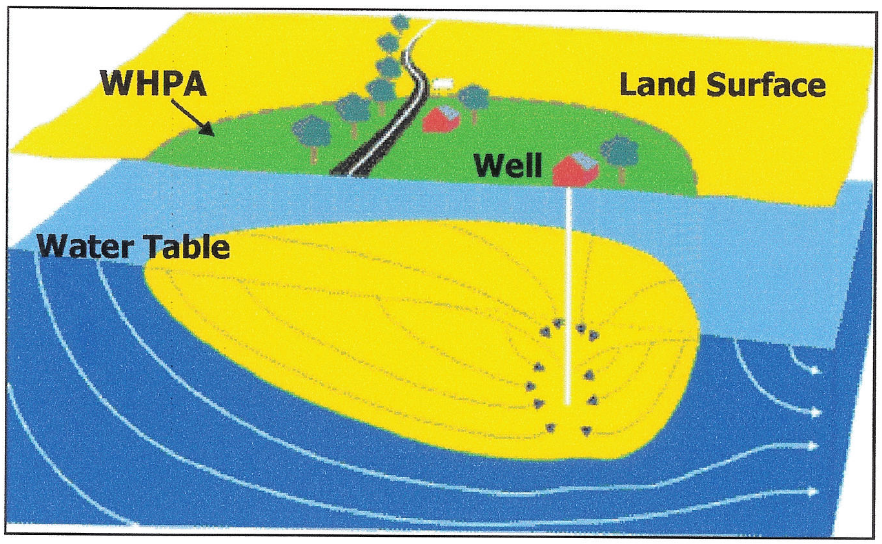
Source Water Assessment

for the Oldfields School
Baltimore County, MD



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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 Oldfields School 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 the Oldfields School's water supply is an unconfined fractured-rock aquifer. The Source Water Assessment area was delineated by the Baltimore County Department of Environmental Protection and Resource Management in a wellhead protection study conducted in 1992 and has been modified in this document using U.S. EPA approved methods.

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 1997 digital land use map for Baltimore 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 Oldfields School water supply is susceptible to contamination by nitrate and volatile organic compounds, and may be susceptible to radon dependent upon the MCL that Maryland adopts for this contaminant. This water supply is not susceptible to other inorganic compounds, synthetic organic compounds, and microbiological contaminants.

Introduction

The Water Supply Program has conducted a Source Water Assessment for the Oldfields School water system in Baltimore County. The Oldfields School is located approximately five miles north of the Cockeysville in northern Baltimore County just east of the Gunpowder Falls River. The Oldfields system serves a population of 200 and has 1 service connection. Oldfields obtains its water supply from three wells.

In 1991 the Baltimore County Department of Environmental Protection and Resource Management conducted a wellhead protection study in which they delineated wellhead protection areas (WHPAs) for eleven community water systems in the rural outskirts of the County. This report summarizes the information from the completed wellhead protection study and also contains the required components of Maryland's Source Water Assessment Plan: delineation, contaminant source inventory, and susceptibility analysis.

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 Oldfields School presently obtains its water supply from three wells (Nos. 1, 2, 3). The wells are all located centrally on the school property (Fig. 1). A review of the well completion reports and sanitary surveys of the Oldfields water system indicates that Well Nos. 1 and 2 were installed prior to the 1973 well construction regulations and may not meet the current construction standards. Well No. 3 was installed after the regulations went into effect and should meet standards. Inspection of the wells reveals that they are in good condition. Well No. 1 is located below grade in a pit with a drain to prevent flooding. Well No. 1 is the primary well used and is generally the most productive well. Well Nos. 2 and 3 are connected to the system but are rarely used according to the school's operator. Well Nos. 2 and 3 have wellheads that extend above the surface. Several other wells are located on the campus but serve only private residences and are not connected to the system. A summary of the well information is located in Table 1.

