

# WATER QUALITY

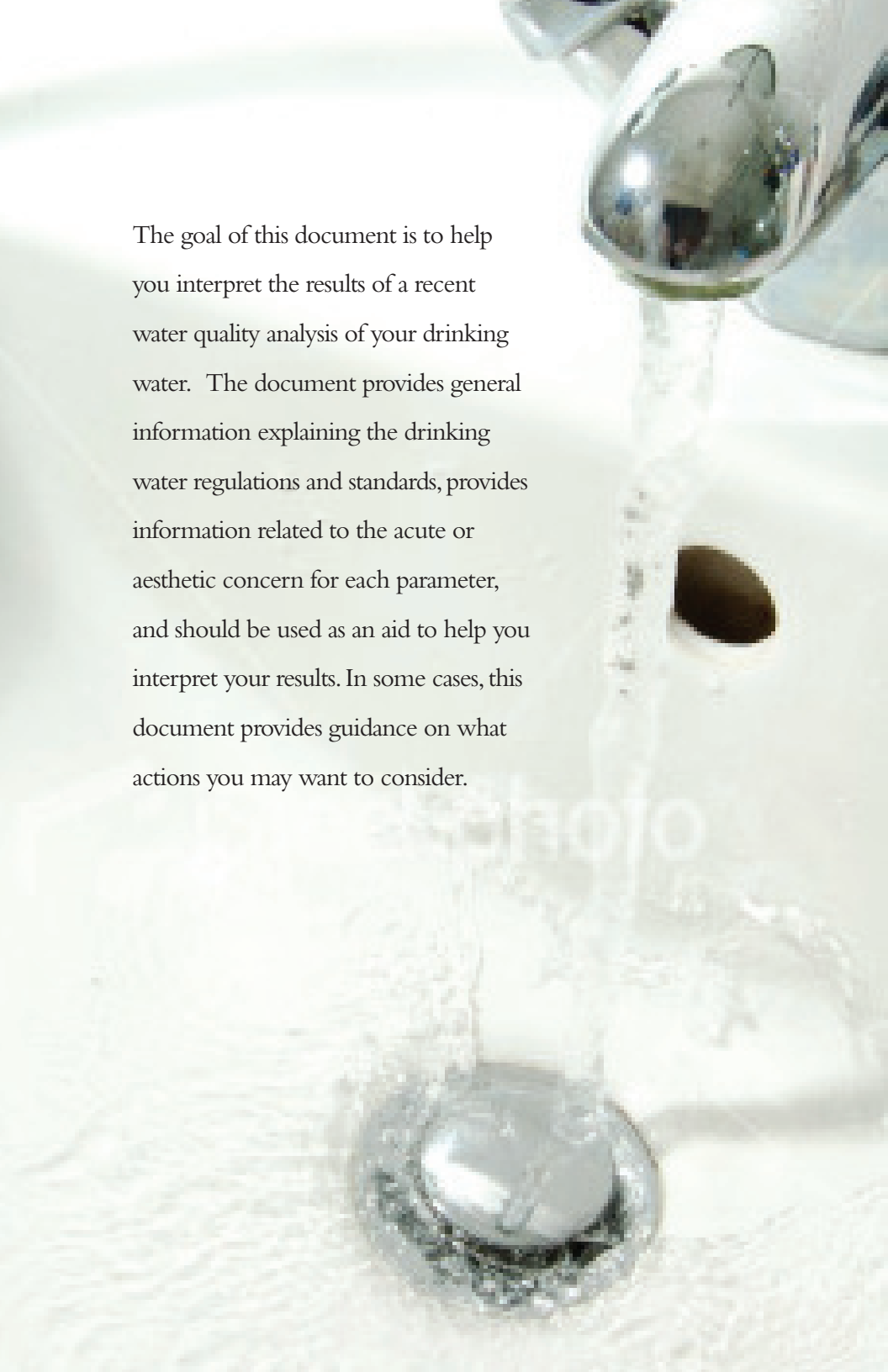
**YOUR PRIVATE WELL: WHAT DO THE RESULTS MEAN?**

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The goal of this document is to help you interpret the results of a recent water quality analysis of your drinking water. The document provides general information explaining the drinking water regulations and standards, provides information related to the acute or aesthetic concern for each parameter, and should be used as an aid to help you interpret your results. In some cases, this document provides guidance on what actions you may want to consider.

## SUMMARY TABLES

*Table 1. Symbols, Units, and Terms.*

The following is a listing of symbols and units that are used in this report.

<b>mg/L</b>	Concentration of a chemical in milligrams per liter ( <i>mass per volume</i> )
<b>ug/L</b>	Concentration of chemical in micrograms per liter ( <i>mass per volume</i> )
<b>ppm</b>	Concentration of a chemical in parts per million.
<b>ppb</b>	Concentration of a chemical in parts per billion.
<b>1 mg/L</b>	1 ppm (Freshwater- low concentrations)
<b>1 ug/L</b>	1 ppb (Freshwater- low concentrations)
<b>1 mg/L</b>	1000 ug/L = 1000 ppb
<b>ntu</b>	nephelometric turbidity units
<b>colonies per 100 ml</b>	Bacterial Test – Number of colonies per 100 ml volume
<b>colonies per ml</b>	Bacteria Test – Number of colonies per 1 ml volume
<b>pCi/L</b>	picocuries per liter (particle activity)
<b>mrem/yr</b>	millirems per year (annual dosage)
<b>TON</b>	threshold odor number
<b>cation</b>	positively charged ions like calcium, magnesium, sodium, iron, lead, and arsenic.
<b>multivalent</b>	ion that has more than one charge
<b>multivalent cations</b>	such as calcium, magnesium, manganese, iron, lead, and arsenic.
<b>single valent cations</b>	such as sodium and potassium
<b>anion</b>	negatively charged ions like sulfate, chloride, and nitrate.

*Table 2 . Possible Treatment Solutions or Improvements*

<b>SW</b>	Shock Well Disinfection
<b>IW</b>	Inspect Well and Casing
<b>SWC</b>	Install Sanitary Well Cap
<b>AER</b>	Aeration
<b>Filtration</b>	Water Particle Filtration
<b>CFiltration</b>	Use of an Activated Carbon Filtration System
<b>NW</b>	Neutralizing System
<b>WS</b>	Water Softener
<b>DIS</b>	Chemical Disinfection System (Chlorine/ Ozone)
<b>Oxid</b>	Chemical or Activated Media Oxidation
<b>UV</b>	UV Disinfection System
<b>RO</b>	Reverse Osmosis
<b>DIS</b>	Distillation System
<b>IE</b>	Ion Exchange

## DRINKING WATER STANDARDS

The U.S. Environmental Protection Agency (EPA) has established drinking water standards for public water supplies, but the Pennsylvania Department of Environmental Protection (PADEP) is the agency that enforces these standards in Pennsylvania. A public water supply is defined as “a system which provides water to the public for human consumption which has at least 15 service connections or regularly services an average of at least 25 individuals daily at least 60 days out of the year.” Therefore, a private well that services your home is not specifically regulated by the Drinking Water Standards, but these standards can be used to evaluate the quality of your drinking water.

