APPENDIX B

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

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To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: August 26, 2016

Subject: Sources contributing to blood lead levels in people

This memo is in response to your request to provide the following information:

- What does research say about the sources of lead in children (or people generally)?
- What are the major sources (water, lead-based paint, ambient air, etc.)?
- What percentage comes from each source?

Sources of lead in children and other people

Lead can enter the human body through ingestion and inhalation. It cannot leach through the skin.

Based on a review of several different sources of information, the following are sources of lead that can end up being found in the human body:

- Old pipes leaching lead into city drinking water from both public infrastructure and water service pipe lines on private property
- Galvanized iron pipes
- Water service pipes constructed of lead
- Water service pipes using lead solder
- Lead solder connecting pipes in household plumbing
- Brass faucets, valves, or fittings
- Other lead plumbing fixtures inside the home
- Lead particles generated by burning materials containing lead, for example, during smelting, recycling, stripping leaded paint, and using leaded gasoline or aviation fuel
- Lead-contaminated dust
- Lead-contaminated food (acquired from lead-glazed or lead-soldered containers)
- Cosmetics
- Medications
- Healthcare products or folk remedies that contain lead
- Soil
- Dust
- Flaked-off paint

- Paint dust from walls, door frames, window frames, and furniture
- Leaded gasoline
- Lead crystal and lead-glazed pottery
- Toys
- Jewelry
- Clothing after working in a job where there is lead exposure

Major sources

Based on information from the Centers for Disease Control and Prevention (CDC) and a study by University of California Los Angeles' Institute of the Environment and Sustainability, the most common sources of lead exposure come from the following (listed in order from most common to least):

1. Lead-based paint (especially flakes and dust from windows (friction of opening and closing windows creates a lot of dust)
2. Soil (lead emitted by motor vehicles decades ago)
3. Lead water service pipes

Percentage from each source

I was unable to find definitive percentages for the sources of lead in blood lead levels because it is difficult to track the source of lead once it has entered the body. However, one article in The News & Observer quoted Ed Norman, head of the Children's Environmental Health division of N.C. Department of Health and Human Services, as saying the bulk of lead contamination cases come from lead paint and 20 percent relate to contaminated water. There was no citation as to where he acquired this figure, and it is the only place I have seen a percentage assigned.

Other information

In addition to providing information related to the above questions, the two attached articles discuss larger implications related to the lead-in-drinking-water issue, which I thought may be of interest to you. The first article from *Mother Jones* magazine contains information regarding the correlation between lead exposure and crime rates. The article makes a case for lead exposure being a primary factor in crime rates to a greater extent than other social factors. (*See* Drum, Kevin. "Lead: America's real Criminal Element." *Mother Jones*. February 11, 2016. *Motherjones.com*. Accessed August 25, 2016.) The second article from *USA Today* criticizes the current EPA rule, which is seen by some as not being adequately protective of public health. The article indicates that due to the testing and reporting requirements established by EPA, lead-contaminated water is a much greater problem than is being reported. (*See* Young, Alison and Mark Nichols. "Beyond Flint: Excessive lead levels found in almost 2,000 water systems across all 50 states." *USA Today*. *Usatoday.com*. Accessed August 25, 2016.)

LRB 166049

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: August 26, 2016

Subject: Lead-in-water Testing

This memo is in response to your request to provide the following information:

1. Is it true that the Milwaukee Water Works (MWW) only conducts lead testing once every 3 years, in only 50 homes, because MWW has been found to be compliant with some federal (EPA?) lead standards?
2. If the MWW did not meet the standard referenced in #1, how many homes would it be required to test?
3. What degree of lead-in-water testing is conducted by the municipal water utilities in the following communities: Washington, DC; Flint, MI; Durham, NC; Greenville, NC?
4. Does the MWW test the same 50 homes every 3 years?
5. Does MWW only conduct lead-in-water tests on homes that have lead City/MWW service lines? Or does it also conduct tests on homes served by non-lead lines?

Overview

The federal rule regulating monitoring requirements for lead and copper in tap water, 40 CFR 141.86, is overseen by the Environmental Protection Agency (EPA). The rule provides for two different types of monitoring: standard monitoring, which is conducted at six-month intervals, and reduced monitoring, which allows for less frequency and fewer sample locations depending upon certain qualifications. All systems are required to adhere to standard monitoring for initial monitoring. Afterward, follow-up monitoring is required until the system can meet requirements for reduced monitoring. If a system violates the requirements, it must institute treatment techniques to bring its levels back in compliance with the rule, and must go back to standard monitoring until it again meets the requirements for reduced monitoring. MWW has met the requirements for reduced monitoring on a triennial basis.

MWW started monitoring for lead in 1996. Its first few samples exceeded the EPA standard of 15 parts per billion (ppb). Because MWW was not in compliance, it had to monitor 100 homes twice per year. When MWW had been in compliance for a few cycles, it was allowed to go down to monitoring once per year to show that the corrosion

control was working very well. The 100 homes all had lead service lines and were randomly chosen. The reduced monitoring for which MWW now qualifies allows for testing of just 50 homes.

Milwaukee Water Works Superintendent Carrie Lewis described the lead monitoring that MWW conducts in compliance with the federal rule. The rule is not designed to test lead in every house. It is designed to demonstrate that the treatment techniques being used are working.

In order to properly conduct the test in a scientific manner, lead monitoring is carried out on the same 50 homes each time (i.e. to have a standard baseline for testing). This demonstrates whether the treatment technique is working. All of the houses being used have lead service lines because they are at the greatest risk of having the highest lead levels. This is the method MWW uses for regulatory compliance testing.

Sample collection is conducted by residents, who are left with the collection containers, instructions, and chain of custody form. Residents leave the samples on the porch, and MWW collects the samples and sends them to a contract lab. The rule has always required that the water sample being collected comes directly from the faucet after having been undisturbed for six hours. The water should be the first one liter that comes out of the tap. MWW has always complied with this requirement. However, prior to February 2016, MWW instructed residents to flush the water prior to the six-hour stagnation period. The EPA was silent on this pre-flushing until February 2016, when they recommended that this practice not be used, at which time MWW discontinued it.

There is no maximum contaminant level. Instead, the EPA uses what is called an "action level." The lead action level is 15 parts per billion (ppb) and is not a health standard. MWW is evaluated by the 90^{th} percentile instead of a hard number. This means that MWW collects 50 sample results, and the 45^{th} highest level is the 90^{th} percentile; it must be less than 15 ppb. If the sample reaches that number, MWW must institute a treatment plan and go back to standard monitoring until the samples are brought back into compliance.

Ms. Lewis is on the advisory board for EPA, so she is part of a group that is providing advice to EPA on simplifying the rule. It is the board's advice that the new rule should have a maximum contaminant level and that if a water sample goes over that, the following should result: the utility will be referred to the local health department, it must conduct outreach to the residents, and it must institute corrosion-control measures. If the corrosion-control measures fail, the utility must replace lead service lines or provide outreach that will be such a hardship that the utility would rather replace the lines than conduct the outreach. This would require the utility to remove the entire lead service line and every inch of lead from the source to the meter. She does not know whether or how much of the board's advice will be incorporated by the EPA in revising the current rule.

As an aside, in February 2016, *The Guardian* published an article pertaining to Chicago's water collection methods following the controversy in Flint, Michigan,

regarding its water crisis. In Chicago, from 2003 to 2015, 40 of the 59 people identified in the city's water testing scheme were current or former city employees. The city developed two separate sets of instructions for sample water: one for city employees and one for the general public. The city provided as its reasoning that it used employees' homes because they knew city employees were required to live in the city, so they would be assured that the homes were inside the city limits. In Chicago, the city's water utility is overseen by EPA Region 5, the same EPA district that oversaw Flint's water. The head of that EPA region, Susan Hedman, resigned in January in connection with the crisis in Flint. Meanwhile, Miguel Del Toral, an EPA water expert who attempted to blow the whistle on Flint's tainted water months before the crisis became public, wrote in a study that when sequential water samples were taken from homes in Chicago, they found "maximum [lead] values more than four times higher than Chicago's regulatory compliance results using a first-draw sampling protocol."

Answers to your specific questions follow.

1. **MWW conducts tests of 50 homes once every three years in compliance with EPA standards.**

MWW has been found to be compliant with the rule, and thus qualifies for testing once every three years, and accordingly follows the protocol outlined above.

2. **MWW is required to test 50 homes.**

EPA only requires testing of 50 homes for triennial monitoring. If MWW were found not to be in compliance, it would like have to increase to monitoring 100 homes every six months until it could bring levels back in compliance and demonstrate that its treatment techniques were working.

3. **Lead-in-water testing conducted in other municipalities**

<u>Washington, DC</u>

DC Water, the water utility in Washington, D.C., complies with EPA's lead and copper rule. It conducts regulatory and voluntary lead testing of 100 single-family homes every six months and reports results to EPA Region III. The sample sites are randomly selected from households with lead service pipes.

In addition, DC Water offers free lead testing to help residents identify potential lead sources. Lead test kits are delivered to households for homeowners to collect water samples. Residents collect two water samples (first draw and second draw) to provide a snapshot of lead in household drinking water. The first draw sample measures lead release from household plumbing and fixtures, especially potential lead sources near the tap where the sample is collected. The second draw sample measures lead release from lead service pipes and

household plumbing. If the lead level is above 15 ppb, DC Water works closely with homeowners to identify sources of lead.

Flint, MI

Flint changed its water supply to the Flint River in April 2014. Problems with the drinking water in Flint immediately began to arise. The water was not treated for lead, and state and city officials ignored or dismissed warnings about the problem for more than a year before a state of emergency was declared. The city's water testing practices did not meet EPA standards, which require Flint to conduct testing in the same way as outlined in the overview section of this memo.

The EPA requires Flint to collect tap samples from sites that are more likely to have plumbing materials containing lead. If more than 10 percent of samples exceed 15 ppb, then water systems are required to take action, including steps to optimize corrosion control treatment. City water officials had filed documents with state regulators claiming the city conducted tests in compliance with the EPA rule. However, those reports were false. An arrest warrant for Michael Glasgow, Flint Utilities Administrator, stated that he admitted submitting information that falsely showed all of the water samples were taken from locations with lead service lines.

Water samples sent to state labs for testing in the first six months of 2015 were marked as having come from homes with lead service lines, but actually almost always came from homes at less risk of lead leaching – houses with underground plumbing made of copper, galvanized steel, or materials that could not be identified, according to city documents given to reporters at the Flint Journal through a Freedom of Information Act request. Flint Utilities Administrator Mike Glasgow stated the city was struggling to collect the number of samples that were required following the city's switch to the Flint River as its water source in April 2014.

Part of the problem stemmed from poor recordkeeping, which went back more than 20 years, when the EPA lead guidelines were put in place. At the time, water systems were required to develop inventories of the materials in distribution systems so they could identify sample sites for lead and copper testing. Flint never did this, according to Mr. Glasgow. Instead, Flint had a hodgepodge of scattered records, tens of thousands of which were individual, hand-written index cards. Some of the slips of paper had service line information, but typically, they did not.

Instead, the city's water collection samples came from a random distribution of 175 testing sites, without regard for whether the homes were at high risk for lead leaching. The city included every test kit that was returned in its results, regardless of what material the homes' service lines were made of. The city also

knowingly dropped at least two water test samples with very high lead levels in the 2015 tests.

Government tests in late 2014, seven months after the Flint River water supply was introduced, showed just two of the 100 homes tested had levels above 15 ppb. An additional 37 had non-detectable lead levels. Further independent testing, however, showed dramatically higher lead concentrations.

In contrast to the city of Flint's testing practices, the University of Michigan-Flint has been quarterly testing its water since the fall of 2014. Additionally, Virginia Tech has conducted an independent study of Flint's water. It sampled 252 homes, the results of which showed that Flint had been failing to meet the EPA lead and copper rule.

Durham, NC

Like Milwaukee, Durham tests for lead every three years. The city maintains a sampling pool of more than 200 homes built between 1983 and 1985 throughout the city for the tests. During a testing year, samples are collected from the volunteer pool and analyzed for compliance. A first draw sample is collected after the water has stood unused in the plumbing for at least 6 hours – usually overnight. Durham's last round of testing in 2013 found compliance with the EPA rule. Testing for 2016 started in June and the results will be available in October.

Lead service lines have not been used in decades. When, on rare occasion, a lead service line is discovered, it is replaced by city water and sewer maintenance staff.

In 2007, excessive levels of lead were found in Durham's water supply, meaning the city failed to meet safety standards. Durham tested water at older homes across the city after a child at a city housing project showed signs of lead poisoning. Out of 89 water samples, 18 showed lead contamination above federal safety guidelines. Following a state citation, an additional 97 test results were turned over and showed the city to be out of compliance with the federal drinking-water standard. Afterward, the city tested its water every six months until it was able to meet requirements to be put back on a triennial monitoring cycle.

Greenville, NC

Greenville qualifies for reduced (triennial) monitoring but elects to conduct testing annually. Greenville Utilities sends more than 100 kits each year, although they are only required to collect 30 samples.

In addition, Mike Hager, a North Carolina state legislator, proposed a bill to require testing at all schools and child care facilities.

4. **MWW collects samples from the same 50 homes.**

MWW tests the same 50 homes every three years and conducts the test in the same manner each time in order to have a standard sample collection site and technique. When conducting scientific studies, it is important to conduct tests with the same conditions each time in order to run an accurate comparison.

5. **Testing is done on homes with lead service lines.**

EPA requires MWW to conduct tests on homes at highest risk of lead exposure, which means homes with lead service lines, and MWW is in compliance with this requirement.

LRB 166044

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

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To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: August 30, 2016

Subject: Disinfectants Used to Treat Public Drinking Water

This memo is in response to your request to provide the following information:

- What disinfectants are used to treat public drinking water in major European cities, particularly the largest cities in Germany (Berlin, Hamburg, München (Munich), Frankfurt, and Köln (Cologne))? Are they using chlorine, UV radiation, or some other method?
- What are the latest or cutting-edge trends in "clean" technology for disinfecting public water supplies (not limited to Europe)?

Disinfectants used to treat public drinking water in major European cities

In Germany, drinking water must comply with the Drinking Water Ordinance, which is based on the 1998 European Commission Drinking Water Directive. Germany works in collaboration with France, the Netherlands, and the United Kingdom to harmonize testing for drinking water. Drinking water may be treated only with agents approved by the Federal Ministry of Health; these agents include free chlorine and chlorine dioxide. Worldwide, chlorine is the most commonly used disinfection agent. Others include ozone, chlorine dioxide, and chloramines.

A summary of water treatment methods for the largest cities in Germany follows.

Berlin

Berlin does not add chemicals to its drinking water. According to information from Berlin's water utility, "Berlin's water is of a higher quality than stipulated by the German Drinking Water Ordinance." Berlin's water supply comes exclusively from groundwater. River water is treated by flocculation and filtration and is used for groundwater recharge or bank filtration. Drinking water chlorination was abandoned in West Berlin in 1978 and East Berlin in 1992 (following unification). However, small amounts of chlorine are used in weekly performance checks in the chlorination plants and occasional chlorination within the pipe system following pipe-burst events.

Hamburg

Groundwater is treated by oxygen aeration, evaporating carbon dioxide and hydrogen sulfide. Iron and manganese are oxidized and flocculated, and the solid flakes are removed in sand filters. The residues in the filters are periodically flushed. Water is then disinfected with chlorine or chlorine dioxide if necessary.

Munich

Drinking water comes from groundwater, which is not processed or purified.

Frankfurt

Drinking water comes from groundwater. Soil conservation is an integral part of groundwater protection. Officials keep records on soil contamination, ensuring that it is cleaned up, and monitor the groundwater. Water from precipitation on airports and roads is collected and diverted to prevent it from seeping into groundwater or contaminating drinking water pumps. Additionally, Frankfurt has replaced most of its lead drinking water pipes.

Cologne

Cologne uses groundwater, which is sprayed into large reservoirs, exposing the water to oxygen to improve the living conditions for microorganisms that help clean the water naturally. The water is then pumped into wells. The water is filtered through activated carbon.

Cutting-edge trends in "clean" technology for disinfecting public water supplies

The most common steps in water treatment include:

- Coagulation and flocculation. Chemicals with a positive charge are added to the water, which neutralizes the negative charge of dirt and other dissolved particles.
- Sedimentation. Settling of dirt and dissolved particles.
- Filtration. Clear water passes through filters.
- Disinfection. Usually chlorine or chloramine.

Typically, surface water requires more treatment and filtration than ground water because lakes, rivers, and streams contain more sediment and pollutants and are more likely to be contaminated than ground water, which has filtered through layers of earth.

Another method of water treatment is the use of barrier technologies, which filter contaminants out of the water. Barrier technologies for treating water include:

- Adsorbents, such as granular activated carbon.
- Membranes, such as nanofiltration, reverse osmosis, and ultrafiltration.

- Oxidation, such as ozone and peroxide.

Other treatment processes include:

- Ultraviolet (UV) treatment.
- Anion exchange (separates substances based on their charges using ion exchange resin, which coats negatively-charged counter-ions).
- Granular activated carbon.

LRB 166048

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

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To: Ald. Jim Bohl

From: Aaron Cadle – Legislative Fiscal Analyst

Date: September 1, 2016

Subject: Milwaukee Water Works Treatment Additives

Per your request, this memo lists the additives used by the Milwaukee Water Works during water treatment and the concentrations of these additives in water at the tap. Concentration levels come from the utility's 2015 Distribution System Water Quality report filed with the federal Environmental Protection Agency and the state Department of Natural Resources.

In answer to your 3 direct questions:

1. Chloramine is one of the additives used, and has been used since the Water Works began treating water at its current treatment plants (Linnwood – 1938 and Howard – 1962).
2. The fluoride additive is hydrofluorosilicic acid, not sodium chloride.
3. The orthophosphate used is phosphoric acid.

Milwaukee Water Works' Water Treatment Additives

- **Ozone gas** is bubbled through incoming lake water to destroy disease-causing microorganisms including Cryptosporidium. Also, ozone serves to control taste and odor, and to impede the formation of chlorinated disinfection byproducts. The gas is removed after this first step in the treatment process so none remains in water at the tap.
- **Aluminum sulfate** is added to neutralize the charge on microscopic particles suspended in the water. This encourages these particles to clump together so they can be more easily removed during the sedimentation process.
- **Chlorine** is added after sedimentation and filtration as a secondary disinfectant to provide extra protection from potentially harmful microorganisms.
- **Hydrofluorisilicic acid** is added as a fluoride treatment to help prevent tooth decay.
- **The** orthophosphate **phosphoric acid** is added to retard water pipe corrosion in order to limit or prevent the leaching of lead and copper into

the water as it passes through water service lines and user plumbing to the customer's tap.

- **Chloramine**, the final additive, is added as a disinfectant to maintain bacteriological protection in the distribution system.

Additive Concentrations

The following table lists concentrations of water treatment additives used by the Milwaukee Water Works at the customer's tap according to the utility's 2015 Distribution System Water Quality report. It should be noted chlorine is the residual substance remaining in the water, and measured for concentration levels, after both chlorine and chloramine (chlorine plus ammonia) treatments.

2015 Water Treatment Additive Concentrations (parts per million)				
	Chlorine	Hydrofluorosilicic Acid	Phosphoric Acid	Aluminum Sulfate
EPA/DNR Standards				
Maximum	4.0	4.0	Unregulated	Unregulated
Sample Concentrations				
Maximum	2.08	0.64	2.10	0.69
Minimum	0.23	0.06	0.95	< 0.002
Median	1.26	0.49	1.58	0.049

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. Jim Bohl

From: Aaron Cadle – Legislative Fiscal Analyst

Date: September 13, 2016

Subject: Sources of Lead in Drinking Water

Introduction

The Legislative Reference Bureau located reports authored by the U.S. Environmental Protection Agency (EPA), the Centers for Disease Control and 4 states (Wisconsin, Connecticut, Pennsylvania and Massachusetts) discussing the issue of lead in drinking water. This memo summarizes the views presented on sources of lead in drinking water, and related issues concerning lead in drinking water.

Sources of Lead in Drinking Water

The EPA estimates 10-20% of human lead consumption comes from drinking water. The Wisconsin Department of Natural Resources (DNR) asserts food is the greatest single source of lead for the average adult. Lead contamination of food typically occurs from lead in the air, or lead in food containers, particularly lead-soldered food containers.

The primary sources for lead in drinking water are lead service lines connecting residencies to utility mains, lead pipes used for interior plumbing inside residencies, lead solder (usually a 50/50, tin/lead compound) and fluxes used to join copper or galvanized steel piping used for interior plumbing, and brass or chrome-plated brass faucet fixtures. Lead leaches into drinking water when motionless water is in direct contact with the source of lead for long periods; the longer the period, the more lead will dissolve into the water.

