DENVER WATER LEAD REDUCTION PROGRAM

ANNUAL REPORT – 2023

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Presented by: Denver Water

DENVER WATER

ISSUE AND REVISION RECORD

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LIST OF ACRONYMS

µg/L	Micrograms per liter
mg/L	Milligrams per liter
ALSLR	Accelerated Lead Service Line Replacement
ALSLR Plan	Planned replacements (regardless of funding source)
CASS	Coding Accuracy Support System
CCT	Corrosion control treatment
CDPHE	Colorado Department of Public Health and Environment
COE	Communications, Outreach and Education
DPS	Denver Public Schools
EPA	Environmental Protection Agency
FFLSLP	Federally Funded Lead Service Line Program
GRR	Galvanized requiring replacement
HE&EJ	Health equity and environmental justice
LCR	Lead and Copper Rule
LCRR	Lead and Copper Rule Revisions
LIMS	Laboratory Information Management System
LRP	Lead Reduction Program
LRPP	Lead Reduction Program Plan
LSL	Lead service line
LSLR	Lead service line replacement
MSLMV	Minimum Service Line Material Verification
NSF	National Sanitation Foundation
OCCT	Optimal corrosion control treatment
Order	Variance Order
QA/QC	Quality Assurance / Quality Control
SLID	Service Line Identification
T&D	Transmission and Distribution
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

The Annual Program Year Report presents the comprehensive evaluation of the Lead Reduction Program (LRP) performance to date using the equivalency model described in the Lead Reduction Program Plan (LRPP). As required by the Variance, the comprehensive evaluation uses model inputs based on actual implementation from Jan. 1, 2020, through Dec. 31, 2023. This Annual Program Year Report also includes an assessment of the metrics that were achieved during calendar year 2023.

All performance metrics required in the Variance have been achieved or exceeded:

- Results from lead sampling indicate that lead levels continue to decline at both lead service line homes and copper plumbing with lead solder homes with pH 8.8 ± 0.3 in the distribution system. The 90th percentile lead levels continued to be measured less than 5 µg/L in 2023.

TABLE ES-1. CCT PERFORMANCE BASED ON OVERALL 90TH PERCENTILE LEAD CONCENTRATION

LCR Six-Month Sampling Period	2019	2020	2021	2022	2023
Spring Overall 90th Percentile Lead Concentration (µg/L)	10.0	6.7	4.1	3.9	3.6[1]
Fall Overall 90th Percentile Lead Concentration (µg/L)	11.0	4.4	4.4	3.8	3.9[2]

[1] See letter from CDPHE dated August 1, 2023.
[2] See letter from CDPHE dated Jan. 26, 2024.

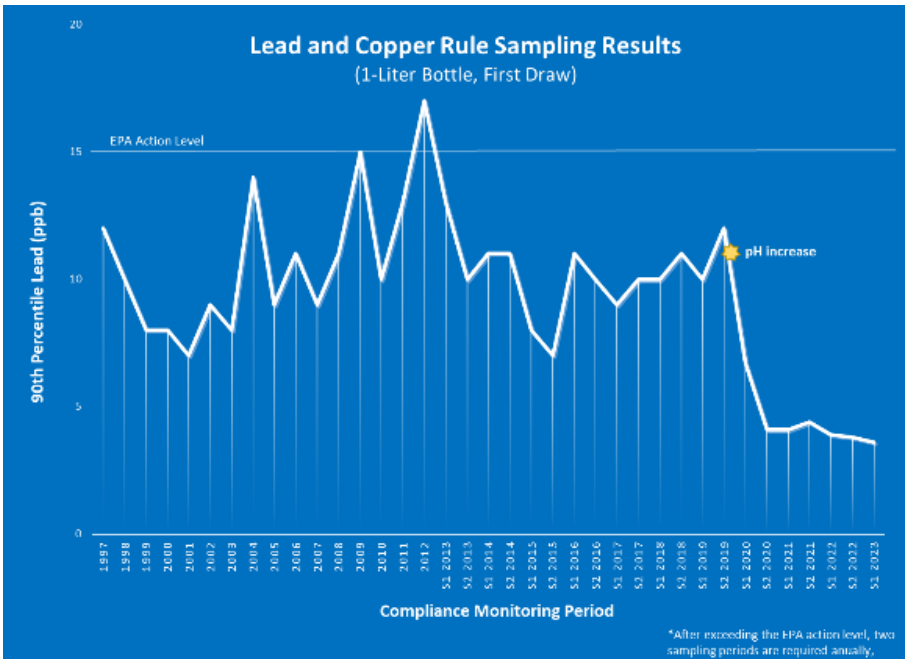


FIGURE ES-1. YEAR-OVER-YEAR CCT PERFORMANCE BASED ON OVERALL 90TH PERCENTILE LEAD CONCENTRATION

- By the end of 2023, a total of 6,891 lead service line replacements were completed for program year 2023, making the annual replacement rate 10.8%, the overall cumulative annual replacement rate 8.8% and the cumulative annual replacement rate within health equity and environmental justice areas of concern 9.9%.
- Responses from the 2023 filter adoption survey suggest that 83% of customers are using their filters for drinking, cooking, and preparing formula if formula-fed infants reside at the household.
- Approximately 81% of samples collected from filters in the customers' homes had no measurable lead. All samples collected from filters in the customers' homes had lead levels below 3 µg/L.

The equivalency model demonstrates that the holistic approach of the LRP is as effective and efficient as an alternative treatment technique as compared with orthophosphate treatment, and exceeds performance predicted with orthophosphate. Overall, the performance of the fourth program year (2023) is equal to or better than the performance of the first three program years (2020 through 2022).

The Nov. 30, 2022, Variance (LCRR Variance) went into effect on Jan. 1, 2023, and did not change the base inventory of 63,955 estimated LSLs. The LCRR Variance did, however, change the required cumulative annual average investigations from 1,169 (1.4% of likely lead properties) to 2,420 (1.4% of all unknowns).

Denver Water must comply with the terms and conditions of the 2022 LCRR Variance as well as all other provisions in the Lead and Copper Rule Revisions (LCRR), including the requirements associated with corrosion control treatment. Therefore, in addition to the efforts to fulfill Variance requirements, Denver Water is working to ensure compliance with the LCRR when it goes into effect on Oct. 16, 2024, by refining the inventory to fit LCRR terminology and description. The inventory and investigations section of this report further expound upon those efforts and the subsequent changes to the inventory.

PART 1: INTRODUCTION

In 2012, at the end of Denver Water's annual lead and copper monitoring period, the 90th percentile value for lead levels in tap water was 17 µg/L, exceeding the Lead and Copper Rule (LCR) action level of 15 µg/L.[1] From 2013 through 2017, Denver Water completed several corrosion control studies and adjusted treatment to optimize pH/alkalinity control. Based on these studies, in 2018, the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division designated phosphate-based corrosion inhibitor addition (orthophosphate) as the optimal corrosion control treatment (OCCT) and ordered Denver Water to install and operate the designated corrosion control treatment by March 20, 2020. The designation of orthophosphate raised concerns among stakeholders that increased loads of phosphorous from orthophosphate treatment would adversely impact Colorado's streams and rivers, which were already nutrient stressed, as well as regional wastewater treatment operations and drinking water treatment supplies. Denver Water was also concerned that orthophosphate treatment would not solve the ultimate public health issue of tackling lead at its source through removal of lead service lines.

In response, Denver Water developed a proposal to implement the Lead Reduction Program (LRP), as a holistic alternative treatment technique with a permanent solution to addressing lead in drinking water though the removal of all lead service lines (LSLs) within 15 years. To request approval, Denver Water developed a Lead Reduction Program Plan (LRPP) that described how Denver Water planned to implement the LRP if it were approved.[2] On Nov. 15, 2019, CDPHE granted Denver Water's request to modify the OCCT designated for Denver Water in accordance with § 11.26(3)(d)(iii) of the Colorado Primary Drinking Water Regulations, 5 CCR §§ 1002-11, et seq., subject to the Environmental Protection Agency (EPA)'s approval of Denver Water's variance request. Subsequently, on Dec. 16, 2019, EPA granted the Variance to Denver Water from OCCT pursuant to § 1415(a)(3) of the SDWA, 42 U.S.C. § 300g-4, and 40 C.F.R. § 142.46 for a three-year term beginning Jan. 1, 2020.[3]

[1] Note there have been no exceedances of the 90th percentile calculation under the LCR since 2012.
[2] See Denver Water's lead webpage for more information on how the LRP is currently implemented and the resource page for all supporting documentation of the LRP.
[3] See Denver Water's 2019 Variance for more details.

In December 2019, Denver Water began the process of implementing the LRPP in accordance with EPA's Dec. 16, 2019, Variance (LCR Variance) approval of Denver Water's request for modification of OCCT under the LCR.

Denver Water met or surpassed all performance metrics required as part of the LCR Variance in the first three years of the program:

- Results from LCR compliance sampling indicate that lead levels continue to decline.
- Since the implementation of corrosion control treatment (CCT) in March 2020, the 90th percentile lead levels have continuously been measured at less than 5 µg/L.
- By the end of 2022, over 15,000 LSLs have been replaced, nearly 10,000 in areas designated as having health equity and environmental justice (HE&EJ) concerns.
- As part of the Filter Program, all customers who have a likely or confirmed LSL are provided a pitcher filter kit and continue to be supplied replacement cartridges, per the manufacturer's recommendations.
- Consistently, the filter adoption survey has shown an adoption rate over 80%.

In 2022, Denver Water sought a new Variance under the Lead and Copper Rule Revisions (LCRR). On Nov. 30, 2022, EPA issued a new variance that allows Denver Water to continue to implement the LRPP as an alternative treatment technique for the remaining 12 years of the program through Jan. 1, 2035. Denver Water currently implements the LRPP under the updated Nov. 30, 2022, Variance (LCRR Variance).[4] All references to the Variance throughout this report are for the LCRR Variance, which the Denver Water LRP operates under, as of Jan. 1, 2023.

This annual report was prepared in compliance with paragraph 7.B of the LCRR Variance and commitments made by Denver Water in the 2019 LRPP. This report addresses the second six months of 2023 for the period of July 1, 2023, through Dec. 31, 2023, as well as the program year as a whole.