With respect to water quality, the drinking water standards are divided into two types of standards. The primary drinking water standards were set based on specific health concerns or impacts; whereas the secondary drinking water standards are based on aesthetic issues and concerns. For example, water which slightly exceeds the secondary standard for iron would still be safe to drink but might have a metallic taste and could leave a reddish-orange stain on plumbing and laundry. The primary drinking water standards are also known as Maximum Contaminant Level (MCL) and the secondary drinking water standards are known as Secondary Maximum Contaminant Levels (SMCL). Appendix A is a partial listing of the MCL and SMCL as established by the safe drinking water act. In Pennsylvania, the primary and secondary drinking water standards are enforceable by law for regulated public water supplies, but the standards can be used as a guide to evaluate private water sources. In addition to the regulated standards, the EPA also provides recommended non-enforceable exposure limits. Maximum contaminant level goals (MCLG) are non-enforceable limits established by the EPA that are based on possible health risks over a lifetime of exposure.

A more detailed listing and description of the primary and secondary drinking water standards can be found at <http://www.epa.gov/safewater>

## DETECTING AND REPORTING IMPURITIES IN WATER

No drinking water is truly pure. Instead, water contains minerals and other substances dissolved from the surrounding rocks and environment. Equipment used to analyze water samples vary in their ability to detect dissolved substances and other impurities, especially at low levels. Some highly sophisticated and sensitive instruments can find and report minute amounts of many impurities in your drinking water. Analytical results sometimes report zero amounts of some contaminant but should properly report it as < , less than, whatever the detection limit of the analytic equipment or methods. It is important to make this distinction because there could still be a significant amount of a contaminant that is present at less than the detection capability of a crude analysis. However, it should also be noted that just because a very good analysis can detect a measurable amount of a contaminant, the tiny amount of contaminant may not

necessarily be significant. It is the purpose of the drinking water standards to tell you at what level the contaminant is considered to be significant. Therefore, it is not only important to have your water tested, but it is important to identify the methods used in the analysis and the detection limit for the method.

## SCREENING TESTS

Thousands of contaminants might be present in water, and it would normally be much too expensive to test for every possible contaminant. However, there are some simple, inexpensive tests that can act as red flags for possible contamination. High conductivity and total dissolved solids, i.e., TDS, tests suggest there likely are high levels of some kind of contamination. These tests will not indicate specifically what the contaminants are but would indicate that additional testing is probably recommended. Low conductivity and TDS results would suggest that there is no serious water contamination, but it is possible for this type of water to be corrosive and cause leaching of trace metals from your household plumbing.

## TYPES OF WATER QUALITY PARAMETERS

Your water can be tested for thousands of possible elements or agents, but only about 100 are covered by the drinking water standards. With respect to private wells, the standards can be divided into the following categories: microbiological, inorganics (IOCs), secondary contaminants, volatile organics chemicals (VOCs), synthetic organic chemicals (SOCs), and radionuclides, i.e., radioactive substances.

### I. Microbiological

From a microbiological perspective, the microbiological agents can include bacteria, protozoans, and viruses. The microbiological contaminants are classified as primary drinking water standards, because of specific health concerns and the spread of disease. Because the cost for testing for specific microbiological agents may be cost prohibitive, the drinking water standards use total coliform bacteria as an indicator of contamination (this is another example of a screening test).

#### Bacteria

1. *Total Coliform* - These bacteria can be easily tested by certified laboratories and can be used as an indicator of the microbiological quality of your water. If these bacteria are not present in your water, i.e., a result of Absent or  $< 1$  colony per 100 ml, this should be interpreted to mean that it is not likely that the water contains a microbiological agent that may pose a health problem. If the bacteria are present in your water, i.e., a result of Present or 1 or more colonies per 100 ml, this should be interpreted to mean that it is more likely that the water contains a microbiological agent that may pose a health problem and that some action is needed.

The Drinking Water Standard for coliform bacteria is a result of Absent, < 1 colony per 100 ml, and for E.coli. Absent.

2. *Fecal Coliform* – This is a sub-group of total coliform bacteria which are more typically found in the waste of warm-blooded animals, but which can be found in non-mammals and insects. Fecal coliform bacteria should not be present in your drinking water and a suitable result would be Absent or < 1 colony per 100 ml.
3. *Escherichia coli* (*E.coli.*)– This is a bacterial strain that is most commonly found in humans and animals and the presence of this group of bacteria would suggest the source is a human or mammalian waste source and a suitable result would be Absent or < 1 colony per 100 ml.

If your water tested positive for total coliform bacteria, this could be also be reported as Too Numerous To Count (TNTC), Confluent Growth (CG), Present, Most Probable Number (MPN) of 1 or more, or 1 or more colonies per 100 ml. If the results suggest that total coliform bacteria, fecal coliform, and/or E.coli.. are present, this would mean that it is more likely that a pathogen is present in your drinking water.

## ACTION

If the water is positive for total coliform or e. coli, the primary recommendation would be to have your well inspected by a professional and or licensed well driller and to conduct a shock disinfection of the well and distribution system. If you need a procedure for shock disinfection or you have questions, please call (XXX) XXX-xxxx or email [eqc@wilkes.edu](mailto:eqc@wilkes.edu). Following the disinfection and purging of the well, the water should be retested by a certified testing laboratory for microbiological quality.

Until the system can be inspected, disinfected, and retested, it would be advisable to not use your water for consumption or bathing, if you have open wounds or sores. If the water must be used for consumption, it would be advisable to boil your water for at least 5 minutes. If the post-treatment water test is positive for bacterial contamination, it may be necessary to make modifications to the well, install a sanitary well cap, and install a disinfection system. To determine the best course of action it would be advisable to hire a certified water treatment or licensed well driller to evaluate your system.  
Possible Treatment Actions: SW, IW, SWC, DIS, UV

## **II. Inorganics (IOCS)**

The following inorganic parameters are regulated and have primary drinking water standards. These parameters are a combination of metals, salts, and mineral complexes that pose a health concern or risk. If your water is elevated for these contaminants, it is likely you will need to conduct some additional water testing and potentially you may need to install a water treatment system. Since the selection of the most appropriate water treatment system requires a comprehensive evaluation of your water quality, your household use, and the configuration of the existing water, the type of water treatment mentioned in this section should be considered only as a guide. If your water system requires a modification or treatment, it is strongly recommended that you seek advice from a water treatment professional.