The Massachusetts Water Resources Authority claims that in extreme cases, older faucets can contribute up to 1/3 of the lead in water that has been sitting in the pipes for several hours, with the remainder coming from lead solder joints in copper pipes or lead service lines.

While there is broad agreement these are the sources of lead in drinking water, the percentage of overall lead contamination at the

consumer's tap attributable to each source is addressed nowhere other than the Massachusetts Water Resources Authority report. To quote a DNR brochure, "The concentration of lead in drinking water can vary greatly, depending on the corrosivity of the water, the type and age of the plumbing materials used in the house and the length of time that the water stands in the pipes."

In general, water acidity acts to corrode pipes and fixtures to leach lead, while high levels of mineral content in water tends to coat pipes with a protective layer that inhibits lead leaching. Water combining high levels of acidity and low mineral content (soft water) corrodes most readily to cause greater amounts of lead to leach into drinking water. Hot water exacerbates lead leaching.

Milwaukee water is treated with phosphate (phosphoric acid), as mandated by the EPA, to reduce its natural corrosiveness. With this additive, Milwaukee water is described, according the Milwaukee Water Works, as not aggressive (not corrosive) and mildly scaling (pipe and fixture coating), reducing the chances of lead leaching.

U.S. Environmental Protection Agency's "Lead Free" Regulation

The EPA's 1986 Safe Drinking Water Act mandated that all solder and fluxes used to join copper pipe, interior plumbing for water consumption, and brass or chrome-plated brass faucet fixtures be "lead free," which the agency defined as containing not more than 8% lead. In 2014, the "lead free" standard was tightened by the agency to 0.25% lead.

The Massachusetts Water Resources Authority notes some manufacturers produce plastic faucets, while others are substituting other metals for the lead in the brass, inserting copper tubes inside the brass faucets, or applying special coatings on the inside of the faucets to meet EPA's "lead free" requirements.

U.S. Environmental Protection Agency Water Utility Regulation

In 1991, the EPA enacted the Lead and Copper Rule to regulate the levels of lead and copper in water distributed by public water utilities. Utilities are required to sample and monitor copper and lead concentrations in water at the tap of customers most likely to be affected by these contaminants. If 10% of customer water samples contain more than 15 parts per billion of lead, or 1.3 parts per million

of copper, the utility is ordered to take remedial action, which could include:

- Optimizing the utility's corrosion control treatment program (as the Milwaukee Water Works was ordered when it failed to meet lead-concentration standards).
- Educating the public about lead in drinking water and actions consumers can take to reduce their exposure to lead.
- Replacing the portions of lead service lines under the utility's control.

In Milwaukee, lead concentration levels for 90% of first-draw water samples (before "running" the water) taken at home taps of 50 sample customers most likely to be affected by lead contamination in 2014 were at or below 8.2 parts per billion, well below the EPA's 15 parts per billion threshold. Copper concentrations similarly sampled were at 0.038 parts per million versus EPA's 1.3 parts per million standard.

Method to Reduce Lead in Drinking Water at the Tap

The reports reviewed agree, that to avoid lead exposure, consumers should never drink or cook with hot water. They also agree the most effective method to reduce lead in drinking water passing through lead service lines or lead found in the piping, solder or faucet fixtures of interior plumbing is to flush water sitting in the pipes for extended periods before consuming. The flush time needed and method used, however, varies.

For residencies served by lead free service lines suspected of having interior lead plumbing, the DNR recommends flushing each tap that has gone unused for 6 or more hours until the water runs cold, usually 2-3 minutes. Residencies supplied by lead service lines should allow the flush water to run an additional 15 seconds after it cools.

According to the DNR, studies by the DNR have shown this flushing technique can reduce lead levels from hundreds of parts per billion to fewer than 3 parts per billion (the current detection limit at the State Laboratory of Hygiene).

The Centers for Disease Control recommend running the kitchen tap (or other principal tap used for water consumption) 1-2 minutes if the service line is known to be lead-free. If water is supplied by a lead service line, the shower or bathtub should first be run for 5 minutes or more, then the kitchen tap run for an additional 1-2 minutes before

drinking or cooking with water that has been sitting for 6 or more hours.

The states of Connecticut and Pennsylvania estimate flushing for 15-30 seconds should be sufficient to render tap water noticeably colder and rid the pipes of lead contamination. Massachusetts reckons a minute will be needed.

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

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To: Ald. James A. Bohl, Jr.
From: Tea Norfolk, Legislative Fiscal Analyst – Lead
Date: September 26, 2016
Subject: Neurological and other health effects of lead and contaminants in water

This memo is in response to your request to provide information regarding the neurological effects of the following substances in drinking water:

- Lead
- Chlorine
- Copper
- Fluoride

Lead

From the time Romans built the aqueducts, lead has been known to have neurotoxic effects, such as behavioral problems and learning and memory impairments. It damages the brain and peripheral nerves, which connect the brain and spinal cord to the rest of the body.

The primary concern for lead exposure is in children, whose developing brains are more vulnerable to toxic effects of lead exposure than those of adults. The detrimental effects of lead occur at lower levels in children than they do for adults exposed to lead. According to the Centers for Disease Control (CDC), the effects in children include: ataxia (lack of voluntary coordination of muscle movements), attention deficit hyperactivity disorder (ADHD), balance, coma, convulsions, death, encephalopathy (overall brain dysfunction), hearing impairment, hyperirritability, muscle coordination and weakness, muscle and bone development and growth, peripheral nerve function, sense of touch, stupor, synapse formation, and transmission of signals from one location to the next.

According to a study published in the Oxford Journals' Toxicological Sciences (Pabello, Nina G. and Valerie J. Bolifar. "Young Brains on Lead: Adult Neurological Consequences?" Volume 86, Issue 2, June 9, 2005, pp. 211-13), additional effects of lead include apoptosis (programmed cell death), excitotoxicity (nerve cells are damaged or killed by excessive stimulation by neurotransmitters), interference with neurotransmitter storage and release mechanisms, alterations in second messengers, damage to mitochondria, reduced viability of newly generated neurons, and glutamatergic transmission, which is a major player in development and neuronal plasticity and relates to memory impairment. Additionally, lead exposure influences mood, anxiety, and violence / aggression. Lead has been associated with the

development of neurodegenerative diseases later in life, such as Alzheimer's, Parkinson's, and possibly Schizophrenia.

According to one study by Anjali Patel ("How Does Lead Effect the Nervous System?"), lead's ability to substitute for calcium is a factor in its toxic actions because calcium ions help to convert the electrical pulse into a chemical signal. Cells absorb lead through the same channels from which they absorb calcium; accordingly, lead interferes with this electrochemical process. High levels of lead decrease transport of calcium and vice versa, therefore, these two elements function as competitive inhibitors. Lead can enter through the same ion channels as calcium and regulate the activity of those channels to uptake more lead into the cell. Additionally, a child's brain has more synapses than an adult brain, and it is patterned according to the stimuli received during development. If neural activity increases as a result of lead exposure, the development process can be inhibited. This can lead to permanent effects on synaptic anatomy and brain function. It is believed that this is one of the causes of learning and behavioral problems that occur in children. Additional effects of lead include interference on protein kinase C and an increase in the permeability of the blood-brain barrier (BBB), which can allow larger molecules to enter the brain and increase intracranial pressure. Neurological effects in children may begin at low blood lead levels (BPb), at or below 10 micrograms per deciliter (µg/dL). The CDC cites studies that have found that for every 10 µg/dL increase in BPb, children's IQ was found to be lower by 4 to 7 points.

According to the CDC, even without encephalopathy symptoms, lead exposure is associated with increased incidences of lasting neurological and behavioral damage. Some researchers have suggested that lead continues to contribute significantly to socio-behavior problems such as juvenile delinquency and violent crime. According to the National Institutes of Health (NIH), increased blood lead levels before birth and during early childhood were associated with higher rates of arrest for any reason and for violent crimes. For example, for every 5 µg/dL increase in BPb at 6 years of age, the risk of being arrested for a violent crime as a young adult increased by almost 50%. Due to the both the public health risk and the safety risk to the public, it is important to prevent all lead exposure.

According to the National Institutes of Health (NIH), lead exposure continues to be a major public health problem, particularly in urban centers in the United States. The developmental effects of lead occur during a critical time window, at 2 years of age and younger. Low-level exposure in early childhood has been shown to be inversely associated with neuropsychological development through the first 7 years of life. Additionally, an increase in lead level in breast milk with increasing maternal BPb poses an additional risk to newborn infants.

The NIH cites a study that examined 2 male cousins who were living in the same household. One subject had elevated BPb and the other did not. A comprehensive neuropsychological evaluation revealed difficulties in reading, writing, linguistics, attention, and arithmetic for the lead-exposed child. Additionally, NIH cites another study of adults who grew up around a smelter. The lead-exposed group had poorer

performance on tasks of abstract reasoning, cognitive flexibility, verbal memory, verbal fluency, and fine motor speed as compared to a control group. Dementia, loss of visual acuity, and peripheral neuropathy were also more prevalent.

Although the primary concern for lead exposure in children is neurological, lead exposure can also lead to additional health effects later in life, such as renal problems, hypertension, reproductive difficulties, and developmental issues with offspring. Lead can also affect the following systems: blood, endocrine, gastrointestinal, cardiovascular, and skeletal. Lead is absorbed and stored in bones, blood, and tissue and becomes a source of continual internal exposure. As the human body ages, bones demineralize and internal exposure increases as a result of larger releases of lead from bone tissue. Because of the way lead operates in the skeletal system, post-menopausal women have been found to have higher BPb than pre-menopausal women.

Lead exposure can negatively impact pregnancy outcomes, including premature birth, low birth weight, congenital abnormalities, and post-birth effects on growth and neurological development. Lead readily crosses the placenta and can adversely affect fetus viability as well as fetal and early childhood development. In addition, a retrospective study has shown a higher proportion of learning disabilities among school-aged children whose biological parents were lead-poisoned themselves as children 50 years prior.

In adults, neurological effects of lead include decreased libido, depression / mood changes, diminished cognitive performance, diminished hand dexterity, diminished reaction time, diminished visual motor performance, dizziness, dullness, fatigue, forgetfulness, headache, high blood pressure, impaired concentration, impotence, increased nervousness, irritability, lethargy, loss of memory, malaise, muscular tremor, paresthesia (prickling or tingling sensation), peripheral nerve function, poor attention span, postural balance, reduced IQ scores, slowed nerve function, forearm extensor weakness (wrist drop), and weakness.

Lead poisoning can happen if a person is exposed to very high levels over a short period of time. Symptoms include: abdominal pain, constipation, depression, distraction, fatigue, headache, irritability, loss of appetite, memory loss, nausea, pain or tingling in the hands and/or feet, and weakness.

The World Health Organization (WHO) notes that lead is a cumulative toxicant, which means it does not get eliminated from the body through normal bodily functions. The effects are irreversible. While there is no known safe blood lead concentration, as lead exposure increases, the range and severity of symptoms and effects does as well. Even BPb as low as 5 µg/dl may result in decreased intelligence in children and behavioral difficulties and learning problems.

Chlorine

The main danger of chlorine, according to the NIH, is from inhalation. According to one study cited by the NIH, subjects exposed to undiluted chlorine had impaired balance, delayed simple and choice reaction times, impaired color discrimination, impaired visual field performance, decreased hearing, decreased grip strength, delayed blink reflex, diminished cognitive performance, diminished verbal recall, elevated adverse mood states, reduced vital capacities, and impaired neurophysiologic and neuropscyhologic functions. These effects were noted one to 48 months after exposure and persisted. These effects are likely the reason chlorine gas has been used as a chemical warfare agent, as noted by the CDC.

According to the CDC, infants born to mothers residing in areas where surface water was disinfected with chlorine had smaller cranial circumference than those residing in areas with untreated well water. Additionally, neonatal jaundice occurred more frequently.

According to the New York State Department of Health, the health effects of chlorine are primarily due to its corrosive properties. The oxidizing effect of chlorine produces corrosive tissue damage and destroys cell structure. Ingestion of chlorine can cause corrosive tissue damage of the gastrointestinal tract.

Children may be more susceptible than adults to the health effects of chlorine, but the damage may not be evident until a later stage of development, according to the CDC. Neurodevelopmental delays and postnatal changes in serum thyroid hormone levels have been observed in animals following exposure of their mothers to chlorine dioxide or chlorite during gestation and/or lactation.

In addition to the health effects of chlorine and corrosiveness on bodily tissues, chlorine's corrosive properties have been found to leach lead from pipes into water, according to the American Society of Civil Engineers (ASCE). However, one study conducted by ASCE also revealed that chloramines were more likely to result in lead release from pipes than free chlorine, which the study found to not be as corrosive. In the study, lead solder provided the only source of lead in a system with pipe loops and copper pipe rigs. The water quality of the treated water had a low alkalinity, neutral pH, and low hardness. Additionally, the study used a corrosion control program that consisted of dosing with zinc orthophosphate.

In a study conducted by the Midwest Technology Assistance Center (MTAC), the researcher concluded that chlorine was of little importance to the galvanic corrosion process in lead pipes. (Cantor, Abigail F., et. al. "The Effect of Chlorine on Corrosion in Drinking Water Systems". November, 2000.) However, chlorine appeared to increase the corrosivity of water in copper pipes. Additionally, phosphate further increased the corrosivity by the end of a year of operation. Several researchers dislike adding phosphorus to the water system, as it stimulates microbial counts, which can increase corrosion in a water system.

Copper

According to the CDC, one study reported neurological effects from acute copper dust exposure as including headache, vertigo, and drowsiness. Other effects from copper include respiratory, hepatic, endocrine, and ocular effects. Children and infants exposed to excess levels of copper, at approximately 30 times higher than the dietary requirement for copper, have suffered liver damage. Idiopathic copper toxicosis has been linked to exposure to high levels of copper in drinking water.

According to the National Academies Press, acute copper toxicosis is manifested by hemolysis (rupture of red blood cells), headache, febrile reactions (fever), prostration (placing body in a prone position), and gastrointestinal symptoms. One child was observed to have these symptoms after a solution containing copper sulfate was applied to burned skin during a debridement procedure.

Fluoride

The neurotoxicity and corrosive effects of fluoride are controversial.

According to the CDC, “the concern that using fluorosilicate additives to fluoridate drinking water causes water system pipes to corrode is not supported by science.” The most common forms of fluoride for approximately 92% of the drinking water comes as either fluorosilicic acid or sodium fluorosilicate.

On the other hand, the National Academy of Sciences (NAS) has published a 2012 study by a group of Harvard scientists and researchers linking low levels of fluoride in drinking water with decreased thyroid function and depressed childhood IQ. Philippe Grandjean, adjunct professor of environmental health at Harvard School of Public Health, has stated that fluoride is in the same class as lead and mercury with respect to causing chemical “brain drain.” He noted that the effect of each toxicant may seem small, but that the combined damage on a population scale can be serious. Additionally, Grandjean noted that fluoride acts topically and need not be ingested for its dental benefits.

In 2006, the National Research Council (NRC) stated that “it is apparent that fluorides have the ability to interfere with the functions of the brain.” In addition to calling for U.S.-based research on fluoride’s IQ effects, the NRC expressed concern about fluoride’s possible contribution to dementia. According to the NRC: “Studies of populations exposed to different concentrations of fluoride should be undertaken to evaluate neurochemical changes that may be associated with dementia. Consideration should be given to assessing effects from chronic exposure, effects that might be delayed or occur late-in-life, and individual susceptibility.”

In 2011, the U.S. Department of Health and Human Services (DHHS) called for a 40% reduction in maximum fluoridation levels, pursuant to the findings in the NAS report. The CDC and the American Dental Association (ADA) has stated that mixing infant

formula with fluoridated water puts infants at risk of excessive fluoride intake. Dr. Hardy Limeback, DDS, a member of NAS Committee on Fluoride and former head of Preventive Dentistry at the University of Toronto, has identified risks of excessive fluoridation as including impaired brain and endocrine functions.

According to an NRC study, researchers noted that rats exposed to fluoride exhibited histopathological (microscopic tissue) changes similar to those traditionally associated with Alzheimer's. Additionally, links to diminished reasoning capabilities, problem-solving, IQ, and short-term and long-term memory were found as was a connection to dementia.

In a news story reporting on Israel's ban on fluoridation, Newsweek reported that high levels of fluoride can cause pitted teeth, bone defects, and thyroid problems. The story also cited to a study published in the medical journal The Lancet, which labeled fluoride as a developmental neurotoxin due to a link between high levels of exposure and reduced IQ in children. The study in The Lancet identified several industrial chemicals as neurotoxicants, including lead and fluoride, and noted that a fetus is not well protected against industrial chemicals, including fluoride. The placenta does not block the passage of these environmental toxicants from maternal to fetal circulation. An analysis of 27 cross-sectional studies of children exposed to fluoride in drinking water in China suggested an average IQ decrease of about seven points in children exposed to elevated fluoride concentrations.

A 2006 report from the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council noted that the EPA's drinking water standard for fluoride at the time (4 milligrams per liter (mg/L) of water) did not protect against the adverse health effects of fluoride. The report concluded that not only were children at risk of severe tooth enamel fluorosis, which causes tooth enamel loss and pitting, but that people who drink water containing 4 mg/L or more of fluoride over a lifetime are likely at increased risk for bone fractures. Children and infants experience 3 to 4 times greater exposure to fluoride than adults due to their bodyweight. Even at 2 mg/L of fluoride, the risk of moderate enamel fluorosis is increased. While skeletal fluorosis is uncommon, fracture risks are present from increased fluoride intake.

According to the National Center for Biotechnology Information, U.S. National Library of Medicine / National Institutes of Health (NIH), fluoride additives in water fluoridation are a potential vehicle for metal ingestion of cadmium, arsenic, lead, chromium, mercury, nickel, uranium, and other metals. Data from 2000 to 2006 and 2007 to 2011 showed detectable levels of up to 13 metal contaminants in finished drinking water samples as a result of water fluoridation procedures. The study warned that the controlled dilution process does not protect public safety in the case of accidents. The study further indicated that gaps in regulation could allow for unreported metal content to enter the public drinking water. The metal contaminant content of raw fluoride additives varies from batch to batch. Fluoride often contains arsenic, and while fluoride is typically monitored daily, arsenic is typically checked only quarterly or annually.

Additionally, combinations of contaminants can trigger chemical degradation, as fluoride tends to act as a corrosive to metals. For example, the NIH has previously reported that rats exposed to lead and sodium fluoride accumulate higher concentrations of lead in their blood and bone tissue than rats that had been exposed to only lead. In a study by University of North Carolina researchers, co-directors of the Environmental Quality Institute at the University of North Carolina – Ashville stated that fluoride chemicals combined with other water additives pull lead from plumbing systems into drinking water, especially a combination of chloramines and fluorosilicic acid.

Dr. J. William Hirzy, Chemist in Residence at American University's College of Arts and Sciences in Washington, D.C., and former EPA senior scientist, wrote a letter in 2013 to the acting administrator of EPA, petitioning EPA to prohibit the use of hydrofluorosilicic acid (HFSA) as a fluoridation agent, instead urging the use of pharmaceutical grade sodium fluoride. He identified HFSA as a hazardous waste by-product of industrial processes, and noted HFSA meets the criteria for classification as a hazardous waste under 42 U.S.C. § 6901 et. seq. More specifically, sodium fluoride is largely derived from by-products of the aluminum smelting industry, and HFSA is a waste by-product of the phosphate fertilizer manufacturing industry. Approximately 90% of drinking water systems that add fluoride use HFSA, which contains arsenic. In combination with chloramine, HFSA leaches lead from pipes and plumbing fixtures into drinking water.

The following countries have banned or stopped using fluoride in their drinking water:

- Austria
- Belgium
- Denmark
- Finland
- Germany
- Hungary
- Israel
- The Netherlands
- Norway

Some communities in the following countries have banned or stopped using fluoride:

- Australia
- Canada
- England
- Ireland
- Japan
- New Zealand

In the United States, hundreds of communities have banned or stopped using fluoride, including communities in the following:

- Alabama
- Alaska
- Arizona
- Arkansas
- California
- Colorado
- Florida
- Georgia
- Hawaii
- Idaho
- Indiana
- Iowa
- Kansas
- Louisiana
- Maine
- Maryland
- Massachusetts
- Michigan
- Mississippi
- Missouri
- Montana
- Nebraska
- New Mexico
- New York
- North Carolina
- Ohio
- Oregon
- Pennsylvania
- South Carolina
- Tennessee
- Texas
- Utah
- Vermont
- Virginia
- Washington
- West Virginia
- Wisconsin
- Wyoming

In Wisconsin, the following communities do not fluoridate their water:

- Balsam Lake
- Bloomer

- Blue River
- Chippewa Falls
- Granstburg
- Holmen
- Milltown
- Montello
- Prairie du Chien
- Saukville
- Shawano
- Shell Lake
- St. Croix Falls
- Village of Orfordville

Some of the communities that do not fluoridate their water provide the following reasons:

Albuquerque, New Mexico – Discontinued supplemental fluoridation because fluoride occurs naturally in water.