The Oldfields School has an appropriation permit which was revised in July 2001. The permitted average use is 30,000 gallons per day (gpd) and a maximum of 34,000 gpd in the month of maximum use. The average daily use was 29,609 gallons in 1999 and 29,753 gallons in 2000. The months of maximum use were December 1999 and 2000 with an average daily use of 31,415 and 33,333 gallons respectively.

PLANT	SOURCE NAME	WELL PERMIT	TOTAL DEPTH	CASING DEPTH	APPROPRIATION PERMIT (*AMT IN GPD*)	AQUIFER
01	WELL 1	BA039489	186	55	BA1982G029 (*30,000*)	BALTIMORE GNEISS
01	WELL 2	N/A	N/A	N/A		
01	WELL 3	BA881108	700	42		

Table 1. Oldfields School Well Information.

HYDROGEOLOGY

The Oldfields School lies within the Piedmont physiographic province, which is characterized by gently rolling hills and valleys. The bedrock underlying the Piedmont is some of the oldest in the State and consists of Precambrian and Paleozoic metamorphic and igneous rocks. The Oldfields wells draw water the Baltimore Gneiss formation. The Baltimore Gneiss is an unconfined, fractured rock aquifer, which is a silicic metamorphic formation that is exposed across a large area in the central portion of the county. The primary porosity and permeability are generally small due to the dense nature of metamorphic rocks. Ground water moves principally through secondary porosity, fractures and joint openings, and is recharged by precipitation percolating through soil and saprolite. The Baltimore Gneiss is generally a low yielding aquifer unless major fracture intersections are encountered.

Ground water systems in crystalline 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 in Baltimore County (Nutter and Otton, 1969), 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 previously delineated Wellhead Protection Area (WHPA) may be considered the source water assessment area for the system. A WHPA was delineated in 1992 for the Oldfields School using the US EPA WHPA code which requires the following input parameters: direction of ground water flow, ground water gradient, transmissivity of the aquifer, porosity of the aquifer, and pumping rate of the wells. The data used for aquifer parameters was mostly obtained from published reports for the specific aquifers and the pumping rates were determined from Oldfields' ground water appropriation permit. The WHPA encompasses the land area estimated to contribute water to the wells that represents a 10-year zone of transport, and is modified by geologic and hydrologic boundaries. The original WHPA covered approximately 13 acres. The WHPA has been modified using a more conservative estimate of 400 gpd/acre recharge, which is the value used by MDE to issue appropriation permits and represents drought year recharge. The recharge area for the wells using drought year recharge rates would be 70 acres. The new WHPA boundary roughly follows topographic divides and is approximately 50 acres. Figure 2 shows the WHPA.

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.

MDE staff inspected one facility within the Oldfields WHPA in October 1998 for ground water discharge violations and no violations were issued.

Point Sources

A review of MDE contaminant databases revealed one existing point source of contamination within the WHPA. An underground heating oil tank is located in the central part of the school (Fig. 2). This 3000 gallon fiberglass tank was installed in 1990 and replaced an older tank that was removed. Seven additional tanks are listed as abandoned and permanently out of use in the Oil Control Program's database. These tanks were also identified as potential sources of contamination in the original wellhead protection study (DEPRM, 1991).

Non-Point Sources

The Maryland Office of Planning's 1997 Land Use map for Baltimore County was used to determine the predominant types of land use in the WHPA (Fig. 3). The land use summary is given in Table 2. The majority of the WHPA is institutional land (78%), which is covered by the school. Smaller areas of forested (20%) and residential (2%) land cover the remainder of the WHPA. The Maryland Office of Planning's 1996 digital sewer map of Baltimore County shows that all of the WHPA is within an area of the county that is not planned for service.

Horse stables occupy much of the school property. Areas where animals are concentrated may present a source of nitrate and bacteria to ground water. Residential areas may be a source of nitrate from septic systems or lawn care practices or may present a source of SOCs if pesticides and herbicides are not used carefully in gardens. However, residential area makes up only a very small portion of the land area in the WHPA.

