

LEAD REDUCTION PROGRAM PLAN

DRAFT FOR PUBLIC COMMENT

Version 1.0: July 11, 2019



Draft Subject to Modification

EXECUTIVE SUMMARY

Introduction

Denver Water is committed to delivering safe water to 1.4 million people in the metro area, which is why Denver Water is working to significantly reduce lead exposure risks for customers with lead service lines and plumbing. The water we deliver to homes and businesses is lead-free, but lead can get into the water as it moves through customer-owned service lines and lead-containing plumbing.

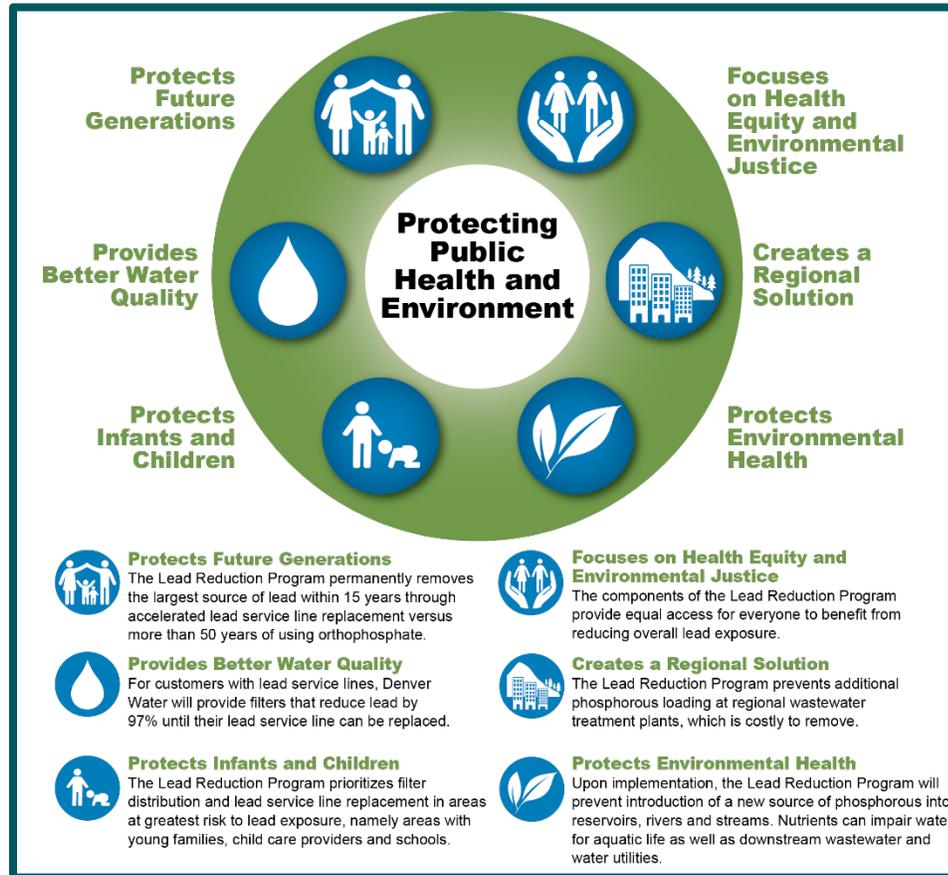
This Lead Reduction Program Plan has been prepared in support of Denver Water's request to the Environmental Protection Agency for a variance from the optimal corrosion control treatment requirements under the Safe Drinking Water Act's Lead and Copper Rule.

Currently, Denver Water maintains a pH of 7.8 to minimize corrosion of lead service lines and plumbing. Denver Water conducted a study on multiple treatment options to reduce the potential for lead to enter drinking water from lead service lines and household plumbing. Based on the results, the Colorado Department of Public Health and Environment, the state regulatory agency that oversees drinking water regulations, required Denver Water to begin adding orthophosphate by March 2020, in accordance with regulatory requirements.