Chippewa Falls, WI – The cost of adding fluoride was too much for the budget.

Davis, California – Community members lobbied the city to stop fluoridating. In the city's decision, the mayor stated that the vast majority of fluoride added to city water would end up on lawns and down drains, calling instead for more focused efforts to combat dental decay. Adding fluoride at the water project's planned treatment plant would have cost the city as much as $301,000 before yearly operating costs, according to preliminary city estimates. Fluoridation costs would have added about $2 per month to residential customers' water bills, according to a city staff report.

Grantsburg, Wisconsin -- "If people want fluoride, they can get it anywhere — toothpaste, mouthwash, even gum," trustee Glenn Rolloff said. "I don't think we should continue injecting it in the water — the people should have the right to decide."

Montello, Wisconsin – Dentists opined that while there are some benefits to having fluoride put in municipal water, a person would get more fluoride from brushing his or her teeth daily than by drinking a gallon of city water.

Portland, Oregon –Portland's clean water campaign was spearheaded by Clean Water Portland (CWP). CWP gathered over 40,000 signatures to halt the mandate of fluoridation. Opposition to fluoridation included the regional Sierra Club, the Portland branch of the NAACP, Oregon's Department of Environmental Quality employees union, and more than 200 local medical professionals. Voters who rejected fluoridation were concerned by research showing low-income communities to be at highest risk of fluoride's adverse effects, with virtually no offsetting benefit.

Santa Fe, New Mexico – “What’s happening is you are fluoridating 100 percent of the water, and anywhere from 95 to 99 percent of it does not get ingested,” said Councilor Chris Calvert. “So you are basically dumping most of it into the environment one way or the other.”

Saukville, Wisconsin – Cost was a major factor in discontinuing fluoride treatment. Utility committee members questioned whether the added cost was justified, since just 4% of municipal water was consumed as drinking water, and the remaining 96% was used for other things. After considering the overall annual operational and maintenance expenses, including testing, the committee decided it was not worth the expense to continue fluoridating the water for such a small added value, especially taking into consideration that fluoride is widely available through other sources.

Shell Lake, Wisconsin – Council decided by unanimous vote to stop fluoridating based on employee safety and cost to properly ventilate the two city pump houses that contain the fluoridation equipment.

Tacoma, Washington – After discontinuing fluoride during a drought, lead concentration in drinking water dropped by almost 50%.

Thurmont, Maryland – Lead levels in the public drinking water system decreased significantly after the utility stopped adding fluoride.

Wichita, Kansas – Voters voted against fluoridation.

The City of Milwaukee fluoridates its water at a level not exceeding 0.7 mg/L and notes that the CDC recommends that parents use a low-fluoride alternative water source for formula-fed infants up to 6 months of age.

LRB 166425

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: October 3, 2016

Subject: Lead Leaching into Stagnant Water and Suggested Flushing Time

This memo is in response to your request to provide information regarding the rate at which lead accumulates in water by means of leaching over a period of time. This question is prompted by the suggested flushing time with respect to lead leaching into stagnant water.

The Milwaukee Water Works (MWW) recommends flushing water lines by means of running water until it is noticeably cold, usually approximately one to two minutes, after the water has been stagnant for at least six hours. This period of time is based on recommendations by the Environmental Protection Agency (EPA) and the Centers for Disease Control (CDC).

According to the EPA, the amount of lead that leaches into water over a given period of time is dependent on several factors, including:

- the chemistry of the water (acidity, alkalinity, corrosiveness) and the types and amounts of minerals in the water;
- the amount of lead it comes into contact with;
- the temperature of the water;
- the age and amount of wear in the pipes;
- how long the water stays in pipes;
- composition of the pipes;
- volume of water in the pipes; and
- the presence of protective scales or coatings inside the plumbing materials.

Leaching is a broad category that includes the dissolution of a variety of metals and chemicals into drinking water. In some instances, it is difficult to differentiate between corrosion and leaching.

According to a 2000 study published by D.A. Lytle and M.R. Schock in the Journal of Water Supply, “Impact of stagnation time on metal dissolution from plumbing materials

in drinking water," the EPA based its six-hour timeframe on a "worst case" lead or copper exposure period. In 1940, researchers found that copper levels increased to a maximum value under some experimental conditions in as little as two to three hours. In Schock's review of investigations related to lead pipe, researchers most often found that lead levels in treated drinking water rapidly increased and reached equilibrium at approximately "overnight" periods of stagnation. The rapidity of the increase was somewhat variable over the first few hours of stagnation and dependent on a variety of factors, as listed above. Thus, a minimum stagnation time of six hours was required to represent the maximum level of lead in water for testing purposes.

LRB 166447

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. Jim Bohl

From: Aaron Cadle – Legislative Fiscal Analyst

Date: October 6, 2016

Subject: 2017 Budget Items to Address Lead in Drinking Water

This memo identifies items in the 2017 Proposed Milwaukee Water Works Budget associated with lead in drinking water. All projected expenditures are from operations (no capital spending), and are associated with the replacement of lead service lines.

The Milwaukee Water Works plans to spend approximately $6.5 million in 2017 to replace lead service lines as follow:

1) $3.4 million to replace lead service lines for approximately 385 daycare facilities and some schools:
   - $1.8 million in Milwaukee Water Works operating spending to replace the City-owned portion of lead service lines replaced.
   - $1.6 million in State funding for the non-City-owned portion of lead service lines replaced.

2) $2.8 million for 300 “emergency” lead service line replacements anticipated in 2017 relating to service line failures:
   - $1.8 million in Milwaukee Water Works operating spending to replace the City-owned portion of lead service lines replaced.
   - $1.0 million in State funding for the non-City-owned portion of lead service lines replaced.

3) $120,000 – Construction supervisor

4) $100,000 – Water quality chemist

5) $100,000 – Program to warn customers of the possible risks of increased lead concentration in the water after service line repair. Supplies (including temporary pitcher-type filters) will also be provided to properties where lead service lines are replaced.

LRB #166426

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Dana J. Zelazny, Legislative Reference Bureau

Date: October 7, 2016

Subject: LEAD TESTING OF DRINKING WATER BY VARIOUS CITY DEPARTMENTS

This memo is in response to your request of September 19, 2016, regarding lead testing in water supplies by various city departments.

Milwaukee Water Works

Milwaukee Water Works (MWW) tests the City's water supply as it exits water treatment plants for a variety of contaminants, including lead. MWW also tests the tap water from 50 city residences for lead triennially, as part of the City's EPA monitoring requirements. All of the 50 residences are single family homes; none are charter schools or licensed daycare facilities.

According to Superintendent Carrie Lewis, MWW has not tested water supplies for lead at any public schools, charter schools or licensed daycares in Milwaukee.

Health Department

Historically, the Health Department has not tested drinking water supplies for lead contamination; rather, lead testing focused on paint, windows, etc., that were known sources of lead poisoning. Approximately three months ago, the Health Department added testing a home's tap water for lead contamination to the Health Department's "Environmental Health and Lead Risk Assessment" for residents found to have an Elevated Blood Lead (EBL) level. Whether or not a person's home water supply is tested depends on the resident's age, actual EBL level, and other factors, according in part to the chart below:

Blood Lead Result	Milwaukee Health Department Response
5 - 14 µg/dL	**All Results / All Ages**
	Letter with test result mailed to family
15 - 19 µg/dL	**Child <73 months with Venous Draw**
	Public Health Services Assistant Home Visit
20+ µg/dL	**Child <73 months with Venous Draw**
	Public Health Nurse Case Manager Home Visit
	Environmental Health and Lead Risk Assessment
45+ µg/dL	**All Results / All Ages**
	Immediate Milwaukee Health Department lead poisoning response
	Public Health Case Manager Home Visit
	Environmental Health and Lead Risk Assessment

The Health Department is being certified by the WI Department of Natural Resources to perform water-lead testing. The certification is expected to be finalized within the next month, and will reduce costs currently incurred from using a third-party to perform the tests. The Health Department has also hired an Environmental and Disease Control Specialist dedicated to testing lead in water, community outreach, data collection and analysis and collaborating with Water Works. This position will work with daycares, utility and DPW construction projects.

Licensed Day Care Facilities

The State daycare licensing body (Department of Children and Families) does not require a daycare to test its water supply for lead contamination unless the water is supplied from a private well. The City is in discussions with the State about whether to roll lead-water testing into the daycare licensing process. The Health Department supports this policy, since it would shift the cost of testing for lead from the City to the State, or at least to the daycare applicants.

The City recently received a $1 million loan from the Department of Natural Resources to begin replacing lead service lines, in addition to other funds dedicated to this purpose in the 2017 Proposed Budget. In the next month or so, the Health Department plans to start testing the water supply at each of the City's licensed daycare facilities that are known to have lead supply lines (approx. 380). Of these, 377 are licensed to provide care for children ages 3 and under, the period when children are most vulnerable to lead poisoning. The test results will determine the priority schedule for replacing lead service lines at the daycares.

Milwaukee Public Schools

On September 9, 2016, Milwaukee Public Schools announced that, out of an abundance of caution, a district-wide effort to conduct precautionary testing of drinking water in schools had begun over the 2016 summer recess. According to correspondence from MPS, the drinking water in all MPS schools is being tested for lead contamination. The water samples will be collected by MPS staff and sent to a contracted laboratory for testing. The analysis will be performed according to methodologies outlined by the City of Milwaukee Health Department and the U.S. Environmental Protection Agency.

According to Mr. Wendell Willis, Chief Operations Officer, "MPS is not aware of any interior lead plumbing lines, and there has been no disassembly of solder connections or individual plumbing fixture components for material analysis."

The targeted timeline for completion was initially Fall 2016, but this appears to have been pushed back somewhat. According to MPS, no cost analysis has been performed in the initial rush to conduct the tests, and test results will be made public after all data has been validated and verified.

City of Milwaukee Charter Schools

According to Ms. Gayle Peay, Administrator for the Charter School Review Committee (CSRC), the CSRC does not require new or existing City of Milwaukee charter schools to test their water supply for lead contamination. Likewise, the current charter school application form merely requires applicants to certify that their facilities are building code-compliant, and that any notices of health or safety code violations are remedied. According to Ms. Peay, the CSRC has no plans in place to require new or existing charter schools to test their water supply for lead, but a representative will be attending future Water Quality Task Force meetings to stay abreast of this issue.

If you have any other question related to this matter, please let me know.
LRB 166424

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. Jim Bohl

From: Aaron Cadle – Legislative Fiscal Analyst

Date: October 10, 2016

Subject: Lead Drinking Water Service Line Replacement Programs

The communities of Madison, WI, and Lansing, MI, are often cited as being in a class by themselves as civic models when it comes to dealing with lead in the drinking water resulting from lead service water supply lines. This memo summarizes the programs in these 2 communities to proactively remove all lead service lines from their drinking water systems as a solution to elevated concentrations of lead in their drinking water.

Madison, WI

The Madison lead service line replacement program was implemented in 2001 after the city failed to meet EPA lead concentrations limits in 1992, and spent many years searching, without success, for an acceptable chemical additive to reduce lead concentrations in the drinking water system. At the time, there were approximately 8,000 lead service lines in the Madison system, roughly 5,600 jointly-owned by the utility and the property owner. When the city decided in 2000 that full replacement of every lead service line connecting a customer to the water main was the only reliable way to significantly reduce lead concentrations in the water to meet EPA limits, it passed an ordinance requiring every property owner to replace his/her portion of a lead service line when the city replaced its portion of the line. The city replaced its portion of the line, while private plumbing contractors replaced the customer-owned portion. The city worked with the customer-engaged contractors to coordinate replacements to keep costs down for property owners by saving the cost of contractors re-digging access trenches, and in some cases bundling replacement projects.

The replacement of the 8,000 lead service lines took 11 years (2001 to 2011), although approximately 80% were completed by 2006. According to the utility, the cost was $15.5 million.

Madison provided rebates (not to exceed $1,000) for 50% of the customer's costs of replacement. The average rebate was $670. This suggests the average customer cost for service-line replacement was $1,340, but because rebates were capped at $1,000, and it is unknown how many replacements cost customers more than $2,000, this cost estimate may be low. The utility did not track how many property owners spent more than $2,000 to replace their lines,

but has the sense it was “only a handful.” While the utility maintains $2,000 was a reasonable estimate of the total property-owner cost for line replacement back in 2001-2006, Madison is considering increasing the maximum rebate to $1,500 for the one or 2 lead service line replacements still being done annually to reflect higher 2016 replacement costs.

Average cost of the utility-owned portion of lead service line replacements was $1,997.

Initially, the utility petitioned the Wisconsin Public Service Commission to include the cost of the rebates in its rate base. When the PSC denied the request, the common council increased sewer rates to pay for the rebates, arguing the cost avoided by not adding phosphates to prevent lead leaching into the drinking water, and then the costs avoided by not needing to remove these phosphates later during wastewater treatment justified using sewer fees to fund the replacement of lead service lines.

In the end, funding from sewer fees failed to materialize (sources at the utility are not clear why) and the utility used revenues from renting space on water towers for cell phone antennas to fund rebates to property owners.

Madison made no attempt to make its lead service line replacement program a “jobs program.” No RFP was issued. Existing utility personnel were used to replace the utility-owned portion of service lines. A private plumbing contractor chosen by the property owner replaced the portion owned by the property owner. Other than to require a licensed plumbing contractor to complete a safety certification issued by Madison Gas and Electric, and to have a permit to work in the public right-of-way, the utility made no efforts to influence property owners’ plumbing contractor selection. There were no EBE, LBE or MBE requirements for private contractors.

Service line removal was initiated by the utility, which required all customers to complete a survey indicating if their service lines were lead before the replacement program began. The utility then mapped a replacement schedule for the 8,000 lines to be replaced, starting with daycares, schools and other priority replacements. As the utility moved through its replacement schedule year by year, multiple notices were sent to property owners whose services lines were coming up for replacement, notifying them that they were required to replace their portion of lead service lines at the same time the utility replaced its portion. In the typical scenario, the utility would move from property to property down a block replacing its portion of the service lines, temporarily connecting the copper lines to the customers’ existing lead service lines, leaving trenches open for private plumbing contractors. The next week, private contractors would move from trench to trench replacing the property owners’ lead service lines, connecting the customers’ new copper lines to the utility’s new copper lines. The

utility then circled back to inspect the plumbing contractors' work, and to refill the trenches.

The utility indicates only a few customers failed to comply with the requirement to replace their portion of lead service lines replaced. Fines for non-compliance, which ranged from $50 to $1,000 per day, helped gain compliance. Occasionally, a property owner would refuse to comply when the utility replaced its portion of the service line. In these cases, the service line remained copper on the utility's side and lead on the property owners' side, the replacement trench was refilled, and the matter was turned over to the Madison City Attorney for legal action. If the property owner then dug out and replaced his/her portion of the service line in a reasonable amount of time (usually one year), he/she would still be eligible for a rebate.

The utility has no plans to address the possibility of lead pipes used for interior plumbing in the private property of customers.

Lansing, MI

The Lansing, MI, Board of Water and Light (BWL) is unique in 2 aspects. The utility owns, and has owned since 1927, all drinking water service lines. In addition, BWL sets its own water rates and is not overseen by a state public service commission. As a consequence, BWL has no ownership hurdles to clear if it wants to replace service lines, and is free to raise water rates to fund service line replacements.

In 2004, BWL's Board of Commissioners (11 local residents appointed by the mayor) approved a lead service line replacement program, despite the fact the utility was in full compliance with EPA lead concentration limits. As of March, 2016, 12 years into the program, the utility had replaced 13,500 lead service lines. Only 600 lead service lines remain to be replaced, and the utility expects to replace the last lead service line in its system by June 30, 2017.

Total costs to replace the 13,500 lead service lines were $42 million, or approximately $3,000 per service line replacement from the main to the customer's meter. All replacements are performed by utility personnel, and are considered infrastructure upgrades and routine capital improvements projects.

Funding for BWL's lead service line replacement program comes exclusively from water use rate increases, implemented by the BWL Board of Commissioners.

Using a special tool developed by utility engineers, BWL has developed a unique method for replacing lead service lines the utility claims has cut the cost of service line replacements in half. Rather than digging a trench to expose the length of the service line, BWL digs 2 holes approximately 4' X 4', one in the

street above the main, and another as near as possible to the customer's meter. The service line is cut at each end, and the copper replacement pipe is threaded into place, pushing out the old lead pipe. From time to time the lead pipe splits forming a partial conduit for the copper pipe, and is left buried. Less frequently, the lead service line does not move, and a trench must be dug to remove it. Flint, MI has used this method with limited success. BWL believes Flint service lines may be bent between the meter and the main, or have kinks that prevent the method from working.

BWL has not sought easements to gain access to its service lines, but prefers to work cooperatively with customers, and depends on good customer relations to enter customer properties to make its service line replacements.

LRB #166423

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: October 7, 2016

Subject: The Effect of Water Additives in the Leaching of Lead Service Lines and Interior Plumbing Sources of Lead

This memo is in response to your request to provide information regarding the effect of water additives in the leaching of lead service lines and interior lead plumbing fixtures.

Chlorine and Chloramine

According to a 2011 study by J. Hu, et. al., "Copper-Induced Metal Release from Lead Pipe into Drinking Water," published in Corrosion Engineering: The Journal of Science and Engineering, the addition of chlorine or chloramine affects the rate of lead oxidation and the corrosive and galvanic effects of water on lead pipes. In general, chloramine has been shown to produce greater galvanic corrosion effects on lead pipes than chlorine.

The corrosive effects of chlorine and chloramine are dependent on the type of pipe used. In one experiment involving new lead pipe, free chlorine caused more lead leaching into water than chloramine regardless of the presence of copper. The study was not conducted, however, on old lead pipes, and further research is required to examine old lead pipes with decades of accumulated rust.

Chloraminated water, however, appeared to have more corrosive effects on copper than chlorinated water. In chloraminated water, the presence of copper ions doubled lead leaching from lead pipes into the water. By comparison, chlorinated water required higher copper levels to increase lead leaching. Chloramine caused either the same or more lead leaching into water versus free chlorine when the water was stagnant.

The presence of either chlorine or chloramine increased the galvanic effects of water that had traveled through copper pipe on lead pipe. Water that had neither chlorine nor chloramine had a decreased galvanic effect when subjected to the same conditions.

According to a 2016 study by Jonathan Cuppett for the Water Research Foundation, “Lead and Copper Corrosion: An Overview of WRF Research,” the corrosion rate of and release of lead from solder alloys was higher in water with a high chloride-to-sulfate mass ratio. Lead solder and lead pipe galvanically connected to copper were the primary concern with respect to a high chloride-to-sulfate mass ratio. Both chlorine and chloramines accelerated the corrosion of copper and its alloys at pH6 but caused minimal corrosion at ph 8. Additionally, although free chlorine was slightly more corrosive than chloramines, systems that disinfected with combined chlorine and chloramine experienced higher rates of corrosion.

In a study conducted by the Midwest Technology Assistance Center (MTAC), the researcher concluded that chlorine was of little importance to the galvanic corrosion process in lead pipes. (Cantor, Abigail F., et. al. “The Effect of Chlorine on Corrosion in Drinking Water Systems”. November, 2000.) However, chlorine appeared to increase the corrosivity of water in copper pipes.

Phosphates and Other Additives

In the 2016 study by Cuppett, there does not appear to be a significant difference in performance between zinc orthophosphate and non-zinc orthophosphate for general corrosion of lead and copper. Copper corrosion is almost exclusively chemical, whereas lead release is governed by a combination of chemical, temperature, hydraulic, and other mechanical factors.

Secondary effects of corrosion control additives could lead to decreased performance, such as inoperable valves, pumps, and meters, and significant loss of capacity in water pipes. The most effective way to reduce total mass of lead measured at the tap was to replace the entire lead service line, lead sources in the premise plumbing, the faucet, and the meter. The study showed that elevated lead levels may occur immediately after lead source replacement and may persist for longer periods, depending on the materials and water quality at each site, and the amount of disturbance during replacement.