The following plans are referenced throughout this report:

- LRPP (submitted Sept. 16, 2019, and approved Dec. 16, 2019) and its amendment (submitted July 17, 2023)
- 2023 Accelerated Lead Service Line Replacement (ALSLR) Plan (not a formal submission, identifies all properties planned for replacement in 2023)
- 2023 Communications, Outreach and Education (COE) Plan (submitted Feb. 10, 2023, alongside the 2022 Annual Report)
- Elevated Lead Response Plan (re-submitted July 6, 2021)
- Corrosion Control Treatment Implementation Plan (re-submitted June 4, 2020)
- Nitrification Control Plan (re-submitted July 15, 2021)

[4] See Denver Water's 2022 Variance for more details.

A technical amendment to the LRPP was submitted to EPA and CDPHE on July 17, 2023, as required by the LCRR Variance.

> *B. Reporting and Recordkeeping. All of the requirements of the LCRR other than the definition of OCCT as the term relates to 40 C.F.R. § 141.82(e) remain in effect, including the reporting and recordkeeping requirements. In addition, Denver Water shall record, maintain records of, and report the following information to CDPHE and EPA every six months on February 10 and August 10, except as noted below. Denver Water will provide any of the raw data to CDPHE and EPA, within 30 Days, when requested.*
>
> *Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.*

What to Expect: Reporting on Program Activities

The purpose of the semi-annual and annual reports is to document the implementation of the LRP, describe the actions taken by Denver Water to reduce lead levels and support the subsequent evaluation of the LRP performance.

The performance data included for the different elements of the LRP described in this report vary depending on the launch date of the different program elements (see Table 1). The reporting dates for the different program elements are shown in Table 2. In general, data are shown for 2023, with details for the second six-month period of July 1, 2023, through Dec. 31, 2023, with the exception to provide additional information not included in previous reports.

TABLE 1. WHAT TO EXPECT IN THIS REPORT

Paragraph (and LRP Task)	What to Expect in this Annual Report and Status
7.B.i CCT	This section includes a summary of CCT results for the first six months of 2023.
7.B.ii LSL Inventory	Denver Water first published the LSL Inventory on its website on March 5, 2020. The map was updated on the Denver Water website on Jan. 23, 2024, using data current up to Jan. 17, 2024.
7.B.iii LSL Replacements (aka ALSLR Program)	This section summarizes the number and type of replacements completed. Denver Water crews have been replacing lead service lines since Jan. 1, 2020. Contractors started lead service line replacement on March 5, 2020.
7.B.iv Filters (aka Filter Program)	This section summarizes filter distribution. Initial filter distribution was completed by Sept. 21, 2020. Replacement filter distribution was initiated on July 1, 2020, and continued through 2023.
7.B.v Compliance Metrics	The Equivalency Model is updated using data collected for the program year.
7.B.vi Communications, Outreach and Education	This section describes implementation of the 2023 COE Plan,[1] virtual community meetings, engagement with the Stakeholder Advisory Committee, and development of new customer resources and materials.
7.B.vii Health Equity and Environmental Justice	This section summarizes implementation of the 2023 COE Plan including updates on activities to support increased equity, community partnerships and outreach.
Paragraph 7.C of the Variance Order	This Annual Report contains a summary of the information and data for the previous Program Year, including an assessment of which metrics were achieved. The Annual Report also provides a comprehensive evaluation of LRPP performance to date using the equivalency model described in the LRPP with updated inputs based on actual LRPP implementation for: • 90th percentile lead levels at LSL and copper plumbing with lead solder sites after operation of increased pH and alkalinity adjustment as CCT. • Number of LSL replacements conducted. • Filter adoption rate. • Filter performance in the field.
Deviations (7.C)	This section documents deviations from the LRPP during the 2023 Program Year.
Appendices	Appendices include CCT, LSL inventory, water quality results, LSL replacements, customer refusal lists, COE and HE&EJ.

[1] See Appendix COE-17 2023 COE Plan in the 2022 Annual Report (submitted Feb. 10, 2023).

TABLE 2. DATES FOR DATA INCLUDED IN THE 2023 ANNUAL REPORT

Description	Annual Program Year Report (2023)
LCR 90th Percentile Lead Concentration based on Compliance and Customer Requested Samples	All LCR compliance samples collected from July 1 to Dec. 31 All customer requested samples reported in LIMS between July 1 and Dec. 31
Elevated Lead Response Reporting	July 1 to Dec. 31[2]
Water Quality Sampling from Select Households (1983 to 1987 Homes)	July 1 to Dec. 31
Inventory – Posting of Map to Denver Water's Website	Data through Jan. 17, 2024 Posted Jan. 23, 2024
Inventory – Update	July 1 to Dec. 31
Investigations – Verification Potholing as Part of ALSLR Program	July 1 to Dec. 31
Investigations – Investigative Potholing Independent of ALSLR Program	July 1 to Dec. 31
Investigations – Water Quality Sampling as part of ALSLR Program (not included in 90th Percentile Calculation)	All results reported in LIMS by Dec. 31
Investigations – Water Quality Sampling Independent of ALSLR Program (not included in 90th Percentile Calculation)	All results reported in LIMS by Dec. 31
Water Quality Sampling Post-LSL Replacement	All results reported in LIMS by Dec. 31
ALSLR Program Replacements	July 1 to Dec. 31
ALSLR Program Consent Forms	July 1 to Dec. 31
Initial Filter Distribution	July 1 to Dec. 31
Replacement Filter Distribution	July 1 to Dec. 31
Filter Program Occupancy Changes[3]	July 1 to Dec. 31
Informal Filter Adoption Survey as Part of ALSLR Program	July 1 to Dec. 31
Filter Testing in the Field	July 1 to Dec. 31
COE Activities	July 1 to Dec. 31

[1] LIMS is the Laboratory Information Management System used by Denver Water.
[2] For samples collected and reported in LIMS by Dec. 31 and follow-up response by December 31, 2023.
[3] Includes occupancy changes at ALSLR properties by definition.

ASSESSMENT OF METRICS ACHIEVED

Compliance Metrics per Paragraphs 2.C, 3.D, 4.I, 5.G, 6.B, and 6.C

As required by the Variance, the performance metrics for the six elements of the LRP, including the application of CCT, the development – and regular updates – of the LSL inventory, the replacement of LSLs overall and within HE&EJ areas, and the distribution of filter outreach and education materials, have been achieved. The overall performance of the LRP is evaluated

by modeling performance under the conditions of the Order and comparing it to modeling performance with orthophosphate. The required performance metrics from the Variance is provided in Table 3.

TABLE 3. SUMMARY OF COMPLIANCE METRICS FOR 2023 (LCRR VARIANCE)

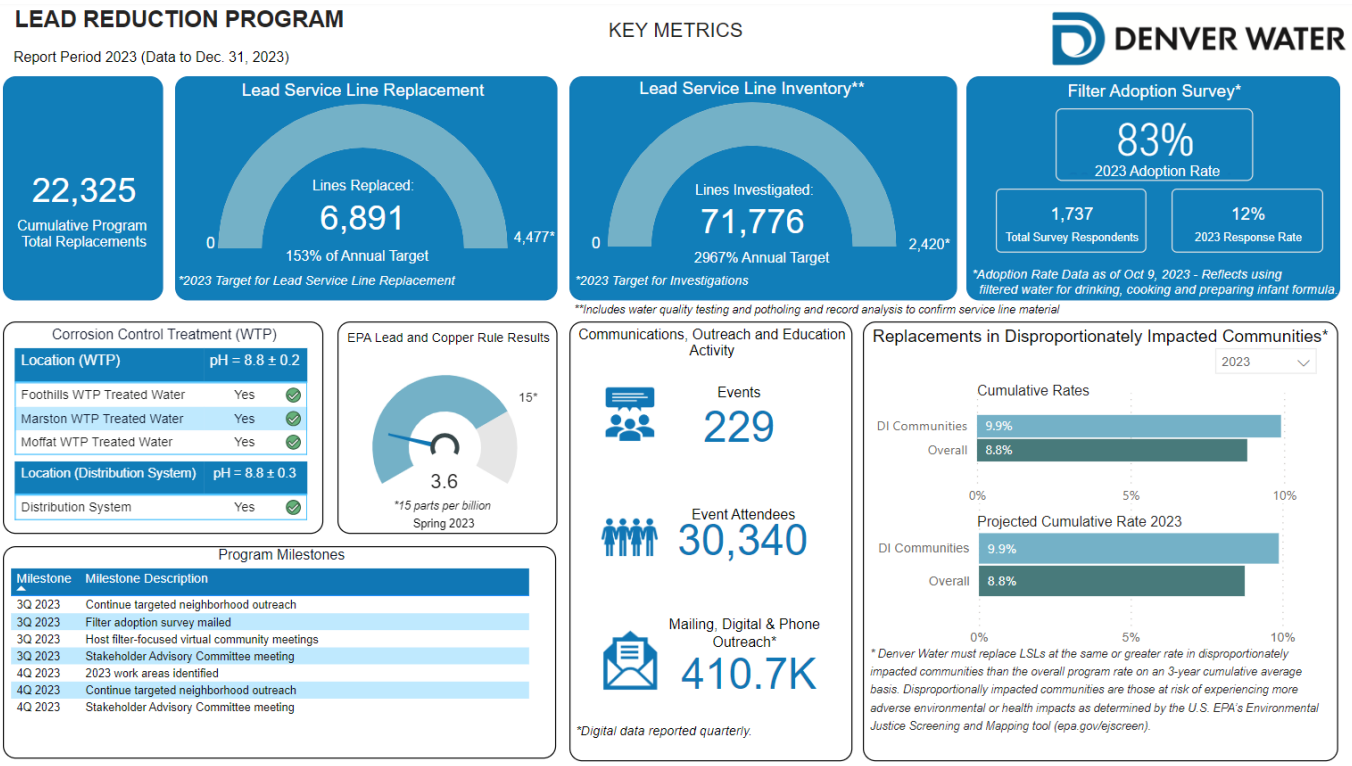
Paragraph	Description	2023 Results
2.C	**C. Corrosion Control Treatment Metric.** Maintain pH and alkalinity within the ranges designated by CDPHE. For the entry points to the distribution system, pH must fall within a range of 8.6 to 9.0 and a minimum alkalinity of 20 mg/L as CaCO3; for distribution location, pH must fall within a range of 8.5 to 9.1 and a minimum of 20 mg/L as CaCO3. CDPHE may modify these required water quality parameters through a modification decision under 5 CCR 1001-11.26(3)(d)(ii).	**Achieved.**
3.D	**D. LSL Inventory Compliance Metric.** Investigate a cumulative average of 1.4% of the total estimated number of unknown service lines in the inventory each Program Year from Jan. 1, 2020, to the Variance End Date. These investigations are performed independently of the LSL replacements.	**Achieved.** Investigated 71,776 service lines independently of the 2023 ALSLR Program.
4.I	**I. Accelerated LSL Replacement Compliance Metric.** Annually achieve at least a 7.0% cumulative average Program Year LSL replacement rate as determined based on reporting required in paragraph 7.B.	**Achieved.** Completed 6,891 LSL replacements in 2023.
5.G	**G. Filter Communication Compliance Metric.** Make direct contact with lead outreach and education materials to 95% of all customers enrolled in the Filter Program in every Program Year. . . Compliance shall be tracked by mailing lists and mail receipts, lists of customer email addresses for customers who elect to receive email communication, or other forms of documentation approved by CDPHE.	**Achieved.** Provided outreach and education materials to over 95% of all customers enrolled in the Filter Program.
6.B	**B. Comprehensive LRPP Performance Metric.** Demonstrate to EPA's satisfaction, using the updated equivalency model results as reported under paragraph 7.C, that the combined actual performance of the LRPP as implemented continues to be "at least as efficient as" OCCT as that term is used in 40 C.F.R 141.82(E) and as it relates to CDPHE's March 2018 designation of OCCT as orthophosphate treatment for Denver Water, in reducing lead exposure on an annual basis.	**Achieved.** See this report for the model output demonstrating that the LRP is more efficient than orthophosphate treatment.
6.C	**C. Health Equity and Environmental Justice (HE and EJ) Compliance Metric.** Annually achieve a cumulative Program Year LSL replacement rate in areas with HE and EJ concern that is equal to or greater than the total replacement rate. Denver Water must also make direct contact with lead outreach and education materials to more than 95% of customers as identified in areas with HE and EJ concerns enrolled in the filter program in every Program Year.	**Achieved.** Completed 3,804 LSL replacements in HE&EJ areas in 2023, equating to a 9.9% cumulative replacement rate. Provided outreach and education materials to over 95% of customers as identified in HE&EJ areas enrolled in the Filter Program.