*Note: It is important to note that while some of these elements are hazardous above certain levels, some, like selenium, copper and chromium, are essential nutrients at lower levels. Others, like lead and arsenic, are undesirable at any level.*

### **Antimony**

The drinking water MCL is 0.006 mg/L. The primary health concerns would include increase in blood cholesterol, decrease in blood sugar, potential carcinogen, and causing irritation to eyes and skin. *Possible Treatment Actions: RO, IE, DIS*

### **Arsenic**

The drinking water MCL is 0.010 mg/L. Arsenic can result in the formation of malignant tumors on skin and lungs and may cause nervous system disorders. For this particular parameter within Northeastern Pennsylvania (NEPA), it would be advisable to retest the water for dissolved and total arsenic. In many cases, the arsenic has been leached from a colloid or particle that could be more cost effectively removed by standard filtration.

*Possible Treatment Actions: Filtration, Oxid, RO, IE, DIS*

### **Barium**

The drinking water MCL is 2.0 mg/L. Barium can cause an increase in blood pressure and affects the nervous and circulatory system.

*Possible Treatment Actions: RO, IE, DIS, WS*

### **Beryllium**

The drinking water MCL is 0.004 mg/L. Beryllium has been associated with intestinal lesions, may affect skin and lung tissue, and is classified as a carcinogen.

*Possible Treatment Actions: RO, IE, DIS*

### **Cadmium**

The drinking water MCL is 0.005 mg/L. Cadmium has been linked to kidney disorders, bronchitis, and anemia. *Possible Treatment Actions: RO, IE, DIS*

## **Chromium**

The drinking water MCL is 0.1 mg/L. Chromium is associated with liver and kidney disorders and it affects the skin and digestive system.

*Possible Treatment Actions: RO, IE, DIS*

## **Copper**

The drinking water EPA Action Level is 1.3 mg/L, but the Federal Food and Drug Administrative Standard for Bottled water is 1.0 mg/L. Copper has been associated with liver and kidney damage and short-term exposure is associated with gastrointestinal disorders. At a level of 1.0 mg/L, copper can have a bitter to metallic taste and cause blue-green staining of piping, sinks, and basins. Elevated levels of copper in the water could mean there is a problem with the corrosiveness of your water, i.e., the water may be able to leach metals from piping and fixtures.

*Possible Treatment Actions: RO, IE, DIS, NW*

## **Cyanide**

The EPA MCL is 0.2 mg/L. Cyanide has been shown to cause nerve damage, thyroid problems, and affect the endocrine system.

*Possible Treatment Actions: RO, IE, DIS*

## **Fluoride**

The MCL for fluoride is 4 mg/L, but because of the potential for dental fluorosis, i.e., mottled or discolored teeth, the EPA has set a secondary standard of 2 mg/L. Elevated levels of fluoride have been shown to cause bone disease. Low levels of fluoride may help to prevent cavities in teeth. *Possible Treatment Actions: RO, IE, DIS*

## **Lead**

The EPA MCL level is 0.015 mg/L if the water is coming from a community water distribution system and a level of 0.005 mg/L if the water is coming directly from the source into the home. Common sources of lead would include corrosion of household plumbing and industrial sources associated with textile mills, glass manufacturing, rubber processing, shooting/firing ranges, and paint/ink manufacturing. Elevated levels of lead in drinking water can result in delayed physical and mental development, attention deficits, kidney disorders, and high blood pressure. *Possible Treatment Actions: RO, IE, DIS, NW*

## **Mercury**

The EPA MCL is 0.002 mg/L. Mercury can affect the kidneys and the nervous system. *Possible Treatment Actions: RO, IE, DIS*

## **Nitrate and Nitrite**

The EPA MCL is 10 mg NO<sub>3</sub>-N/L for nitrate and 1 mg NO<sub>2</sub>-N/L for nitrite. The primary concern for nitrate and nitrite is that infants less than 6 months are susceptible to blue-baby syndrome, which is potentially fatal if not treated. The



primary source of nitrate and nitrite would be agricultural runoff, poorly maintained septic systems, sewage disposal, acid solutions in injection fluids, urban runoff, and natural deposits. *Possible Treatment Actions: RO, IE, DIS*

#### **Selenium**

The EPA MCL is 0.05 mg/L. Elevated levels of selenium have been associated with hair and fingernail loss, numbness in fingers and toes, and circulatory disorders. *Possible Treatment Actions: RO, IE, DIS*

#### **Thallium**

The EPA MCL is 0.002 mg/L. Thallium exposure can result in hair loss and can cause changes in blood chemistry and problems with the kidney, intestine, and liver. *Possible Treatment Actions: RO, IE, DIS*

#### **Turbidity**

The EPA MCL ranges from 1 to 5 ntu. Elevated levels of turbidity may interfere with water treatment and disinfection and cause aesthetic problems. Because of the potential association of elevated particles to bacterial or microbiological contamination, the level of turbidity is used as a red flag for potential microbiological contamination or secondary water quality problems with the water. The primary recommendation is that the turbidity levels not exceed 1 ntu. *Possible Treatment Actions: IW and Filtration*

### **III. Secondary Contaminants**

The secondary drinking water standards are known as Secondary Maximum Contaminant Levels (SMCL). The standard for these parameters are based on aesthetic problems with the water and not a specific acute or chronic health concern. The secondary drinking water standards can be divided into three broad categories: aesthetic effects — undesirable tastes or odors; cosmetic effects — effects which do not damage the body but are still undesirable, such as skin and tooth discoloration; and technical effects — can damage or reduce the efficiency of water equipment or a treatment process.