According to a 2010 study for the Water Research Foundation, “Contribution of Galvanic Corrosion to Lead in Water After Partial Lead Service Line Replacements” by Simoni Triantafyllidou and Marc Edwards, sulfate inhibited corrosion of lead-bearing materials. As the relative concentration of chloride to sulfate increased, so did lead concentration.

In the 2000 MTAC study by Cantor, phosphate further increased the corrosivity by the end of a year of operation. Several researchers oppose adding phosphorus to the water system, as it stimulates microbial counts, which can increase corrosion in a water system.

LRB 166677

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: October 7, 2016

Subject: Galvanic Effects on the Leaching of Lead in Pipes

This memo is in response to your request to provide information regarding the galvanic effects on the leaching of lead in pipes.

Galvanic corrosion is an electrochemical process in which the presence of one metal increases the corrosion of another metal when both metals are in electrical contact in the presence of an electrolyte. Water chemistry is a controlling factor in increasing galvanic corrosion and water lead contamination. This memo reviews studies of galvanic corrosion of lead pipes when copper pipes are attached to them.

According to a 2011 study by J. Hu, et. al., "Copper-Induced Metal Release from Lead Pipe into Drinking Water," published in Corrosion Engineering: The Journal of Science and Engineering, when lead pipe and copper pipe are electrochemically connected for drinking water distribution, galvanic lead corrosion is expected to occur. The presence of copper ions in continuously recirculating water increases the release of lead into water by orders of magnitude. Aside from "normal" lead corrosion, which occurs when lead pipe alone contacts drinking water, plumbing systems having a copper-to-lead pipe connection can introduce additional corrosion, which can exacerbate water lead contamination. Studies have shown abnormally erratic lead concentrations when lead pipe is connected to copper pipe. Because of the electrochemical connection, the corrosion rate of lead pipe can be markedly accelerated relative to that of a pure lead pipe.

When a copper pipe is placed upstream of a lead pipe, dissolved copper ions can collect onto the lead pipe surface and create multiple micro-galvanic cells between lead and plated copper. Each site of copper deposition can act as an individual galvanic cell, increasing the concentration of lead in the water. When lead pipe is placed upstream of copper pipe in the plumbing sequence, the risk of galvanic corrosion is decreased. In a common scenario where a partial lead pipe replacement is connected to a home with copper plumbing, there are two galvanic connections, which may maximize the potential

for lead deposition corrosion. Depending on plumbing materials in the home, partial lead service line replacement with copper has the potential to introduce or enhance galvanic corrosion.

In addition to the type of pipes used, other factors can affect the rate of lead oxidation, including the addition of chlorine or chloramine and the type of joint used to connect pipes together. Chloramine has been shown to produce greater galvanic corrosion effects than chlorine.

A 2010 study published by the Water Research Foundation, “Contribution of Galvanic Corrosion to Lead in Water After Partial Lead Service Line Replacements,” found similar results: connecting copper pipe to lead pipe creates an electrochemical or galvanic cell, which can accelerate corrosion of the lead pipe via galvanic connection to copper. Under stagnant water conditions, galvanic connections between lead pipe (either old or new) and copper pipe increased lead release into the water, compared to a full-length lead pipe alone. Additionally, the quality of water in the pipes (water chemistry, temperature, etc.) affects the extent of galvanic corrosion. In turn, the galvanic process affects the quality of drinking water output. Partial lead service line replacements have been known to increase the concentration of lead in drinking water. Short-term lead increase can occur from disturbing the lead rust that has accumulated on the pipe over decades of use and/or from creating metallic lead particles when the pipe is cut. Longer-term problems arise from creating a new electrochemical or galvanic cell between the old lead pipe and newly installed copper pipe. A rise in lead levels has been reported as lasting anywhere from four to eighteen months after a partial pipe replacement.

A partial lead service line replacement was linked to adverse health effects in Washington, D.C., and a 2010 announcement by the Centers of Disease Control and Prevention (CDC) warned that partial lead service line replacements may have increased the incidence of elevated blood lead levels in children.

A 2013 study by Brandi Clark, et. al., “Effect of connection type on galvanic corrosion between lead and copper pipes,” published in the Journal – American Water Works Association supported findings in the studies cited above. The study focuses on pipe connectors that can significantly influence galvanic corrosion by distancing the lead from the copper pipe.

LRB 166666

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: October 17, 2016

Subject: The Concentration of Lead in Drinking Water for Thurmont, Maryland and Tacoma, Washington

This memo is in response to your request to provide information regarding the concentration of lead in the drinking water of two communities: Thurmont, Maryland and Tacoma, Washington.

Brief Summary

According to a 2008 study by Peter L.D. Van Caulart, VP & Director Environmental Training Institute in Ontario, "Fluorosilicate Compounds Increase Drinking Water Lead Levels, Hence Source Water Contamination," fluosilicic acid is a good solvent for lead, and the prevalence of children with elevated blood lead levels is about double that in non-fluoridated communities. In his study, he notes the following:

> 1992 Tacoma, Washington had to shut down the fluoridation equipment due to the fact that fluoride had eaten the pipes. The municipal water had approximately 32 parts per billion (ppb) lead at the time of the breakdown. After the breakdown, the lead level dropped to 17 ppb. When the equipment was fixed, the lead level shot back up to 32 ppb. The city fathers decided to discontinue the use of fluoride, and the lead level again dropped. Over the next several years the lead level continued to drop, and today it is about 5 ppb. IAOMT p24-25.
>
> Thurmont, Maryland had an identical experience with fluoride raising lead levels in their municipal water system. IAOMT p25.

A 2015 report by Geoff Pain, “Plumbosolvency exacerbated by Water Fluoridation,” reports the same results: when Tacoma, Washington, discontinued fluoridation of its drinking water, lead levels in water dropped from 32 ppb to 17 ppb, and in Thurmont, Maryland, the lead levels dropped from 30 ppb to 7 ppb when fluoridation ceased.

A presentation by Frances Frech, “Fluoride and Lead,” originally presented at a State Lead Commission hearing in Hannibal, Missouri in 1994 stated the following:

> Let us tell you a tale of two cities–Tacoma, Washington, and Thurmont, Maryland. Both of them saw significant decline in lead levels only six months after fluoridation was stopped. (In Tacoma, that was due to equipment problems, in Thurmont, it was a temporary ban by the city council.) Tacoma registered a drop of nearly 50% (20); in Thurmont it was 78%. To the best of our knowledge, no other explanations were offered. In Thurmont the ban is now permanent.
>
> Unfortunately, Tacoma returned to fluoridating its drinking water and a battle continues over whether to stop it.

Thurmont, Maryland

In 1992, Thurmont, Maryland stopped fluoridating its water. Lead levels dropped by 78%. Thurmont turned off the fluoridation equipment permanently.

Thurmont’s water department posts the following notice to residents: “The Town of Thurmont does not add fluoride to the water system.” Thurmont gets its water from five wells, one of which is ground water under the influence of surface water and is, accordingly, treated as surface water. Although the drinking water is not treated with fluoride, some fluoride does naturally occur in Thurmont’s drinking water.

Thurmont issues an Annual Drinking Water Quality Report. The 2016 report identified the likely source of fluoride as “[e]rosion of natural deposits” and “[d]ischarge from fertilizer and aluminum factories.” It further states that fluoride is a “[w]ater additive which promotes strong teeth. Of the sites tested under the U.S. EPA’s Lead and Copper Rule, one had lead levels in the 90^{th} percentile for parts per billion of lead. The likely source of contaminants was listed as “[c]orrosion of household plumbing systems; [e]rosion of natural deposits.” No lead was detected in 2012.

According to a February 2, 1994 article by Julia Robb published in The Frederick Post:

> Lead levels in town water have decreased significantly since town officials stopped adding fluoride, commissioners reported at Wednesday's meeting. They also voted to officially ban fluoridation.
>
> Fluoride itself does not produce high lead levels, but fluoride must be introduced along with fluorosilicic acid, and town officials believe that the acid washes lead from pipe soldering, said Mayor Terrence Best.
>
> When commissioners first had water tested in 1992, some houses had 50 times the accepted limit established by the U.S. EPA, and the average amount measured twice the limit, he said. Commissioners then stopped using fluoride.
>
> The suggested lead limit in water is 15 parts per billion. A May 1993 test showed decreasing levels of lead in water. The high was 136.25 ppb, and the average was 9.25 ppb.
>
> A third test, conducted in November, found the high at 31.95 ppb and the average at 7.11 ppb.

Tacoma, Washington

According to a 1992 letter written by C. R. Myrick, Water Quality Coordinator of Tacoma Public Utilities, after Tacoma temporarily ceased fluoridation:

> It is interesting to note the 90th percentile lead concentration was 17 ppb this time compared to 32 ppb last time. We have not been using fluoride since the drought this summer. This latest testing gives us some limited insight as to the amount of chemical adjustment that may be necessary. The percentage of homes that failed the "action level" was 9.8 percent.

According to a January 4, 2014 article by Robert Jay Rowen, MD, published in the Sonoma County Gazette:

Tacoma had to close down fluoridation in its system in 1992. Fluoridated water had eaten away metallic copper from its pipes, exposing lead in fittings. Lead levels soared. When fluoridation was stopped, lead fell, only to rise again when fluoride was restarted. Fluorsilicic acid caused lead levels to spike to over 900 ppb. Fluoride's addition creates ammonium fluosilicate, an established solvent for metallic copper alloys. Other cities have documented clear dangerous lead drinking water elevations after fluoridation began (Lebanon, OR, NYC, Thurmont MD).

Studies Linking Fluoride's Effects on Lead Leaching into Water

According to a 2007 study by RP Maas, et. al., published in Neurotoxicology, "Effects of fluoridation and disinfection agent combinations on lead leaching from leaded-brass parts," when chlorine was added to water, lead levels doubled from 100 to 200 parts per billion (ppb). When fluosilicic acid, a type of fluoride, was added to chlorinated water, lead levels increased to more than 900 ppb. In this study, lead concentrations seemed to increase with time over a three-week period of using water treated with chlorine and added fluosilicic acid. The conclusion of the study was that fluoride chemicals combined with other water additives, especially a combination of chloramines and fluosilicic acid, pull lead from plumbing systems into drinking water.

According to a 2007 study by Myron J. Coplan, et. al, published on Neurotoxicology, "Confirmation of and explanations for elevated blood lead and other disorders in children exposed to water disinfection and fluoridation chemicals," living in communities with silicofluoride treated water is associated with prevalence of children with elevated blood lead at a rate of approximately double the rate in non-fluoridated communities. Silicofluoride is associated with corrosion of lead-bearing brass plumbing, producing elevated water lead levels at the faucet.

According to a 2000 study by RD Masters, et. al., published in Neurotoxicology, "Association of silicofluoride treated water with elevated blood lead," previous epidemiological studies have associated silicofluoride-treated community water with enhanced child blood lead parameters. The highest likelihood of children having elevated blood lead levels occurs when they are exposed to both silicofluoride-treated water and likely to be subject to another risk factor known to be associated with high blood lead levels, such as old housing.

According to a 2010 study by RM Sawan, et. al., published in Toxicology, “Fluoride increases lead concentrations in whole blood and in calcified tissues from lead-exposed rats,” higher blood lead levels have been reported in children living in communities that receive fluoride-treated water. The authors found that fluoride consistently increased concentrations of blood lead and calcified-tissue lead in animals exposed to low levels of lead. The authors suggested that a biological effect not yet recognized may underlie the epidemiological association between increased blood lead levels in children living in water-fluoridated communities.

Dr. J. William Hirzy, Chemist in Residence at American University’s College of Arts and Sciences in Washington, D.C., and former EPA senior scientist, wrote a letter in 2013 to the acting administrator of EPA, petitioning EPA to prohibit the use of hydrofluorosilicic acid (HFSA) as a fluoridation agent, instead urging the use of pharmaceutical grade sodium fluoride. He identified as one of his reasons for urging this prohibition, the fact that, in combination with chloramine, HFSA leaches lead from pipes and plumbing fixtures into drinking water.

Note, however, that the CDC states that “according to the U.S. EPA and the National Association of Corrosion Engineers, corrosion is not related to fluoride.” Instead, corrosion is caused primarily by dissolved oxygen, pH, water temperature, alkalinity, hardness, salt, hydrogen sulfide, and certain bacteria. Additionally:

> Fluoride, at concentrations found in potable water, does not cause corrosion. A small increase in the corrosivity of potable water that is already corrosive may occur after treatment with alum, chlorine, fluorosilicic acid, or sodium silicofluoride, which decreases pH. This may occur in some potable water sources with little buffering capacity; it can easily be resolved by adjusting the pH upward.

LRB 166720

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: November 2, 2016

Subject: Lead Testing Compared to Other Cities

This memo is in response to your request to provide information regarding Milwaukee's lead testing compared to other cities. This topic was discussed in the August 26, 2016 memo, LRB no. 166044. Below is a brief summary of that memo; for a more in-depth discussion, please see the original memo.

Milwaukee conducts its lead-in-water testing pursuant to the Lead and Copper Rule, the federal rule regulating monitoring requirements for lead and copper in tap water, 40 CFR 141.86, which is overseen by the Environmental Protection Agency (EPA). Milwaukee is in compliance with the requirements of the rule and qualifies for reduced monitoring. Accordingly, Milwaukee Water Works (MWW) conducts a test of 50 homes once every three years. Cities that are not in compliance with the rule must test 100 homes every six months.

Lead-in-water testing conducted in other municipalities

Washington, DC

DC Water, the water utility in Washington, D.C., complies with EPA's lead and copper rule. It conducts regulatory and voluntary lead testing of 100 single-family homes every six months and reports results to EPA Region III. The sample sites are randomly selected from households with lead service pipes.

In addition, DC Water offers free lead testing to help residents identify potential lead sources. Lead test kits are delivered to households for homeowners to collect water samples.

Flint, MI

Flint, MI, is required to test its water every six months. In contrast to the City of Flint's testing practices, the University of Michigan-Flint has been testing its water quarterly since the fall of 2014.

Durham, NC

Like Milwaukee, Durham tests for lead every three years. The city maintains a sampling pool of more than 200 homes built between 1983 and 1985 throughout the city for the tests.

Lead service lines have not been used in decades. When, on rare occasion, a lead service line is discovered, it is replaced by city water and sewer maintenance staff.

Greenville, NC

Greenville qualifies for reduced (triennial) monitoring but elects to conduct testing annually. Greenville Utilities sends more than 100 kits each year, although it is only required to collect 30 samples.

In addition, Mike Hager, a North Carolina state legislator, proposed a bill to require testing at all schools and child care facilities.

LRB 166044-4

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: November 2, 2016

Subject: List of Laboratories Providing Lead Testing Service

This memo is in response to your request for a list of vendors providing lead-in-water testing service.

Milwaukee Water Works provides a list of local commercial laboratories certified by the Wisconsin Department of Natural Resources for testing water for lead. Those labs are as follows:

Eurofins/Eaton Labs
(Formerly S-F Analytical)
2345 S. 170th Street, New Berlin
(262) 754-5300
Approximate cost per lead sample: $41.50

Northern Lake Service
2420 N. Grandview Blvd., Waukesha
(262) 547-3406
Approximate coast per lead sample: $30.00

Wisconsin State Lab of Hygiene
2601 Agriculture Drive, Madison
(800) 442-4618
Approximate cost per lead sample: $29.00 for results in 10 days and $58.00 for results in 2 days.

Additionally, residents can buy lead testing kits from most home improvement stores, such as Bliffert Lumber, Ace Hardware, or Home Depot ranging in price from approximately $10 to $50. The testing samples are sent to labs according to instructions in the kits.

LRB 166044-5

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: November 15, 2016

Subject: Audit on Water Additives

This memo is in response to your request to identify outside firms that conduct audits of public water systems.

In 1994, Milwaukee Water Works had an independent audit conducted on its lead and copper corrosion control procedures. The report was prepared as a joint effort among Milwaukee Water Works, Wisconsin Department of Natural Resources, Wauwatosa Water Utility, CH2M Hill, and the University of Illinois.

Any engineering consulting firm that specializes in drinking water treatment could conduct an audit of a public water system. Following is a brief list of firms offering this service:

CH2M Hill
135 S. 84th Street
Suite 400
Milwaukee, WI 53214

AECOM
1555 North River Center Drive
Suite 214
Milwaukee, WI 53212

Black and Veatch
225 E. Mason St.
Suite 801
Milwaukee, WI 53202

CDM Smith
330 E. Kilbourn Ave.
Suite 1219
Milwaukee, WI 53202

HNTB
11414 West Park Pl.
Suite 300
Milwaukee, WI 53224

MWH, now part of Stantec
789 North Water Street
Suite 430
Milwaukee, WI 53202

Tetra Tech
175 N. Corporate Dr.
Suite 100
Brookfield, WI 53045

Kennedy / Jenks Consultants
1515 East Woodfield Road
Suite 360
Schaumburg, IL 60173

Cornwell Engineering
712 Gum Rock Ct.
Newport News, VA 23606

LRB 167023

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: December 7, 2016

Subject: Possible funding sources for private-side lead water service line replacement

This memo is in response to your request to identify possible funding sources to help homeowners pay for replacement of the private-side portion of lead water service lines.

Community Development Block Grant

A) Whether any potential funds could offset costs on private-side work

Community Development Block Grant (CDBG) funds are only available to residents who are income eligible. Each resident would need to be individually assessed for income eligibility. CDBG could not create a block grant specifically for water service line replacement. Instead, a department, such as Department of Public Works (DPW) or Department of Neighborhood Services (DNS) or another City department, would need to act as the provider. DPW and DNS currently administer CDBG funds for other housing-related projects, and to use these funds specifically for lead service line replacement, the funds would need to be administered by one of these departments.

B) Whether block grant funding could be applied to workforce development component

At the time of this writing, no CDBG funds have been identified that could be applied to the workforce development component of this work.

C) Other considerations

CDBG funds require overhead that increase costs of using those funds. Some of the overhead includes prevailing wages and requirements to fix other issues on the property if there are aspects of the property that do not meet federal

standards. A CDBG-funded renovation project can cost approximately 20-30% more than funding the project from another source, such as self-funding.

CDBG funds are also a finite source. When allocating CDBG funds to a particular project, those funds are being taken away from another project that would have otherwise had those funds allocated to it.

Lead water service line funds are specifically allocated by the state and federal governments. The Health Department, for example, has received $40 million in lead abatement grants, and even those do not allow for payment of lead service line replacement. Those funds are specifically allocated for paint abatement. In order to use funds for water service line replacement, federal rules and grant rules would need to be amended.

Federal money from the Wisconsin Department of Natural Resources for lead service line replacement is targeted toward water system improvements. The State determines allocation of these funds. Currently, this is the source the City will rely on for 2017-18 lead service line replacement.

Creating a New Lead Remediation Fee

The City Attorney's Office is preparing an opinion in answer to this portion of the request.

LRB 167023

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: December 22, 2016

Subject: Costs of replacing lead water-service lines

This memo is in response to your request for a breakdown of cost estimates from when Lansing and Madison each started replacing lead water-service lines to when they finished that work. This memo further describes what each community did to drive down costs and become more efficient in their replacement efforts.

Lansing

A December 19, 2016 article by Eric Lacy[1] published in the Lansing State Journal, "BWL removed Lansing's last lead water-service line," stated that the last lead water-service line was removed in December 2016, and that it took 12 years from start to finish to complete the project of total lead water-service line removal in Lansing. In 2004, when the work first started, it costed approximately $9,000 per line for removal. By the time the last line was removed, it took a crew four hours at a cost of $3,600 per line. However, when the city did multiple blocks at a time, the cost could be even less than $3,600 per line.

Dick Peffley, General Manager of Lansing's Board of Water & Light, stated that when the lead water-service line project began, city workers opened a trench from the curb to the house, and it took approximately eight to nine hours to complete a line replacement. Approximately one year after the start of the project, the city started using a method of pulling pipes through the ground without digging a trench. Instead, workers dug a hole in the street at the water main, then threaded a cable through the old pipe from the customer's house. They attached a cutter head and the new copper pipe onto the end of the cable and pulled the cable and new pipe through the ground.

[1] Note that a January 22, 2016 article by Eric Lacy in the Lansing State Journal, "Lansing BWL's push to remove lead water lines continues," stated that at the beginning of the lead water-service line removal project, it costed approximately $3,100 to replace each lead line, but that at the time the article was printed, the cost was approximately $2,000 per line for a crew of two to three employees. In a follow-up conversation with Board of Water & Light's General Manager, Dick Peffley confirmed the December 2016 article's numbers and stated the January 2016 article's numbers were not accurate.