Type	Area (acres)	% of WHPA
Residential	0.8	1.7
Institutional	38.5	78.6
Forest	9.6	19.7

Table 2. Oldfields WHPA Land Use

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database for Safe Drinking Water Act (SDWA) contaminants. A list of contaminants regulated under the SDWA is included in the appendix. 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, 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. All data reported is from the finished (treated) water unless otherwise noted. The Oldfields School water treatment plant currently has chlorination for disinfection.

A review of the monitoring data since 1993 for Oldfields School indicates that the water supply meets drinking water standards. Of the inorganic compounds, nitrate was the only contaminant detected above the SWAP threshold level. Radon-222 was the only radiological contaminants present at a level of concern. Volatile organic compounds and synthetic organic compounds have not been detected in the water supply. The water quality sampling results are summarized in Table 3. The most recent monitoring schedule, which outlines the sampling requirements, due dates, and sampling frequencies for the water system, is included in the appendix.

Contaminant Group	No. Of Samples Collected	No. of Samples Above 50% of an MCL
Inorganic Compounds (except Nitrate)	3	0
Nitrate	14	1
Radiological Contaminants	4	1
Volatile Organic Compounds	8	0
Synthetic Organic Compounds	3	0
Microbiological Contaminants*	4	0

Table 3. Summary of Water Quality Samples

*Raw water results

Inorganic Compounds (IOCs)

Nitrate levels are generally close to 4 ppm but have been measured as high as 6.5 ppm (Table 4). The MCL for nitrate is 10 ppm. Nitrate was detected above the threshold level of 5 parts per million (ppm) in 1 of the 14 samples. Table 4 lists all nitrate data available from 1993 to 2000. No other inorganic compounds were detected.

Sample Date	Result (ppm)
01-Feb-93	4.9
18-Dec-93	4.9
28-Jun-94	3.3
19-Jan-95	**6.47**
06-Apr-95	3.61
06-Jul-95	3.74
05-Oct-95	4.26
30-Jan-96	4.26
07-Oct-96	3.5
23-Jan-97	4.75
08-Jan-98	3.86
14-Jan-99	3.5
15-Nov-99	3.8
07-Jan-00	3.2

Table 4. Nitrate Results from Oldfields School.
(MCL for Nitrate is 10 ppm, results in bold indicate greater than 50% MCL.)

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 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. The Radon-222 result reported for Oldfields was 370 pCi/L, which is just above the lower proposed MCL of 300 pCi/L.

Volatile Organic Compounds (VOCs)

A review of the data shows that VOCs have **not** been detected in eight samples collected since 1991.

Synthetic Organic Compounds (SOCs)

A review of the data shows that SOCs have **not** been detected in three samples collected since 1996.

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. All four wells were free of coliform bacteria.

SUSCEPTIBILITY ANALYSIS

The wells serving the Oldfields School water supply draw water from an unconfined fractured-rock aquifer. 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 5 summarizes the susceptibility of Oldfields School 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

Nitrate is present in less than 10% of samples at greater than 5 ppm (Table 4). The MCL for nitrate is 10 ppm. Sources of nitrate can generally be traced back to land use. Fertilization of agricultural fields and residential lawns, residential septic systems, and areas with high concentrations of livestock are all common sources of nitrate loading in ground water. Most of the land area within the WHPA is considered institutional because it is covered by the school property. Horses are kept on the school property, which could present a source of nitrate, although horses are generally not densely concentrated in a small area like cattle or other livestock. Due to the levels of nitrate found, the vulnerability of the aquifer to land activity, and the presence of nitrate sources in the WHPA, the water supply **is** considered susceptible to this contaminant.

The water supply is **not** susceptible to inorganic compounds other than nitrate, based on water quality data and lack of potential contaminant sources within the WHPA.