Performance Dashboard

Denver Water uses a dashboard to communicate key metrics to share the progress of the LRP with the public. The dashboard will be posted on Denver Water's website upon submittal of this report, in both English and Spanish, and will show data through Dec. 31, 2023.[5] The dashboard can be accessed from the Denver Water website at: https://www.denverwater.org/your-water/water-quality/lead/dashboard

In April 2023, the dashboard was reformatted to include the new health equity and environmental justice (HE&EJ) metric included in the LCRR Variance.[6] To integrate this information into the dashboard, the graph showing month-to-month service line replacement totals for the year was removed. The overall total number of replacements for the year-to-date continues to be shown in the top row of the dashboard, while the newly added HE&EJ metric is displayed in the bottom right corner, presenting Denver Water's and the LRP's commitment to equity. The term "disproportionately impacted communities" is used to describe communities that meet the HE&EJ metric and aligns with the definition adopted by the Colorado Legislature.

FIGURE 1. DASHBOARD AS POSTED TO THE DENVER WATER WEBSITE (DATA TO DEC. 31, 2023)



[5] See the 2020 Second Quarterly Report for an explanation of the metrics used in the dashboard.
[6] See Section 7.B.vii.c for details on how the HE&EJ metric is calculated.

PART 2: REQUIRED REPORTING

7.B.i CCT

Section 7.B.i of the LCRR Variance addresses Denver Water's Corrosion Control Treatment (CCT) recordkeeping and reporting requirements for 2023 for the following parameters:

> *i. CCT*
>
> *a. notification to CDPHE and EPA of elevated lead levels and the actions that Denver Water is taking to reduce drinking water exposure to lead at those locations;*
>
> *b. all lead and copper compliance tap sampling results, as required in Subpart I of 40 C.F.R. Part 141 and Section 11.26 of 5 CCR 1002-11, as well as the results of any customer requested samples;*
>
> *c. 90th percentile lead levels overall, for LSLs, and for copper with lead solder sites;*
>
> *d. CCT water quality parameters for pH and alkalinity; and*
>
> *e. all lead and water quality results collected as part of Denver Water's investigation of LSLs and post LSL replacement and service line material of those sites.*
>
> *Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.*

Denver Water uses a combination of water quality parameters and lead sampling results to report the performance of CCT. Since monthly reports are no longer required under the LCRR Variance, information that was previously reported as part of the monthly reports is not included in this report, with the exception of a summary of some data. Additional data can be provided upon request.

CCT with pH adjustment is used to manage lead release from lead service lines, as well as homes with copper plumbing with lead solder. Homes with an LSL that opt out of the LRP are also offered some protection through pH adjustment. Denver Water's LRP webpage has a page dedicated to pH adjustment. The page describes the reasoning of the pH adjustment and how it benefits customers with an LSL or lead in their premise plumbing, answers FAQs and describes any downstream effects. Water treatment to adjust pH above 8.5 (required by the Dec. 16, 2019, Variance) was initiated at the Marston and Foothills Treatment Plants on March 3, 2020; treatment was initiated at the Moffat Treatment Plant when it returned to service on May 1, 2020. The cumulative 90th percentile lead level in the system before the pH change on March 3, 2020, was approximately 13 micrograms per liter (µg/L). After the pH stabilized at 8.8, the lead levels started to decline, eventually stabilizing by August of that same year to a 90th percentile lead concentration below 5 µg/L. The 90th percentile lead levels represent a greater than 60% decrease in lead levels due to CCT implementation.

During this reporting period, Denver Water continued to operate at or near a pH of 8.8 at all three plants. In addition to the information presented in this report, Denver Water also submitted several miscellaneous reports to CDPHE and EPA as required in the LRPP and described in Table 4.

TABLE 4. OVERVIEW OF 7.B.I REQUIREMENTS

Paragraph Reference	Description	Refer to
7.B.i.a	Notify CDPHE of elevated lead levels and actions taken by Denver Water to reduce lead exposure.	See Table 5 and Appendix.[1]
7.B.i.b	Lead sampling results per the Lead and Copper Rule and from customer requested sampling.	See Table 7 (90th percentile to date).
LRPP III.E (p 70)	Monthly trending of LCR compliance samples and customer requested samples.	See Table 5.
7.B.i.c	90th percentile lead levels for LSLs and for copper with lead solder sites.	See Table 7.
7.B.i.d	CCT parameters for pH and alkalinity, reported monthly.	See Table 8.
LRPP III.E (p 70)	Install automated pH control loops at all three treatment plants by March 2020.	All three plants have feedback loops in place and are functioning.
7.B.i.e	All lead and water quality sampling results from investigations for LSLs. All lead and water quality sampling results from post-LSL replacement sampling. Note that lead results from investigations and post-LSL replacement sampling are not included in the calculation of the 90th percentile lead concentration.	See Table 10 and Table 11.
LRPP Executive Summary LRPP III.E (p 65)	Targeted communications for select households built between 1983 to 1987 that self-identify as expecting or existing families with formula-fed infants and children up to 2 years of age. Offer water quality sampling; provide filter if lead measured > 3 µg/L (as described in paragraph 5.D).	Described with section 7.B.vi. Outreach materials launched Aug. 21, 2020. See Section 5.D.
LRPP III.E (p 71)	Complete distribution system modeling, evaluating pH, disinfection by-products and water age by Jan. 31, 2020. Submit nitrification control plan by June 30, 2020, to address sampling, monitoring, and flushing.	Submitted July 6, 2020. Re-submitted July 15, 2021.
Voluntary	Results from continued operation of the pipe racks.	Submitted Feb. 16, 2022.

[1] See Appendix CCT-5 Summary of Response to Elevated Lead Levels (Second Six-Month Period of 2023).

Water quality testing is a simple and effective method for Denver Water and its customers to identify potential risks of lead exposure. Denver Water manages lead and water quality samples via its Laboratory Information Management System (LIMS), with analysis performed by either the Denver Water Quality Lab or a contract lab. The sub-category (pre-LSLR, post-LSLR, customer-requested) under which the sample was collected is reported in LIMS, including LCR compliance samples, customer-requested samples, customer-requested samples from select households built between 1983 to 1987 (self-identifying as a home with a formula-fed infant), pre-LSL replacement investigative water quality samples and post-LSL replacement water quality samples. Denver Water uses a 3-bottle test for customer-requested and investigative water quality sampling under the LCRR Variance for consistency with past practices, as the 3-bottle technique is a very effective sampling method for finding service line material.

Summary of Actions Taken to Reduce Drinking Water Exposure to Lead at Locations with Elevated Lead Levels [7.B.i.a]

Per Section 7.B.i.a of the LCRR Variance, Denver Water must provide "notification to CDPHE and EPA of elevated lead levels and the actions that Denver Water is taking to reduce drinking water exposure to lead at those locations." In 2020, Denver Water set the elevated lead investigative response level at 15 and 25 µg/L in LCR compliance and customer requested samples, respectively, under its Elevated Lead Response Plan approved by CDPHE and EPA. Denver Water continues to sample the first liter under the LCR but will transition to fifth-liter sampling in 2024 to meet the requirements of the LCRR.[7]

All customer-requested samples with first draw concentrations above 25 µg/L analyzed by month during the second half of 2023 are listed in Table 5.[8] A lead result over 25 µg/L in the first sample bottle for a customer's home will trigger follow up and investigative sampling, as outlined in the Corrosion Control Treatment Implementation Plan.[9] Lead was measured above 25 µg/L in 19 samples during the reporting period for the second six months of 2023.

[7] See EPA's Lead and Copper Rule Revisions for more details on sampling methods.

[8] See Appendix CCT-5 Summary of Response to Elevated Lead Levels (Second Six-Month Period of 2023) for elevated lead measured in the first bottle of the 3-bottle test.

[9] See Corrosion Control Treatment Implementation Plan re-submitted to CDPHE on June 4, 2020.

TABLE 5. COUNT OF PROPERTIES WITH ELEVATED LEAD CONCENTRATIONS IN LCR AND CUSTOMER REQUESTED SAMPLES[1]

Description (Based on Sampling Date)	July 2023	August 2023	September 2023	October 2023	November 2023	December 2023	Response
Properties with Lead >25 µg/L in first 1 L sample bottle	1	3	0	4	0	0	See Appendix.[2]

[1] Although the Elevated Lead Response Plan applies only to LCR and eligible customer requested samples, the features of the plan are applied to results generated from pre-LSL replacement water quality samples obtained from properties included in the LRP for a consistent customer experience. The actions taken at these properties to investigate elevated lead are described in Appendix CCT-5, Summary of Response to Elevated Lead Levels (Second Six-Month Period of 2023) per the definition used in the LCRR Variance. Data reflect samples analyzed by Dec. 31, 2023.