Approximately 80% of the time, this process took the old lead pipe out of the ground, and approximately 20% of the time, it split the old lead pipe and left it unusable in the ground. This new process reduced the amount of time for replacing a single line to 4 hours. Additionally, Lansing was able to keep costs down because it did not charge permit fees for completing the work. Mr. Peffley stated, however, that the city had first right to do asphalt repair after the line-replacement work was completed. He stated that the city's rates are higher than a contractor's because of requirements to pay higher wages than a contractor is allowed to pay. Therefore, Mr. Peffley believes further savings could be realized without the requirement for the city having first right to do the roadwork repair.

Madison

Madison's program started in 2001 and aimed to replace 8,000 lead water-service lines with copper lines. Madison Water Utility's website states that the program has "largely been completed." Although most of the work has been done, a few lead lines remain. The City covers half of a homeowner's cost, up to $1,000.

Robin Piper, Customer Service Manager for Madison Water Utility, stated that Madison initially thought each homeowner's service-line replacement would cost approximately $1,500, which would cost the utility approximately $700 per customer in reimbursements. Throughout the duration of the replacement project, Madison paid customers an average of $675.85 per reimbursement, so customers were typically charged a little more than $1,350 per replacement for their side of the work. In 2016, these costs have gone up because there are fewer lines to replace, and economies of scale cannot be realized. Accordingly, contractors charge more when they are setting up and digging one property at a time. Currently, customers are receiving estimates closer to $2,000 to $2,500 per line replacement. Madison is considering changing the reimbursement to $1,500 to help customers who have received higher estimates this past year.

As for replacement of the utility's side of a lead water-service line, the city started tracking its costs in 1995. In the beginning, instead of replacing lines with copper, the city cut off a line without replacing it at a cost of approximately $628 per line. That cost has not changed much over time. To replace lead water-service lines with copper, it cost the city an average of $2,318 on the utility side up until 2010. In 2008, a slow year, the city only replaced 12 lines at a cost of $6,600 on average for the utility's side of the replacement. In other years, the city was completing 360 to 528 projects per year at a

cost of $2,000 per line. Cost savings were realized through economies of scale. It was more cost-effective to replace a whole block's worth of lines at one time than to do one line at a time. The more lines Madison replaced, the lower the cost per line.

Madison requires customers to coordinate with contractors to do the private side of the work. Madison provides customers with a list of contractors authorized to do the work. If work is being done on a property, contractors notify nearby residents to let them know work is going to be done, and costs are typically lower to do a customer's work at the same time as their neighbors. Throughout the duration of the project, if the city was planning a street resurfacing project, the city would notify residents that it would be more cost-effective to get their service-line replacement work done at that time because the street was already being opened up for work on the pipes and the residents would not need to pay extra excavation costs.

Like Lansing, Madison uses the method of digging up the ground at the curb stop and threading the new copper line through the ground rather than digging a trench. Unlike Lansing, which provided city workers to complete the entire project, Madison required residents to hire a contractor for the private side of the work. Madison does work with the customer to leave the curb-stop hole open for a few additional days, as needed, to give the customer time to coordinate with the plumber and so the hole would not have to be opened up more than once.

Average Statewide Estimate

According to an April 27, 2016 Wisconsin Public Radio article, "Wisconsin Launches Effort To Replace Aging Lead Pipes To Safeguard Drinking Water," the Department of Natural Resources estimated that, statewide, replacement of a homeowner's portion of a lead water-service line would cost approximately $3,000.

LRB 167267

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: January 3, 2017

Subject: Date Milwaukee Started Using Copper for Water-Service Lines

This memo is in response to your request for information regarding the reason 1951 is used as a reference date for properties being serviced by lead water-service lines versus copper water-service lines.

The 1951 date does not come from the Milwaukee Code of Ordinances, but rather, from a search that Milwaukee Water Works (MWW) conducted of the actual materials historically used in water-service lines that were installed throughout the City.

A search of the historic Code did not reveal specific requirements for copper to be the only material used for water-service lines in 1951. A 1948 publication by Milwaukee Water Works provided that either copper or lead may be used for water-service lines. In 1957, the Common Council passed a resolution giving MWW and the Commissioner of Public Works authority to set forth water service piping specifications. In 1962, the City mandated copper as the material to be used in water-service lines.

Please see the pertinent provisions from the MWW and Department of Public Works publications below, followed by an explanation of MWW's searchable database used to determine the materials in water-service lines.

Pertinent Provisions

In 1948, Section 6.07 of the "Rules, Regulations and Rates Governing Water Service" by the Milwaukee Water Works (MWW) provided as follows:

> 6.07 Required Size, Type and Control
>
> The size and type of piping for a water supply to the premises and the means of controlling such supply shall be as set forth herein:

Size of Corp. Stop or Tapping Valve	Size of Service	Control of Service	Pipe Material
5/8”	3/4”	Curb Stop	Lead or Copper
3/4”	1”	Curb Stop	Lead or Copper
1”	1-1/4”	Curb Stop	Lead or Copper
1-1/2”	1-1/2”	Curb Stop	Lead or Copper
2”	2”	Branch Gate	Lead or Copper
3” & Up	3” & Up	Branch Gate	Lead or Copper

In 1957, the Common Council passed a resolution by File No. 57-1603 which provided, in pertinent part, as follows:

> *Whereas*, The interests of the utility are best served by having a separate publication of “Rules and Regulations” governing water service by the Milwaukee Water Works and a separate publication of “Water Service Piping Specifications” to be used separately and independently, as the situation requires, and…. therefore be it…
>
> *Resolved*, That the Commissioner of Public Works is hereby authorized and directed to alter and modify the “Water Service Piping Specifications” in the future, as required, without the approval of the Common Council….

In 1962, Section 2.1.3 of “The Specifications For Water Service Piping” by the Department of Public Works and MWW provided, in pertinent part, as follows:

2.1.3 Copper Water Service Piping

1. Use–Copper piping shall be used in all new service installations two (2) inches or smaller. Copper piping may be used to repair existing lead water service piping. Connections to lead pipe shall be made “lead to copper” wiped solder joints.

Milwaukee Water Works Search of Records

Milwaukee Water Works (MWW) keeps records of the materials used in the City-owned portion of water-service lines. The records are kept because a permit is required every time a water main is tapped. Tapping permits are numbered in sequential order,

beginning with Number 1, which was issued in 1874. Permits provide the address and the material used for the water-service line.

A search of the records revealed that all city-owned water-service lines up to permit no. 139,000, which was issued in 1947, were made of lead. All water-service lines after permit no. 150,000, which was issued in 1951, were made of copper. The water-service lines installed from 1947 to 1951 (permit nos. 139,001 – 149,999), were made of either lead or copper. Because some permits for lead lines were issued in 1951 prior to permit no. 150,000, using 1951 as the reference year is an estimate of the last year lead service lines were used.

MWW keeps records of the material used on the city-owned portion of the water-service lines for each specific property in its database of permit records. The records are searchable so that any property owner can contact MWW or download from the MWW website the list of properties that have a water meter or active billing account to find out whether the city-owned portion of their water-service line is made of lead or copper.

Note that the year refers to the date the water-service line was originally established. In some instances, a house may have burned down or been taken down, and a new house may have been built on the existing foundation. If the original water-service line remained connected and was still used in the new home, then the records reflect that original installation date and not the date that the new home was built on the property.

Also note that MWW does not have records of the material used for the privately-owned portion of the water-service line or even whether the material on the private side has been changed. Unless MWW has information to the contrary, MWW assumes that the material used on the private side is the same as the material used on the public side of the water-service line.

LRB 167349

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: January 9, 2017

Subject: Costs of replacing lead water-service lines

This memo is in response to your request for a breakdown of cost estimates from when Lansing and Madison each started replacing lead water-service lines to when they finished that work. This memo further describes what each community did to drive down costs and become more efficient in their replacement efforts.

Lansing

A December 19, 2016 article by Eric Lacy[1] published in the Lansing State Journal, "BWL removed Lansing's last lead water-service line," stated that the last lead water-service line was removed in December 2016, and that it took 12 years from start to finish to complete the project of total lead water-service line removal in Lansing. In 2004, when the work first started, it costed approximately $9,000 per line for removal. By the time the last line was removed, it took a crew four hours at a cost of $3,600 per line. However, when the city did multiple blocks at a time, the cost could be even less than $3,600 per line.

Dick Peffley, General Manager of Lansing's Board of Water & Light, stated that when the lead water-service line project began, city workers opened a trench from the curb to the house, and it took approximately eight to nine hours to complete a line replacement. Approximately one year after the start of the project, the city started using a method of pulling pipes through the ground without digging a trench. Instead, workers dug a hole in the street at the water main, then threaded a cable through the old pipe from the customer's house. They attached a cutter head and the new copper pipe onto the end of the cable and pulled the cable and new pipe through the ground.

[1] Note that a January 22, 2016 article by Eric Lacy in the Lansing State Journal, "Lansing BWL's push to remove lead water lines continues," stated that at the beginning of the lead water-service line removal project, it costed approximately $3,100 to replace each lead line, but that at the time the article was printed, the cost was approximately $2,000 per line for a crew of two to three employees. In a follow-up conversation with Board of Water & Light's General Manager, Dick Peffley confirmed the December 2016 article's numbers and stated the January 2016 article's numbers were not accurate.

Approximately 80% of the time, this process took the old lead pipe out of the ground, and approximately 20% of the time, it split the old lead pipe and left it unusable in the ground. This new process reduced the amount of time for replacing a single line to 4 hours. Additionally, Lansing was able to keep costs down because it did not charge permit fees for completing the work. Mr. Peffley stated, however, that the city had first right to do asphalt repair after the line-replacement work was completed. He stated that the city's rates are higher than a contractor's because of requirements to pay higher wages than a contractor is allowed to pay. Therefore, Mr. Peffley believes further savings could be realized without the requirement for the city having first right to do the roadwork repair.

Madison

Madison's program started in 2001 and aimed to replace 8,000 lead water-service lines with copper lines. Madison Water Utility's website states that the program has "largely been completed." Although most of the work has been done, a few lead lines remain. The City covers half of a homeowner's cost, up to $1,000.

Robin Piper, Customer Service Manager for Madison Water Utility, stated that Madison initially thought each homeowner's service-line replacement would cost approximately $1,500, which would cost the utility approximately $700 per customer in reimbursements. Throughout the duration of the replacement project, Madison paid customers an average of $675.85 per reimbursement, so customers were typically charged a little more than $1,350 per replacement for their side of the work. In 2016, these costs have gone up because there are fewer lines to replace, and economies of scale cannot be realized. Accordingly, contractors charge more when they are setting up and digging one property at a time. Currently, customers are receiving estimates closer to $2,000 to $2,500 per line replacement. Madison is considering changing the reimbursement to $1,500 to help customers who have received higher estimates this past year.

As for replacement of the utility's side of a lead water-service line, the city started tracking its costs in 1995. In the beginning, instead of replacing lines with copper, the city cut off a line without replacing it at a cost of approximately $628 per line. That cost has not changed much over time. To replace lead water-service lines with copper, it cost the city an average of $2,318 on the utility side up until 2010. In 2008, a slow year, the city only replaced 12 lines at a cost of $6,600 on average for the utility's side of the replacement. In other years, the city was completing 360 to 528 projects per year at a

cost of $2,000 per line. Cost savings were realized through economies of scale. It was more cost-effective to replace a whole block's worth of lines at one time than to do one line at a time. The more lines Madison replaced, the lower the cost per line.

Madison requires customers to coordinate with contractors to do the private side of the work. Madison provides customers with a list of contractors authorized to do the work. If work is being done on a property, contractors notify nearby residents to let them know work is going to be done, and costs are typically lower to do a customer's work at the same time as their neighbors. Throughout the duration of the project, if the city was planning a street resurfacing project, the city would notify residents that it would be more cost-effective to get their service-line replacement work done at that time because the street was already being opened up for work on the pipes and the residents would not need to pay extra excavation costs.

Like Lansing, Madison uses the method of digging up the ground at the curb stop and threading the new copper line through the ground rather than digging a trench. Unlike Lansing, which provided city workers to complete the entire project, Madison required residents to hire a contractor for the private side of the work. Madison does work with the customer to leave the curb-stop hole open for a few additional days, as needed, to give the customer time to coordinate with the plumber and so the hole would not have to be opened up more than once.

Challenges

Milwaukee faces a number of challenges with respect to construction and contracting, some of which Lansing and Madison faced as well. Those are addressed below.

1. <u>Water meter locations in the basement that are not at the front of the house. Accordingly, the water-service line runs underneath the basement floor.</u>

   Lansing

   Lansing did encounter properties with the water meter located at places other than the front of the house. In these situations, Lansing Board of Water and Light (BWL) would first try to work with the building owner to relocate the meter to the front of the building. If that was not an option, BWL then installed new service pipe from the main to the back of the building or to the nearest point where it could connect to the existing meter. If the service line ran under the basement floor, BWL excavated the basement floor and bore in new service from the inside excavation to the curb stop.

Most of the work done by contractors was for standard replacement. If contractors encountered anomalies, they contacted BWL, which worked with the building owner to find a reasonable resolution to the replacement. Each situation was taken on a case-by-case basis.

When relocating a meter to the front of the building, BWL hired a local plumber to run new internal plumbing from the new meter location to the old meter location. This work was done at the utility's expense.

Madison
While most meters in Madison were located at the front of the house, some meters were located at the back. In those instances, workers had to run the water-service line across the basement, and additional plumbing costs were associated with those situations. These situations were not, however, identified on the reimbursement form.

2. <u>The basement is a finished living unit.</u>

Lansing
Lansing did encounter homes with basements that were finished living units. In most of those instances, BWL would remove the finish materials and make the necessary replacements of the service and meter. BWL did not restore the finished area. Instead, the utility informed the building owner that its Rules and Regulation for service required the meter to be in a heated area of the building on an exterior wall and that it must be accessible.

Madison
In finished living units, meters were often located at the front of the house in a closet or an area hidden from view. However, occasionally, workers would need to remove sheetrock or paneling to do the work. The homeowner was required to coordinate repair of the area. Additionally, Madison has standards related to accessibility of water meters, so if a meter had sheetrock over it, the homeowner was required to put an access panel over it. The homeowner was reimbursed for the plumber's cost, but any carpentry or finishing work was the responsibility of the homeowner.

3. The water main is located along one side of a street, meaning half of the water-service lines run across a parking lane, a lane of traffic, a boulevard (possibly), another lane of traffic, and another parking lane.

   Lansing
   Lansing took into account that, in almost all cases, the location of the main would make it such that the water-service lines on one side of the street would be short and the water-service lines on the other side of the street would be long. BWL notes that its pulling technique did not work very well on longer pulling distances.

   Madison
   Although most of the services were in residential areas, there were some situations where workers had to go across several lanes of traffic. In those instances, Madison typically dug an open trench to do the work or coordinated with main replacement projects.

4. The building is set back far from the street, with a long service line.

   Lansing
   If possible, BWL used the pulling technique for buildings with long set-backs. When not possible, it bore in the service. BWL accepted bids based on an assumed average service length of 60 feet. Contractors submitted reimbursement for reasonable expenses for replacements longer than 60 feet.

   Madison
   Madison has several lake homes that are very far from the water main. For homeowners with such deep lots, the cost would be approximately $3-5,000 to replace the water-service line; those homeowners exceeded the reimbursement Madison allotted to each homeowner.

5. Davis-Bacon wage requirement.

   Lansing
   BWL did not use federal funds, so this did not apply.

   Madison
   Madison did not receive any federal funding, so it did not have to comply with the Davis-Bacon requirement.

6. Small / disadvantaged / woman-owned business requirement.

Lansing
Lansing does not require this.

Madison
Madison has a local ordinance requiring it to hire a certain percentage of small businesses to do any contractor work for projects over $100,000.

7. Residents preference requirement.

Lansing
Lansing does require local contractor preference for bids of $100,000 or greater. Local labor preference applies only to construction projects, and utilization of local labor may be considered in the evaluation of proposals.

Madison
Madison does not have a residents preference requirement.

Average Statewide Estimate

According to an April 27, 2016 Wisconsin Public Radio article, “Wisconsin Launches Effort To Replace Aging Lead Pipes To Safeguard Drinking Water,” the Department of Natural Resources estimated that, statewide, replacement of a homeowner’s portion of a lead water-service line would cost approximately $3,000.

LRB 167267

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: February 3, 2017

Subject: Great Lakes Cities That Have Conducted Independent Water Quality Audits on Water Chemistry and Additives

This memo is in response to your request for information regarding other cities that draw their drinking water from the Great Lakes and have conducted water quality audits on the water chemistry and additives they place in their drinking water.

Of the Great Lakes cities contacted, Kenosha is the only one that has conducted an audit, which it did in the mid-1990s prior to installing a microfilter plant. The engineering firm Montgomery Watson spearheaded the study for the purpose of determining which filter would be appropriate. Additionally, Kenosha has hired Abigail Cantor and Process Research Solutions to conduct studies related to polyphosphates and corrosion control.

The following Great Lakes cities have not conducted independent water quality audits outside of regular monitoring of water quality:

- Duluth, MN
- Marquette, MI
- Green Bay, WI
- Racine, WI
- Detroit, MI
- Cleveland, OH
- Erie, PA

The following cities did not respond to messages:

- Chicago, IL
- Gary, IN
- Sandusky, OH
- Buffalo, NY

LRB 167481

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. James A. Bohl, Jr.

From: Tea Norfolk, Legislative Fiscal Analyst – Lead

Date: February 16, 2017

Subject: Legislation regarding lead pipes

This memo is in response to your request to verify the accuracy of the Common Council action of 1921 mandating the use of "extra strong" lead pipes for all water pipes laid underground that are less than 2 inches in diameter, as well as information regarding when the code changed with respect to the use of brass in indoor water pipe installations.

The attached document, Common Council File No. 18790, making certain rules and regulations governing the introduction, supply, and consumption of water and the installation of plumbing connected therewith, was effective January 1, 1921. The specific provision in question states as follows:

> Sec. 23. All water pipes laid underground whether outside or inside the building and of a diameter less than two (2) inches shall be "extra strong" lead pipe. When the pipe is of 2" diameter it may be, and when of greater diameter than two (2) inches, it shall be cast iron "bell and spigot" pipe and what is termed as "Class C" pipe.
>
> When installed inside the building—above ground, or in a tunnel or pipe conduit, after passing the meter, the pipe may be lead, cast iron, galvanized iron or brass with corresponding fittings.
>
> Provided—that nothing contained in this section shall be construed to prohibit the use of wrought iron black pipe for fire service systems above ground, or of wrought iron black pipe under ground for grass plot or lawn sprinklers only, the depth of which piping must not exceed two (2) feet and must be provided with stop cock and drains for winter protection.

1921 is the first time there was a provision regarding inside pipes, and that was the first time brass was listed as an optional material. The 1922 edition is largely the same and also attached for your reference. The next significant change to the Rules and Regulations was in 1957; in this edition, brass is no longer specified as a material to use for internal pipes. Copper and lead are specified as material for pipes, and brass is only mentioned as a material for fittings; this edition is also attached for your reference.

LRB 167715

RULES AND REGULATIONS

Governing

WATER SERVICE

By The

MILWAUKEE WATER WORKS

The Rules and Regulations set forth herein are prescribed and established pursuant to the authority and power granted by the —

Wisconsin Statutes and enactments of the State Legislature

Milwaukee City Charter

Milwaukee Code of Ordinances

Resolutions of the Milwaukee Common Council

Public Service Commission of Wisconsin

and supersede all previously established Rules and Regulations governing water service by the Milwaukee Water Works.

Adopted by the Common Council of the City of Milwaukee. on September 17, 1957. Resolution File No. 57-1602.

Filed with the Public Service Commission of Wisconsin, on October 21, 1957.

1.1.9 Water Service Piping

Water service piping is the piping installed from the water mains to and including the valve and/or bypass tee and valve on the discharge side of the meter. Water service piping is further defined, depending on size and arrangement, as either Tap service piping or Branch service piping. The components of Tap service piping are a corporation stop, with or without a clamp, copper tubing or lead pipe, a curb stop, a service box, a meter stop, a meter with or without a meter horn, and a meter outlet valve. The components of Branch service piping are a tapping sleeve and valve, or a branch 3-way and a gate valve, a valve box, cast iron pipe, special castings, a meter, a meter inlet valve and outlet valve, and test connections, complete with valves. Branch service piping may be for regular water service, or private fire protection service. Branch service piping may have a single or battery meter settings.

