Water and Health

SONIA ALLMAN
MANAGER OF STRATEGIC COMMUNICATIONS
Metro Water Services provides public water (treatment and distribution) and wastewater (collection and treatment) services to customers located in Nashville/Davidson County and portions of five surrounding counties and stormwater services for customers located in Nashville/Davidson County.

The public drinking water system is also a vital part of the fire protection in the community.
Nashville’s Water System

Nashville has had a public water system since October 1, 1833. The original system consisted of a reservoir and a steam driven pumping station on the bluff behind the old General Hospital.

This system provided untreated river water from the Cumberland River.

Rolling Mill Hill stands at this site today.
Water Sources

Rivers, streams, lakes, and reservoirs have long been important sources of drinking water.

In the past, these sources were often heavily contaminated by sewage discharges and, unfortunately, were also important in the transmission of communicable diseases such as typhoid and cholera.
1833 The first recorded occurrence of cholera in Nashville took 174 lives.

1849 Nashville lost 311 people to cholera.

1850 Cholera reappears and takes 316 lives.

1854 88 more people die of Cholera.

1866 Over 800 people in die of cholera in Nashville.
Another cholera outbreak occurred in 1873 during the Nashville Industrial Exposition killing 750 people.

On May 27, 1874, the ordinance creating the Board of Health became law.

Plans were made to purify drinking water as much as possible and build water-tight sewers.
1876 Dr. Buist, President of the Board of Health, along with the Superintendent of Nashville Water Works convinced the city council to appropriate money for a filter project in order to clean the river water.

1877 A filtering gallery was constructed in the upper island of the river, the same year the State Board of Health was created.
The filtering gallery was nothing more than a 152 foot long by 6 foot wide cage filled with stone and topped with sand. The river water was filtered as it percolated through the gravel and sand.

This filter gallery was successfully used until 1900 as long as the river level remained above the gallery. At lower water levels, it was necessary to pump muddy water directly from the River.
The 1879 Board of Health Report proposed a new plan for improving the water supply of Nashville.

In 1884 Vanderbilt Professor, Olin H. Landreth, analyzed several potential sites for long range water quality and suitable water quality.
Construction of the Eighth Avenue Reservoir began in 1887.

Construction of the new Pumping Station began in 1888.

Both were completed in 1889 and are still in use today.
Chemical Treatment

In response to the discovery of harmful bacteria, and to improve the color of the drinking water, Nashville began chemical treatment of the water supply in 1908.

Sulphate of alumina (alum) reduced the bacteria and increased the clarity of the naturally muddy Cumberland River water by coagulating smaller particles into larger, heavier pieces that settled to the bottom of the reservoir.

Hypochlorite of lime, added in 1909, was used to disinfect the water.

1914 U.S. Public Health Service set standards for the bacteriological quality of drinking water. This was the first Federal regulation.

1920 Liquid chlorine replaced hypochlorite of lime.
Water Treatment Plants

Omohundro WTP

K.R. Harrington WTP
Public drinking water systems use various methods of water treatment to provide safe drinking water to their communities.

MWS uses a conventional treatment method:

- Screening of raw water
- Coagulation & Flocculation
- Sedimentation

- Filtration
- Disinfection
- Distribution
Water Source

The Cumberland River

- 15 billion gallons/day pass by Nashville
Screening of Raw Water

Raw water is pulled from the Cumberland River and screened to remove sticks, leaves and other large debris.
Coagulation & Flocculation

Alum is added to the water in order to alter the characteristics. The positive charge of the alum neutralizes the negative charge of dirt and other dissolved particles in the water. When this occurs, the particle bind with the chemicals and form larger particle, called floc.
Sedimentation

Floc
Disinfection

On-Site Generation of Hypochlorite

Salt + Water + Electricity

NaCl + H2O + 2e- → NaOCl(aq) + H2
April **2015**, the U.S. Department of Health and Human Services released the final Public Health Service recommendation for the optimal fluoride level in drinking water to prevent tooth decay. The new recommendation is for a single level of 0.7 mg of Fluoride per liter of water. This replaces the previous recommended range of 1.2 mg/L which was issued in **1962**.