Despite its benefits, orthophosphate added to drinking water can increase phosphorous levels in wastewater and storm water, resulting in adverse impacts to wastewater treatment plants and downstream reservoirs, streams and rivers. Once started, orthophosphate treatment cannot easily be discontinued without causing an increase in corrosion, making orthophosphate a potentially permanent treatment method.

Due to these concerns, Denver Water, along with the Colorado Department of Public Health and Environment and other stakeholders, convened working groups in 2018 to further evaluate the benefits and risks of orthophosphate alongside other options to reduce lead exposure. As part of this process, Denver Water investigated whether a lower dose of orthophosphate, a higher pH of 9.2 with alkalinity adjustment, or a multi-faceted approach including pH/alkalinity adjustment to 8.8 combined with the accelerated replacement of lead service lines and the provision of filters to customers could achieve the same or greater reduction in lead exposure risk. Based on this analysis, and as highlighted in Figure 1, Denver Water seeks to implement the multi-faceted Lead Reduction Program in place of adding orthophosphate to drinking water because the Lead Reduction Program provides the greatest benefit to public health and the environment.

FIGURE 1: LEAD REDUCTION PROGRAM PLAN BENEFITS



The Lead Reduction Program includes multiple elements, the most essential of which involve:

- A communication, outreach, and education plan
- Development of a lead service line inventory to identify and track lead service line replacement
- A filter program
- An accelerated lead service line replacement program
- Corrosion control treatment with pH and alkalinity adjustment

Overall, as compared to orthophosphate, the Lead Reduction Program provides a holistic and permanent lead reduction approach that is as effective at protecting public health, more efficient in reducing lead exposure, less harmful to the environment, more equitable in its public health benefits, and potentially more cost-effective with fewer regional risks.

History

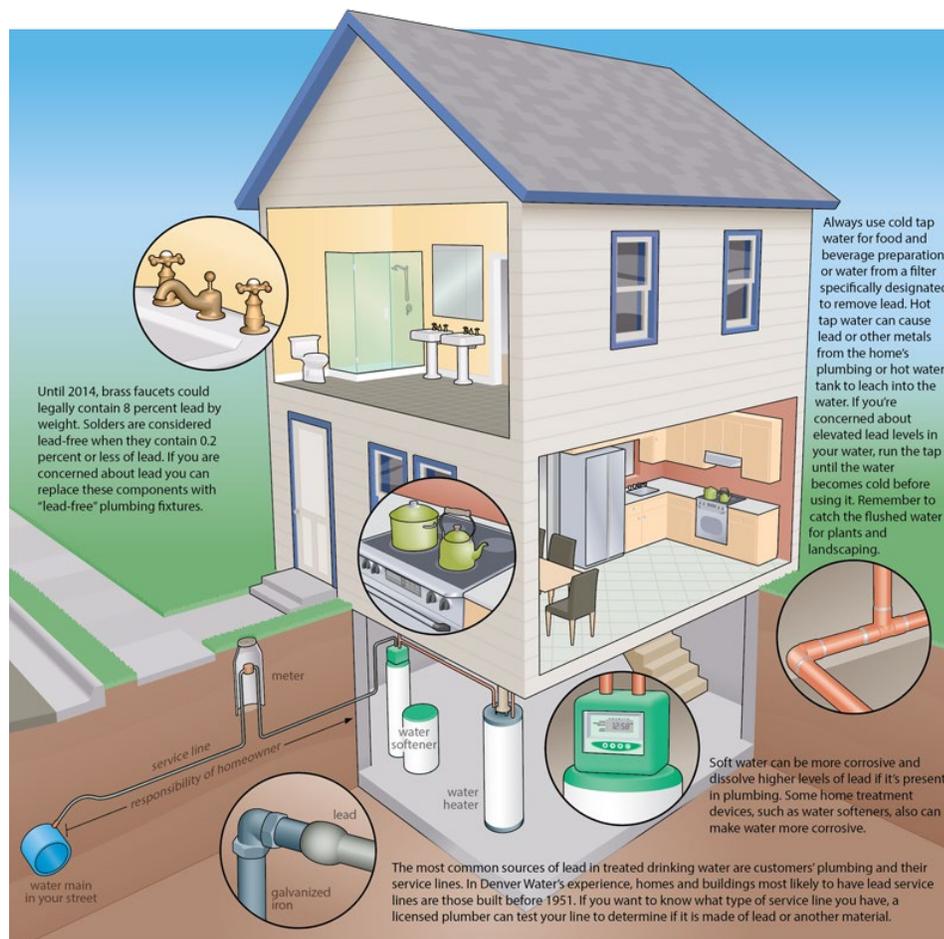
How does lead enter drinking water?