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 is present in the water supply above of the lower proposed MCL of 300 pCi/L. The median level of Radon-222 in gneiss-bedrock was found to be 2600 pCi/L and ranged from less than 80 to 13,000 pCi/L in a recent study of ground water quality in Baltimore County (Bolton, 1998). Thus, the level of radon may prove to be higher in the Oldfields water supply if additional samples are collected. 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 due to radioactive decay of uranium bearing minerals in the bedrock. The EPA 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 the water supply may be susceptible to radon if the lower MCL is adopted.

Other radiological contaminants were not detected in the water supply and no sources of these contaminants were identified. Therefore the water supply is **not** susceptible to radiological contaminants other than Radon-222.

Volatile Organic Compounds

VOCs have not been detected in the water supply. The underground heating oil tank was identified as a potential source of VOCs within the WHPA. It is newly constructed, but because of its proximity to the wells it poses a threat to the water supply. Therefore, the water supply **is** considered susceptible to VOCs.

Synthetic Organic Compounds

The wells are **not** susceptible to synthetic organic compounds. SOCs have not been detected in the water supply and no potential contaminant sources were identified within the WHPA.

Microbiological Contaminants

All three wells did not have coliform bacteria in their raw water samples and thus are considered **not** susceptible to microbiological contaminants.

Contaminant Group	Are Contaminant Sources Present in WHPA?	Are Contaminants Detected In WQ Samples?	Is Well Integrity a Factor?	Is the Aquifer Vulnerable?	Is the System Susceptible?
Nitrate	YES	YES	NO	YES	YES
Inorganic Compounds (except nitrate)	NO	NO	NO	YES	NO
Radiological Compounds	YES	YES	NO	YES	YES
Volatile Organic Compounds	YES	NO	NO	YES	YES
Synthetic Organic Compounds	NO	NO	NO	YES	NO
Microbiological Contaminants	YES	NO	NO	NO	NO

Table 5. Susceptibility Analysis Summary.

Management of the Source Water Assessment Area

With the information contained in this report the Oldfields School 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

- The Oldfields School should contact the county to 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 WHPA. The team should work to reach a consensus on how to protect the water supply.

- A management strategy adopted by the Oldfields School 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.

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 school office or MDE.

- 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.

Planning/ New Development

- Review the State's model wellhead protection zoning ordinances for potential adoption. Coordinate with Baltimore County Department of Planning to adopt a wellhead protection ordinance.

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

- Oldfields 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.

Contaminant Source Inventory Updates/ Inspections

- Oldfields School should conduct their own field survey of the source water assessment area to ensure that there are no additional potential sources of contamination.

- The facility should follow all tank testing and maintaineance requirements for its underground storage tanks as outlined in the State's oil control regulations (COMAR 256.10).

- Periodic inspections and a regular maintenance program for the supply wells will ensure their integrity and protect the aquifer from contamination.

Changes in Use

- Oldfields 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 Oldfields should contact the Water Supply Program if a new well is being proposed.

REFERENCES

Bolton, D.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.

Bolton, D.W., 1998, Ground-Water Quality in the Piedmont Region of Baltimore Coutny, Maryland, Report of Investigations No. 66, 191 pp.

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).

Cross, F.T., N.H. Harley, and W. Hofmann, 1985, Health effects and risks from ^{222}Rn in drinking water: Health Physics, vol. 48, no.5, p. 649-670.