#### **Aluminum (Technical/Aesthetic)**

The EPA SMCL is 0.2 mg/L. The source of aluminum can include leaching from coal refuse, natural leaching for soil and rock, and aluminum salts used in water treatment. It has been suggested that long-term exposure to aluminum may be associated with adult degenerative neurological disorders, but the primary issue is that when the aluminum concentration is between 0.05 to 0.2 mg/L it can impart a color to the water. *Possible Treatment Actions: RO, IE, DIS, NW*

#### **Chloride (Technical/Aesthetic)**

The EPA SMCL is 250 mg/L. The standard has been set because of potential aesthetic problems associated with the taste of the water and that elevated levels can facilitate the corrosion of piping and fixtures. Chlorides are found naturally in the environment, but elevated levels of chloride can also be associated with septic

system effluent, stormwater runoff, deicing agents, brine water, cleaning solutions, and other industrial solutions. *Possible Treatment Actions: RO, IE, DIS*

### **Color (Aesthetic)**

The EPA SMCL for color is 15 color units. This is the level on the color scale where individuals tend to be able to detect a visual change in the appearance or tint of the water. Color can be indicative of elevated levels of dissolved organic material like tannins, corrosion by-product, and foaming agents.

*Possible Treatment Actions: CFiltration, DIS, Oxid*

### **Corrosivity (Technical/Aesthetic)**

It is recommended that the water be non-corrosive. Corrosive water can be described as acidic, has a low pH, and has a very low total dissolved solids. A corrosion index known as the Langelier Saturation Index can be used to evaluate the corrosion potential of the water. If the water is corrosive, the water may have a bitter taste, can leach metals from piping and fixtures, cause premature failure of heat exchange units or other systems, and damage piping. Corrosive water can even leach vinyl chloride from inferior PVC piping. A Langelier Saturation Index  $< -2$  would suggest a significant potential for corrosion and a Langelier Saturation Index  $> 2$  should suggest the potential for scale formation in the piping

*Possible Treatment Actions: NW*

### **Foaming Agents (Technical/Aesthetic)**

The SMCL for foaming agents is 0.5 mg/L. Foaming agents can include detergents and other substances that produce foam when aerated. Foaming agents can also impart an oily or fishy taste to the water. The concentration of foaming agents is typically determined by an evaluation of the concentration of methylene blue active substances (MBAS). *Possible Treatment Actions: Filtration, CFiltration*

### **Iron (Technical/Cosmetic/Aesthetic)**

The SMCL for iron is 0.3 mg/L. Iron in the water can be associated with a bitter/metallic taste, formation of sediment and yellow, red, and orange films, and discolored clothing during washing.

*Possible Treatment Actions: Filtration, WS, DIS, Oxid, and IE*

### **Manganese (Technical/Cosmetic/Aesthetic)**

The SMCL for manganese is 0.05 mg/L. Manganese in the water can be associated with a bitter/metallic taste, formation of sediment and brown to black films, and discolored clothing.

*Possible Treatment Actions: Filtration, WS, DIS, Oxid, and IE*

### **Odor (Technical/Aesthetic)**

The maximum EPA SMCL threshold odor number is 3. This means if the odor is eliminated by diluting the water with an equal volume of clean water the odor is eliminated. If the water has an odor, it is important to note the nature of the odor.

*Possible Treatment Actions: AER, DIS, Oxid, CFiltration*

Table 3. Common Water Odors and Causes.

TYPE OF ODOR	POSSIBLE SOURCE
<b>Rotten-Egg Odor Smell or Musty Odor Smell</b>	Hydrogen sulfide, sulfate-reducing bacteria Chemical reaction in hotwater tanks, algal by-products mercaptans – sulfur compound added to natural gas to create an odor
<b>Earthy, musty, grassy, fishy, vegetable and cucumber</b>	Algal by-products, fungi and mold
<b>Oily Smell</b>	Gasoline or oil contamination, possibly nuisance bacteria
<b>Fuel Smell</b>	Industrial or gasoline contamination- more volatile
<b>Chemical Smell</b>	Organic chemicals, Industrial

### pH (Technical/ Cosmetic/ Aesthetic)

The commonly acceptable range is pH 6.5 – 8.5. pH is one way of measuring if the water is acidic (< 6.5), i.e., can corrode metal piping or cause the water to have a bitter or metallic taste, or basic (> 8.5), i.e., the water may be associated with scale formation in the piping or cause the water to have a slippery feel and an alkali taste. The selection of a treatment process depends on other water quality parameters, such as the presence of trace metals, total hardness, alkalinity, and sodium content of the water (see– Corrosivity and Hardness).

*Possible Treatment Actions: NW/WS, DIS, and IE.*

### Silver (Cosmetic)

The SMCL for silver is 0.1 mg/L. This standard was not set for health concerns, but because elevated levels of silver may cause skin discoloration, i.e., argyria, or graying of the white part of the eye. This is not a common water quality issue and the primary reason the standard was created was because some point-of-use water treatment systems use silver as a biocide.

*Possible Treatment Actions: RO, DIS, and IE.*

### Sulfate (Aesthetic)

The SMCL for sulfate is 250 mg/L. At a level of 250 mg/L, sulfate can impart a bitter to salty taste to the water, but at a level of over 500 mg/L the sulfate can have a laxative effect. *Possible Treatment Actions: RO, DIS, and IE.*

Sulfates may also be associated with the presence of hydrogen sulfide or rotten egg odors to the water. A hydrogen sulfide odor could be caused by a combination of chemical or biological reactions. There is no specific drinking water standard for hydrogen sulfide, but there is a secondary drinking water standard for odor.

*Possible Treatment Actions for hydrogen sulfide odors: AER, CFiltration, DIS, and Oxid.*

### Total Dissolved Solids (Technical/ Aesthetic)

The SMCL for total dissolved solids (TDS) is 500 mg/L. This is a measure of the total amount of dissolved substances in the water sample. It is not a direct measure of a specific element or contaminant. An elevated TDS may be associated with an elevated water hardness, chemical deposits, corrosion by-products, staining, or salty bitter tastes. If the TDS content of the water is high, the primary recommendation would be to test the water for additional parameters, such as: total hardness, iron, manganese, sodium, chloride, sulfate, alkalinity, and nitrate, to determine the nature of the water quality problem. The TDS test is an indicator of the potential for water quality problems. *Action – Conduct additional water testing to determine nature of the dissolved solids.*

Because of the recent exploration into the Marcellus Shale and other oil and gas development, it is important to know the meaning of the terms associated with saline water, which is defined by the TDS concentration. The following is a summary of the classification for saline water.

Table 4. Saline Water Classification (Lehr, J. 1980)

Classification	Total Dissolved Solids (mg/L)
Freshwater	0 – 1000 mg/L
Slightly Saline	1000 to 3000 mg/L
Moderately Saline	3000 to 10,000 mg/L
Very Saline	10,000 to 35,000 mg/L
Briny	> 35,000 mg/L

### Zinc (Technical)

The SMCL for zinc is 5 mg/L. At a level at or above 5 mg/L zinc, the water can have a metallic taste and the water could be corrosive.