Lead exposure, whether from paint, soil, air or water, is a significant public health concern because it has the potential to adversely affect some of our most vulnerable populations, especially children. When it comes to lead in drinking water, no levels are safe. That is why Denver Water is working with the Colorado Department of Public Health and Environment, the Environmental Protection Agency and our customers to reduce the risks of lead exposure as drinking water moves through homes and businesses with lead service lines and lead plumbing.

While Denver Water delivers safe, lead-free water to customers' homes, lead can enter the water through three sources: (1) a customer's lead service line, which conveys water from the water main in the street to the customer's home, (2) a customer's household plumbing that contains lead solder; and (3) a customer's plumbing fixtures that contain lead (e.g., faucets, valves). Figure 2 highlights the sources of lead in drinking water.

Denver Water studies show that lead service lines, typically found in homes built before 1951 within the Denver Water service area, are the primary source of lead in drinking water.

FIGURE 2: SOURCES OF LEAD IN DRINKING WATER



What has Denver Water done historically to control lead and reduce lead exposure?

For decades, Denver Water has been working to reduce lead in drinking water. Figure 3 highlights the history of lead in drinking water and provides an overview of Denver Water’s activities to reduce lead exposure. Since 1992, Denver Water has tested water from inside customer homes with known lead service lines or lead solder as part of the Safe Drinking Water Act’s Lead and Copper Rule. Additionally, Denver Water has provided corrosion control treatment in the form of pH adjustment of the water delivered to customers’ homes to minimize the corrosion of customer-owned lead service lines and plumbing.

FIGURE 3: HISTORY OF LEAD IN DRINKING WATER



Since 1994, Denver Water has been authorized to maintain a minimum pH/alkalinity of 7.5. In accordance with this authorization, in recent years, Denver Water has sought to consistently maintain a pH of 7.8. This approach has resulted in the following lead levels measured from Tier 1 homes as defined in the Lead and Copper Rule. A Tier 1 home is a sample site that is a single-family structure built between 1983 and 1987 that (1) contains copper pipes with lead solder; (2) contains lead pipes; and/or (3) is supplied by a lead service line.

Category	Lead Concentration Range (expressed in units of ppb – parts per billion)
Average lead levels for Tier 1 homes	4 to 8
90 th percentile lead levels for Tier 1 homes	7 to 17*

* Lead and Copper Rule action level is 0.015 mg/L = 15 ppb; 17 ppb was reported once in 2012.

Although these treatment efforts were largely effective for many years, in 2012, the 90th percentile value for sample results of lead levels in tap water was 17 ppb, exceeding the Lead and Copper Rule action level of 15 ppb. Since the Lead and Copper Rule was adopted in 1992, the 2012 exceedance of the lead action level was Denver Water's first and only exceedance.

As a result of this one exceedance, Denver Water was required to investigate the cause and evaluate alternative treatment solutions. These studies included a lead service line pipe rack study that required the harvesting of lead service lines from homes in the distribution system. These studies, especially the pipe rack study, required a significant investment of time and resources by Denver Water and resulted in the submittal of an Optimal Corrosion Control Report in late 2017. Based on the data in the report, in March 2018, the Colorado Department of Public Health and Environment designated orthophosphate added to drinking water as the optimal corrosion control treatment and directed Denver Water to prepare to implement orthophosphate treatment by March 2020.

Corrosion Control

What is corrosion control?

