DES MOINES WATER WORKS
Board of Water Works Trustees

Des Moines Water Works
Water You Can Trust for Life

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MEMORANDUM

DATE: January 20, 2016

TO: William Stowe, CEO and General Manager

FROM: Ted Corrigan, Chief Operating Officer

SUBJECT: Flint Michigan Water Crisis

Lead and Copper in Drinking Water

- Typically, lead and copper are not present in treated drinking water. Water leaves treatment plants across America lead and copper free.
- Lead and copper are present in piping and plumbing fixtures in customers' homes.
- If drinking water is corrosive it can attack these pipes and plumbing fixtures releasing lead or copper into the water.
- Customers who drink water which has been contaminated in this way can suffer long term health impacts including damage to the liver, kidneys, or even the brain. Mental development issues are a significant concern for children exposed to lead contamination.

Lead and Copper Rule

- The Lead and Copper Rule is a federal drinking water regulation that governs treatment and monitoring intended to reduce the risk of lead and copper corrosion.
- The rule was promulgated in 1991.
- It established an action level of 0.015 mg/L for lead and 1.3 mg/L for copper.
- It requires sampling at up to 100 locations within a utility's distribution system. These sample locations are intended to be those which may be the most susceptible to lead or copper contamination.
- Samples are collected in the customers home because that is where lead and copper contamination are most likely to occur.
- If the action level is exceeded, it triggers other requirements including water quality monitoring, finished water parameter management, and corrosion control treatment.

DMWW Corrosion Control Treatment

- A number of factors impact how corrosive treated drinking water will be.
- These factors include the total amount of dissolved solids in the water (TDS), alkalinity, temperature, and pH.
- Finished water pH is an important factor in corrosion equation not only because it has a significant impact but also because it is easily monitored and relatively easily adjusted.
- All other things being equal, water tends to be more corrosive if the pH is low and tends to be more scale-forming if the pH is high.
- For nearly 70 years, DMWW has lime softened to remove hardness. Lime softening is a process which involves significantly raising water pH to drive the softening reaction.
- After softening, the water is stabilized by carefully reducing the final pH to the point where the water is just slightly scale-forming.
- This process helps ensure our finished water will not be corrosive and, in fact, will actually form a protective coating on the inside of water mains and service lines.
- DMWW also feeds polyphosphate as a corrosion inhibitor at our lime softening plants and has done so for decades in accordance with our water supply operation permit.

DMWW Lead and Copper Sampling

- DMWW follows a written Lead and Copper Sampling Plan. This plan helps ensure we stay in compliance with the sampling requirements of the Lead and Copper Rule.
- Initially, DMWW collected 100 samples every six months. After demonstrating compliance with the rule, DMWW qualified for reduced monitoring.
- Currently, DMWW collects 50 samples every three years from customers' taps and analyzes them for signs of lead and copper contamination.
- DMWW continues to be in compliance with Lead and Copper Rule requirements.
- Perhaps more importantly, DMWW lab and operations staff monitors water quality parameters on a daily or even hourly basis to ensure the drinking water we produce will not be corrosive. Finished water pH is one of the most important parameters, but others include calcium hardness, phosphate residual, and a calculated index referred to as the Calcium Carbonate Precipitation Potential (CCPP). CCPP is an index which specifically evaluates the potential for water to be corrosive. Maintaining this index in the appropriate range helps ensure ongoing stability of the water in our system.

Background on the Flint Water Crisis

- For many years the City of Flint Michigan purchased treated drinking water from Detroit.
- In 2013, Flint voted to join the Karegnondi Water Authority which intends to pipe raw water from Lake Huron and treat it. This decision was made because it was expected to save millions of dollars, compared to continued purchase of water from Detroit, over time.
- After this decision was made, Detroit asked Flint to discontinue use of the Detroit supply within one year; before water from the new pipeline would be available.
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- Flint invested millions of dollars in their water treatment plant, which had been used only sporadically for many years, so they could treat Flint River water until the pipeline from Lake Huron was completed. The switch to the Flint River was made in April of 2014

Flint River Water Treatment

- Flint River water is similar in many respects to the surface water sources used by DMWW; it must be treated to reduce hardness and to ensure biological safety.
- There is also the potential for industrial contaminants which must be considered.
- The Flint Water Treatment Plant uses a conventional lime softening treatment process, similar in many respects to the process used at DMWW's Fleur Drive and L.D. McMullen Water Treatment Plants
- Flint River water treatment began in April of 2014, and in June of 2014, the Michigan Department of Environmental Quality's office of drinking water and municipal assistance, reported that drinking water treated at the Flint Water Treatment plant met all drinking water standards including those for nitrate, metals, residual disinfectant, and arsenic.

The Problem

- Problems started almost immediately when the City of Flint began delivering water treated from the Flint River.
- Customers complained about taste, odor, and appearance of the treated water – it was brown.
- Positive bacteria samples led to boil water advisories.
- Chlorine dosages were increased to combat the bacteria issues but the increased residuals led to a violation of disinfection byproducts requirements; levels of TTHMs in the system exceed the standard.
- The problems in Flint may well all have been rooted in the corrosive nature of the treated Flint River water. The water was causing corrosion which made the water brown. The iron which was making the water brown was also consuming chlorine in the distribution system. Low chlorine residuals in the system resulted in positive bacteria samples. Positive bacteria samples necessitated increasing chlorine feed rates. Increased chlorine feed rates resulted in a TTHM violation. It all points back to corrosion, but the biggest issue was yet to come.
- Children in Flint were found to have elevated levels of lead in their blood.
- Samples taken from homes in Flint were found to have lead levels in excess of the standard, likely due to the corrosive nature of the treated Flint River water.
- No corrosion inhibitor was being fed as part of the water treatment process.
- Stability of the treated water (corrosiveness) does not appear to have considered when the finished water parameters (pH primarily) were set.