*Possible Treatment Actions: NW, RO, DIS, and IE.*

## IV. Volatile Organic Chemicals (VOCs)

Volatile organic chemicals include a group of chemicals that have a high vapor pressure and low solubility in water, i.e., these chemicals would prefer to volatilize than stay dissolved in water. Since most VOCs consist of man-made chemicals, it is uncommon to find VOCs in uncontaminated water. VOCs are used in manufacturing, industrial, and petrochemicals, plus they can be found in many chemicals used in your home. VOCs can enter your body by direct consumption or breathing. The primary concern with VOCs is that at relative low concentrations they are carcinogenic, cause damage to the circulatory and nervous system and other major organs, and may create a slight odor. Appendix A contains the listing of the regulated VOCs.

In 1996, the U.S. Geological Survey conducted a recent survey of 118 shallow wells in southern and eastern Pennsylvania. The results of the investigation found that 27 percent of the samples had at least one volatile organic compound detectable, but not at a level above the drinking water standard. Based on data compiled by the USGS and local cases of groundwater contamination, the following are the most common VOCs in the groundwater aquifer: methyl tert-butyl ether (MTBE), chloroform, benzene, xylenes, toluene, trichloroethylene, tetrachloroethylene, and carbon tetrachloride. The elevated levels of VOCs have been associated with contamination from industrial complexes, unapproved landfills or waste disposal sites, dry cleaning facilities, and gasoline stations.

### **Benzene**

Benzene is regulated as a primary drinking water standard and the MCL is 0.005 mg/L, but the MCLG is zero. Benzene is a carcinogen, i.e., cause cancer, and a common organic chemical associated with gasoline contamination. It is clear, colorless, and highly flammable. In addition to being a carcinogenic, benzene exposure has been associated with anemia.

*Possible Treatment Actions: AER and CFiltration.*

### **Carbon Tetrachloride**

Carbon tetrachloride is regulated as a primary drinking water standard and the MCL is 0.005 mg/L, but the MCLG is zero. The use of carbon tetrachloride by industry has been decreasing, but it was widely used to make refrigerants and propellants, dry cleaning agents, solvents, nylons, insecticides, and other household products. Carbon tetrachloride has been shown to adversely affect the nervous and reproductive systems, liver and kidneys, and cause leukemia and anemia.

*Possible Treatment Actions: AER and CFiltration.*

### **Chloroform or Trichloromethane**

Chloroform is not specifically regulated, but regulated through a standard identified by total trihalomethanes. Trihalomethanes are chemicals that form in the water as a by-product of disinfection. Chloroform is a suspected human carcinogen and has shown to produce tumors in the kidney and liver of animals. The MCL for trihalomethanes is 0.08 mg/L and the MCLG for chloroform is 0.07 mg/L.

*Possible Treatment Actions: CFiltration.*

### **Ethylbenzene**

Ethylbenzene is regulated as a primary drinking water standard and the MCL and the MCLG is 0.7 mg/L. Elevated levels of ethylbenzene have been associated with damage or problems associated with the liver and kidneys. Ethylbenzene is used to make plastic wrap, rubber, and specially coatings.

*Possible Treatment Actions: AER and CFiltration.*

### **MTBE**

Based on a USGS study, MTBE was identified as the most common organic chemical found in the shallow freshwater aquifers in Pennsylvania. The

Department of Environmental Protection (PADEP) has established a lifetime health advisory level of 0.02 mg/L. Because of taste and odor concerns, EPA has suggested that the MTBE concentration be no more than 0.02 to 0.04 mg/L. MTBE was used as an additive in gasoline to reduce air pollution and MTBE imparts an unpleasant taste and odor to the water. The primary source of MTBE is leaking underground gasoline tanks (LUST) or spills. MTBE has been identified as a possible carcinogen. *Possible Treatment Actions: AER and CFiltration, Oxid*

### **Tetrachloroethylene (TCE)**

Tetrachloroethylene is a manufactured chemical used for dry cleaning and metal degreasing. Tetrachloroethylene is regulated as a primary drinking water standard and the MCL is 0.005 mg/L, but the MCLG is zero. Long-term exposure has been linked to damage to the liver and increased risk to cancer.

*Possible Treatment Actions: AER and CFiltration.*

### **Trichloroethylene**

Trichloroethylene is a manufactured chemical used for metal degreasing and production of some textiles. Trichloroethylene either is colorless or has a blue tint with a sweet odor. Trichloroethylene is regulated as a primary drinking water standard and the MCL is 0.005 mg/L, but the MCLG is zero. Long-term exposure has been linked to damage to the liver and increased risk to cancer.

*Possible Treatment Actions: AER and CFiltration.*

### **Toluene**

Toluene is regulated as a primary drinking water standard and the MCL and the MCLG is 1.0 mg/L. Long-term exposure has been linked to problems with the nervous system, kidneys or liver. Sources of toluene can include gasoline, high octane fuels, and solvent used to make paints, coatings, gums and resins. If you recently installed your private drinking water well or installed a replacement pump, it is possible that the source of toluene is the electrical tape used in the well.

*Possible Treatment Actions: AER and CFiltration.*

### **Xylenes**

Xylene is regulated as a primary drinking water standard and the MCL and the MCLG is 10.0 mg/L. Xylene is a component of gasoline, is used to make plastics, and is a solvent. Long-term exposure has been linked to problems with the nervous system. *Possible Treatment Actions: AER and CFiltration.*

## **V. Synthetic Organic Compounds**

The Synthetic Organic Compounds (SOCs) are less volatile, i.e., less likely to escape into the atmosphere, when compared to the VOCs. Most of the SOC's are represented by a combination of herbicides, insecticides, or fungicides that had been used or are being used in the Commonwealth of Pennsylvania. Within the groundwater of Pennsylvania, SOC's have been detected in groundwater aquifers in areas with limestone geology and a history of agricultural use. Based on a study completed by the United States

Geological Survey, the most common semi-volatile synthetic organic compounds found in the shallow groundwater system were atrazine and other trazines, metolachlor, and alachlor. In the Mid-Atlantic Region, the four most widely used pesticides that have MCLs are atrazine, alachlor, glyphosate, and 2,4-D. Based on a recent regional water quality analysis, it appears that some of the drinking water sources may contain elevated levels of bis(2-Ethylhexyl) phthalate.