When water interacts with metal, the metal can oxidize, resulting in corrosion. By adjusting the chemistry of the water, it is possible to cause a buildup or coating on pipe walls, which reduces the amount of lead released from lead-containing pipes and fixtures. This protective coating, however, requires the maintenance of a delicate chemistry in the water. To reduce corrosion and maintain the coating, the Lead and Copper Rule requires drinking water systems to maintain "optimal corrosion control treatment," which means a corrosion control treatment that minimizes the lead and copper concentrations at customers' taps. This can be done through orthophosphate added to drinking water, pH/alkalinity adjustment, or calcium hardness adjustment. Depending on the chemistry of the water, some corrosion control treatment methods can be more effective than others.

What is orthophosphate treatment?

Orthophosphate is a phosphate-based corrosion control inhibitor that changes the chemistry of water to create a protective coating on service lines and plumbing that, in turn, reduces the corrosion that causes lead releases. Although orthophosphate is effective at reducing lead exposure, it can increase phosphorous levels in wastewater and add excessive nutrients to surface water, adversely affecting rivers, streams, and lakes in our region. To remove phosphorous, wastewater treatment plants would need to invest in facility upgrades. In addition, once Denver Water begins to treat with orthophosphate, it will likely need to continue treatment indefinitely to avoid upsetting the delicate chemistry of the water that maintains the protective coating on service lines and plumbing.

Are there effective alternatives to orthophosphate?

Because of concerns about the negative impact of orthophosphate on wastewater treatment plants and the environment, Denver Water engaged stakeholders to assess alternatives to using orthophosphate that may provide even greater protection to Denver Water customers.

These studies investigated two treatment approaches: (1) the lowest effective dose of orthophosphate (3, 2 or 1 mg/L as orthophosphate) required to minimize lead at drinking water taps in Denver Water's system, and (2) the effects of a higher pH of 9.2 as a corrosion control treatment method on lead releases. Denver Water and stakeholders also analyzed the costs to remove phosphorous from the watershed as well as the costs to counter the potential effects of increasing pH. In addition, Denver Water developed a lead control model, demonstrating the efficiency of replacing lead service lines in combination with both use of lead removal filters and pH/alkalinity adjustment, as compared with orthophosphate corrosion control treatment alone.

Based upon these studies, Denver Water is proposing an alternative, holistic approach that directly tackles the biggest issue, customer-owned lead service lines, at its source by accelerating the removal of those lines through a Lead Reduction Program. The Lead Reduction Program would reduce the risk of public exposure to lead beyond what can be achieved by adding orthophosphate to the drinking water by:

- Developing a lead service line inventory so our customers can investigate the likelihood of having a lead service line
- Implementing the Filter Program, a program that would distribute filters to all homes with a known, suspected or possible lead service line, reducing lead by 97% or more
- Implementing an accelerated lead service line replacement program that would remove the major source of lead decades ahead of the current rate of replacement: approximately 75,000 lead service lines would be removed within 15 years versus 50 years or more under current practices
- Adjusting pH from 7.8 to 8.8 and maintaining alkalinity above 30 mg/L as CaCO₃ for corrosion control treatment to reduce corrosion of lead service lines, household plumbing and fixtures
- Enhancing the communication, outreach and education program to help customers understand the Lead Reduction Program and ways that they can reduce their exposure to lead

Variance Request and Lead Reduction Program

How does the Environmental Protection Agency determine whether an alternative treatment method is as effective as orthophosphate?

To implement the Lead Reduction Program, Denver Water must apply for a variance from the Environmental Protection Agency. Under 42 U.S.C. § 300g-4(a)(3) and 40 C.F.R. § 142.46, the

Environmental Protection Agency may grant a variance from the optimal corrosion control treatment requirements under the Safe Drinking Water Act's Lead and Copper Rule *“upon a showing from any person that an alternative treatment technique not included in such requirement is at least as efficient in lowering the level of the contaminant with respect to which such requirements was prescribed.”*

Is Denver Water proposing the Lead Reduction Program on a voluntary basis?