[2] See Appendix CCT-5 Summary of Response to Elevated Lead Levels (Second Six-Month Period of 2023).

Lead Sampling Results from LCR Compliance and Customer Requested Sampling and 90th Percentiles [7.B.i.b and c]

Per Section 7.B.i.b and 7.B.i.c of the LCRR Variance, Denver Water must provide "all lead and copper compliance tap sampling results, as required in Subpart I of 40 C.F.R. Part 141 and 5 CCR 1002-11.26, as well as the results of any customer requested samples, and 90th percentile lead levels overall, for LSLs, and for copper with lead solder sites."

Denver Water conducts LCR compliance water quality sampling at Tier 1 sites, which are defined by the LCR as single-family structures that have an LSL or copper plumbing with lead solder (CPLS) in homes built between 1983 through 1987. The compliance period occurs January through June (Spring) and July through December (Fall). The cumulative 90th percentile lead concentration for LCR compliance samples for the Spring and Fall compliance periods since program inception is presented in Table 6. The 90th percentile calculated from the LCR compliance sampling is not to exceed 15 µg/L, as defined by the action level of the LCR. Data used to calculate the 90th percentile lead concentration align with reporting requirements of the LCR.

TABLE 6. LCR LEAD CONCENTRATIONS FOR LSL AND CPLS HOMES (SINCE PROGRAM INCEPTION)

Historical Cumulative LCR Lead Concentrations (µg/L)	2019		2020		2021		2022		2023	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring[1]	Fall[2]
Overall 90th Percentile	10	11.8	6.7	4.1	4.1	4.3	3.9	3.8	3.6	3.9
LSL 90th Percentile	10	12.4	6.7	4.3	4.1	4.5	4.0	3.9	3.4	3.6
CPLS 90th Percentile	7.8	5.1	4.8	2.9	3.4	2.3	1.2	1.7	1.8	1.7

[1] The 90th percentile Spring 2023 lead concentration as approved by CDPHE in their Aug. 1, 2023, letter.
[2] The 90th percentile Fall 2023 lead concentration as approved by CDPHE in their Jan. 26, 2024, letter.

Results from customer-requested sampling are included in the overall 90th percentile lead concentration reported in Table 7.

TABLE 7. SUMMARY OF LCR 90TH PERCENTILE LEAD CONCENTRATIONS (JULY 1 TO DEC. 31, 2023)

LCR Compliance Results for Lead – Fall 2023 Compliance Period[1]	Result	Number of Homes
LCR Compliance 90th Percentile Lead[2]	3.9 µg/L	101
Overall 90th Percentile Lead Concentration using LCR Compliance + Customer Requested Samples[3]	3.9 µg/L	438 (101 + 337)

[1] The 90th percentile Fall 2023 lead concentration as approved by CDPHE in their Jan. 26, 2024, letter.
[2] Includes results for all LCR compliance samples (from 1951 and older homes plus 1983 to 1987 homes with copper piping and lead solder) and reported in LIMS for the July 1 to Dec. 31, 2023, compliance period.
[3] Includes results from customer-requested samples reported in LIMS between July 1 and Dec. 31, 2023. Sampling to support the ALSLR Program is excluded from the compliance calculation.

Corrosion Control Treatment Water Quality Parameters for pH and Alkalinity [7.B.i.d]

Per Section 7.B.i.d of the LCRR Variance, Denver Water must provide "CCT water quality parameters for pH and alkalinity." Chemical feed systems were brought into service for enhanced pH CCT on March 3, 2020, at the Marston and Foothills Water Treatment Plants and on May 1, 2020, at the Moffat Water Treatment Plant. Trends for pH and alkalinity since Jan. 1, 2020, and operating data with adjusted pH since March 2020 can be provided upon request. Data for pH in treated water from the active water treatment plants and the distribution system are summarized in Table 8 based on the lowest daily average pH measured each month from each sampling point. Data for alkalinity in treated water from the active water treatment plants are summarized in Table 9 based on the lowest daily average alkalinity measured each month from each sampling point. On Aug. 13, 2020, Denver Water provided a letter to CDPHE that steady state performance of CCT was achieved in the distribution system. One year of data to describe CCT performance was provided to CDPHE on May 6, 2021, including pH and alkalinity data. The treatment targets for pH and alkalinity in the effluent of the three treatment plants and across the distribution system were announced by CDPHE on June 9, 2021. CDPHE established a target of 8.8 ± 0.2 for pH in treated water, 8.8 ± 0.3 for pH in the distribution system, and alkalinity greater than or equal to 20 mg/L as $CaCO_3$, all effective July 1, 2021.

TABLE 8. MINIMUM DAILY AVERAGE PH REPORTED EACH MONTH

Description	July 2023	August 2023	September 2023	October 2023	November 2023	December 2023
Effluent Variance Requirement	pH 8.8 +/- 0.2 in WTP effluent					
Marston Water Treatment Plant Effluent[1]	8.82	8.86	8.87	8.85	--	--
Foothills Water Treatment Plant Effluent	8.81	8.84	8.87	8.89	8.87	8.87
Moffat Water Treatment Plant Effluent	8.84	8.85	8.85	8.84	8.81	8.86
Distribution System Variance Requirement	pH 8.8 +/- 0.3 in distribution system					
Distribution System	pH levels in the distribution have been within 8.8 +/- 0.3 since March 12, 2020.					

[1] The Marston Water Treatment Plant went offline on Oct. 19, 2023, for maintenance.

TABLE 9. MINIMUM DAILY AVERAGE ALKALINITY REPORTED EACH MONTH

Description	July 2023	August 2023	September 2023	October 2023	November 2023	December 2023
Effluent Variance Requirement	≥ 20 mg/L as $CaCO_3$					
Marston Water Treatment Plant Effluent[1]	57.1	58.5	56.0	68.1	--	--
Foothills Water Treatment Plant Effluent	59.9	57.9	56.1	54.2	52.1	59.4
Moffat Water Treatment Plant Effluent	44.8	45.1	44.9	44.9	44.3	43.5

[1] The Marston Water Treatment Plant went offline on Oct. 19, 2023, for maintenance.

Water Quality Sampling Results from Pre-LSLR Sampling [7.B.i.e]

Per Section 7.B.i.e of the LCRR Variance, Denver Water must provide "all lead and water quality results collected as part of Denver Water's investigation of LSLs and post LSL replacement and service line material of those sites." Results from water quality sampling can provide an indication of lead at single-family residential properties and, when reviewed with additional results from field methods, the status of a service line can be changed in the inventory (i.e., from unknown to confirmed LSL).[10] The 3-bottle tests are performed to aid in the classification of service line materials of properties within Denver Water's integrated service area to provide the following:[11]

- To confirm the service line material before LSL replacement at properties included in the 2023 ALSLR Task Orders where lead has not been confirmed (i.e., p-value < 1).[12]
- To inform the inventory and predictive model at properties in the City and County of Denver and in distributor areas with a likely LSL (i.e., p-value ≥ 0.5 and < 1).

[10] See Section 7.B.ii LSL Inventory for more details.
[11] Details and results for pre-LSL replacement sampling efforts can be provided upon request.
[12] Since July 22, 2020, kits are sent to all properties with a p-value of 0.5 to 0.9. Any property with a p-value < 1 is verified in the field before replacement, using visual inspection of materials at the interior connection and/or potholing on the exterior.

- To support the designation of the service line material at all single-family residential properties within a distributor boundary identified with a likely LSL (i.e., p-value ≥ 0.5 and < 1).[13]

- To validate customer comments on the presence (or absence) of an LSL and requests to opt into (or out of) the LRP.

Lead results over 3 µg/L in the second or third sample bottle will trigger a review of inclusion in the LRP, and the property will be added to the list for LSL replacement and added to the Filter Program if not already enrolled.[14] A summary of the water quality results prior to LSL replacements is presented in Table 10. Due to a data transition error, samples analyzed in December were not reported in LIMS by the Dec. 31, 2023, date. These samples will be reported in the First Semi-Annual Report of 2024. The maximum lead concentration measured year-to-date was 1,010 µg/L in the third bottle of samples collected at a single-family property in April 2023; the lead service line at this property was replaced in May 2023. Multi-family residences with five or more units that request a water quality kit are sent a 1-bottle sampling kit and are included in Table 10.

TABLE 10. SUMMARY OF WATER QUALITY RESULTS PRE-LSL REPLACEMENT AT SINGLE-FAMILY RESIDENCES USING THE 3-BOTTLE TEST

Water Quality Sampling for Investigation (pre-LSL Replacement)	Count	Unit
Total Number of Kits Mailed Out from July 1 to Dec. 31, 2023[1]	5,378	Kits
Total Number of Kits Received and Analyzed to Investigate the Service Line Material from July 1 to Dec. 31, 2023[2]	1,348	Kits
Maximum Lead Concentration Measured Year-to-Date	1,010	µg/L
Average Lead Concentration from July 1 to Dec. 31, 2023 (in second and third bottles only)[3]	1.55	µg/L

[1] If a sampling kit is re-sent to a property, the additional distribution of the water quality kit is counted on top of the original distribution count. Total includes one 1-Bottle kit.

[2] As reported in LIMS by Dec. 31, 2023.

[3] If a value was reported as less than the detection limit (i.e., < 1 µg/L) the measured value was taken as 0.5 µg/L for calculation of the average concentration.

Water Quality Sampling Results for Post-LSL Replacement [7.B.i.e]

Per Section 7.B.i.e of the LCRR Variance, Denver Water must provide "all lead and water quality results collected as part of Denver Water's investigation of LSLs and post LSL replacement and service line material of those sites."

[13] This approach applied to all distributors with one exception. Sampling kits were delivered to 500 residential properties in Consolidated Mutual, although any customer can request a sample kit.

[14] The threshold used as an indicator for a lead service line was reduced to reflect the impact of corrosion control treatment with pH adjustment on lead release measured in water quality samples. Samples collected on May 1, 2020, and after with lead measured about 3 µg/L are considered lead. Samples collected prior to May 1, 2020, are assessed using the original threshold of 5 µg/L.

For LSL replacements completed prior to Dec. 31, 2019, letters were mailed to customers to offer post-replacement sampling three months after LSL replacement to single-family, multi-family and commercial properties. Customers could then call Denver Water to request a sampling kit. This process was discontinued on April 2, 2020.