**Atrazine (Common Trade Names- AAtrex, Gesaprim)**

The MCL and MCLG for atrazine is 0.003 mg/L. Atrazine is a herbicide that is widely used in growing corn, soybeans, and wheat. For short-term exposure, atrazine can potentially cause congestion of heart, lungs and kidneys; low blood pressure; muscle spasms; weight loss; damage to adrenal glands; whereas, long-term exposure may result in weigh loss, heart damage, retinal and muscle degeneration and cancer. *Possible Treatment Actions: CFiltration.*

**Alachlor (Common Trade Names-Lasso and Alanox)**

The MCL for alachlor is 0.002 mg/L, but the MCLG is zero. Alachlor is a herbicide that is widely used in growing corn, soybean, and wheat. Long-term exposure to alachlor can result in an increase risk to cancer and can adversely affect the spleen, liver, kidneys, and eyes. *Possible Treatment Actions: CFiltration.*

**Glyphosate (Common Trade Names-Roundup and Rattler)**

The MCL and MCLG for glyphosate is 0.7 mg/L. Glyphosate is a herbicide that is widely used in both agricultural and non-agricultural uses to control broadleaf plants and grasses. For non-agricultural uses, it is commonly used of “road-side treatment”, lawns, and golf courses and it is commonly used to control weeds when growing corn, soybeans, and wheat. Long-term exposure can affect the reproductive systems and kidneys. *Possible Treatment Actions: CFiltration.*

**2,4-D (Common Trade Names-Weed-B-Gon, Chloroxone)**

The MCL and MCLG for 2,4-D is 0.07 mg/L. 2,4-D or 2,4-Dichlorophenoxyacetic acid is a herbicide that is used to control broad-leaf weeds, grasses, and woody plants along right-of-ways, rail-lines, and roadsides and used to control weeds when growing row crops. Long-term exposure can result in damage to the liver, kidneys, liver, and endocrine glands. *Possible Treatment Actions: CFiltration.*

**bis(2-Ethylhexyl)phthalate**

The MCL for bis(2-Ethylhexyl)phthalate is 0.006 mg/L, but the MCLG is zero. Since phthalates are used as a plasticizer in polyvinylchloride (PVC) piping, the most likely source is the PVC piping in the home. It is possible that the PVC piping did not meet NSF International (NSF) Standard 61. Long-term exposure to phthalates in drinking water may result in liver and reproductive disorders and increase your risk to cancer. *Possible Treatment Actions: Flush piping prior to use, changing piping, and CFiltration.*

## VI. Radioactive Compounds, i.e., Radionuclides

In Pennsylvania, the level of radioactive compounds in the freshwater system are naturally occurring and at levels that are well below levels that would pose a long-term or short-term public health concerns. The EPA has established MCL for Combined Radium 226/228, gross alpha, beta particles, and uranium. The drinking water standards are as follows:

<b>Gross Alpha</b> ( <i>Radon and Uranium</i> ) .....	15 pCi/L
<b>Combined Radium</b> ( <i>226+228</i> ).....	5 pCi/L
<b>Beta Particle and Photo Activity</b> ( <i>Man-Made Radionuclides</i> ) .....	4 mrem/yr
<b>Uranium</b> .....	30 ug/L

Long-term exposure to radionuclides can result in cancer and exposure to uranium can also result in kidney disorders.

Within Pennsylvania, the primary radiological exposure of concern is exposure to radon gas. Radon gas is formed by the “breakdown” of uranium that is present in the soil, bedrock, groundwater, and construction materials (granite counter tops). Long-term exposure to radon gas can result in lung cancer. The EPA estimated that exposure to radon causes over 20,000 deaths per year. The goal for indoor exposure to radon is to maintain an indoor air level of less than 2 pCi/L, but that level of exposure is currently not technically feasible so the EPA has recommended an action limit of 4 pCi/L for radon in air. It should be noted that statistically speaking, while 15 % of lung cancers are caused by radon exposure, the other 85 % can be linked to cigarette smoking.

Besides the direct release of radon gas from the soil, rock, and building products, the next potential source is your drinking water. Radon can accumulate in the groundwater as it moves through the aquifer. When the groundwater is pumped to the surface, the radon gas can be released into the atmosphere prior to consumption or during bathing. Therefore, the primary route of entry is inhalation, i.e., breathing and not consumption. The EPA has not set a specific standard for radon in water, but the EPA has established a proposed standard of 300 to 4,000 pCi/L.

For Northeastern Pennsylvania, the following is a summary of the median indoor levels of radon by zip code for a number of counties in Northeastern Pennsylvania.



Table 5. Summary of Radon in Air Data for Pennsylvania by Zip Code.

COUNTY (ZIP CODE)	AVERAGE RESULT
<b>Bradford (18848)</b>	5 pCi/L
<b>Columbia (17814)</b>	39.8 pCi/L
<b>Lackawanna (18407)</b>	3.2 pCi/L
<b>Luzerne (18612)</b>	5.1 pCi/L
<b>Pike (18324)</b>	5.5 pCi/L
<b>Wayne (18341)</b>	3.7 pCi/L
<b>Wyoming (18657)</b>	6.7 pCi/L
<b>Susquehanna (18844)</b>	4.2 pCi/L
<b>Tioga (16901)</b>	5.8 pCi/L

If your zip code is not listed, you can visit the website listed below to conduct your own search for average radon levels in indoor air for your zip code. Source: [http://www.dep.state.pa.us/RadiationProtection\\_Apps/Radon/](http://www.dep.state.pa.us/RadiationProtection_Apps/Radon/)

If you are within a county or zip code with the average level of radon at or above 4 pCi/L, the EPA recommends an indoor air test. If the result of your specific indoor air level is actually at or above 4 pCi/L, the EPA is recommending a radon in water test. The primary treatment for radon in air may be a ventilation system, but for radon in water it may be possible to use a ventilation or activated carbon system.

*Possible Treatment Actions: Aero, CFiltration.*

## VII. Common Water Quality Parameters with no Standards

A number of common water quality parameters have no specific drinking water standards, but the tests are great indicators for potential aesthetic problems or concerns. This report highlights two of the commonly used water quality tests that are used to evaluate your water.

### Alkalinity

Alkalinity is a measure of the ability of the water to resist a change in the pH of the water caused by the addition of an acid. It is the capacity of the water to resist a change in the pH of the water. Depending on the cations, i.e., positively charged multivalent ions like calcium, iron, manganese, and magnesium, present in the water, a high alkalinity can be associated with either a salty to chalky taste or the creation of chemical precipitates, scale on the piping, or scale on filters and heat exchange systems.

## Bromide

Bromide is found in seawater, brine water, and rock formation water. In addition, bromine is used as a disinfectant for cooling towers and swimming pools and ethylene bromide is found as an anti-knock chemical. In freshwater, the concentration of bromide is typically  $< 0.05$  mg/L. Because the bromide can react with ozone during water treatment to form bromates, the bromated limit for bottled water is 0.01 mg/L. Therefore, if you are considering an ozone treatment system the bromide level of your water should be less than 0.0063 mg/l bromide.