Denver Water is proposing the Lead Reduction Program on a voluntary basis as an alternative to orthophosphate treatment under the Lead and Copper Rule. Denver Water cares about the 1.4 million people it serves and the safety of the water at their taps. Denver Water wants to provide the best short- and long-term solution to prevent lead exposure. In addition, Denver Water is concerned about the adverse impact that orthophosphate could have on the downstream reservoirs, rivers and streams, the quality of the source of supply, and the costs wastewater treatment and storm water management providers would incur to remove phosphorous. For these reasons, Denver Water is proposing the Lead Reduction Program as a proactive measure to permanently remove lead service lines from its service area as efficiently as possible, provide additional public health protection that cannot be achieved through orthophosphate treatment alone, protect the watersheds and help reduce regional costs that would be incurred to remove phosphorous from wastewater.

What commitments is Denver Water making?

Denver Water will actively engage its customers with lead service lines within the City and County of Denver and the service areas of its distributors that collectively make up Denver Water's "integrated system." The Lead Reduction Program will aim to reduce lead levels by distributing filters to customers with known, suspected or possible lead service lines, replacing 7.0% of the lead service lines annually, and replacing all lead service lines within 15 years. The six elements necessary to accomplish this goal are described in Table ES-1.

TABLE 1: DENVER WATER'S COMMITMENTS UNDER THE PROPOSED LEAD REDUCTION PROGRAM

Communications, Outreach and Education
<p>Denver Water is committing to:</p> <ul style="list-style-type: none"> • Educate and engage with residents, customers, distributors, local public health agencies and government stakeholders about lead awareness and reduction efforts. • Educate the public on measures they can take to reduce their exposure to lead in drinking water. • Seek feedback from residents and other stakeholders to learn best practices and effective ways to implement program activities. • Strive for 100% participation in the Filter Program.
Lead Service Line Inventory
<p>Denver Water is committing to:</p> <ul style="list-style-type: none"> • Research, investigate, and document the presence of customer-owned lead service lines. • Help customers identify if they have a lead service line. • Maintain a current lead inventory and map. • Confirm materials at properties with a suspected or possible lead service line. • Use the inventory to target communications, outreach and education efforts at areas with the greatest risk.
Filter Program
<p>Denver Water is committing to:</p> <ul style="list-style-type: none"> • Provide filters and filter cartridge replacements to properties with known, suspected, and possible lead service lines for up to 15 years during the life of the Lead Reduction Program. • Educate and inform residents on the importance of using filters for drinking water.
Accelerated Lead Service Line Replacement Program
<p>Denver Water is committing to:</p> <ul style="list-style-type: none"> • Replace all known lead service lines in 15 years. • Replace 7.0% of the lead service line inventory each year, based on a cumulative annual average. • Using predictive modeling to help prioritize lead service line replacement taking into consideration the following factors: public health/toxicology concerns, child care providers, primary schools, neighborhoods with high density of young families, and socioeconomic and environmental factors. • Follow up with residents and provide filters until the service line is confirmed as non-lead or until six months after the lead service line is replaced.
Corrosion Control Treatment
<p>Denver Water is committing to:</p> <ul style="list-style-type: none"> • Maintain water quality by implementing corrosion control treatment through pH and alkalinity adjustment.
Learning by Doing
<p>Denver Water is committing to:</p> <ul style="list-style-type: none"> • Evaluate the performance of the Lead Reduction Program to improve outcomes.

How will the performance of the Lead Reduction Program be evaluated?

Denver Water will use the criteria shown in Table ES-2 to evaluate the performance of the Lead Reduction Program. An annual report will detail the program's success and provide regulators with clear criteria to determine when to require correction or take enforcement action.

TABLE 2: LEAD REDUCTION PROGRAM EVALUATION CRITERIA

(Data are provisional and subject to change)