For LSL replacements completed between Jan. 1 and Dec. 31, 2020, single-family residential property customers were automatically mailed a 3-bottle sampling kit approximately three months after replacement and multi-family and commercial properties were mailed a letter offering post-LSL replacement sampling inviting the customer to request a sampling kit. The letter was sent to every unit in a multi-family building.

For LSL replacements completed after Jan. 1, 2021, all single-family, multi-family, and commercial properties receive an offer letter for post-LSL replacement sampling approximately three months after LSL replacement.[15] If the customer elects to participate, single-family properties receive a 3-bottle sampling kit and multi-family and commercial properties receive a 1-bottle sampling kit. A summary of post-LSL replacement sampling offers is provided in Table 11. Due to a data transition error, samples analyzed in December were not reported in LIMS by the Dec. 31, 2023, date. These samples will be reported in the First Semi-Annual Report of 2024. As of July 2021, only those single-family properties with replacements completed by Denver Water crews automatically receive a 3-bottle sampling kit, with offer letters continuing to be mailed to all other residential multi-family and commercial properties.

[15] See Appendix CCT-6 Post LSL Replacement Sampling – Summary of Completed Offer to Test (Cumulative since LRP Inception).

TABLE 11. SUMMARY OF POST-REPLACEMENT SAMPLING OFFERS AND WATER QUALITY (JULY 1 THROUGH DEC. 31, 2023)

Water Quality Sampling after LSL Replacement	Count[1]						
	July 2023	Aug 2023	Sept 2023	Oct 2023	Nov 2023	Dec 2023	TOTAL
Total Number of Letters Mailed to Offer Post-LSL Replacement Sampling[2,3]	878	799	972	755	794	641	4,839
Total Number of Kits Mailed Out[2,3]	168	209	245	181	185	154	1,142
Total Number of Kits Received and Analyzed to Confirm post-LSL Replacement Water Quality[2,4]	69	69	37	67	38	0	280
Total Number of Kits Received and Analyzed to Confirm post-LSL Replacement Water Quality Not Previously Reported[5]	41	0	0	0	0	0	41
Number of Properties with Lead > 15 µg/L in First Bottle[2] (triggers additional investigation effort)	0	0	0	0	0	0	0
Number of Properties with Lead ≥ 5 and < 15 µg/L in the Second and/or Third Bottle[6] (triggers additional investigation effort)	0	0	0	0	0	0	0
Number of Properties with Lead ≥ 5 and < 15 µg/L in First Bottle[2] (triggers customer education)	1	1	1	2	0	0	5

[1] Counts are based on the month of sample collection, per the LCRR Variance. Not applicable to "Total Number of Letters Mailed to Offer Post-LSLR Replacement Sampling" or "Total Number of Kits Mailed Out", which are based on the date of mailing.

[2] Applies to single-family and multi-family residences.

[3] If a duplicate letter or sampling kit was sent to a property/customer, it is counted twice.

[4] Total number of kits analyzed refers to results available in LIMS by Dec. 31, 2023, with samples collected since July 1, 2023.

[5] One water quality sample collected in February 2020 and 40 water quality samples collected in June 2023 (added to count for July) not previously reported.

[6] Applies to single-family residences only.

During this reporting period, eight properties with a completed LSL replacement did not receive an offer letter or sampling kit and required additional review due to the replacement being performed by a third party, data discrepancies, tap status changes, mailing address errors, etc. In many circumstances, a homeowner or contractor elects to replace a service line as part of redevelopment or renovation, a process that can take several months to complete. Once the data are reconciled, a water quality sampling kit or offer letter is sent to these properties. All properties received their offer letter within the six-month post-replacement timeline. A detailed list of properties that did not receive the offer and explanation is provided in Appendix CCT-7, including follow-up activities.[16]

Post-replacement sampling offer letter mailing lists are created every month by compiling a list of properties from the inventory where the p-value status changed to 0 due to replacement of the LSL three months prior to the month the mailing list is created. The Quality

[16] See Appendix CCT-7 Post LSL Replacement Sampling – Summary of Incomplete Offer to Test (Cumulative since LRP Inception).

Assurance/Quality Control process to determine valid addresses includes evaluating who completed the replacement (i.e., Denver Water T&D crews or ALSLR contractors), if the property is CASS[17] certified, and the initial status of the property in the inventory.

Water Quality Results from Select Households (1983 to 1987 Homes) [5.D]

Section 5.D of the Variance provides that:

> *… If a child up to 24 months of age resides in a Select Household and the water quality results in the first draw sample show lead concentrations above 3 ppb, Denver Water must offer a filter and enough replacement filters and cartridges, at no cost, to the customer until the child exceeds the age of 24 months.*
>
> *Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.*

Outreach to customers residing in all households built between 1983 and 1987 was launched in August 2020, with a second round of outreach performed in November 2021. "Select households" are defined as homes built between 1983 to 1987 with copper piping and lead solder and that self-identify as having a formula-fed infant under the age of 24 months. If a customer from a 1983 to 1987 home requests a water quality sampling kit, Denver Water will mail a kit whether or not a formula-fed infant resides at the property. If lead is measured above 3 µg/L, and the customer self-identifies as having a formula-fed infant, the customer is invited to enroll into the Filter Program. In the second six months of 2023, eight water quality sampling results were analyzed for select households, none of which identified as having a formula-fed infant. None of the households with formula-fed infants had lead measured above 3 µg/L and therefore were not enrolled in the Filter Program.[18]

5th L Sample Collection

During the Fall 2023 LCR compliance sampling round, technicians collected five 1 L sequential samples at 57 properties with an LSL included in the LCR study pool in preparation for new sampling protocols described in the EPA's LCRR published in January 2021. Results are shown in Table 12. Lead was measured less than 1 µg/L in the 5th L at 15 properties, most of which also measured less than 1 µg/L in the first draw. The results of Table 12 were compared to results described in the LRPP which included sampling using ten sequential samples. In general, the 5th L profile sampling suggests the first draw (i.e., the compliance sample under the existing LCR) does not capture the highest lead concentrations within a service line. One home had a concentration as high as 15 µg/L in the fifth draw (17.1 µg/L) and two homes had concentrations greater than 10 µg/L but less than 15 µg/L in the first draw. All results are an indication that the CCT component of the LRP is effective and CCT practices are expected to meet the needs of the LCRR.

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[17] CASS (Coding Accuracy Support System) is used by the United States Postal Service to verify and improve the accuracy of an address and its associated zip code.

[18] See Appendix CCT-8 Summary of Water Quality Sampling Results from Select Households (1983 to 1987 Homes, Cumulative since LRP Inception).

TABLE 12. OVERVIEW OF 5TH LITER SAMPLING DATA IN FALL 2023

5th L Sampling in 2023	Count
Total Number of Properties Sampled for 5th L	57
Number of Properties with inconclusive data (all results <1.0)	15
Number of Properties where the 5th L < 1st L concentration	12
Number of Properties where the 5th L > 1st L concentration	45

7.B.ii LSL Inventory

Section 7.B.ii of the LCRR Variance requires that Denver Water maintain records and report the following information with respect to its LSL Inventory:

> *ii. LSL Inventory.*
>
> *a. In Order to meet the October 16, 2024, deadline in which the requirements for an initial inventory that complies with the LCRR must be met:*
>
> *1. total number of service lines;*
> *2. the total number of replaced LSLs and GRR;*
> *3. the total number of confirmed and likely LSLs;*
> *4. the total number of unlikely LSLs;*
> *5. the total number of non-LSLs, indicating the number designated as non-LSLs solely based on statistical factors;*
>
> *b. the number of Investigations conducted each year, demonstrating that the cumulative average 1.4% verification rate has been met;*
> *c. an updated service line inventory map; and*
> *d. the rationale for a change in the status of a service line in the inventory (e.g., Investigation, replacement, water quality data).*
>
> *Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.*

Denver Water must comply with the terms and conditions of the 2022 LCRR Variance as well as all other provisions in the LCRR, including the requirements associated with CCT. Therefore, in addition to the efforts to fulfill Variance requirements, Denver Water is working to ensure compliance with the LCRR when it goes into effect on Oct. 16, 2024, by refining the inventory to fit LCRR terminology and description. This section of this report further expands upon those efforts and the subsequent changes to the inventory.

An overview of the LSL Inventory reporting requirements is shown in Table 13.

TABLE 13. OVERVIEW OF 7.B.II REQUIREMENTS

Paragraph Reference	Description	Refer to
3.A	Continue to maintain on an ongoing basis an inventory of the material of each service line connected to the public water distribution system that is a confirmed or likely LSL. By October 16, 2024, Denver Water must have conducted an initial inventory that complies with the service line inventory requirements in 40 C.F.R. § 141.84(a).	Refer to Table 15. In progress.
3.C	Continue to provide public access to its LSL inventory on its external customer website and update at least annually. By October 16, 2024, the inventory must list by specific street address which service lines are lead, galvanized requiring replacement, non-lead, or lead status unknown.	Re-posted on Jan. 23, 2024, using data through Jan. 17, 2024. In progress.
7.B.ii.a.1	Total number of LSLs and GRR.	Refer to Table 15. See Appendix.[1]
7.B.ii.a.2	Total number of replaced LSLs during the Variance.	Refer to Table 16.
7.B.ii.a.3	Total number of confirmed and likely LSLs.	Refer to Table 15.
7.B.ii.a.4	Total number of unlikely LSLs.	Refer to Table 15.
7.B.ii.a.5	Total number of non-LSLs. Total number of non-LSLs determined solely by statistical methods.	Refer to Table 15. Described after Table 15.
7.B.ii.b **3B, 3.D**	Number of investigations that supports a determination of the material of the service line and that are performed independently of an LSL replacement or not at the request of the customer.	Refer to Table 22.
LRPP III.B (p 51)	Use results from investigations to update the predictive model which is used to plan and prioritize efforts of the COE Plan, ALSLR Program and Filter Program as well as refine the LSLI.	See Section 7.B.vii.
7.B.ii.c	Updated LSL Inventory Map.	https://www.denverwater.org/your-water/water-quality/lead
7.B.ii.d	Rationale for change to status of the service line in the LSL Inventory.	See Appendix.[2]

[1] See Appendix INV-6 Summary of Service Line Status and p-Value (Second Six-Month Period of 2023).

[2] See Appendices INV-7A Line by Line p-Value Changes: Status Descriptions and Notes (Second Six-Month Period of 2023) and INV-7B Line by Line p-Value Changes by Status (Second Six-Month Period of 2023).

