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# Onsite Sewage Treatment Program

## Communities Addressing Chloride Case Study: Alexandria Lake Area Sanitary District



Lake Winona is classified as an impaired water body.

### **The problem:**

Wastewater with high chloride levels discharged into Lake Winona

### **The solution:**

A central water softening treatment plant in combination with city ordinances restricting water softener use

### **Main implementation challenge:**

Lack of funding

Minnesota municipalities are wrestling with high chloride levels in their wastewater. Chloride is one of the components of salt, which is used in forms such as sodium chloride (table salt), calcium chloride and magnesium chloride (road salts). Sodium chloride is commonly used in home water softeners and by water treatment plants to treat “hard” water. Minnesota generally has groundwater with high levels of calcium and magnesium that must be removed through softening in order to improve taste and prevent lime scale buildup in appliances, pipes and water fixtures. The majority of home water softeners use sodium chloride (NaCl) in a softening process that replaces calcium and magnesium ions with sodium, while the chloride ions are discharged in the wastewater and eventually end up in the environment.

High chloride use can lead to environmental issues. Chloride released into local lakes and streams does not break down, and instead accumulates in the environment, potentially reaching levels that are toxic to aquatic wildlife and plants. Because salt water is more dense than fresh water, it settles at the bottom of lakes potentially preventing the natural mixing of oxygen and nutrients and in effect creating a “dead zone.”

The Minnesota Pollution Control Agency (MPCA) has authority to require discharges to comply with water quality standards using the Clean Water Act and National Pollutant Discharge Elimination System (NPDES) permits. This ensures the protection of aquatic plants, invertebrates and fish. Compliance schedules and variances can be used to assist in meeting permit requirements. Both permitting tools allow time to comply with the permit; however, the variance process considers economic factors that allow more flexible timelines, and offers the potential for renewal of a variance if the permit goal remains unachievable. The variance process may take longer than a compliance schedule and requires approval by the Environmental Protection Agency (EPA). Each community needs to determine which tool is appropriate for their situation.

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## Alexandria Background

The Alexandria Lakes Area Sanitary District (ALASD) discharges wastewater into Lake Winona under a wastewater discharge permit regulated by the MPCA. The permit requires the District to attain compliance with chloride effluent limits by March 30, 2017. The permit also required the District to develop a Chloride Management Plan that identifies specific actions that the District will take to reduce or minimize influent chloride sources by working with the influent contributors, and the expected reduction to chloride in the effluent from that action, if implemented. The ALASD discharges wastewater effluent directly into Lake Winona with chloride concentrations ranging from 515 mg/L to 863 mg/L. Minnesota Rule 7050.0222 Subp. 2 sets chloride water quality standards in for lakes and streams at 230 mg/L.

Lake Winona is first in the Agnes Henry Winona chain of lakes that drain into Lake Carlos, the Long Prairie River, and eventually the Mississippi River. Lake Winona is on the MPCA's impaired waters list for chloride.

### City of Alexandria Demographics

Total Population	Number of Households	Median Household Income
11,843	5,523	\$40,633

The ALASD is located in Douglas County and serves 24,000 people (10,107 accounts) located within a 100 square mile service area based out of Alexandria, MN. Because of recent population growth and aging infrastructure, the ALASD completed upgrades to its wastewater facility in 2009 to increase capacity. While ALASD processes the sewage and wastewater of Alexandria and the surrounding communities, ALP Utilities provides Alexandria with drinking water through eight wells that pull water from the Quaternary Buried Artesian Aquifer. The water from these wells has a hardness level of 26 grains, while the water hardness levels in other parts of the ALASD service boundary vary in range from 15 to 75 grains. Alexandria's groundwater has naturally occurring chloride present at levels ranging from 57.6 mg/L to 75 mg/L according to independent tests and the ALP's Finished Water Analysis.

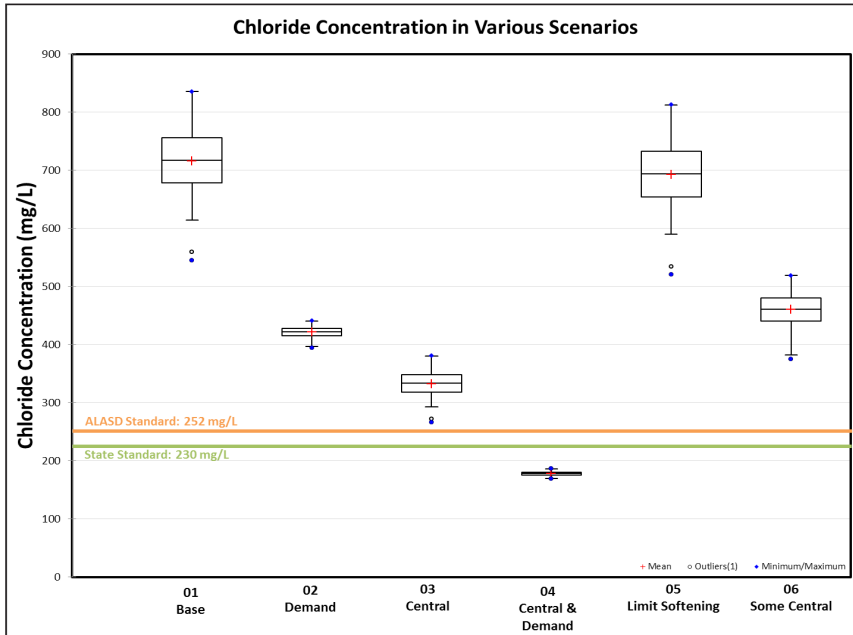
To deal with water hardness, almost all households and businesses in Alexandria use water softeners. The recommended water hardness level for taste and to prevent buildup of lime on pipes and home appliances is less than 5 grains, though many homeowners prefer levels closer to 0 grains. Residential and commercial water softener users contribute the most substantial amount of chloride to the ALASD wastewater treatment plant, while 16% of the chloride that ends up in wastewater effluent comes from industrial sources, and 10% is naturally occurring in the groundwater.