Element	“Meets Expectation”	“Fails”	Corrective Action Upon Failure
Communication, Outreach & Education	One contact made per program year to all Denver Water households enrolled in the Filter Lead Out of Water Program	One contact made per program year to less than 40% of all Denver Water households enrolled in the Filter Lead Out of Water Program	Make contact to all Denver Water households enrolled in the Filter Lead Out of Water Program; and send a public notice to all Denver Water customers that the metric was not achieved
Lead Service Line Inventory	Investigate more than 1.4% of the total estimated number of suspected and possible lead service lines for the same program year.	Investigate less than 1.1% of the total estimated number of suspected and possible lead service lines in one program year	Increase use and types of methods to investigate service line type Send a public notice to all households enrolled in the Filter Lead Out of Water Program
Filter Lead Out of Water Program	___% annual filter adoption rate	A filter adoption rate of less than ___% after a single program year or that remains less than ___% but greater than ___% for three consecutive program years.*	Implement orthophosphate Send a public notice to all Denver Water households
Accelerated Lead Service Line Replacement	7.0% cumulative annual average replacement rate	Less than 6.0% cumulative annual average replacement rate for three consecutive program years	Implement orthophosphate Send a public notice to all Denver Water households
Corrosion Control Treatment	[Under Consideration]		

What if the variance request is not approved or the variance criteria are not met?

Following the Colorado Department of Public Health and Environment’s designation of orthophosphate for optimal corrosion control treatment, Denver Water initiated design and construction of chemical feed systems to dose orthophosphate at 3 mg/L at Denver Water’s three treatment plants. If the variance request is not approved, these systems will begin introducing orthophosphate on March 20, 2020.

If the variance is granted and certain criteria in Table ES-2 are not met during the 15-year period of the Lead Reduction Program, Denver Water might also be required to implement orthophosphate using the chemical feed systems.

More details on the optimal corrosion control treatment designation of orthophosphate can be found at:

www.colorado.gov/cdphe/lead-dw-treatment

How to navigate through this Lead Reduction Program Plan

This executive summary introduces the Lead Reduction Program Plan, the variance request, and Denver Water’s commitments if the variance is approved by the Environmental Protection Agency.

Section I presents the history of lead occurrence and control in the Denver Water system, from the single exceedance of the action level for lead in 2012 until the designation of orthophosphate for optimal corrosion control treatment by the Colorado Department of Public Health and Environment in March 2018.

Section II provides a summary of the investigations undertaken by Denver Water since March 2018 to demonstrate that the Lead Reduction Program is as effective as the alternative of orthophosphate at reducing lead levels in drinking water. An overview of the elements that together make up the Lead Reduction Program is presented.

Section III describes how Denver Water will implement all six elements of the Lead Reduction Program.

Section IV details how Denver Water will evaluate the performance of the Lead Reduction Program and ultimately maintain regulatory compliance with the Lead and Copper Rule.

Section V presents the implementation schedule for the Lead Reduction Program, including opportunities for public comment.

Section VI describes how Denver Water will address health equity and environmental justice needs through the Lead Reduction Program.

Section VII presents the estimated costs of the Lead Reduction Program (to be provided).

A series of technical memoranda were prepared during the development of the Lead Reduction Program and are included in the appendices to this plan.

What is Denver Water asking of the customer?

- Understand your risks related to lead exposure and what you can do to reduce lead sources
- If you have a lead service line:
 - Allow Denver Water to replace the lead service line at no cost to the property owner
 - Use a filter until the lead service line can be replaced
- If you have sources of lead in premise plumbing inside the home:
 - Replace faucets and indoor plumbing with lead-free components

To minimize exposure to lead when using water for drinking, cooking, and making beverages, ice, and infant formula:

- Use a filter certified by the National Safety Foundation to remove lead for drinking and cooking. Replace the filter cartridge according to the manufacturer's instructions.
- Use only cold water for drinking, cooking and making baby formula. Remember, boiling water does not remove lead from water and hot water often contains higher levels of lead than cold water.
- If water has not been used in the home for a few hours, such as first thing in the morning or when getting home from work, run the kitchen or any bathroom faucet for five minutes (remember to capture the water and reuse it!). You can also run the dishwasher, take a shower, or do a load of laundry to help flush water in your internal plumbing before drinking or cooking.
- Regularly clean your faucet's screen (also known as an aerator). View step-by-step instructions.
- Consider replacing faucets and indoor plumbing with lead-free components

YOU MAY SEE FULL DRAFT OF LEAD REDUCTION PROGRAM PLAN [HERE](#).