MWS began maintaining fluoride levels of 0.07 mg/L in 2011 based on guidance from the Metro Health Department.
Analysis

Over 50 samples are analyzed every single day:

- **Microbiological**
  - Total coliform
  - E. coli
- **Metals**
  - Iron
  - Copper
  - Manganese
- **Total Hardness**
- **Alkalinity**
- **Fluoride**
- **Chlorine Residual**
- **Conductivity**

**This is not a complete list.**
Distribution

- 190,699 Water Customers
- 3,000 miles of Pipe
- 57 Pumping Stations
- 41 Reservoirs with a storage capacity of 87.8 million gallons
- 16,793 Fire hydrants
Drinking water (both bottled and tap) can reasonably be expected to contain at least a small amount of contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk.

How do you know if your water is safe?

The EPA requires community water systems to provide an annual report called the Consumer Confidence Report or CCR.
MWS analyzes for 105 different contaminants.
The EPA has set maximum contaminant levels and/or treatment technique requirements for over 90 of these contaminants.
MWS meets or exceeds all EPA, Federal and State requirements.

http://ccr.nashville.gov
A Maximum Contaminant Level Goal (MCLG) is the level of a contaminant in drinking water below which there is no known or expected risk to human health.

EPA sets an enforceable regulation for most contaminants called a maximum contaminant level (MCL). MCLs are set as close to the MCLGs as possible, considering cost, benefits and the ability of public water systems to detect and remove contaminants using suitable treatment technologies.
What is clean water worth?

According to the World Health Organization, contaminated drinking water is estimated to cause 502,000 diarrheal DEATHS per year.

What would you pay for clean, safe drinking water delivered to your home???
It only costs 60 cents per year to drink the recommended 8 glasses of water per day.

<table>
<thead>
<tr>
<th>Charge</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.0031 per Gallon</td>
<td>$ 18.69</td>
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</tbody>
</table>

Total bill for 8 ccf (5984 gallons) = $ 18.69

1 ccf = 748 gallons
8 ccf = 5984 gallons

Cost per gallon = $ 0.0031
During the past century, many improvements in health of the U.S. population can be attributed to improvements in drinking water.

Drinking water supplies in the United States are among the safest in the world.

However, even in the U.S., there continue to be emerging challenges.

Utilities must properly maintain infrastructure in aging systems and be prepared to address concerns regarding new contaminants.
Aging Infrastructure

- 64% of our water mains are over 40 years old.

- Over the past 5 years, Metro Water Services has averaged 450 main breaks a year. (Most occurring during the winter months.)

- In 2014, crews responded to over 580 breaks.
Lead

- Lead is a naturally occurring element and is commonly used in household plumbing materials and water service lines.

- Lead typically occurs when it leaches from the lead pipes and solder that are in mainly older homes.

- A prohibition on lead in plumbing materials has been in effect since 1986 and the State mandated a lead monitoring program in 1992.
Cryptosporidium

Cryptosporidium in drinking water is a critical concern to water utilities worldwide.

Cryptosporidium is an intestinal protozoa and very difficult to kill using disinfectants such as chlorine.

Therefore, source water protection, tightened standards regarding allowable level of cloudiness, or turbidity, and increased filter performance are important.
Cyanobacteria

- Also known as blue-green algae.
- Result of high nutrients, low flow and warm weather.
- *Not true algae* - Gram negative bacteria which contain chlorophyll and perform photosynthesis.
- Rapid, excessive growth is referred to as a “bloom”.
- Often seen as scums, foams or mats on the surface of a lake or stream.
- Each summer, utilities are faced with issues related to blue-green algae.

*Photo credit USGS*
Taste & odor compounds, 2-methyl isoborneol (MIB) and geosmin give water an earthy, or dirty taste and odor.

There are not any health related guidelines or regulations for Geosmin or MIB. However, water with a displeasing taste or odor is often perceived to be less safe or healthy by consumers.

To improve the detection and elimination of these compounds, river data is monitored, water samples are analyzed in the laboratory utilizing Gas Chromatography/Mass Spectrometry (GC/MS) technology and a 5 person taste and odor panel performs “sniff tests”.
Algal Toxins or Cyanotoxins

- Cyanobacteria blooms that produce cyanotoxins are called harmful algal blooms or HABS.

- Health effects of cyanotoxins can be acute or chronic and have been observed in the liver, nervous system, and gastrointestinal system.

*NOT all Cyanobacteria produce cyanotoxins.*
These non-regulatory levels are levels below which there are expected to be no health impacts.

As part of an updated risk assessment process, EPA has issued two different advisory levels based upon a person's age.

The EPA has issued health advisories for two cyanotoxins: *microcystins* and *cylindrospermopsin*.

