary surveys of the system indicates both the wells were drilled after 1973, when the State's well construction regulations went into effect, and meet current well construction standards for grouting and casing. Table 1 contains a summary of the well construction data. The system abandoned two older shallower production wells in 1998 in accordance with the State's well construction regulations. The database indicates that there is an unused well and another well that is probably used seasonally for the beach pavilion.

SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH (ft)	CASING DEPTH (ft)	YEAR DRILLED	AQUIFER NAME
01	Crystal Beach Manor Well 1	CE880737	220	200	1989	POTOMAC
02	Crystal Beach Manor Well 2	CE941759	215	190	1997	POTOMAC

*Table 1. Crystal Beach Manor Well Information.*

## HYDROGEOLOGY

Ground water flows through pores between gravel, sand and silt grains in unconsolidated sedimentary rock aquifers such as the one used by Crystal Beach Manor. An aquifer is any formation that is capable of yielding a significant amount of water. The transmissivity is a measure of the amount of water an aquifer is capable of producing and is related to the hydraulic conductivity and the thickness of the aquifer. A confining layer is generally composed of fine material such as clay and silt, which transmits relatively very little water. Confined aquifers are those formations that are overlain by a confining unit. Confined aquifers are recharged from the water stored in the confining unit above and from precipitation that infiltrates into the formation where it is exposed at the surface.

The Crystal Beach area lies within the Atlantic Coastal Plain physiographic province. This province, which in Maryland includes roughly the area east of Interstate 95, is underlain by unconsolidated clastic sediments of Lower Cretaceous to recent age, which thicken to the southeast so that they appear wedge-shaped. These sediments crop out in a concentric band that lies parallel to the Fall Line which marks the western boundary of the Coastal Plain. Crystal Beach Manor's wells pump water from the Potomac aquifer which is confined and consists of predominantly fine-grained sand, silt and clay. Coarse-grained materials that vary greatly in thickness and lateral extent are interspersed irregularly throughout the section (Otton et al, 1988). The top of the Potomac aquifer in the Crystal Beach area is at sea level.

## SOURCE WATER ASSESSMENT AREA DELINEATION

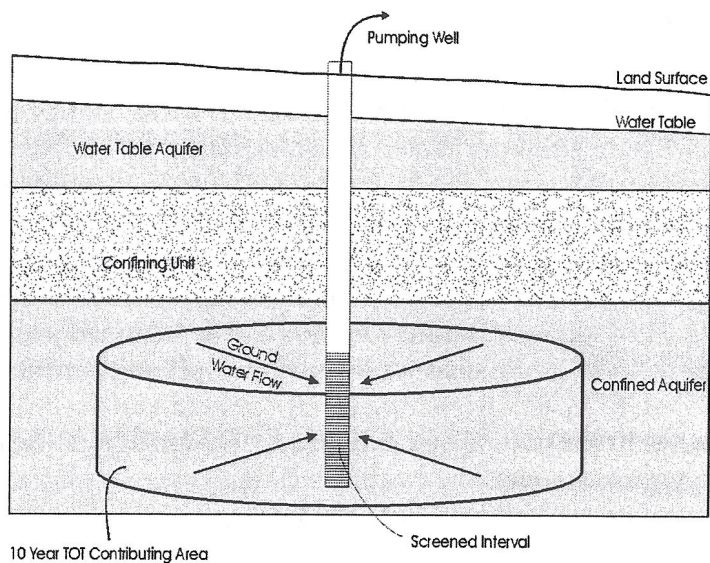
Source Water Assessment Areas (SWAAs) were delineated for the Crystal Beach Manor wells using the methodology described in Maryland's Source Water Assessment Plan (1999) for confined aquifers in the Coastal Plain, often referred to as the "Florida Method". The area is a radial zone of transport within the aquifer and is based on a 10 year time of travel (TOT), pumping rate and the screened interval(s) of the well or wells included in the SWAA, and the porosity of the aquifer (see illustration below for conceptual model). The Florida Method is a modification of Darcy's Law for radial flow to a well and the SWAA's were calculated using the following volumetric equation:

$$r = \sqrt{\frac{Qt}{\pi nH}}$$

where  $r$  = calculated fixed radius (ft)  
 $Q$  = pumping rate of well (ft<sup>3</sup>/yr)  
 $n$  = aquifer porosity (dimensionless)  
 $H$  = length of well screen (ft)  
 $t$  = time of travel (yr.)

Crystal Beach Manor has a water appropriation permit, one for 32,000 gallons per day (gpd). The pumping rate ( $Q$ ) used is the permitted daily average and total appropriated amount was used for each of well since only one well is used at a time.

A conservative estimate of porosity ( $n$ ) of 25% was used for the aquifer based on published reports. The lengths of the well screen ( $H$ ) were obtained from well completion reports. Using these parameters the radius was calculated with the above equation for the WHPA delineation (table 2). The circles for each well were merged to form one larger WHPA as shown in Figure 1. The circle represents the aquifer zone of transport in the subsurface as illustrated below.