Current LSL Inventory [7.B.ii.a, b, c, and d]

The baseline LSL Inventory was updated using additional information and further analysis of the data presented and submitted in the September 2019 LRPP (see Table 15).[19] The initial LSL inventory designating known, suspected, and possible LSLs was subsequently submitted on Feb. 5, 2020.

Table 14 below details the terminology used for various submittals of the lead service line inventory under the LRP.

[19] See the September 2019 LRPP for more information.

TABLE 14. LEAD SERVICE LINE INVENTORY SUBMITTALS

Naming	Submittal Date	Notes
Baseline Inventory	September 2019	Included in the Denver Water proposed Lead Reduction Program Plan (LRPP).[1] This inventory serves as the basis for the 63,955 LSL estimate and the 7% replacement rate.
Initial Inventory	February 2020	Provided an initial inventory within 35 days of the effective date of the 2019 LCR Variance, per paragraph 3.A.[2]
Annual Inventory	Yearly	Submitted along with each program year's Annual Report and used in the application of the equivalency model to evaluate the performance of the LRP.
LCRR Inventory	October 2024	Note that the LCRR calls this an initial inventory but since we already have an initial inventory, we have been specifying this is the LCRR inventory.

[1] Refer to the September 2019 LRPP for more information.
[2] Refer to the LCR Variance for more information.

Adjustments to service line designations to either the known lead or known non-lead categories are made based on available information from:

- Potholing (main-to-meter and meter-to-building),
- Interior inspections at the point of entry,
- Water quality sample results,
- Desktop review of existing Denver Water records,
- Predictive modeling,
- Customer submitted proof of replacement and City of Denver plumbing permits, and
- Review of individual distributor records.

Service line reviews are an ongoing daily task of the program since 2020. Changes in the service line material designation are reflected in Denver Water's online map which is updated bimonthly.[20] Large changes to the inventory occurred in 2023 due to investigations and are described in the investigation section of this report. Beginning in October 2024, the program will

[20] See Denver Water's online map for more information.

shift to the terminology defined in the LCRR, grouping likely (possible and suspected LSL) and unlikely into unknowns.

The information presented in Table 15 demonstrates the progress of Denver Water's understanding of the current lead service line inventory compared with the baseline inventory submitted in September 2019. The inventory is used to establish the total number of estimated lead services and the mandated annual number of replacements. For the purposes of Table 15, the total number of "confirmed LSLs" includes the number of properties with a known lead service that remain in the ground and those that have been replaced by the LRP.

The LCRR defines galvanized requiring replacement (GRR) as any service line where either:

1) A portion of the line is galvanized, and that segment is or was at any time, downstream of a lead service line; or

2) The galvanized service line is currently downstream of an unknown service line.

Currently, Denver Water does not have a clearly defined method to prove that lead was never upstream of the galvanized section and would not require replacement. Therefore, Denver Water replaces all galvanized service lines found as a precaution. Since Denver Water categorizes any service line where lead is identified as an LSL, regardless of other materials being identified, this classification encompasses GRR service lines where galvanized was confirmed downstream of lead. Therefore in 2023, as shown in Table 15, the program has confirmed 32,864 LSLs with an additional subset of 4,054 GRR service lines. It is important to note that a substantial number of these properties identified lead between the main and meter and galvanized between the meter and home. The additional 4,054 service lines classified as GRR in Table 15 represent those galvanized service lines where lead was not found. Ongoing investigations have shown that 3,973 of these properties have found copper upstream of the galvanized section. Denver Water continues to explore these properties through record review, water quality sampling, potholing, and interior inspections to identify trends in the installation practices from the era when galvanized was installed.

TABLE 15. LEAD SERVICE LINE INVENTORY AS OF DEC. 31, 2023

Status of Service Line	Sept. 6, 2019 Submittal (Aug. 8, 2019 Data) BASELINE INVENTORY	Feb. 5, 2020 Submittal (Jan. 28, 2020 Data) INITIAL INVENTORY	Feb. 10, 2023 Submittal (Dec. 31, 2022 Data) 2022 ANNUAL REPORT[1]	Feb. 10, 2024 Submittal (Dec. 31, 2023 Data) CURRENT INVENTORY[2]
Confirmed LSL[3] *(previously referred to as Known Lead)*	1,066	1,149	16,145	32,864
GRR[4]	*(Included with Confirmed LSL count)*		2,760	4,054
Likely LSL *(Suspected Lead + Possible Lead)*	83,480	82,337	58,394	34,964
Unlikely LSL	89,388	90,745	87,589	31,579
Non-LSL[5,6]	145,766	146,528	157,826	217,292
Total Number of Services	319,700	320,759	320,714	320,753
TOTAL ESTIMATED Number of Lead Service Lines[7]	**63,955**	**63,195**	**62,504**	**62,114**

[1] Inventory values updated to reflect omission of 1,716 replacements that were not counted in the Feb. 10, 2023, submittal.

[2] The "current inventory" is the basis of enrollment in the Filter Program (calculated as the sum of the properties with a confirmed or likely LSL, plus distribution of additional filters to multiple units at the same property and less the number of vacant properties).

[3] Since the 2020 Annual Report, the current inventory counts for "known lead" include properties that are either known to be lead, GRR, or that have had a lead or galvanized service line replaced. The 22,239 properties categorized as "confirmed LSL" in the current inventory were replaced since program inception (see Table 16 and Table 25). Due to ongoing data integration and QC processes, 51 of the 22,239 properties identified as confirmed replacements remain to be integrated into the LRP database to drive a p-value change to 0. Of these 51, 1 remains as "unlikely LSL", 24 as "likely LSL", 3 as "confirmed LSL", and an additional 234 are described as non-active or non-potable (coded as NULL). The counts for these categories in the current inventory (most right column) have been reduced accordingly.

[4] Previous inventory reporting counted GRRs under the "confirmed LSL" count. GRRs in the Dec. 31, 2023, LSLI include galvanized-galvanized (50 properties), copper-galvanized (3,973 properties), and galvanized-copper (83 properties) service lines. Properties with galvanized (and no lead identified in potholing) with water quality results ≥ 3 µg/L lead are included in this number.

[5] The "non-LSL" count currently does not include properties where galvanized was identified but did not require replacement (lead was never upstream of the galvanized service line). Denver Water plans to assess their processes in 2024 for galvanized service lines to identify which galvanized service lines require replacement.

[6] Since the 2020 Annual Report, the counts for "non-LSL" do not include the properties at which the LSL was replaced as part of the LRP (see Table 16 and Table 25), as these are already included in the count for "confirmed LSL."

[7] See Appendix INV-6 Summary of Service Line Status and p-Value (Second Six Month Period of 2023) for details on how this was calculated.

Of the 217,292 service lines identified as non-lead in the current inventory, 199,773 are included in this category based solely on statistical assumptions (143,437 from the initial September 6, 2019, inventory, 2,778 since identified through desktop evaluation and 53,558 based on recommendations from the predictive model). The material of these service lines was not confirmed via field observations, rather the service line was classified as non-lead based on the age of the building, history of development in the Denver Water service area, operating rules

requiring copper at post-1971 properties, water main tap date, etc.[21] Properties built or connected between 1951 and 1971 are considered "unlikely LSL" based on historical records and evidence of non-lead materials.[22] Denver Water continues to review investigation data on these service lines in an effort to further classify the materials of these service lines.

Number of LSL Replacements Completed and Incorporated into the Inventory [7.B.ii.d]

The total number of LSLs replaced between July 1 and Dec. 31, 2023, is shown in Table 16. Denver Water does not count the replacement of copper service lines (i.e., non-LSL) toward the total number of LSL replacements for compliance purposes.[23]

TABLE 16. NUMBER OF LSL REPLACEMENTS BETWEEN JULY 1 AND DEC. 31, 2023

Description	Count[1]
Number of LSLs Replaced in July 2023	629
Number of LSLs Replaced in August 2023	822
Number of LSLs Replaced in September 2023	602
Number of LSLs Replaced in October 2023	700
Number of LSLs Replaced in November 2023	516
Number of LSLs Replaced in December 2023	292
Total Number of LSLs Replaced in the Second Six Months of 2023	3,561
Total Number of LSLs Replaced in 2023	6,891
Number of LSLs Replaced not Previously Reported[2]	65
Total Number of LSLs Replaced since inception of LRP on Jan. 1, 2020[3]	22,406

[1] The number of replacements identified in the "Lead Replacement" column of Appendix INV-7B (Line by Line p-Value Changes by Status, Second Six-Month Period of 2023) does not match the number of LSL replacements shown in Table 16 due to a lag in the quality assurance review during data integration from field replacements to LRP database. To validate replacements per month**,** refer to LSL-6 Addresses and Types of Replacements (Second Six-Month Period of 2023).

[2] This includes the net change to the number of LSL replacements completed since program inception not previously reported (70 added) and previously reported LSL replacements that upon review were removed (5 deductions); see Appendix LSL-6 Addresses and Types of Replacements for Properties Not Previously Counted and Duplicates (Since Program Inception) for details**.**

[3] The total number of LSLs replaced since program inception presented in this table are tracked separately from the inventory and, therefore, may not match the numbers presented in Figure 1 or Table 15. Totals include tap cuts that occurred after the replacement and other records that have been subsequently removed from the inventory.

[21] This is the number which retains the original number of non-lead properties (p-value = 0) from the inventory in the Lead Reduction Program Plan (see Appendix III.B.2, Preliminary Identification of Lead Service Lines).

[22] See Appendix II.B.2 of the Lead Reduction Program Plan for details and assumptions.

[23] See paragraph 4.B of the Variance Order and the notes for the column "Actual Previous Materials" in Appendix LSL-6 Addresses and Types of Replacements (Second Six-Month Period of 2023).

Investigations of Service Line Material [7.B.ii.b]

Section 3.D of the LCRR Variance requires that "Denver Water . . . [i]nvestigate a cumulative average of 1.4% of the total estimated number of unknown service lines in the inventory each Program Year. . ."

As required by the LCRR Variance, Denver Water continues to conduct investigations of service lines and make refinements to the LSL Inventory of service line materials connected to its water system. Investigations are performed at properties to improve the assumptions that were used to develop the LSL Inventory.[24]

Investigations are counted by investigation type and may include desktop evaluation of available data from Denver Water, assessors, permits, distributors, and customers; water quality sampling; potholing, predictive model, and/or interior inspection. After 15 years of the LRP, there should be no remaining properties in the LSL Inventory categorized as likely LSL and all confirmed LSLs should be replaced.