1.1.10 Building Piping

Building piping is the piping from the valve, on the discharge side of the water meter, to its terminus at the point of consumption, or outlet. The City Plumbing Code is to be referred to for building piping. Applicable codes of the National Board of Fire Underwriters are to be referred to for building piping to be used for fire protection purposes.

1.1.11 Meter Setting

An installation of piping which includes a meter, or meters, complete with all valves and fittings necessary for normal operation of the meter, or meters.

1.1.12 Battery

Battery meter settings have two, or more, meters in parallel.

1.1.13 Rules and Regulations

A prescribed guide for conduct, action, and usage in relationship between the Utility and the Customer.

PART 3.00 — WATER SERVICE PIPING

Chapter 3.1.0 New Water Service Piping

3.1.1 General

Each Customer shall be served through water service piping which serves that Customer only.

3.1.2 Installation

New water service piping shall meet the requirements of the "Water Service Piping Specifications".

Chapter 3.2.0 Existing Water Service Piping

3.2.1 Protection Against Water Hammer

Where water hammer occurs in the house piping, a shock absorber should be installed as close to the fixture causing the hammer as possible, in order to protect the water service piping from damage.

3.2.2 Use of Existing Water Service Piping for New Structure

When a building has been razed, and plans have been filed with the Department of Building Inspection for a new structure on the premises, and water can be supplied through the existing water service piping, such water service piping may remain in service, upon owner's application; provided, that the installation conforms to the specifications for water service piping.

3.2.3 Unused Service Piping to be Capped

Existing unused service piping, found in an excavation near a main, is to be capped at the corporation stop by the Utility. Existing unused service piping, to an abandoned or demolished building, is to be capped between the lot line and the curb-stop, by the Customer's plumber.

SPECIFICATIONS

FOR

WATER SERVICE PIPING

The Specifications for Water Service Piping set forth herein are prescribed and established pursuant to the authority and power granted by the —

Wisconsin Statutes and enactments of the State Legislature

Milwaukee City Charter

Milwaukee Code of Ordinances

Resolutions of the Milwaukee Common Council

Public Service Commission of Wisconsin

and supersede all previously established Specifications for Water Service Piping.

Adopted by the Common Council of the City of Milwaukee, September 17, 1957. Resolution File No. 57-1603.

Filed with the Public Service Commission of Wisconsin, on October 21, 1957.

PART 2. MATERIALS

CHAPTER 2.1.0 MATERIALS

2.1.1 General — Material specifications have been prepared on the basis that the materials specified will be available when required. If any material specified is not available when required, the Commissioner of Public Works shall be contacted for written permission to substitute specific items for those specified and to vary the procedure of installation as the substitute material requires.

Page 8, Section 2.1.2 The coded figures after each item (for example: A-4-4a) identify specifications which are on file at the Milwaukee Water Works in the City Hall.

A — Cast Iron Pipe
Bell and Spigot Pipe A-4-4a

B — Fittings
Bell and Spigot Fitting A-4-4d

*C — Gate Valves A-4-2a

*D — Tapping Valves A-4-3a

*E — Tapping Valve Sleeves A-4-3b

F — Valve Boxes
Buffalo Type (Cast Iron) A-4-7a

G — Service Boxes
Buffalo Type A-4-7b
Shockproof Type (Hollow Walk Only) A-4-7d

*H — Curb Stops
Copper A-4-9a
Lead A-4-9b

*I — Corporation Stops
Copper A-4-9a
Lead A-4-9b

J — Meter Stops
Copper A-4-9a
Lead A-4-9b

K — Angle Stops
Copper Service Piping A-4-9a

L — Disc
Lead Disc for future extensions and abandonments

M — Meter Horn A-4-11d

N — Meter Well Cover — See Drawing 26.

O — Meter Pit — Double Trap Door — See Drawing 43.

P — Meter Pit — Ladders — See Drawing 45.

Q — Meter Pit — Manhole Frame & Lid — A-4-6a.

R — Metal Strapping — Tie rods, bolts, bands, nuts, washers and paint to suit.

S — Meters — A-4-11a or approved type.

T — Bronze Check Valves

U — Bronze Gate Valves

V — Clamp

2.1.3 Flanged Cast Iron Piping Materials — Cast Iron Pipe and Fittings — All cast iron pipe and fittings not furnished by the City shall be 125 pound Standard.

Gate Valves — All gate valves, three inches and larger shall be flanged and shall conform to AWWA specifications, 100 pound WOG. ~~All gate valves two inches and smaller shall be 150 pound brass gate valves — wedge disc screwed ends.~~

Check Valves — All check valves, three inches and larger shall be flanged and shall be "Underwriters Approved."

2.1.4 Copper Piping Materials — Tubing — Copper tubing shall conform to the standards prescribed in Federal Specifications WW-T-799 for "Seamless Copper Tubing for use with Flared Fittings" (Fed. Specification Board, October 18, 1932) and to the Specifications of the American Society for Testing Materials B88 and revisions thereof. Such tubing shall be free from grooving, cracks, indentations, flaws or other defects. The name or trade-mark of the manufacturer and a mark indicative of the type shall be permanently and plainly marked on the tubing at intervals not greater than one and one-half (1½) feet.

For underground installations from the street main to the water meter, copper services shall be "soft annealed" and shall be only of the type designated in the aforesaid Federal Specifications as "Type K", the dimensions and weights, for the various sizes of which are herein set forth:

Nom. I. D.	O. D.	Wall Thickness	Gage B. W. G.	Theoretical Lb./Ft.
¾	0.875	.065	16	0.641
1	1.125	.065	16	0.839
1¼	1.375	.065	16	1.04
1½	1.625	.072	15	1.36
2	2.125	.083	14	2.06

Dimensions-Inches

Copper tubing in ¾", 1", and 1¼" size may be furnished in coils or straight lengths, and copper tubing in 1½" and 2" sizes shall be furnished in straight lengths only. See Section 3.3.5.

Fittings — Fittings for copper tubing shall be of cast brass having an alloy of 85% copper, 5% tin, 5% zinc, and 5% lead. They shall be well made to assure uniformity in wall thickness and strength and shall be free from any defect which may affect their serviceability.

Each fitting shall be permanently and plainly marked with the name or trademark of the manufacturer.

Fittings shall be of the "flared" or "compression" type only. Unions shall be extra heavy 3-part unions only.

Meter Horns — Meter horns shall conform to City of Milwaukee specification A-4-11d.

2.1.5 Lead Piping Material — Lead Pipe — Lead pipe shall be made from virgin refined pig lead and shall conform to the U.S. Department of Commerce Commercial Standard for Lead Pipe, CS-95-41 and revisions thereof. It shall be of the dimensions, weight and classifications set forth herein, except as indicated in the note immediately following the table:

Nom. I. D.	Class	O. D.	Min. O. S. Cir.	Wall Thick.	Nom. Lb./Ft.
¾	XS	1.212	$3\frac{11}{16}$	.231	3.50
	XXS	1.336	$4\frac{1}{16}$	.293	4.75
1	XS	1.492	$4\frac{9}{16}$	.246	4.75
	XXS	1.596	$4\frac{7}{8}$	.298	6.00
1¼	XS	1.765	$5\frac{3}{8}$	.258	6.00
	XXS	1.889	$5\frac{13}{16}$	.320	7.75

Dimensions — Inches

Max. Working Pressure (psi) XS = 75 XXS = 100

If the pressure in the main exceeds 100 psi and lead pipe is desired by the customer, special written permission designating the class of pipe to be used shall be obtained from the General Office.

Solder — Solder use for making "wiped joints" shall conform to the standards specified by the American Society for Testing Materials for "Soft Solder Metal" A.S.T.M. Designation B32 and revisions thereof, and shall be of the chemical composition prescribed therein for Alloy Grade 40A, namely 40 percent tin and 60 percent (Nominal) lead.

2.1.6 Steel and Wrought Iron Pipe Materials — Pipe — Pipe shall be wrought iron or steel threaded pipe, thoroughly zinc coated (galvanized), and of no lesser weight than that known as "Standard" weight pipe, and shall conform to the standard specifications of the American Society for Testing Ma-

terials for "Welded Wrought Iron Pipe" — A.S.T.M. Designation A-72, and for "Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses" — A.S.T.M. Designation A-120, and revisions thereof, the dimensions and weights for the various sizes of which are herein set forth:

"STANDARD WEIGHT" PIPE

Size Nom. I. D.	O. D.	Threads per Inch	Thickness Stl.	Thickness W. I.	Weight Lb./Lin. Ft. (Threaded w. Couplings)
¾	1.050	14	0.113	0.115	1.13
1	1.315	11½	0.133	0.136	1.68
1¼	1.660	11½	0.140	0.143	2.28
1½	1.900	11½	0.145	0.148	2.73
2	2.375	11½	0.154	0.158	3.68
3	3.500	8	0.216	0.221	7.62
4	4.500	8	0.237	0.242	10.89
6	6.625	8	0.280	0.286	19.18

Dimensions — Inches

Fittings — All fittings shall be 125 or more pound fittings. Fittings two (2) inches and smaller shall be cast or malleable iron with reinforced or "Beaded" ends and thoroughly galvanized.

Unions shall be equal to Crane Railroad.

Fittings three (3) inches and larger shall be flanged-black cast iron.

Flanges shall be cast iron equal to Crane Catalog No. 553.

Valves — Check valves up to and including two-inch (2) shall be brass with brass disc and shall withstand a working pressure of 150 psi. W.O.G.

Gate Valves up to and including two (2) inch shall be made entirely of bronze with stuffing box and handwheel. Gate valves shall be of the wedge type with non-rising stems and shall be

guaranteed to withstand a working pressure of 150 psi. W.O.G. Valves with drips shall be furnished where shown on drawings.

Gate Valves larger than the two (2) inch size shall be AWWA Iron Body Double Disc Gate Valves.

All gate valves shall open to the left.

2.1.7 Regular Water Meters — Water meters shall be of the size and type necessary to insure accurate registration of the water requirements of the premises. Meters shall be of the size shown on Drawings 20, 21 and other attached drawings unless special permission is obtained. Meters 5/8 inch to 2 inches shall conform to specification A-4-11a. Meters 3 inches and larger for ordinary service shall be "compound" type with either bronze or iron case. Meters 3 inches and larger for large steady flows may be the "current" type.

2.1.8 Meters for Private Fire Protection Systems

Meters for private fire protection systems shall be either "Detector Check with By-Pass," "Compound-Proportional" or "Compound" depending on maximum flow through the meter and additional service required.

"Detector Check with By-Pass" meters will be approved by the Utility for installations within the City where the rate of flow due to leakage in the private fire protection system does not exceed 50 gpm. Hersey model DC "Detector Check with By-Pass" meter or equal are acceptable meters.

"Compound-Proportional" meters will be approved by the Utility for installations within the City where the rate of flow due to leakage in the private fire protection system exceeds 50 gpm. Hersey Model FM or Trident Protectus meters or equal are acceptable.

"Compound-Proportional" meters will be approved by the Utility for installations outside the City for private fire protection systems.

All meters for private fire protection systems are to be set by the customer's contractor and tested by the Utility.

1922

WATER SERVICE.

Water Pipe.

Sec. 22. Water pipes shall be installed in a workmanlike manner, well supported and thoroughly protected against damage by settlement, frost, or other causes, and shall be so laid or installed as to be readily drained.

Protected and drained.

Depth.

When laid in a street or alley, or in a lot outside of a building, the water pipe shall have not less than six (6) feet of earth covering. If the grade of the roadway is higher than the established or proposed grade, the pipe shall be so laid that it will not be less than six (6) feet below such established or proposed grade.

Where present grade is higher than proposed or established grade.

Character of pipe and fittings.

Sec. 23. All water pipes laid underground, whether outside or inside the building and of a diameter less than two (2) inches, shall be "extra strong" lead pipe. When the pipe is of 2" diameter it may be, and when of greater diameter than two (2) inches, it shall be cast iron "bell and spigot" pipe and what is termed as "Class C" pipe.

Underground.

Inside building—above ground.

When installed inside the building, above ground, or in a tunnel or pipe conduit, after passing the meter, the pipe may be lead, cast iron, galvanized iron or brass with corresponding fittings.

Exceptions: Fire Service Grass Plot Sprinklers.

Provided, that nothing contained in this section shall be construed to prohibit the use of wrought iron black pipe for fire service systems above ground, or of wrought iron black pipe under ground for grass plot or lawn sprinklers, only, the depth of which piping must not exceed two (2) feet and must be provided with stop-cock and drains for winter protection.

Corporation cocks. Curb and meter cocks and meter couplings.

Sec. 24. All corporation cocks, curb and meter cocks, and meter couplings shall be of the pattern adopted by the Milwaukee Water Works and shall be furnished by the Milwau-

kee Water Works only, on presentation of the receipted "tap" permit or the material bill.

Curb box.

Sec. 25. Curb boxes shall be cast iron "extensible pattern" two and one-half (2½) inches in diameter and seven feet in length with cover fastened to the box with a brass pentagon head screw bolt. The cover shall have the word "WATER" cast in raised letters across the face.

Tapping of mains.

Sec. 26. No street main of a greater internal diameter than twenty-four (24) inches shall be tapped for the distribution of water supply to any premise, nor shall a main be tapped at a distance of less than six (6) feet from the side line of the building to be supplied, nor within one (1) foot of another ferrule, or the bell end, or any sleeve connection on the main.

Request for tap or branch connection.

Sec. 27. Requests for the insertion of any corporation cock or branch connection in the City mains shall be made the day previous to the time desired for such connection. All lead services shall be in a position in the trench, from the main to the curb box, at the time of such insertion.

Service pipe diameter.

Sec. 28. Where "Street Improvement" or "Curb Services" are installed under private contract by the owner of any lot or parcel of land, such installations shall be of the same diameter as prescribed by the Commissioner of Public Works for similar installations under City Contract.

The minimum diameter of service pipes other than those installed to the curb for "future use" ("Curb Service") shall be three-fourths (¾") inch. All service pipe shall be full size from the street main to the meter. (For size of building service and size of meters see Sections 29-32, inclusive.) Service pipes shall be laid at the depth heretofore

provided and shall have sufficient extra length to provide for unforseen settlement. All service pipes shall be laid on a shelf of solid ground and not nearer than eight inches to any sewer trench or conduit. No pipe shall be laid through or across the interior of any sewer or any conduit carrying electric or telephone wires or cables, nor shall any pipe be imbedded in or pass through cinders, concrete or masonry, unless such pipe is thoroughly protected against damage by same.

Services one diameter larger than tap.

Lead service pipes shall be one lead pipe diameter larger than the corporation cock connection with the main, and shall have a brass stop-cock encased in a cast iron extensible box placed not more than two (2) feet inside the line of the street curb and on a line at right angle with the corporation cock connection. If the space inside the curb line is excavated the stop-cock and box shall be enclosed in concrete or masonry in such manner as to prevent the operation of the curb cock except from the street walk.

Curb cock and box in excavated walks.

One and one-half and two inches.

Lead services one and one-half (1½) and two (2) inches in diameter shall be connected to the street main by means of a two inch "branch connection" having a gate valve at the street main. The connection between the lead service and the gate valve shall be made with not less than twelve (12) inches of heavy brass pipe with a half coupling caulked into the gate valve and joined to the lead pipe by a wiped joint. No curb cock or box will be required for this installation.

Replacing old services.

When an old service pipe is to be replaced by another service, the new service shall, when possible, be laid in proximity to the old, and if not used in connection with the new service, the old corporation cock shall be uncovered and turned off at the main by the master plumber and a report of the turning off made to the Milwaukee Water Works.

Ald. Carney moved that the rules and regulations governing the introduction, supply and consumption of water and the installation of plumbing connected therewith and schedules of rates for water furnished by the Milwaukee Water Works accompanying the foregoing matter and submitted to the Common Council on October 18, 1920, be printed in full in the Proceedings and further action thereon be deferred until the next regular meeting.

The motion prevailed.

THE CHAIR thereupon presented the following:

FILE NUMBER 18790

RULES AND REGULATIONS GOVERNING THE INTRODUCTION, SUPPLY AND CONSUMPTION OF WATER AND THE INSTALLATION OF PLUMBING CONNECTED THEREWITH, AND SCHEDULE FOR THE PAYMENT OF RATES FOR WATER FURNISHED BY THE MILWAUKEE WATER WORKS.

The Commissioner of Public Works of the City of Milwaukee, under and by virtue of the authority vested in him by the Charter and Ordinances of the City of Milwaukee, hereby makes and establishes, subject to the approval of the Common Council, the following water rates, rules and regulations governing the introduction, supply and consumption of water furnished by the Milwaukee Water Works, and the installation and inspection of all plumbing connected therewith.

Made and established by the Commissioner of Public Works and approved by the Common Council of the City of Milwaukee , 192 , and effective January 1, 1921.

Consumers' Agreement

Shall be bounden by all rules

Section 1. It is hereby expressly stipulated as a condition of the grant of water service by the City of Milwaukee, that all persons now under grant of such service, or who may hereafter make application therefor, shall be considered as having agreed to be bounden by, all and singular, the rules and regulations as are herein, or as may hereafter be prescribed.

Shall enter no claim for damage

And it is further stipulated that no claim for damage shall be entered against the City of Milwaukee or any officer thereof, for damage caused by water leakage, or for damage to any pipe or appurtenance by reason of interrupted supply or variation in pressure, or for any damage of any nature whatsoever, caused by the turning off, or on, partially or wholly, of the water supply for the extension, alteration or repair of any water main, or the discontinuance of the water service for violation of any rule.

Grant of water service to premises annexed subsequent to laying of mains

Sec. 2. No permit for water service shall be granted for any property annexed to the City of Milwaukee subsequent to the laying of the water main in any thoroughfare abutting such property, until a water pipe assessment, based upon the frontage of the property and at a rate prescribed by the Superintendent of Water Works and Water Purification, has been paid.

Automatic Sprinkler Systems in City

Bond

Service Fee

Shall file plan

Sec. 3. Applications for connection of automatic sprinkler systems to the city mains, for premises within the city, must be accompanied by a bond to the City of Milwaukee in the sum of one thousand ($1,000.00) dollars, the form and security of which bond shall be approved by the Superintendent of Water Works and Water Purification, setting forth that the applicant or his successors, shall, at all times, be governed by the rules of the Milwaukee Water Works, as herein are, or as may hereafter be, prescribed, and further that the applicant will pay to the City of Milwaukee, on filing the application for the turning on of the water service, and annually thereafter, between the first and twentieth days of January, while said service is in use, the fee established for each branch connection with the city main. (See schedule of rates.) The applicant shall also file, with said application, an accurate plan of the system to be installed.

Systems outside city

No annual fee

Must provide meter

Applications for connection of automatic sprinkler systems to the city mains, for premises beyond the limits of the city, shall conform with the requirements set forth above, except that the applicant shall not be required to pay the moneys named on the filing of the application and annually thereafter, but shall be required to provide a suitable meter for the entire system and to pay the established rates for metered service for such system.

System to be sealed

On placing in service, those automatic sprinkler systems on the unmetered basis, all valves, hydrants and drain cocks, will be sealed by the Milwaukee Water Works, and it

Destruction of seals prohibited

Penalty

shall be the duty of the owner or occupant of the premise served, to prevent the destruction of these seals (except in case of water damage arising from the operation of a sprinkler head or breakage of a pipe) without the sanction of the Superintendent of Water Works and Water Purification. For any infraction of the provision of this section, the Superintendent of Water Works and Water Purification may cause the discontinuance of the service.

Installation and Maintenance of pipes, meters, etc.

Exempt from meterage

Sec. 4. The applicant for water service connection shall install, under the supervision of the Milwaukee Water Works, all piping, curb cocks and boxes, meters, meter cocks and valves, and other appurtenances, for the introduction and control of the water service, and shall maintain same in a manner free from leakage, inaccessibility or dangerous condition: Provided that the meterage of services for fountains, watering troughs and bubblers on public thoroughfares, sprinklers in center plots of boulevards, and automatic sprinkler systems may not be required.

Penalty

If the owner or occupant of any premise neglects or refuses to repair any defective service pipe or remedy any inaccessible or dangerous condition of any curb cock or curb box within forty-eight (48) hours of the written notification of the Milwaukee Water Works, it shall be optional with the Superintendent of Water Works and Water Purification to cause repairs made by the city at the expense of the premise, or to cause the discontinuance of the water service thereto.