*Conceptual illustration of a zone of transport for a confined aquifer*

Well Name	Well pumpage (Q) in gpd	Well pumpage (Q) in ft <sup>3</sup> /yr	Screened interval in feet	Aquifer	Calculated radius for WHPA in feet	Acreage of WHPA	Comments on WHPA
CRYSTAL BEACH MANOR WELL 1	32000	1561497	20	POTOMAC	1000	880	Wells 1 and 2 circles merged
CRYSTAL BEACH MANOR WELL 2	32000	1561497	25	POTOMAC	900		

**Table 2. Parameters used for the Wellhead Protection Area delineations**

## POTENTIAL SOURCES OF CONTAMINATION

In confined aquifer settings, sources of contamination at the land surface are generally not a threat unless there is a pathway for direct injection into the deeper aquifer such as unused wells or along well casing that are not intact or have no grout seal. Wells that are not being used or maintained will eventually corrode and provide a pathway for contaminants present in the shallow aquifers at higher-pressure heads to migrate to the deeper aquifers.

Potential sources of contamination identified at the land surface have the potential to impact the shallow water table aquifer. Based on the MDE databases, no potential sources of contamination were identified in the Crystal Beach Manor WHPA. Therefore as long as there is no potential for direct injection into the deeper confined aquifers, Crystal Beach Manor's water supply should be well protected from ground water contamination.

## 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 State's SWAP defines a threshold for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is at or greater than 50% of a MCL, this 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. All data reported is from the finished (treated) water unless otherwise noted. The treatment currently used at Crystal Beach Manor is hypochlorination for disinfection, pH adjustment for corrosion control.

A review of the monitoring data since 1996 for Crystal Beach Manor's water supply indicates that it meets the current drinking water standards. The water quality sampling results are summarized in Table 3.

IOCs		SOCs		VOCs		Radionuclides	
No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL
10	0	2	0	10	0	3	1*

Table 3. Summary of Water Quality Samples for Crystal Beach Manor's Water Supply

\*based on proposed lower MCL for radon

### ***Inorganic Compounds (IOCs)***

No IOCs above 50% of the MCL have been detected in Crystal Beach Manor's water supply since 1996. Sodium has been detected five times at levels ranging 3.9 ppm to 38.7 ppm. Sodium does not have an MCL, but people with sodium restrictions are to be notified by the system when levels exceed 20 ppm. The source of the sodium is probably from water treatment since sodium hypochlorite and sodium hydroxide are used for disinfection and corrosion control.

### ***Volatile Organic Compounds (VOCs)***

No VOCs have been detected in Crystal Beach Manor's water supply since 1996.

### ***Synthetic Organic Compounds (SOCs)***

No SOC above 50% of the MCL have been detected in Crystal Beach Manor's water supply since 1996. Decachlorobipheyl was detected one time in 1994 at 0.1ppb. The MCL for this SOC is 0.5 ppb.

### ***Radionuclides***

No radionuclides above 50% of the MCL have been detected in Crystal Beach Manor's water supply. Low levels of gross alpha and gross beta have been detected one time in the water supply.

Radon-222 was reported at 200 picoCuries/Liter (pCi/L) in a sample taken in February 2000. 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. This report used the lowest proposed MCL of 300 pCi/L, in an effort to be more conservative in this analysis.

### ***Microbiological Contaminants***

Routine bacteriological monitoring is conducted in the finished water for each community water system on a monthly basis and measures total coliform bacteria. Since Crystal Beach Manor's water supply uses disinfection for its treatment, the finished water data does not give much indication of the quality of raw water directly from the wells. Total coliform bacteria are not pathogenic, but are used as an indicator organism for other disease-causing microorganisms. A major breach of the system such as due to flooding a well, ruptured water line or back siphonage of contaminated water could cause a positive total coliform result in the distribution system, and would require follow-up total and fecal coliform analysis. Since 1997 Crystal Beach Manor has conducted routine bacteriological sampling 94 times, but no samples had any detections of total coliform bacteria.

## **SUSCEPTIBILITY ANALYSIS**

The wells serving Crystal Beach Manor's water supply pump water from confined aquifers. Confined aquifers are naturally well protected from activity on the land surface due to the confining layers that provide a barrier for water movement from the surface into the aquifer below. A properly constructed well with the casing extended to the confining layer above the aquifer and with sufficient grout should be well protected from contamination at the land surface. Wells that are not being used or maintained will eventually corrode and provide a pathway for contaminants present in the shallow aquifers at higher-pressure heads to migrate to the deeper aquifers. Only direct injection into the aquifers from point sources within the SWAA like underground injection wells or improperly abandoned wells could cause a potential contamination threat to the supply. The information that was used to conduct the susceptibility analysis is as follows: (1) available water quality data (2) presence of potential contaminant sources in the WHPA (3) aquifer characteristics (4) well integrity and (5) the likelihood of change to the natural conditions. The susceptibility of Crystal Beach Manor's water supply to the various contaminant groups is shown in table 4 at the end of this section.