Figure 2 below details the process flow for the investigation methods used under the LRP and how each method is used to identify material type, removing a property from the unknown category into the known (lead or non-lead) category. All data gathered from water quality sampling, potholing, interior inspections, and desktop reviews are used to train the predictive model. The predictive model is discussed in further detail later in this section.[25]

[24] See Denver Water's Investigations Webpage and the LCRR Variance for more information.

[25] For additional information on the predictive model, see Appendix INV-10 Predictive Model Technical Memorandum.

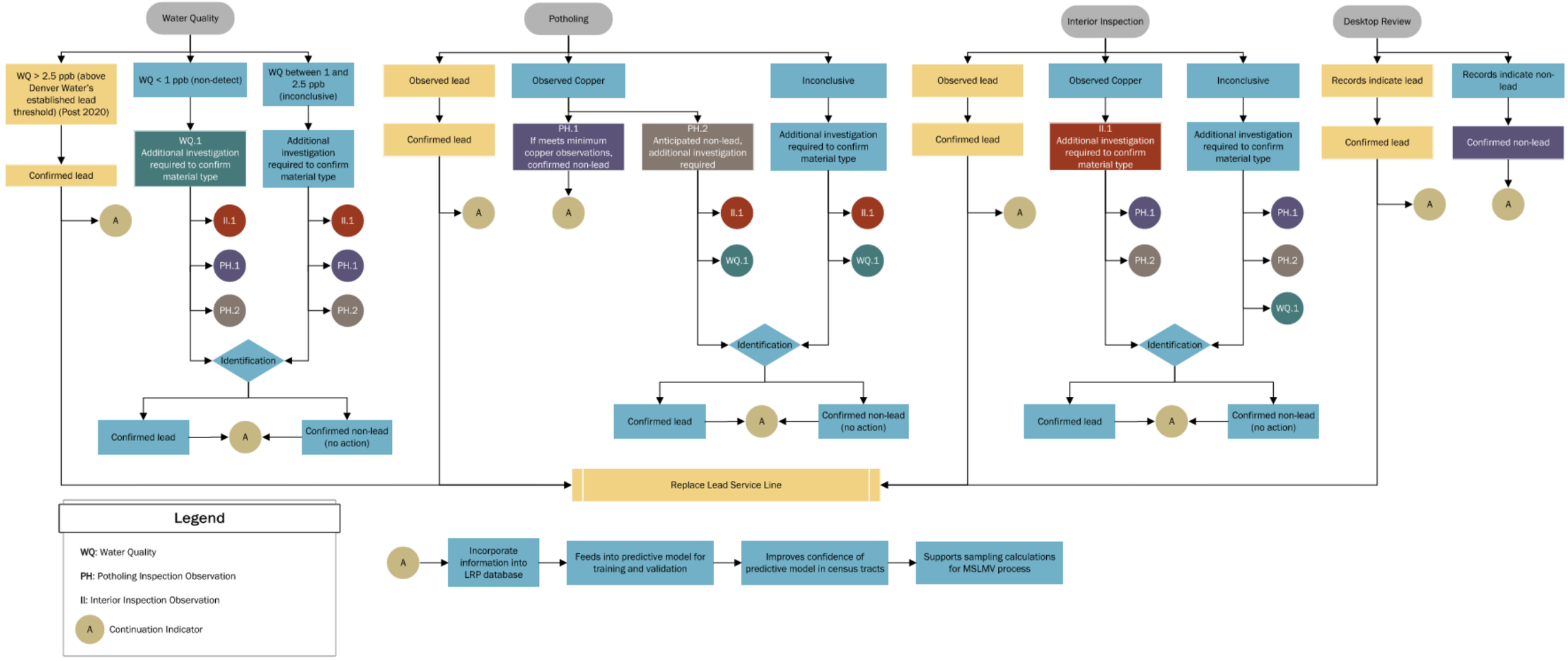


FIGURE 2. INVESTIGATION FLOW DIAGRAM

A property can be counted toward an investigation up to five times (one time per category, described later in this section) over the duration of the program. An investigation does not need to result in a p-value change, unless the method is predictive modeling.

An investigation is counted if all the following conditions apply:

1) The property is originally classified as unknown (see paragraphs 3.B and 3.D in the LCRR Variance).

2) The investigation was performed independently of LSL replacements (see paragraph 3.D in the LCRR Variance). Visual verifications that result in a copper material designation, and therefore do not result in a replacement, are counted as an investigation. If Denver Water includes an investigation in the semi-annual report and later replaces said LSL even though it was not originally planned, that investigation will still count towards the 1.4% metric and will not be removed from the investigation metric total.

3) The investigation was not the result of a customer-requested water quality sample (see paragraph 1.L in the LCRR Variance).

Definitions used to categorize the service line material:[26]	
Confirmed LSL	based upon direct evidence that gives a 100% estimated probability per the LRPP that a service line is an LSL or a "galvanized requiring replacement" service line.
Likely LSL	based upon available data that provides an estimated probability value between 50% to 99% that a service line is an LSL or a "galvanized requiring replacement" service line.
Unlikely LSL	based on conflicting or missing data that provides an estimated probability value between 1% to 49% that a service line is an LSL based on the LRPP; or a "galvanized requiring replacement" service line.
Non-Lead	0% likelihood of finding lead.

The number of investigations to support a determination of the service line material are counted toward the required 1.4% of the unknowns in the LSL Inventory investigated each year. An unknown service line is defined as any service line that does not have a p-value of 0 (non-lead) or 1 (known lead). Denver Water considers five types of investigations that can be performed on service lines:

[26] As defined in paragraphs 1.C, 1.P, and 1.X of the Order, dated Nov. 30, 2022, for confirmed LSL, likely LSL, and unlikely LSL, respectively. Note that the definition of non-lead was not provided in the Order. These are consistent with the terminology used on Denver Water's public inventory, which was first published in March 2020.

1) Interior inspections,
2) Potholing,
3) Water quality sampling,
4) Desktop reviews, and
5) Predictive modeling.

SERVICE LINE IDENTIFICATION PROCESS

CDPHE published a Service Line Identification (SLID) Policy on Sept. 7, 2023, that provided a process for establishing an initial lead service line inventory and identifying unknowns in preparation for the LCRR. For a decade, Denver Water has worked on the lead service line inventory and has taken steps to achieve a completed inventory, which align with Steps 1 through 3 of the SLID Policy. The LRP does, however, have some practices that may differ from Step 4 of the SLID Policy for identifying unknowns and, instead, goes above and beyond what is required, as detailed within this section.

Predictive modeling was incorporated into the LRP as an investigative method in 2023. The predictive model has been a part of the LRP since inception but was historically not used to change lead service line inventory p-values until 2023. With the large number of unknowns in Denver Water's service area, the predictive model drives to refine the inventory (i.e., identify unknown materials), using machine learning, as discussed later in this section. CDPHE's SLID Policy defines a minimum service line material verification (MSLMV) process, or a multi-source analysis, that takes a combination of methods (interior inspections, potholing, water quality, desktop reviews, and predictive modeling) and uses the results to determine a material. Therefore, Denver Water began incorporating the predictive model into the inventory, driving to material designations (p-value changes). P-value changes due to the predictive model are counted toward Denver Water's investigation metric defined by the LCRR Variance, as well as investigations that occurred within replacement work areas that resulted in a confirmed non-lead service line (and therefore were not replaced as part of the ALSLR Program). The large uptick in investigations seen in 2023 are due to this shift in investigation perspective and are summarized at the end of this section.

INTERIOR INSPECTIONS

Interior inspections provide Denver Water field crews with a visual observation of the service line as it enters the premise (Point of Entry). This helps the field crew confirm the material that was observed at the meter to building pothole. There are, however, limitations to interior inspections, and at times observing the service line entering the building is not possible due to obstructions or lack of consent from the homeowner. Interior inspections alone are not sufficient for non-lead material designation and must be considered in conjunction with other types of investigation.

TABLE 17. INTERIOR INSPECTION OBSERVATIONS (JULY 1 TO DEC. 31, 2023)

Service Line Status	Total Number of Investigations	Interior Inspection Observation	Follow-up Action
Initial Status 0.5 ≤ p ≤ 0.9	970	Observed lead	Property added to list for LSL replacement and is scheduled to be replaced.
	1,871	Observed non-lead	Additional investigation is required.
	366	Incomplete	Additional investigation is required.
Initial Status 0.01 ≤ p < 0.5	0	Observed lead	Property added to list for LSL replacement and is scheduled to be replaced.
	4	Observed non-lead	Additional investigation is required.
	0	Incomplete	Additional investigation is required.
Total Number of Interior Inspections (Second Six Months Only)[1]			**3,211**

[1] 15 interior inspections were conducted outside of the ALSLR Plan for investigative purposes.

POTHOLING

Potholing can be used in to identify “lead” status as a stand-alone investigative method or can be used combination with other investigative methods to determine that a property is designated “non-lead”. To confirm “non-lead,” there can be no lead or galvanized visually observed from potholing and interior inspections and there can be no contradictions with the desktop records review and/or water quality sampling results.

Verification potholing is used at properties included in the 2023 ALSLR Plan to confirm the material of the service line before replacement to help further develop the inventory. As of Aug. 10, 2020, all likely LSLs (0.5 ≤ p-value < 1) are verified prior to replacement, with potholing and/or water quality sampling, to reduce the likelihood of replacing a non-LSL.

Visual observations are conducted to observe the material type of the service line using potholing. Results from potholing as part of the ALSLR Program are presented in Table 18 along with the next steps to either replace a service line that is confirmed to be lead or to pursue additional investigative methods. If copper is observed at three or more points used for verification (e.g., copper is observed at two exterior potholes and at the interior connection), the service line is not categorized and the p-value is not adjusted; rather, the property is subjected to additional investigation efforts (i.e., interior inspections, additional potholing, water quality sampling, desktop review) to identify the service line material. To confirm “non-lead,” there must be no signs of lead or galvanized pipe material visually observed when potholing activities are conducted.