*Possible Treatment Actions: RO, DIS, IE.*

## Total Hardness

There is no specific drinking water standard for water hardness. The hardness of the water is reported as the equivalent concentration of calcium carbonate per liter of water, i.e., mg Ca/L, but the actual test measures the calcium, magnesium, manganese, iron, and other multivalent positively charged ions. Total hardness is also reported as grains per gallon (1 gpg is equivalent to 17.12 mg CaCO<sub>3</sub>/L). Individuals typically report aesthetic problems with the water when the total hardness is above 160 mg CaCO<sub>3</sub>/L, but it is possible that corrosion problems could be associated with water with very low water hardness. The total hardness test can not be used to accurately predict the trace metal content of your water. Groundwater in Northeastern Pennsylvania is not normally hard.

*Table 6. Hardwater Classification (Lehr, J. 1980)*

CLASSIFICATION	TOTAL HARDNESS (MG CaCO <sub>3</sub> /L)
<b>Soft</b>	0 – 17
<b>Slightly Hard</b>	17 – 60
<b>Moderately Hard</b>	60 – 120
<b>Hard</b>	120 – 180
<b>Very Hard</b>	> 180

## Sodium

Sodium is currently not regulated by the drinking water standards. Sodium is naturally occurring, but elevated levels of sodium can be present in groundwater because of the use of deicing agents, brine water, saline water, domestic sewage, cleaning products, preservatives, and softener or treated water backwash. The human body requires small amounts of sodium to maintain normal blood pressure and proper function to nerves and muscles. The EPA has recommended a maximum sodium content of 20 mg/L for individuals on a low sodium diet. If your drinking water is above 20 mg/L and you are on a low sodium diet, the

primary recommendation would be to provide your doctor with the water quality data and determine if there is a need to change or modify your diet or install or modify an existing water treatment system. When sodium is present at a concentration of over 250 mg/L, the water can have a salty taste.

*Possible Treatment Actions: RO, DIS, IE.*

*Note: Beware that treating water with a water-softener system will raise the level of sodium or potassium chloride content of the water.*

### **Strontium**

Strontium is currently not regulated as a drinking water standard, but strontium is listed on the EPA list of parameters being evaluated and is a candidate for inclusion as a standard. Strontium is a naturally occurring element and naturally occurring strontium is not radioactive. Strontium is used in making glass, ceramics, paint pigments, medicines, and pyrotechnics. Strontium has been found in brine water, flowback, and production wastewater at concentrations ranging from a few hundred to over 7000 mg/L. For one of the radioactive forms of strontium, i.e., strontium-90, the EPA has set a public drinking water limit of 8 pci/L. The radioactive role of strontium-90 would be identified during a testing of the water for beta particles, i.e., man-made radioactive particles. The Agency for Toxic Substances and Disease Registry reports the amount of strontium that has been measured in drinking water in different parts of the United States by the EPA is less than 1 milligram for every liter of water, i.e., < 1 mg/L. Exposure to natural, or stable, strontium may affect the growth and strength of bone because the strontium may replace calcium in the bone. The EPA recommends that drinking water levels of stable strontium should not be more than 4 mg/L.

*Possible Treatment Actions: CFiltration, RO, DIS, IE*

# COMMON QUESTIONS OR PROBLEMS IN NORTHEAST PENNSYLVANIA



In all cases, it is recommended that you hire a professional and/or a certified water quality specialist to review your water quality test results and make recommendations regarding changes or the installation of pretreatment systems. There are a number of professional associations that certify water treatment professionals, such as Water Quality Association (WQA), National Groundwater Association (NGWA), and Association of Water Technologists (CWT Program).

### **Situation 1: My water is positive for total coliform bacteria.**

Action: Have a professional or PA licensed well driller inspect the well and disinfect with a chlorine shock to the well and pipeline. After the system has been flushed, the water should be immediately tested for total coliform bacteria.

#### **Situation 1a: The retesting was positive for total coliform bacteria.**

Action: If the professional well contractor identified a weakness in the well construction, wellbore, or other surface feature, it may be advisable to up-grade the system and install a disinfection system. The type of disinfection system (DIS) will depend on the quality of your water.

### **Situation 2: My water was negative for total coliform bacteria, but had an elevated level of iron and manganese.**

Action: If the water was tested for nuisance related bacteria and standard plate count and the levels were low, it may be possible to reduce the level of iron and manganese through the installation of a water softener (WS) or other technologies. The treatment technology most appropriate depends on the form of the iron and manganese and general water quality.

If nuisance bacteria were not detected and the water has an odor or creates a slimy coating, it may be advisable to conduct a shock disinfection of the well and retesting for the level of bacterial contamination, general water quality, and total and dissolved iron and manganese.

### **Situation 3: My water pH is low or the concentration for copper and lead was elevated in my water or the water has a bitter taste.**

Action: It is possible that your water is potentially corrosive to the metal piping and fixtures in the well and home. This may not mean the groundwater is contaminated, but it may mean that the metals are being leached from your household piping. Before taking any specific action that would require the installation of a treatment system, it would be advisable to conduct a visual inspection of the household plumbing and conduct a retesting of the water near the source after the water has set in the pipe for 6 to 12 hours.

If professional assessment indicates that treatment is needed, the common treatment approach is the installation of a system to adjust the pH of the water or the installation of a neutralizing system.

#### **Situation 4: My water has a sulfur or rotten egg smell.**

Action: It is important to understand the cause of the odor. The odor could be caused by a chemical reaction and/or a biological reaction. If the water was positive for microbiological agents, it would be advisable to shock disinfect the well and distribution system and then install a system to disinfect the water. If the water was negative for bacterial contamination, it may be advisable to install an aeration or carbon filtration system. Prior to taking action it would be advisable to document the hydrogen sulfide content of the water. It is best if the hydrogen sulfide test was conducted at your home at the time of sampling. There are field testing kits for conducting this evaluation. If the test is conducted at a laboratory the sample needs to be preserved with acetic acid and a strong base and there is a very stringent holding time.

#### **Situation 5: I have methane in my water.**

There is no specific standard for methane gas in drinking water. Methane is a colorless, odorless, tasteless, combustible gas. Therefore, you can not detect this gas using the taste, appearance, or odor of the water. The smell of natural gas that you may use to heat your home is actually butyl mercaptan, a sulfur-compound, which is added to natural gas by the gas company so that if there is a gas leak you have something to smell to warn you that there is a leak. If the concentration is  $< 2$  mg/L, there should be no specific concerns, but you may want to install a vented well cap. If the concentration is over 2 mg/L, additional action is warranted.