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

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

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 BA1982G029
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 Hereford and Phoenix
USGS Topographic 7.5 Minute Quadrangles for Hereford and Phoenix
Maryland Office of Planning 1997 Baltimore County Digital Land Use Map
Maryland Office of Planning 1996 Baltimore County Digital Sewer Map

FIGURES

APPENDIX

United States Environmental Protection Agency | Office of Water (4606) | EPA 816-F-01-007 March 2001 www.epa.gov/safewater

EPA National Primary Drinking Water Standards

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water
MICROORGANISMS				
Cryptosporidium	as of 01/01/02: zero	as of 01/01/02: TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and fecal animal waste
Giardia lamblia	zero	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
Heterotrophic plate count (HPC)	n/a	TT[3]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment
Legionella	zero	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems
Total Coliforms (including fecal coliform and *E. coli*)	zero	5.0%[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Total coliforms are naturally present in the environment; fecal coliforms and *E. coli* come from human and animal fecal waste.
Turbidity	n/a	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff
Viruses (enteric)	zero	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
DISINFECTANTS AND DISINFECTION BYPRODUCTS				
Bromate	as of 01/01/02: zero	as of 01/01/02: 0.010	Increased risk of cancer	Byproduct of drinking water disinfection
Chloramines (as Cl_2)	as of 01/01/02: MRDLG=4[1]	as of 01/01/02: MRDL=4.0[1]	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes
Chlorine (as Cl_2)	as of 01/01/02: MRDLG=4[1]	as of 01/01/02: MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes
Chlorine dioxide (as ClO_2)	as of 01/01/02: MRDLG=0.8[1]	as of 01/01/02: MRDL=0.8[1]	Anemia; infants & young children: nervous system effects	Water additive used to control microbes
Chlorite	as of 01/01/02: 0.8	as of 01/01/02: 1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection
Haloacetic acids (HAA5)	as of 01/01/02: n/a[6]	as of 01/01/02: 0.060	Increased risk of cancer	Byproduct of drinking water disinfection
Total Trihalomethanes (TTHMs)	none[7] / as of 01/01/02: n/a[6]	0.10 / as of 01/01/02: 0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection
INORGANIC CHEMICALS				
Antimony	0.006	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
Arsenic	none[7]	0.05	Skin damage; circulatory system problems; increased risk of cancer	Erosion of natural deposits; runoff from orchards; runoff from glass and electronics production wastes
Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	7 MFL	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits
Barium	2	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water
Beryllium	0.004	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries
Cadmium	0.005	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff frc waste batteries and paints
Chromium (total)	0.1	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits
Copper	1.3	TT[8]; Action Level= 1.3	Short term exposure: Gastrointestinal distress Long term exposure: Liver or kidney damage People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits
Cyanide (as free cyanide)	0.2	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories
Fluoride	4.0	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosio of natural deposits; discharge from fertilizer and aluminum factories
Lead	zero	TT[8]; Action Level= 0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion natural deposits
Mercury (inorganic)	0.002	0.002	Kidney damage	Erosion of natural deposits; discharge from refineri and factories; runoff from landfills and croplands
Nitrate (measured as Nitrogen)	10	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tan sewage; erosion of natural deposits
Nitrite (measured as Nitrogen)	1	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tan sewage; erosion of natural deposits
Selenium	0.05	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines
Thallium	0.0005	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories
ORGANIC CHEMICALS				
Acrylamide	zero	TT[9]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/wastewater treatment
Alachlor	zero	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops
Atrazine	0.003	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops
Benzene	zero	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storag tanks and landfills
Benzo(a)pyrene (PAHs)	zero	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines
Carbofuran	0.04	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa
Carbon tetrachloride	zero	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industri activities
Chlordane	zero	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide
Chlorobenzene	0.1	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemica factories
2,4-D	0.07	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops
Dalapon	0.2	0.2	Minor kidney changes	Runoff from herbicide used on rights of way
1,2-Dibromo-3-chloropropane (DBCP)	zero	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards
o-Dichlorobenzene	0.6	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water
p-Dichlorobenzene	0.075	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories
1,2-Dichloroethane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
1,1-Dichloroethylene	0.007	0.007	Liver problems	Discharge from industrial chemical factories
cis-1,2-Dichloroethylene	0.07	0.07	Liver problems	Discharge from industrial chemical factories
trans-1,2-Dichloroethylene	0.1	0.1	Liver problems	Discharge from industrial chemical factories
Dichloromethane	zero	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories
1,2-Dichloropropane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
Di(2-ethylhexyl) adipate	0.4	0.4	General toxic effects or reproductive difficulties	Discharge from chemical factories
Di(2-ethylhexyl) phthalate	zero	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories
Dinoseb	0.007	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables
Dioxin (2,3,7,8-TCDD)	zero	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories
Diquat	0.02	0.02	Cataracts	Runoff from herbicide use
Endothall	0.1	0.1	Stomach and intestinal problems	Runoff from herbicide use
Endrin	0.002	0.002	Liver problems	Residue of banned insecticide
Epichlorohydrin	zero	TT[9]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals
Ethylbenzene	0.7	0.7	Liver or kidneys problems	Discharge from petroleum refineries
Ethylene dibromide	zero	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries
Glyphosate	0.7	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use
Heptachlor	zero	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide
Heptachlor epoxide	zero	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor
Hexachlorobenzene	zero	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories
Hexachlorocyclopentadiene	0.05	0.05	Kidney or stomach problems	Discharge from chemical factories
Lindane	0.0002	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens
Methoxychlor	0.04	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock
Oxamyl (Vydate)	0.2	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes
Polychlorinated biphenyls (PCBs)	zero	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals
Pentachlorophenol	zero	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories
Picloram	0.5	0.5	Liver problems	Herbicide runoff
Simazine	0.004	0.004	Problems with blood	Herbicide runoff
Styrene	0.1	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills
Tetrachloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners
Toluene	1	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories
Toxaphene	zero	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle
2,4,5-TP (Silvex)	0.05	0.05	Liver problems	Residue of banned herbicide
1,2,4-Trichlorobenzene	0.07	0.07	Changes in adrenal glands	Discharge from textile finishing factories
1,1,1-Trichloroethane	0.20	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories
1,1,2-Trichloroethane	0.003	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water
Trichloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories
Vinyl chloride	zero	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories
Xylenes (total)	10	10	Nervous system damage	Discharge from petroleum factories; discharge fron chemical factories
RADIONUCLIDES				
Alpha particles	none[7]	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation
Beta particles and photon emitters	none[7]	4 millirems per year (mrem/yr)	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation
Radium 226 and Radium 228 (combined)	none[7]	5 pCi/L	Increased risk of cancer	Erosion of natural deposits