### ***Inorganic Compound (IOCs)***

No IOCs above 50% of the MCL have been detected in the Crystal Beach Manor water supply.

Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination, Crystal Beach Manor's water supply is **not** susceptible to the other inorganic compounds.



### ***Volatile Organic Compounds (VOCs)***

No VOCs above 50% of the MCL have been detected in Crystal Beach Manor's water supply.

Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination in the aquifers, Crystal Beach Manor's water supply **is not** susceptible to volatile organic compounds.

### ***Synthetic Organic Compounds (SOCs)***

No SOC above 50% of the MCL were detected in Crystal Beach Manor's water supply.

Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination, Crystal Beach Manor's water supply **is not** susceptible to synthetic organic compounds.

### ***Radionuclides***

The source of radionuclides in ground water can be traced back to the natural occurrence of uranium and thorium in rocks. Radionuclides are present in ground water due to radioactive decay of uranium and thorium bearing minerals in the sediment that makes up the aquifer material.

There is currently no MCL for radon-222, however EPA has proposed an MCL of 300 pCi/L or an alternate of 400 pCi/L if the State has program to address the more significant risk from radon in indoor air. Using the more conservative lower proposed MCL, the water supply had radon levels greater than 50% of 300 pCi/L.

Based on the natural occurrence of radon in the aquifer and water quality data, Crystal Beach's water supply **may be susceptible** to radon-222, but not to the other radionuclides.

### ***Microbiological Contaminants***

Raw water monitoring for microbiological contaminants is not required of water systems in confined aquifers because they are considered naturally protected from sources of pathogens at the land surface. Routine bacteriological testing for these plants revealed no positive total coliform in the water supply. Therefore, Crystal Beach Manor's water supply **is not** susceptible to microbiological contaminants.

CONTAMINANT TYPE	Are Contaminant Sources present in the WHPA?	Are Contaminants detected in WQ samples at 50% of the MCL	Is Well Integrity a Factor?	Is the Aquifer* Vulnerable?	Is the System Susceptible to the Contaminant
Inorganic Compounds	NO	NO	NO	NO	NO
Volatile Organic Compounds	NO	NO	NO	NO	NO
Synthetic Organic Compounds	NO	NO	NO	NO	NO
Radionuclides	NO	NO	NO	NO	NO* maybe to radon-222
Microbiological Contaminants	NO	NO	NO	NO	NO

**Table 4. Susceptibility Chart for Crystal Beach Manor's Water Supply**

## MANAGEMENT OF THE WELLHEAD PROTECTION AREA

With the information contained in this report, Crystal Beach Manor water system is in a position to protect its water supplies by staying aware of the areas delineated for source water protection. Specific management recommendations for consideration are listed below:

### *Public Awareness and Outreach*

The Consumer Confidence Report should report should list that this report is available to the general public through their county library, or by contacting the operator or MDE.

### *Monitoring*

Continue to monitor for all required Safe Drinking Water Act contaminants. Annual raw water bacteriological testing is a good check on well integrity.

### *Contaminant Source Inventory Updates*

Conduct a survey of the WHPA and inventory any potential sources of contamination, including unused wells that may not have been included in this report. Keep records of new development within the WHPA and new potential sources of contamination that may be associated with the new use.

### *Well Inspection/Maintenance*

Work with the County Health Department to ensure that there are no unused wells within the WHPA. An improperly abandoned well can be a potential source of

contamination to the aquifer. All unused wells must be abandoned and seal as per State well construction regulations.

Water operation personnel should have a program for periodic inspections and maintenance of the supply wells and backup wells to ensure their integrity and protect the aquifer from contamination, and ensure they are not subject to flooding.

### **Changes in Use**

The system is required to notify the MDE Water Supply Program if new wells are to be added or increase in water usage is proposed. An increase in use or the addition of new wells may require revisions to the WHPA.

## **REFERENCES**

Higgins, M. W., and Conant, L. B., 1990, The Geology of Cecil County, Maryland, Maryland Geological Survey Bulletin 37, 183 p.

Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36 p.

Otton, E. G., Willey, R. E., McGregor, R. A., Achmad, G., Hjordahl, S. N., and Gerhart J. M., 1988, Water Resources and Estimated Effects of Ground-Water Development, Cecil County, Maryland, Maryland Geological Survey Bulletin 34, 133 p. .

Willey, R. E., McGregor, R., A., DeGrouchy, J., and Tompkins, M. D., 1987, Hydrologic Data for Cecil County, Maryland, Maryland Geologic Survey Basic Data Report No.16, 150 p.

United States Environmental Protection Agency, Office of Ground-Water Protection, 1987, Guidelines for Delineation of Wellhead Protection Areas.

## **SOURCES OF DATA**

Water Appropriation and Use Permit No. CE1969G014  
Public Water Supply Inspection Reports  
Monthly Operating Reports  
Monitoring Reports  
MDE Water Supply Program Oracle Database  
MDE Waste Management Sites Database  
Earleville DNR DOQQ (2000)