At atmospheric pressures, the methane solubility in water ranges from 26 to 32 mg/L. At a level of greater than 26 mg/L methane, it is possible for the gas to reach its lower explosive limit (LEL) inside the well or within a confined space. In general, a level of methane gas under 10 mg/L is considered safe, but venting, monitoring, and other facilities changes may be advisable.

##### **Action 5a: Recommendation**

If the concentration was  $> 2$  mg/L, but less than 7 mg/L – a well ventilation system should be installed and additional water testing is warranted. It may be advisable to conduct compositional analysis and carbon isotopic analyses to determine the source of the gas.

##### **Action 5b: Recommendation**

If the concentration was  $> 7$  mg/L, but less than 10 mg/L – a well ventilation system, real-time monitoring system, well recirculation system, and active aeration system should be installed, and additional water quality testing is warranted.

**Action 5c: Required**

If the concentration was  $> 10$  mg/L, a well ventilation system, real-time monitoring system at multiple locations within your home, active aeration system, well recirculation system should be installed, and it may be necessary to have your heating system reconfigured for your home and make necessary electrical changes.

**Situation 6. Radon in Water is above 300 pCi/L.**

Action 1: There is no specific standard for radon in water. If you are located within an area where the average level of radon in air is reportedly  $> 4$  pCi/L, it may be advisable to install a radon treatment system for your home and you should hire a radon professional. If you have a radon remediation system or the level of radon in air was below 4 pCi/L, it would be advisable to contact a professional to evaluate your results and system.

For more information and a listing of certified radon professionals, please go to [http://www.dep.state.pa.us/brp/radon\\_division/Radon\\_Homepage.htm](http://www.dep.state.pa.us/brp/radon_division/Radon_Homepage.htm)

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Add - Appendix A - Spreadsheet



# APPENDIX

## I. Primary Contaminants

### Volatile Organic Compounds (VOCs)

Parameter	MCL	Units
Benzene	0.005	mg/L
Carbon Tetrachloride	0.005	mg/L
o-Dichlorobenzene	0.6	mg/L
para-Dichlorobenzene	0.075	mg/L
1,2 Dichloroethane	0.005	mg/L
1,1-Dichloroethylene	0.007	mg/L
cis-1, 2- Dichloroethylene	0.07	mg/L
trans-1.2- Dichloroethylene	0.1	mg/L
Dichloromethane	0.005	mg/L
1,2-Dichloropropane	0.005	mg/L
Ethylbenzene	0.7	mg/L

### Synthetic Organic Chemicals (SOCs)

Parameter	MCL	Units
Alachlor	0.002	mg/L
Atrazine	0.003	mg/L
Benzo(a)pyrene	0.0002	mg/L
Carbofuran	0.04	mg/L
Chlorodane	0.002	mg/L
2,4-D	0.07	mg/L
Dalapon	0.2	mg/L
Dibromochloroproane (DBCP)	0.0002	mg/L
DI(2-ethylhexyl) Adipate	0.4	mg/L
Di(2-ethylhexyl) Phthalate	0.06	mg/L
Dinoseb	0.007	mg/L
Diquat	0.02	mg/L
Endothall	0.1	mg/L
Endrin	0.002	mg/L
Ethylene Dibromide (EDB)	0.0005	mg/L

### Inorganic Chemicals (IOCs)

Parameter	MCL	Units
Antimony	0.006	mg/L
Arsenic	0.01	mg/L

Barium	2	mg/L
Beryllium	0.004	mg/L
Cadmium	0.005	mg/L
Chromium	0.1	mg/L
Copper	1	mg/L
Free Cyanide	0.2	mg/L

### Microbiological Contaminants

Parameter	MCL	Units
Total Coliform	Zero or < 1	#/100 ml
e. coli	Zero or < 1	#/100 ml
Other- Parameters	MCL	Units
Turbidity	1 to 5	ntu

## II. Secondary Contaminants

Parameter	SMCL	Units
Aluminum	0.2	mg/L
Chloride	250	mg/L
Color	15	color units
Foaming Agents	0.5	mg/L
Iron	0.3	mg/L
Manganese	0.05	mg/L

### Volatile Organic Compounds

Parameter	MCL	Units
Monochlorobenzene	0.1	mg/L
Styrene	0.1	mg/L
Tetrachloroethylene	0.005	mg/L
Toluene	1	mg/L
1,2,4-Trichlorobenzene	0.07	mg/L
1,1,1 - Trichloroethane	0.2	mg/L
1,1,2- Trichloroethane	0.005	mg/L
Trichloroethylene	0.005	mg/L
Vinyl Chloride	0.002	mg/L
Xylenes, total	10	mg/L

### Synthetic Organic Chemicals

Parameter	MCL	Units
Glyphosate	0.7	mg/L

Heptachlor	0.0004	mg/L
Heptachlor epoxide	0.0002	mg/L
Hexachlorobenzene	0.001	mg/L
Hexachlorocyclopentadiene	0.05	mg/L
Lindane	0.0002	mg/L
Methoxychlor	0.04	mg/L
Oxamyl	0.2	mg/L
PCBs	0.0005	mg/L
Pentachlorophenol	0.001	mg/L
Picloram	0.5	mg/L
Simazine	0.004	mg/L
2,3,7,8-TCDD (Dioxin)	0.00003	ug/L
Toxaphene	0.003	mg/L
2,4,5- TP (Silvex)	0.05	mg/L

### **Inorganic Chemicals (IOCs)**

Parameter	MCL	Units
Fluoride	2	mg/L
Lead	0.005	mg/L
Mercury	0.002	mg/L
Nitrate (as Nitrogen)	10	mg/L
Nitrite (as Nitrogen)	1	mg/L
Selenium	0.05	mg/L
Thallium	0.002	mg/L

### **Radionuclides**

Parameter	MCL	Units
Gross Alpha	15	pCi/L
Combined Radium (226 +228)	5	pCi/L
Beta Particle & Photon Activity	4	mrem/yr
Uranium	30	ug/L
Parameter	SMCL	Units
Odor	3	TON
pH	6.5 - 8.5	units
Silver	0.1	mg/L
Sulfate	250	mg/L
Total Dissolved Solids	500	mg/L
Zinc	5	mg/L

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water quality, please visit  
**[www.wilkes.edu/water](http://www.wilkes.edu/water)**.



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