NOTES

1 - Definitions

- Maximum Contaminant Level Goal (MCLG) - The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allo for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using t best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG) - The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL) - The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT) - A required process intended to reduce the level of a contaminant in drinking water.

2 - Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 - EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium*:(as of January 1, 2002) 99% removal
- *Giardia lamblia*: 99.9% removal/inactivation
- Viruses: 99.99% removal/inactivation
- *Legionella*: No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter

4 - No more than 5.0% of samples may be total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample may be total coliform-positive during a month). Every sample that has total coliforms must be analyzed for either *E. coli* or fecal coliforms to determine whether hur n or animal fecal matter is present (fecal coliform and *E. coli* are part of the total coliform group). There may not be any fecal coliforms or *E. coli*.

5 - Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people witl severely compromised immune systems.

6 - Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

7 - MCLGs were not established before the 1986 Amendments to the Safe Drinking Water Act. The standard for this contaminant was set prior to 1986. Therefore, there is no MCLG for this contaminant.

8 - Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

9 - Each water system must certify, in writing, to the state that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monc level does not exceed the levels specified, as follows: Acrylamide = 0.05% dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent).

Figure 3. Land Use in the Oldfields School Wellhead Protection Area.

Baltimore County Land Use

Low Density Residential	Cropland
Medium Density Residential	Pasture
High Density Residential	Orchards
Commercial	Forest
Industrial	Water
Extractive	Wetlands
Open Urban Land	Feeding Operations
	Barren Land

N

500 0 500 1000 Feet