Defective or unsuitable meters and indicators

Shall repair or replace within 5 days

Repairs of Indicators

Replacement by indicators prohibited

Sec. 5. Whenever a water meter or an indicator for a hydraulic elevator shall be found defective, or unsuitable for the proper control of the service, the Superintendent of Water Works and Water Purification shall cause notification of such condition, addressed to the "Owner or Occupant" delivered to the premises in which such water meter or elevator indicator has been in service. Said owner or occupant shall, within five (5) days from date of such notification, authorize the Superintendent of Water Works and Water Purification to repair said water meter or elevator indicator at his expense, or shall signify his intention to have the water meter repaired elsewhere, or that he will have the water meter or indicator replaced by an approved meter. It is expressly provided, however, that defective elevator indicators shall be repaired by the Milwaukee Water Works only and further provided that no defective indicator shall be replaced by another of a similar device.

Penalty

Failure to comply with the provisions of this section shall be punishable by the discontinuance of the water service.

Meter location and connection maintenance

Sec. 6. The location of every meter shall at all times be maintained in a safe, clean, and sanitary condition and shall have unobstructed passage way thereto, and all connections for the meter shall be of the standard as hereinafter provided and shall be maintained free from defect or obstruction of any nature whatsoever.

Remedial measures within 5 days

Whenever such meter location or meter connection shall be found in a condition contrary to this section, the owner or occupant shall, within five (5) days from date of notification thereof, cause the condition remedied in all respects as set forth in such notification.

Penalty

Non-compliance with the provisions of this section shall constitute sufficient cause for the discontinuance of further water service to the premise.

Connections with water supply from other source prohibited

Existing connections to be removed

Sec. 7. No connection of any nature shall be made, either directly or indirectly, with the piping for the city water supply and that of the supply from any other source, and existing installations of this nature shall be removed upon five (5) days' notification by the Superintendent of Water Works and Water Purification, if in his judgment such installation is dangerous to the public supply, failing in which removal the premise shall be deprived of further city water service.

Consumers' request for meter test

Sec. 8. Consumers may have their meters tested on filing an application for such meter test, agreeing to pay the test charge herein set forth for the size of the meter tested. If the meter does not test within the accuracy limitations, such charge shall be cancelled, and for any over-registration shown, a credit shall be entered for such rate of over-registration for a period not exceeding three (3) months previous to the test

of the meter. In all cases the test report of the Milwaukee Water Works shall be accepted as final.

METER TEST CHARGE.

Test Charge

⅝ in. to 1¼ in. meters (inclusive)	$1.00
1½ in. and 2 in. meters	2.50
3 inch and larger	7.50

Meter removal for building operations

Sec. 9. The removal of meters on account of the remodeling, reconstruction or removal of the building shall be made by the MILWAUKEE WATER WORKS only. Such removal will be made upon request of the owner or agent of the premise, or if advisable the MILWAUKEE WATER WORKS may make the meter removal without such request. On removal of the meter the water shall be turned off and the meter placed in storage subject to the owners' notification of disposal—unless the meter is in such condition that repairs cannot be made, in which case the meter may, after obtaining the registration reading thereof, be left on the premise. In the absence of specific directions, the meter may be returned to the premise at the expiration of six (6) months and the signature of the occupant of the building on the premise formerly served by the meter shall be considered sufficient for the delivery receipt.

Temporary Service

Service basis optional with Superintendent

Sec. 10. It shall be optional with the Superintendent of Water Works and Water Purification to grant water service for temporary use (building construction, public improvement or special service) upon an unmetered basis at the rates herein established, or to place such service upon a metered basis at the established meter rates.

Unmetered temporary service from tap connection

Method of control

If such service is on the unmetered basis and is supplied from a service tap, the consumer shall prepay the water rate therefor, and provide a hose cock or valve to be screwed into the connection furnished by the plumber for the control of such service.

From fire hydrant

Wrench deposit

If such unmetered service is from a fire hydrant the consumer shall, in addition to the prepayment of the water rate, deposit the sum of three ($3.00) dollars as security for a hydrant wrench.

Method of control

The connection to the hydrant shall be made by a brass reducing hydrant coupling and a valve. In the use of the hydrant, the hydrant valve shall be turned full open with the official hydrant wrench only and regulation of flow shall be by means of the valve on the service line.

Confiscation of Unofficial Wrenches

The use or possession of any hydrant wrench other than the official hydrant wrench of the Milwaukee Water Works, or of any gate valve key, at any place where water is used for purpose set forth in this section, is strictly prohibited. And any such unofficial wrench or such gate valve key so found may be confiscated by the Milwaukee Water Works.

Metered temporary service

Deposits

If the temporary service is to be on the metered basis, the applicant shall deposit, with the Milwaukee Water Works, a sum of money not less than twenty-five ($25.00) dollars for each meter used, as guarantee of payment for the water rates, or other accounts accruing from use of such service, and the further sum of three ($3.00) dollars as security for hydrant wrench if the service is to be taken from a fire hydrant.

Shall provide Meter

Fire hydrant connections

The applicant shall provide a suitable meter and connections therefor and shall pay all charges for the test and installation of the meter by the Milwaukee Water Works. All connections with, and the control of water from fire hydrants shall be as hereinbefore provided.

Refund of deposits

All moneys deposited as security for payment of metered service and hydrant wrenches will be refunded upon payment of accounts accruing for such service and upon return of the hydrant wrench.

Water on or off

Sec. 11. Water service will be turned on or off by the Milwaukee Water Works only upon written request.

MASTER PLUMBERS' BOND.

Who may do plumbing work

Section 12. No person shall make any connection or attachment whatsoever with the mains furnishing water supply from the Milwaukee Water Works, or shall do any plumbing work, or prepare such work for the introduction, extension or alteration of any pipe for such water supply, unless such person shall have secured a permit therefor from the Milwaukee Water Works as hereinafter provided.

Master plumbers' license and bond

Sec. 13. No permit shall be granted to any person to do any plumbing work as provided in section 12 of these rules, unless such person shall have been licensed by the State Board of Health as a Master Plumber in accordance with Chapter 383, Laws of 1919, and shall have executed, to the City of Milwaukee, a bond in the sum of one thousand ($1,000.00) dollars, the security of which shall be approved by the Superintendent of Water Works and Water Purification and of a form as herein provided.

Bond Security

Condition of bond

The condition of such bond shall be that, in consideration of the grant of the permit to do plumbing work as herein before provided, the applicant therefor shall agree to be bounden by any and all rules or regulations as are now, or as may hereafter be enacted by the Commissioner of Public Works, by and with the approval of the Common Council, and that said applicant, shall indemnify and save harmless the City of Milwaukee, or any officer thereof, of and from any accident or damage arising from any negligence, unfaithful, imperfect or inadequate work by virtue of his license and permit as master plumber, and that he will replace, restore and maintain, for a period of six (6) months next thereafter, any excavation or any pavement over any opening he may make in any thoroughfare, and that he will pay all fines imposed on him for violation of any rule or regulation of the Milwaukee Water Works.

There shall be set forth in said bond the business address of the applicant, and the name of the firm or corporation, if any, which he represents, and it shall be a condition of said bond that immediate notification shall be given by the applicant, to the Superintendent of Water Works and Water Purification of any change of the business address of said applicant. Such bond shall have full force and effect only during the limitation of the master plumbers' license and shall be considered sufficient for all permits issued during such limitation of the master plumbers' license.

No fee

No fee shall be required by the Milwaukee Water Works for the filing of the master plumbers' bond.

Exception

Nothing contained in this section shall apply to any person, firm or corporation engaged in the laying of water mains under the jurisdiction of the Milwaukee Water Works, in any street, alley, or any thoroughfare designed for public use.

Unlawful grant or use of name

Sec. 14. No master plumber shall grant or allow the use of his name by any other person for the purpose of obtaining permits or doing work under his license.

Penalty

Sec. 15. Any master plumber who shall violate any rule or regulation of the MILWAUKEE WATER WORKS, or who shall make any misrepresentation of his work to any person acting under the authority of the MILWAUKEE WATER WORKS, or who shall neglect or refuse to make a return for any work performed under his permit, or shall turn on, or leave turned on, any water not officially turned by the Milwaukee Water Works, may, in the discretion of the Commissioner of Public Works, after review of testimony or evidence of such violation or misrepresentation, be suspended from any act or power arising from any permits, for a period not exceeding sixty (60) days.

APPLICATIONS AND RETURNS.

Forms

Sec. 16. All applications for permits and meter installations, and all returns of the work performed under such permit shall be on forms prescribed and furnished by the City of Milwaukee; and all information required therein, or any additional information necessary for a full knowledge of the work to be, or which has been performed, shall be fully and truthfully furnished by the master plumber making such application or return.

Applications by Master Plumbers only

Sec. 17. Application for a permit to do any plumbing connected or designed to be connected with the water supply furnished by the MILWAUKEE WATER WORKS, shall be made by a licensed and bonded master plumber only.

Applications not required for certain work

Such application shall be signed by the owner or authorized agent of the owner of the premise for which the work is to be done. *Provided*—that no application for a permit shall be required for the installation of water mains, under the jurisdiction of the MILWAUKEE WATER WORKS in any street or alley or in any thoroughfare designed for public use, or for the repair or the replacement of defective pipes, valves or cocks.

Returns

Sec. 18. Every master plumber shall make a full return of the work performed under his permits, within forty-eight (48) hours after the completion thereof; and any omission or misrepresentation in the return or any violation of these rules, in the installation of the work shall be rectified within forty-eight (48) hours after notification thereof.

Must not turn on water

Sec. 19. No master plumber shall turn on, or leave turned on, any water service after the completion and trial of his work, whether installed, under his permit, from the street main or curb service, or in the extension or repair of any water supply, which for any reason has been turned off by the Milwaukee Water Works.

Water service "on" order

No water service will be turned on by the Milwaukee Water Works until the master plumber's return has been approved and an order signed for such service.

STREET EXCAVATION.

Street permit

Sec. 20. No person shall open or excavate any street or alley unless he has secured a permit therefor from the Commissioner of Public Works. All such openings or excavations shall be made in a manner to cause the least possible inconvenience to public travel, and shall provide for the passage of water along the gutter of the street or alley.

Precautionary measures

Such openings or excavations shall be provided with sufficient night lamps, barriers, sheeting, bracing and other precautions to guard against accidents to persons or property of any kind.

The person to whom such permit is granted shall relay or repair any water pipe, conduit or sewer damaged. He shall do the excavation and refilling of the trenches and the restoration of the pavement or the surface of the street, alley or walk in a workmanlike manner as expeditiously as possible. He shall remove all surplus material and maintain the trench filling in a perfect condition for a period of six (6) months next thereafter.

Liability

For any damages resulting from negligence, to provide reasonable precaution against accident to person or property, the person to whom such permit has been issued shall be held liable.

Street Pavements

Sec. 21. No permit shall be granted for opening any street or alley having a permanent pavement on a concrete foundation, unless satisfactory evidence is presented that the foundation and pavement shall be restored in a manner satisfactory to the Commissioner of Public Works.

Where period of guarantee has not expired

If the paving contractor's guarantee period has not expired, the applicant shall obtain and file with his application, a written statement from the paving contractor that the applicant has made satisfacory arrangements for the restoration of the foundation and pavement and that the grant of such permit shall in no way affect the terms of the guarantee.

Where period of guarantee has expired

If the guarantee period has expired, the applicant shall deposit the fee established by the Commissioner of Public Works for the repair of the pavement.

TRENCH CUTS

Unpaved or Macadamized roadways

Trench cuts in the surface of unpaved or of macadamized streets or alleys may be of the same width as the trench.

Trench cuts Concrete base

For streets or alleys having a "permanent" pavement on a concrete base, the pavement and concrete foundation must be cut eight (8) inches beyond each wall of the trench to allow an eight (8) inch solid earth shoulder on each of the four sides of the trench for the new concrete foundation. Should the sides of the trench cave during the progress of the work, an additional amount of the pavement and concrete must be removed to maintain the ground shoulder of eight (8) inches. All pipes or conduit,

encountered during the excavation, shall be protected against damage by the provision of vertical props, not less than 2″ x 3″ in cross section, securely blocked on solid bottom.

These props shall not be disturbed during the refilling of the trench.

Refilling trenches

In refilling trenches the material shall be replaced in the same relative manner in which it was found. Stones, hard lumps of clay, or other material of a diameter exceeding five (5) inches shall not be used, but shall be replaced by fine filling, sand, or gravel.

Flooding

The filling shall be thoroughly puddled with water to a point within eighteen (18) inches of the finished surface of the street or alley. When filled to this point the trench shall be allowed to remain open for a period not less than three (3) days to thoroughly dry out and settle.

Finish for unpaved and macadamized roadways

For unpaved and macadamized streets or alleys, the upper eighteen (18) inches shall be thoroughly tamped in layers of not more than six (6) inches in depth and crowned not to exceed two (2) inches above the surface of the roadway.

Finish for permanent paved roadways

For paved streets or alleys, the succeeding twelve (12) inches shall be tamped in layers not to exceed six (6) inches in depth and the top six (6) inches shall be of concrete and surface paving material.

Penalty

Failure through neglect or refusal to properly restore or repair the pavement within three (3) days after notification thereof by the Commissioner of Public Works, shall be sufficient cause for the Commissioner of Public Works to cause such repairs made at the expense of the holder of the permit and the grant of further permits shall be refused until such repair charge has been paid.

WATER SERVICE.

Water Pipe Protected and drained

Sec. 22. Water pipes shall be installed in a workmanlike manner, well supported and thoroughly protected against damage by settlement, frost, or other causes, and shall be so laid or installed as to be readily drained.

Depth Where present grade is higher than proposed or established grade

When laid in a street or alley, or in a lot outside of a building, the water pipe shall have not less than six (6) feet of earth covering. If the grade of the roadway is higher than the established, or proposed grade, the pipe shall be so laid that it will not be less than six (6) feet below such established or proposed grade.

Character of pipe and fittings Underground

Sec. 23. All water papes laid underground whether outside or inside the building and of a diameter less than two (2) inches shall be "extra strong" lead pipe. When the pipe is of 2″ diameter it may be, and when of greater diameter than two (2) inches, it shall be cast iron "bell and spigot" pipe and what is termed as "Class C" pipe.

Inside building —above ground

When installed inside the building—above ground, or in a tunnel or pipe conduit, after passing the meter, the pipe may be lead, cast iron, galvanized iron or brass with corresponding fittings.

Exceptions: Fire Service Grass Plot Sprinklers

Provided—that nothing contained in this section shall be construed to prohibit the use of wrought iron black pipe for fire service systems above ground, or of wrought iron black pipe under ground for grass plot or lawn sprinklers only, the depth of which piping must not exceed two (2) feet and must be provided with stop cock and drains for winter protection.

Corporation cocks Curb and meter cocks and meter couplings

Sec. 24. All corporation cocks, curb and meter cocks, and meter couplings shall be of the pattern adopted by the MILWAUKEE WATER WORKS and shall be furnished by the Milwaukee Water Works only, on presentation of the receipted "tap" permit or the material bill.

Curb Box

Sec. 25. Curb boxes shall be cast iron "extensible pattern" two and one-half (2½) inches in diameter and seven feet in length with cover fastened to the box with a brass pentagon head screw bolt. The cover shall have the word "WATER" cast in raised letters across the face.

Tapping of mains

Sec. 26. No street main of a greater internal diameter than twenty-four (24) inches shall be tapped for the distribution of water supply to any premise, nor shall a main be tapped at a distance less than six (6) feet from the side line of the building to be supplied, nor within one (1) foot of another ferrule, or the bell end, or any sleeve connection on the main.

Request for tap or branch connection

Sec. 27. Requests for the insertion of any corporation cock or branch connection in the city mains, shall be made the day previous to the time desired for such connection. All lead services shall be in a position in the trench, from the main to the curb box, at the time of such insertion.

Service pipe diameter

Sec. 28. Where "street improvement" or "curb services" are installed under private contract by the owner of any lot or parcel of land, such installations shall be of the same diameter as prescribed by the Commissioner of Public Works for similar installations under city contract.

The minimum diameter of service pipes other than those installed to the curb for "future use" ("curb service") shall be three-fourths (¾) inch. All service pipe shall be full size from the street main to the meter. (For size of building service and size of meters—see sections 29-32, inclusive.) Service pipes shall be laid at the depth heretofore provided and shall have sufficient extra length to provide for unforeseen settlement. All service pipes shall be laid on a shelf of solid ground and not nearer than eight inches to any sewer trench or conduit. No pipe shall be laid through or across the interior of any sewer or any conduit carrying electric or telephone wires or cables, nor shall any pipe be imbedded in or pass through cinders, concrete or masonry, unless such pipe is thoroughly protected against damage by same.

Services one diameter larger than tap

Curb cock and box in excavated walks

Lead service pipes shall be one lead pipe diameter larger than the corporation cock connection with the main, and shall have a brass stop cock encased in a cast iron extensible box placed not more than two (2) feet inside the line of the street curb and on a line at right angle with the corporation cock connection. If the space inside the curb line is excavated, the stop cock and box shall be enclosed in concrete or masonry in such manner as to prevent the operation of the curb cock except from the street walk.

One and one-half and two inches

Lead services one and one-half (1½) and two (2) inches in diameter shall be connected to the street main by means of a two inch "branch connection" having a gate valve at the street main. The connection between the lead service and the gate valve shall be made with not less than twelve (12) inches of heavy brass pipe with a half coupling caulked into the gate valve and joined to the lead pipe by a wiped joint. No curb cock or box will be required for this installation.

Replacing old services

When an old service pipe is to be replaced by another service, the new service shall, when possible, be laid in proximity to the old, and if not used in connection with the new service, the old corporation cock shall be uncovered and turned off at the main by the master plumber and a report of the turning off made to the Milwaukee Water Works.

No division of service pipe at curb

No division of any water service shall be made at the curb line for the supply of two or more buildings.

Building Supply

Sec. 29. Pipes for the supply of water to fixtures inside any building or lot, shall be of ample size to adequately serve the fixtures therein, but in no instance shall be of a diameter smaller than three-fourth (¾) inch for iron pipe, or five-eighth (⅝) inch lead pipe to the first branch for fixtures other than lawn sprinklers. (For meter sizes, see "meters.")

Immediately upon the extension of the service into the building the master plumber shall attach thereto a suitable cock or valve for the use of water for building construction under the provision of section 10. When extended to a rear building, the diameter of the pipe shall not be less than five-eighth (⅝) inch.

Cross-connected supplies to have check valves

Sec. 30. Where services are installed from different street mains to connect to a single main within the premise or where an auxiliary supply is connected to the supply from the street main, such installation shall be provided with suitable check valves on each service line and near the outlet of the meter.

Minimum diameter for fixture supply

Sec. 31. No fixture supply pipe shall be of a smaller diameter than herein provided:

Water Closet, Lavatory, Urinal	⅜ inch
Sink, Bath, Shower	½ inch
Lawn Sprinklers, Boilers	⅝ inch
Laundry Trays (per set)	⅝ inch
Flushometer Valves (Urinal)	¾ inch
Flushometer Valves (Water Closet)	1¼ inch

Diameter of Risers and Branch lines

Sec. 32. Risers shall be amply sized to serve the fixtures thereon, but in no case shall be of a smaller diameter than one-half (½) inch for the supply of not more than two fixtures whose minimum diameter is three-eighth (⅜) inch, or smaller than five-eighth (⅝) inch for fixtures whose minimum diameter is one-half (½) inch or five-eighth (⅝) inch. No branch from a riser, or from a main line, for the supply of fixtures, shall be less than one-half (½) inch, unless such branch be for the supply of one lavatory, urinal or water closet only, and is less than five (5) feet in length, in which case three-eighth (⅜) inch pipe may be used.

Riser, Cocks and Drains

Sec. 33. Each rising pipe or drop pipe shall be provided with a suitable cock or valve at its base, or connection with the main line, and shall have facilities for drainage. The formation of traps in the piping installation shall be avoided as far as possible, but when unavoidable such traps shall have suitable drain cocks.

Stop cocks on fixture branches

In all buildings, residences excepted, a separate cock or valve shall be placed in an accessible location for the control of branch lines to the series of fixtures.

Boiler cocks or valves

Each hot water boiler shall be provided with a stop cock or valve for the control of the cold water supply thereto independently of other fixtures.

Boilers

All boilers (for the domestic hot water service) shall be connected in a manner to prevent siphonage of the boiler or the interruption of the circulation between the boiler and the heating agency.

WATER METERS.

Water Meters

Sec. 34. Water meters shall conform in every respect with the MILWAUKEE WATER WORKS specifications for water meters, and shall be provided by the owner or occupant of the premise supplied with water, and tested and installed by the MILWAUKEE WATER WORKS only, on connections provided by the master plumber.

Elevator Indicators prohibited

The installation, transfer or replacement of any device for the measurement of the travel of a hydraulic elevator, in lieu of the measurement by meter, of the water consumed in the operation of the elevator, is strictly prohibited.