## Solutions

Removing chloride from wastewater after it has been added is not feasible, and any solution must involve reducing the amount of salt added to drinking water. According to the ALASD plant manager, treating chloride at the wastewater plant through reverse osmosis would cost approximately \$100 million, almost 10 times more than treating drinking water before it has reached resident's homes and businesses. Some communities have been successful in meeting chloride standards through local ordinances that require residents to upgrade to high-efficiency water softeners and use on-demand settings rather than a timer setting, a change that can reduce salt use by up to 80% according to EcoWater Systems. In 2013, the ALASD hired Wenck Associates, Inc. to conduct a chloride feasibility study to identify the sources of chloride and strategies to reduce chloride concentrations. Wenck surveyed water softener installers and maintainers in the ALASD service area to learn about common types of water softeners, settings, and salt use. Based on survey results, they estimated that 25-50% of the water

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Results of chloride reduction scenarios for ALASD's wastewater treatment facility

softeners in the District are on a timer system while 50-75% are on-demand. If the City of Alexandria passed an ordinance requiring all residents to switch to on-demand systems the total chloride concentration in ALASD's wastewater effluent would decrease from an average of 712 mg/L to 430 mg/L. Wenck also examined the possibility of central softening the Alexandria's drinking water to get rid of the need for individual water softeners. In this scenario, the chloride wastewater levels would decrease to approximately 342 mg/L, a concentration still well above the state limit of 230 mg/L.

The chloride situation is complicated by the fact that while Alexandria can lower its chloride levels, other communities

and residents in the ALASD service area receive water from individual rural wells. A change within Alexandria would have to result in substantial chloride discharge reductions to offset chloride contributions from other users. Wenck determined that a combination of switching to on-demand systems (maintained at peak performance) for all private well users and central softening at the City's water treatment facility would be necessary to bring chloride concentrations within state standards.

The next step for the ALASD and the City of Alexandria is to determine the type of central softening treatment that would be most feasible for treating the city's drinking water. Reverse osmosis systems are extremely effective at treating hard water as well as iron, manganese, sulfates, and total dissolved solids. Reverse osmosis systems are sold in individual cells that can be easily replaced, removed, or added on to depending on the changing needs of a community. Another benefit of these systems is that they are much easier to maintain and require less personnel and maintenance than more traditional systems.

One of the major disadvantages of a reverse osmosis system to treat water hardness and chloride in the City's well water is the up-front expense, estimated at over \$12 million along with a \$3 million increase in yearly maintenance costs. Reverse osmosis systems also use water less efficiently. Approximately 25% of water passing through the system is discharged as contaminated brine, which also must meet MPCA discharge standards or be shipped away for disposal. In some communities, specific factors or circumstances could make reverse osmosis the best alternative. The City of Alexandria is considering the technology, but would require a great amount of state funding in order to proceed.

Lime or soda ash softening is another common method of water treatment used by Minnesota municipalities to reduce total dissolved solids, and remove iron and other contaminants. Through lime softening the water hardness level is greatly reduced, but usually not to zero. Residents might continue to use home water softeners, but would only need a fraction of the salt. A disadvantage of lime softening are the substantial capital and operational costs, however the solid waste byproduct can be used in agricultural settings as a liming agent, an advantage over reverse osmosis.

## Project Description

The District and the City of Alexandria have not chosen a strategy for addressing chloride to date due to a lack of funding. The Minnesota Public Facilities Authority's (PFA) Point Source Implementation Grant Program (PSIG) currently provides \$7 million in grant funding for water treatment projects. It is also possible that the City of Alexandria could take advantage of a low interest loan program through the Minnesota Department of Health's Drinking Water Revolving Fund if they proceeded in designing a new water treatment facility.

## Conclusion

Without funding, the construction of a new central softening water treatment plant is on hold. Alexandria Mayor Sara Carlson is president of the Coalition of Greater Minnesota Cities, a group that has been actively lobbying the state legislature for water infrastructure spending that could enable the City of Alexandria to move forward on a centralized softening system. Once built, a new water treatment plant would substantially reduce water hardness levels, however Alexandria would also need to issue a city ordinance requiring all residents to switch to on-demand, high efficiency water softeners. The city might even need to ban water softeners completely in order to lower chloride concentrations below the state standard.

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