The health advisory levels, which are based upon 10 days of exposure, are:

- 0.3µg/L for microcystin and 0.7µg/L for cylindrospermopsin for children less than six years old.
- 1.6 µg/L for microcystin and 3.0 µg/L for cylindrospermopsin for children six and up and adults.
Prevention and Treatment

T & O Action Plan
- Monitor raw water.
- Use sensory analysis as well as analytical tools for T & O detection.
- Feed powder activated carbon (PAC) during the treatment process.

Cyanotoxin Action Plan
- Monitor raw water.
- Perform enzyme-linked immune assays.
- Adjust treatment process accordingly.
  - PAC
  - Disinfection
  - Increased filtration
Pharmaceuticals

Water professionals have the technology to detect more substances – at lower levels than ever before. As analytical methods improve, many compounds are being found at extremely low levels - typically parts per trillion.

To date, research has not demonstrated an impact on human health from pharmaceuticals at the very low levels reported in drinking water. Therefore, the U.S. Environmental Protection Agency has not set drinking water standards for these types of substances, and utilities are not required to test for them.

However, testing and research continues regarding the impacts to human health as well as the effectiveness of treatment techniques.

The best and most cost-effective way to ensure water is free of pharmaceuticals is to limit the introduction into our water supply.
EPA’s National Effluent Study on Emerging Contaminants

- Assess concentration and magnitude of emerging contaminants in municipal WWTP effluents.
- 54 highest priority pharmaceuticals, 8 steroids, Bisphenol A (BPA), 19 Nonylphenols, and 14 perfluorinated compounds, and estrogenic potential in fathead minnows.

Samples collected November 2010 – March 2011
Prescription Surrender Programs

Nashville’s Pharmaceutical Program
Tons Disposed/Yr

- Jan-11: 1.09 Tons/Yr
- Jan-12: 1.77 Tons/Yr
- Jan-13: 2.09 Tons/Yr
- Jan-14: 2.79 Tons/Yr
- Jan-15: 1.85 Tons/Yr
Proper Disposal of Pharmaceuticals

Do NOT flush unused medications down a toilet or sink!

Remove the unused medication from its original container and place it in a sealable plastic bag such as a baggie or sandwich bag, mix with an undesirable substance such as used coffee grounds or kitty litter, and place the bag in your normal household trash. Dispose of the trash as you would other household garbage.

This will insure the medication is disposed of safely in an environmentally engineered and protective landfill.
On August 31st, the U.S. Environmental Protection Agency announced that it is proposing two new hazardous waste rules, one of which is designed to prevent healthcare facilities from flushing pharmaceuticals down sinks and toilets.

“The proposed hazardous waste pharmaceuticals rule will make our drinking and surface water safer and healthier by reducing the amount of pharmaceuticals entering our waterways,” EPA said in its official press release. “EPA’s proposal is projected to prevent the flushing of more than 6,400 tons of hazardous waste pharmaceuticals annually by banning healthcare facilities from flushing hazardous waste pharmaceuticals down the sink and toilet.”

A 60-day public comment period will begin upon its publication in the Federal Register, which is expected to be in the next couple of weeks.
Bottled Water

- FDA regulates bottled water as packaged food under the Federal Food, Drug and Cosmetic Act.

- Bottled water is much more expensive, per gallon, than tap water.

- Some bottled water comes from surface water sources. This water typically comes from a public water system and receives additional treatment, such as filtration and disinfection, before it is bottled.

- Many public water systems add fluoride to their water; most bottlers do not.
Filtration Devices

- Can be costly.

- All units (point of use and point of entry) require some maintenance. It is important to follow manufacturers recommendations for maintenance to ensure effectiveness.

- Different units remove different contaminants or classes of contaminants from the water.

- When considering a filtration device, be sure the unit you purchase can address your concerns.

Some contaminants and their size in microns:

- *Giardia lamblia* – 8 to 12 microns
- *Cryptosporidium parvum* – 4 to 6 microns
- Bacteria (i.e. salmonella and E. coli) – 0.2 to 4 microns
- Viruses – 0.004 to 0.1

*Generally, only ultrafilters and reverse osmosis can assure removal of viruses. However, viruses can be killed using a disinfectant such as chlorine.*
Before considering bottled water or a filtration device, consider your local water quality and value.

If you object to the chlorine taste of tap water, place the water in an uncovered pitcher overnight.

People with severely weakened immune systems or other specific health conditions such as those who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, should learn about their drinking water quality and seek advice from their health care providers.
NASHVILLE IS FORTUNATE TO HAVE A CLEAN AND SAFE WATER SUPPLY.

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