Diameter of Meters

Sec. 35. All meters shall be of the same diameter as the corporation cock or the branch connection with the city water main; provided—that no meter shall be of a smaller size than five-eighths (⅝) inch and further provided that when a one and one-half (1½) inch lead service is connected to the main by means of a two (2) inch branch connection, as provided in section 28, the diameter of the meter may be one and one-fourth (1¼) inches. Where meters are installed "battery" form, each meter may be one size less than the connection with the water main.

Meters for Changed Service Conditions

Whenever the service requirements of a premise has been changed, and the installation of a meter in conformity with the provisions of this section shall be deemed improper for the service under such changed conditions, the Superintendent of Water Works and Water Purification may authorize the use, on the old service, of a meter of the size and type he shall determine most suitable under the changed conditions.

Type of Meters

Sec. 36. Meters of the five-eighth (⅝) to two (2) inch sizes, inclusive, shall be bronzed cased meters of the disc type. Meters of a size larger than two (2) inches, shall be bronze or iron cased meters of the compound type.

Type of meters for "special service" and "transfer"

Iron cased disc type meters and meters of the piston or plunger type may be used for the following services only:

(A) For the meterage of "temporary," "construction" or "special improvement" services.

(B) For the meterage of a building formerly controlled by such meter, though the building be moved to another location.

(C) For the meterage on the same lot as formerly controlled of a new building or a building moved thereon.

Transfer of Meters

Sec. 37. The transfer of meters from one service to another, whether under the same or a new ownership, or the transfer of the ownership of a meter discontinued from service, will be granted only upon the filing of an order from the owner of the meter authorizing such transfer.

Meter location

Sec. 38. Meters must be installed on or above the floor of the basement or ground floor of the building just inside the building wall line nearest the street in which the connection is made with the city main, except where the building is more than fifty (50) feet from the lot line of the street in which the water connection is made, or where the fixtures or appurtenances are in an unheated building or open space, then the meter shall be placed not more than ten (10) feet inside the lot line in a pit or frostproof well of the form and dimension hereinafter provided. The installation of a meter in a pit below any plumbing fixture is strictly prohibited.

Each meter independent of any other meter

Each meter shall receive the water for measurement independent of any other meter, and the supply thereto shall be separately controlled by a stop cock at the curb. No connection or fitting other than those hereinafter provided for the connection of the meter, shall be inserted between the curb cock and the meter or between the meter and the meter outlet coupling or valve—*provided*—that connections for the installation of meters in "battery" shall not be construed a violation of this provision.

Meter connections ⅝-in. to 1-in.

Sec. 39. Connections for meters from five-eighth (⅝) inch to one (1) inch in size, inclusive, shall be provided with a round way nut and washer bottom brass cock for lead and iron pipe, and two brass meter couplings of the diameter of the meter. The meter cock and meter couplings shall be of a type conforming with the specifications of the MILWAUKEE WATER WORKS.

There shall be a space of not less than six (6) inches between the end of the meter outlet coupling and the turn of house pipe, to permit the installation of the meter box.

Connections for 1¼, 1½, 2-in. meters

Connections for meters of the one and one-fourth (1¼), one and one-half (1½) and two (2) inch sizes shall be provided with two brass body gate valves and galvanized iron unions. The gate valves shall be placed within one foot of the inlet and outlet of the meter, and each connection for these meters shall be provided with "swing joints" made up with nipples and elbows.

Connections for 3-in and larger meters

Connections for meters of a greater size than two (2) inches, shall be provided with iron body gate valves placed within two (2) feet of each side of the meter, and a T fitting having a two (2) inch side outlet, into which shall be screwed a two inch brass body gate valve. This T fitting shall be placed between the outlet side of the meter and the outlet valve and shall be for the exclusive use of the Milwaukee Works for meter test purposes. Each meter connection shall be provided with "swing joints" of nipples and elbows. The use of any flange union not of the standard of the meter is strictly prohibited.

Meter connection length

The diameter and length of connection pipe and the type of connection fittings for the various meter sizes shall be as follows:

Meter Size	Connection Length	Fittings
⅝ inch	¾ inch iron pipe 7½ inches long	meter cock and couplings
¾ inch	1 inch iron pipe 9 inches long	meter cock and couplings
1 inch	1¼ inch iron pipe 10½ inches long	meter cock and couplings
1¼ inch	1¼ inch iron pipe 22½ inches long	two gate valves and unions
1½ inch	1½ inch iron pipe 22½ inches long	two gate valves and unions
2 inch	2 inch iron pipe 23 inches long	two gate valves and unions

3 inch-12 inch connection pipes and flanges furnished on filing application for test and installation of meter.

Old connections

Sec. 40. In the repair, or change of connections, or the replacement of meters, the connections shall be made to conform with the standards above specified, and in the repair of connections for Worthington Piston meters the connections shall be of the standard as follows:

Meter Size	Connection Length	Fittings
⅝ inch	1 inch iron pipe 16½ inches long	cock and brass couplings
¾ inch	1 inch iron pipe 17½ inches long	cock and brass couplings
1 inch	1¼ inch iron pipe 22½ inches long	cock and brass couplings
1½ inch	1½ inch iron pipe 22½ inches long	two gate valves and unions
2 inch	2 inch iron pipe 23 inches long	two gate valves and unions

3 inch to 6 inch connection standards on request.

Meter Wells

Sec. 41. Meter pits or frostproof wells for five-eighth (⅝) inch and three-quarter (¾) inch meters shall be constructed of three full lengths (six feet) of salt glazed vitrified clay pipe of an internal diameter of twenty (20) inches, set hub end upward and provided with a special iron cover furnished by the MILWAUKEE WATER WORKS, the top of which cover shall finish flush with, or slightly above, the surface of the ground.

The bottom of the pit or well shall be free from any cement, brick, plank or other material, and the joints between the pipe and between the pipe and the cover shall be carefully cemented. The meter connection shall be twenty-two (22) inches from the top of the iron cover to the center of the connection and provided with brass meter couplings and two (2) brass body gate valves connected to the under ground lead service by galvanized iron pipe and brass soldering nipples.

Concrete Pits

Sec. 42. Pits for meters of greater size than three-quarter (¾) inch, shall be constructed of concrete, having concrete bottoms and reinforced concrete tops, and provided with an iron or steel cover frame and cover. The cover shall be not less than 28 inches in diameter and provided with lifting ring. The cover frame shall be securely imbedded in the top slab and directly above three-quarter (¾) inch round iron ladder rungs firmly anchored in the side wall of the pit.

The pit shall be drained to a sewer by a pipe not less than four (4) inches in diameter and having a deep seal trap. If no sewer is available the pit shall be provided with suitable facilities for the removal of water therein. The pit dimensions for the various meter sizes shall be as follows:

Pit Size

Meter Size	Length	Width	Depth
1 inch to 2 inch (inclusive)	4 ft.	3 ft.	7 ft.
3 inch to 6 inch (inclusive)	9 ft.	5 ft.	7 ft.
8 inch	12 ft.	5 ft.	7 ft.

Pit sizes for "battery installation" and "fire service" meters on request.

AUTOMATIC SPRINKLER SYSTEMS.

Automatic Sprinkler Systems Applications

Sec. 43. No connection shall be made with the city main nor shall any pipe, the purpose of which is for Automatic Sprinkler Service, be installed in any premise until the provisions of section 3 have been complied with; provided that for the extension or alteration of any system no bond or fee shall be required.

Character of Pipe

How laid

Sec. 44. All underground fire service mains and fittings shall be cast iron bell and spigot Class "C" water pipe, and shall be laid on solid bottoms at a depth not less than six (6) feet from the surface, for outside installations, and not less than one (1) foot for inside installation. Pipes and fittings must be well braced or anchored to prevent damage by blow outs under pressure. Under no circumstances will the imbedding of mains in cinders or concrete be permitted.

Pipe in tunnels and above ground

Pipes above ground or in tunnels may be of wrought iron and fittings of cast iron screw joint. Where connection is made between a cast iron bell and spigot pipe, or fittings, and a threaded pipe or fitting, a special extension fitting of cast iron with spigot and threaded, or flanged, end must be used. The use of flanged gate or check valves in pits or above ground, or of flanged variable pressure valves shall not be construed contrary to this rule.

Connection with mains

Each Automatic Sprinkler Service main leading to the premise shall be connected to the city main by a single branch connection of a diameter no greater than six (6) inches.

No other supply connection

There shall be no connection on any part of the system for the purpose of receiving supply from any source other than the city service, nor shall there be any connection for the purpose of supplying water therefrom for any purpose other than fire protection.

Gate and Check Valves

The Automatic Sprinkler Service main shall be provided with an approved gate and check valve placed in a pit inside the building, or, if the building is more than twenty-five (25) feet from the lot line, in a concrete pit at the lot line. The check valve must be within two (2) feet of the inlet side of the gate valve and provided with a one-quarter (¼) inch brass gauge cock on each side of the check.

Fire Pump Suction and Primer

There shall be no direct connection of a suction pipe of a fire pump with the mains of the fire service or the city main. Such suction pipe must be connected with a reservoir or cistern supplied by city water only. Water for priming fire pumps or replenishing pressure tanks must be taken from the metered service of the building.

Test

All underground mains, inside the check valve of the fire service system, must be tested by the contractor in the presence of an inspector of the Milwaukee Water Works, who shall be notified twenty-four hours in advance of such test. The test shall be made by applying a water pressure of two hundred fifty (250) lbs. per square inch for at least fifteen (15) minutes. Any defective pipe or fitting shall be immediately removed.

SCHEDULE OF WATER RATES.

Class I—Meter Rates.

Water rates are made up of two items: first, a "service charge" against every meter to meet the cost of accounting, meter reading, delivery of bills, collection of accounts, etc.; second, a charge for water furnished to cover the cost of pumping and purifying the water, distribution, maintenance of plant, etc.

(a) Service Charge.

A uniform service charge of $2.00 per annum shall be assessed against every meter, regardless of the size of meter, service pipe or the amount of water consumed. This charge to be billed quarterly in amounts of 50c per meter and shall be payable in the same manner and at the same time when water rates are due.

(b) Charge for Metered Water.

The charges for metered water for premises inside the city limits shall be uniform, to-wit: 7 cents per 100 cubic feet, equal to 9⅓ cents per 1,000 gallons.

For water furnished for any purpose beyond the city limits, there shall be a uniform charge of 10 cents per 100 cubic feet, equal to 13⅓ cents per 1,000 gallons.

No deductions to be made on account of any leakage or wastage.

Class II.

Unmetered service to private fire protection system (automatic sprinklers).

	Connection Size 4″	6″
For the whole or fractional part of each quarterly year's service—first year, per quarter	$ 6.25	$12.50
Annually thereafter	25.00	50.00

Where the private fire protection system (automatic sprinklers) is metered, the above connection charges shall be eliminated and in lieu thereof, an annual service charge of $2.00 per meter in addition to the charge at the established rates for water consumed shall be made.

Class III.

Public Fire Hydrants, each	$ 10.00
Public Drinking Troughs (large) each per annum	150.00
Public Drinking Troughs (small), each per annum	75.00
Public Bubblers, each per season (six months)	50.00
Street Sprinkling and Flushing, per 1,000 gallons	.10
Flushing Sewers—	
For each 100 feet or less of 6″ sewer	1.00
For each 100 feet or less of 8″ sewer	1.20

For each 100 feet or less of 12″ sewer	1.50
For each 100 feet or less of 15″ sewer	1.75
For each 100 feet or less of 18″ sewer	2.00
Settling Trenches—	
For each 100 feet or less of 2 feet wide trench	.50
For each 100 feet or less of 3 feet wide trench	.75
For each 100 feet or less of 4 feet wide trench	1.00
For each 100 feet or less of 5 feet wide trench	1.25
For each 100 feet or less of 6 feet wide trench	1.50
For each 100 feet of gas pipe trench	.50

Class IV—Construction Purposes.

Brick, per 1,000	.05
Blocks—concrete, per 100 square feet	.10
Blocks—tile, per 100 square feet	.10
Cement—floor or walk, per 100 square feet	.10
Cement—curb and gutter, per 100 lin. feet	.15
Concrete, per cubic yard	.01
Grouting (pavement), per 1,000 square feet	.10
Plastering, per 100 square yards	.15
Concrete Mixers (steam), per week	1.00
Hoisting Engines (steam), small, per week	.50
Hoisting Engines (steam), large, per week	1.00
Pile Driver, per week	1.25
Street Rollers (steam), per week	1.00
Steam Shovel, per week	1.50
Trenching Machine, per week	1.50
Minimum charge for any permit	.50

Class V—Miscellaneous Purposes.

Circuses and Exhibitions (small), per day	7.50
Circuses and Exhibitions (large), per day	15.00
Dog and Pony Show, per day	3.00
Filling cisterns per sprinkling tank (inside city), exclusive of cartage	.35
Filing cisterns per sprinkler tank (outside city), exclusive of cartage	.50
Filling steamship tanks, per tank	.50

Water required for purposes not specified in the foregoing schedule shall be at a rate fixed by the Commissioner of Public Works.

Milwaukee, Wis., October 18, 1920.

PERCY BRAMAN,
Deputy Commissioner of Public Works.

Laid over until the next regular meeting.

ALD. RADKE—

From the Committee on Water Works-Sewerage reported upon

FILE NUMBER 18734

Communication from His Honor the Mayor relative to making city party to action instituted by Mrs. John L. Mitchell to prevent the dumping of noxious industrial trade waste into the Kinnickinnic river.

(Printed in full in the Proceedings of October 4, 1920, at page 529.)

by recommending that it be indefinitely postponed.

Ald. Gauer moved separate action on the foregoing matter.

The motion prevailed.

Ald. Gauer moved that the foregoing matter be re-referred to the Committee on Water Works-Sewerage.

The motion prevailed.

ALD. RADKE—

From the Committee on Water Works-Sewerage reported upon

FILE NUMBER 17023

AN ORDINANCE

Ordering an extension to the Milwaukee Water Works in the shape of a filtration addition and providing for the issuance of mortgage certificates against the water works for the payment thereof. (Page 699.)

John L. Mitchell to prevent the dumping of noxious industrial trade waste into the Kinnickinnic river.

(Printed in full in the Proceedings of October 4, 1920, at page 529.)

reported thereon by recommending the adoption of the following resolution:

FILE NUMBER 18734

Whereas, Mrs. John L. Mitchell has instituted suit to prevent the dumping of noxious industrial waste into the Kinnickinnic river; and

Whereas, The City of Milwaukee is vitally interested in that the public health is constantly menaced by the conditions prevailing in the vicinity of the said Kinnickinnic river; therefore be it

Resolved, By the Common Council of the City of Milwaukee, that the City Attorney be and he hereby is directed to make the City of Milwaukee a party to that certain suit instituted by Mrs. John L. Mitchell to prevent the dumping of noxious industrial waste into the Kinnickinnic river toward the end that this nuisance be abated and the public health and welfare in that vicinity promoted.

Adopted.

ALD. JANICKI presented the following:

FILE NUMBER 18790

Milwaukee, December 13, 1920.

To the Honorable the Common Council:

Your Committee on Water Works-Sewerage, to which was re-referred

FILE NUMBER 18790

Communication from Percy Braman, Esq., Deputy Commissioner of Public Works, transmitting proposed rates, rules and regulations governing the introduction, supply and consumption of water furnished by the Water Works of the City of Milwaukee.

(Schedule printed in full in the Proceedings of November 15, 1920, at pages 667 to 678, inclusive.)

together with resolution relating thereto.

(As printed in full in the Proceedings of November 1, 1920, at page 630.)

reports thereon by the following substitute resolution and recommends its adoption.

FILE NUMBER 18790

Resolved, That the rates, rules and regulations governing the introduction, supply and consumption of water furnished by the Water Works of the City of Milwaukee, as prescribed, made and submitted to the Common Council by the Deputy Commissioner of Public Works on October 18, 1920, and printed in full in the Proceedings of November 15, 1920, be and the same are hereby amended as follows:

Amend Section 13 by striking out the following: "Chapter 383, Laws of 1919," where same appears in the ninth and tenth printed lines from the top of page 670 of the Proceedings of the regular meeting held November 15, 1920, and inserting in lieu thereof the following: "Chapter 731, Laws of 1913, as amended by Chapter 383, Laws of 1919, Sections 959-53 to 959-58, inclusive, of the Statutes;" further, amend Section 44 under the side heading "Fire Pump Suction and Primer" by striking out the words "Suction and" where they appear in said side heading at page 677; further, amend by striking out the following: "There shall be no direct connection of a suction pipe of a fire pump with the mains of the fire service or the city main. Such suction pipe must be connected with a reservoir or cistern supplied by city water only" where same appears in the ninth, tenth and eleventh printed lines from the top of page 677; further amend by striking out the following: ".10" where same appears under the heading "Schedule of Water Rates. Class III" in the fourth printed line from the bottom of page 677, after the words and figures "Street Sprinkling and Flushing, per 1,000 gallons," and inserting in lieu thereof the following: ".09⅓;" and be it further

Resolved, That the aforesaid rates, rules and regulations, as amended, be and the same hereby are accepted and approved by the Common Council.

HENRY BULDER,
ALBERT JANICKI,
HERMAN O. KENT,
ARTHUR SHUTKIN.

Substitute accepted and substitute resolution adopted.

ALD. GROGAN IN THE CHAIR.

PRESIDENT CORCORAN IN THE CHAIR.

ALD. RADKE—

From the Committee on Water Works-Sewerage reported upon the following matters, viz.:

FILE NUMBER 18946

Communication from Percy Braman, Esq., Deputy Commissioner of Public Works, transmitting resolution authorizing the sale of two vertical automatic engines and dynamos at North Point Pumping Station.

(As printed in full in the Proceedings of November 29, 1920, at page 750.)

by recommending the adoption of the said resolution.

Adopted.

FILE NUMBER 18948

Communication from Percy Braman, Esq., Deputy Commissioner of Public Works, transmitting resolution for construction of sections of sewers in Grove street and Pease street.

(As printed in full in the Proceedings of November 29, 1920, at page 750.)

by recommending the adoption of the said resolution.

Adopted.

FILE NUMBER 18949

Communication from Percy Braman, Esq., Deputy Commissioner of Public Works, transmitting resolution providing for concellation of contract number 174, awarded to J. B. Forrestal Co., for laying pipe.

MEMORANDUM

LEGISLATIVE REFERENCE BUREAU

WWW.MILWAUKEE.GOV/LRB

To: Ald. Jim Bohl

From: Aaron Cadle – Legislative Fiscal Analyst

Date: March 1, 2017

Subject: 2017 Lead Abatement Budget

This memo identifies amounts and funding sources for lead abatement expenditures authorized by the 2017 Adopted Budget.

Lead abatement expenditures authorized by the 2017 Budget total $11 million, with $4.5 million provided by the City and $3.9 million coming from the federal government. The final $2.6 million is funded with federal monies funneled through the state in the form of a forgivable loan. Highlights of these expenditures are indicated in the chart below, and details are included in the chart on the following page.

Highlights of Milwaukee City's 2017 Budget for Lead Abatement				
	Funding Source			
	City	**Federal**	**State**	**Total**
Lead water service line replacements	$3,720,000	$0	$2,600,000	$6,320,000
Lead paint abatement	$340,000	$3,934,667	$0	$4,274,667
Additional lead testing	$170,000	$0	$0	$170,000
Filters, bottled water and outreach	$250,000	$0	$0	$250,000
Total	**$4,480,000**	**$3,934,667**	**$2,600,000**	**$11,014,667**

Milwaukee City's 2017 Budget for Lead Abatement				
	Funding Source			
	City	Federal	State	Total
Mliwaukee Water Works				
Lead Service Line Replacements				
385 daycares/schools	$1,800,000	$0	$1,600,000	$3,400,000
300 emergency leak repairs	$1,800,000	$0	$1,000,000	$2,800,000
Construction coordinator	$120,000	$0	$0	$120,000
Additional lead testing	$100,000	$0	$0	$100,000
Filters, bottled water and outreach	$100,000	$0	$0	$100,000
Milwaukee Water Works Total	**$3,920,000**	**$0**	**$2,600,000**	**$6,520,000**
Health Department Lead Abatement				
Lead paint - 440 housing units	$340,000	$3,934,667	$0	$4,274,667
Water testing	$70,000	0	0	$70,000
Water filters (est. 2,800-3,000)	$150,000	$0	$0	$150,000
Health Department Total	**$560,000**	**$3,934,667**	**$0**	**$4,494,667**
Total	**$4,480,000**	**$3,934,667**	**$2,600,000**	**$11,014,667**

LRB #167796