TABLE 18. POTHOLING OBSERVATIONS AS PART OF THE 2023 ALSLR PLAN (JULY 1 TO DEC. 31, 2023)

Service Line Status	Total Number of Investigations	Pothole Observation	Follow-up Action
Initial Status 0.5 ≤ p ≤ 0.9	3,017	Confirmed lead.	Property added to list for LSL replacement and is scheduled to be replaced.
	903	Confirmed non-lead.	Remove property from LRP.
	1,233	Incomplete.	Additional investigation is required.
Initial Status 0.01 ≤ p < 0.5	2	Confirmed lead.	Property added to list for LSL replacement and is scheduled to be replaced.
	2	Confirmed non-lead.	Remove property from LRP.
	3	Incomplete.	Additional investigation is required.
Total Number of Properties Potholed within 2023 ALSLR Program (Second Six Months Only)[1]			**5,203**

[1] Includes 43 premises with initial p-value of 0, not included in the above, and 6 with an initial p-value of less than 0.5 in the Feb. 2020 Inventory (from Table 15) that were subsequently increased to greater than or equal to 0.5 and therefore eligible for potholing as part of the ALSLR Plan. 17 of the 49 premises have p-values that remain greater than or equal to 0.5, 13 had their p-values changed to 0 due to visual verification, and 19 had their p-values changed to 0 due to replacement as part of the ALSLR Plan. (**5,160** + **43** = **5,203**).

During the second six months of 2023, potholing was performed at 2,375 properties not included in the 2023 ALSLR Plan.[27] Results are included in Table 19. If potholing occurred at a critical customer property and lead is found, the property is scheduled for replacement in 2023 and therefore does not contribute to the required number of annual investigations.

[27] See Appendix INV-8 Results from Visual Verifications (Second Six-Month Period of 2023).

TABLE 19. POTHOLING OBSERVATIONS INDEPENDENT OF THE 2023 ALSLR PLAN (JULY 1 TO DEC. 31, 2023)

Service Line Status	Total Number of Investigations	Pothole Observations[1]	Follow-up Action
Initial Status 0.5 ≤ p ≤ 0.9	914	Confirmed lead.	Property added to list for LSL replacement and is scheduled to be replaced.
	973	Confirmed non-lead.	Remove property from LRP.
	474	Incomplete.	Additional investigation is required.
Initial Status[2] 0.01 ≤ p < 0.5	0	Confirmed lead.	Property added to list for LSL replacement and is scheduled to be replaced.
	3	Confirmed non-lead.	Remove property from LRP.
	0	Incomplete.	Additional investigation is required.
Total Number of Properties Potholed Independent of the 2023 ALSLR Program (Second Six Months Only)[3]			**2,375**

[1] The number of visual investigations completed as shown in Appendix INV-7B Line by Line p-Value Changes by Status (Second Six-Month Period of 2023) does not match data shown in this table due to a time lag between field activities and the data being collected, reviewed, confirmed, and added to the LRP database. Values presented in the table above related to Appendix INV-7B reflect only visual investigations (potholing and interior inspection). Appendix INV-7B also includes p-value changes made based on other observations not included in the totals reflected in the table above.

[2] This includes critical customers that were originally assigned a p-value < 0.5. Zero critical customers under this category were potholed in the second six months of 2023.

[3] Includes 11 additional properties, not included in above categories, 10 records with a Feb. 2020, p-value of 0 required further field verification, one additional record was added to the inventory after the Feb. 2020, submittal.

Currently, when galvanized service line material is observed, Denver Water makes the conservative assumption that the galvanized pipe was/is downstream of an LSL and therefore replaces the service line. To prepare for upcoming regulations regarding GRRs under the LCRR, Denver Water continues to investigate the service line, regardless of galvanized being found, to gather as much information as possible on the property. Denver Water has discovered multiple circumstances where copper is identified upstream of galvanized and water quality sampling results are non-detect. Understanding the characteristics and trends of GRRs in Denver Water's service area will help the predictive model improve its confidence and may allow Denver Water to avoid replacing all galvanized encountered if it is possible to prove the galvanized service line was never downstream of lead.

WATER QUALITY

Results from water quality sampling can provide an indication of lead at single-family residential properties, and the status of a service line can be changed in the inventory (i.e., from unknown to confirmed lead). The 3-bottle tests are performed to aid in the classification of service line materials of properties within Denver Water's integrated service area. This sampling process not only provides insight into the material profile of the service line, but also aids in the categorization of material through supporting investigations including the predictive model.

Water quality alone is known to achieve success for locating individual LSLs, but the LRP extends beyond this and looks at opportunities where water quality coupled with predictive model-reinforced learning provides guidance for lead service line inventory refinement of unlikely LSLs to known non-lead.

Results for water quality sampling at properties included in the 2023 ALSLR Plan are presented in Table 20 (i.e., verification pre-LSL replacement sampling) and results from properties not included in the 2023 ALSLR Plan are presented in Table 21 (i.e., investigative sampling).[28] As of Feb. 25, 2021, results from water quality sampling are assessed against a reduced threshold concentration used to indicate lead in pre-LSL replacement samples. A lower threshold was selected because of the degree of lead reduction achieved when pH is consistently maintained at 8.8 ± 0.3 across the distribution system. This means that any sample collected on or after May 1, 2020, with lead measured at or above 3 µg/L in the second or third bottle of the 3-bottle test is considered conclusive for an LSL. Lead measured below this threshold at properties with an initial status of likely LSL (i.e., p-value ≥ 0.5) is inconclusive for non-lead and additional investigations or review of data are needed to determine the status of the service line material. Lead measured below this threshold at properties with an initial status of unlikely lead (i.e., p-value < 0.5) is considered conclusive for non-lead and no additional investigations are undertaken and the property is not added to the LRP. Finally, lead measured below the detection limit of 1 µg/L is also considered indicative of non-lead only when copper is visually observed at three or more points. In summary, whereas water quality sampling at or above 3 µg/L is conclusive for lead, additional steps are taken to confirm non-lead and the p-value is not reduced to 0 based on water quality results alone.

TABLE 20. OBSERVATIONS FROM WATER QUALITY INVESTIGATIONS AS PART OF THE 2023 ALSLR PLAN (JULY 1 TO DEC. 31, 2023)

Service Line Status	Total Number of Investigations[1]	Water Quality Observations	Follow-up Action
Initial Status 0.5 ≤ p ≤ 0.9	106	Confirmed lead.[2]	Property added to list for LSL replacement and is scheduled to be replaced.
	189	Non-detect.[3]	Additional investigation is required.
	47	Inconclusive.[4]	Additional investigation is required.
Initial Status 0.01 ≤ p < 0.5	0	Confirmed lead.[2]	Property added to list for LSL replacement and is scheduled to be replaced.
	9	Non-detect.[3]	Additional investigation is required.
	0	Inconclusive.[4]	Additional investigation is required.
Total Number of Water Quality Samples within 2023 ALSLR Program (Second Six Months Only)[5]			**356**

[1] Excludes customer requested sample results. These samples were collected at properties included in the 2023 ALSLR Plan (and therefore do not count toward the required 1.4% investigations).
[2] Lead measured ≥ 3 µg/L in the second or third sample bottle from the 3-bottle test.
[3] Lead measured < 1 µg/L in the second and third sample bottle from the 3-bottle test.
[4] Lead measured < 3 µg/L in the second and third sample bottle from the 3-bottle test.
[5] Includes five additional properties, not included in the above categories, with an initial p-value of 0.

[28] See Appendix INV-9 Water Quality Sampling (Second Six-Month Period of 2023).

TABLE 21. OBSERVATIONS FROM WATER QUALITY INVESTIGATIONS INDEPENDENT OF THE 2023 ALSLR PLAN (JULY 1 TO DEC. 31, 2023)

Service Line Status	Total Number of Investigations[1]	Water Quality Observations	Follow-up Action
Initial Status 0.5 ≤ p ≤ 0.9	9	Confirmed lead.[2]	Property added to list for LSL replacement and is scheduled to be replaced.
	55	Non-detect.[3]	Additional investigation is required.
	8	Inconclusive.[4]	Additional investigation is required.
Initial Status 0.01 ≤ p < 0.5	4	Confirmed lead.[2]	Property added to list for LSL replacement and is scheduled to be replaced.
	562	Non-detect.[3]	Additional investigation is required.
	13	Inconclusive.[4]	Additional investigation is required.
Total Number of Water Quality Samples Independent of 2023 ALSLR Program (Second Six Months Only)[5]			**659**

[1] Excludes customer requested sample results. These samples were collected at properties independent of the 2023 ALSLR Plan and therefore do count toward the required 1.4% investigations, if the conditions that define an investigation are met.
[2] Lead measured ≥ 3 µg/L in the second or third sample bottle from the 3-bottle test.
[3] Lead measured < 1 µg/L in the second and third sample bottle from the 3-bottle test.
[4] Lead measured < 3 µg/L in the second and third sample bottle from the 3-bottle test.
[5] Includes eight additional properties, not included in the above categories. Seven of which had an initial p-value of 0 and one of which with an initial p-value of 1.

DESKTOP REVIEWS

The desktop review process consists of a review of existing documentation pertaining to a specific property and its service line. Typically, the purpose of the review is to determine if there is sufficient supporting evidence to indicate if a service line is non-lead, commonly due to an LSL replacement conducted pre-2020 prior to implementation of the LRP. A desktop review is used to collect, organize, and combine available data for a given property using methodologies that do not require a field investigation.

The supporting evidence used in a desktop review varies, as does the information available for each individual property. Generally, supporting evidence consists of construction and plumbing permits, Denver Water work orders, customer submitted proof of replacement or other field notes. Records indicating a partial service line replacement require additional verification, either through desktop or field investigation, to confirm that the entire service line is non-lead following the partial replacement. In the second six-month period of 2023, desktop reviews were conducted on 687 properties.

PREDICTIVE MODEL

The predictive model advances the decision logic developed for the lead service line inventory by associating known service line material derived through pothole or water quality field data with property characteristics such as location, build date, tap year, property type and value, income, and many other factors. The model generates a probability of lead or non-lead for properties with unknown service line material using these observable property characteristics.

The program has met the target accuracy and the other key performance metrics that are suitable for the use and application of the model as described in the application section of the Predictive Model Technical Memorandum.[29] Performance metrics cited in the memorandum represent global performance (i.e., considering validation data set aside from the entire Denver Water service area together). More granular performance at the census tract level is then assessed to identify areas within the service area where the model predictions are reliable, or where further training or investigation is indicated. Specifically, the 95% confidence bounds of metrics such as positive and negative predictive value, and positive and negative likelihood ratios are considered in model assessment.

While the model's global false negative rate (where lead services are misidentified as non-lead) is low, it is important to acknowledge that this misclassification is significant from a human health perspective and cannot be eliminated using the model alone. For this reason, model performance is evaluated at the census tract level prior and check against the validation data as described in Section 2.4.2.b of the CDPHE SLID Policy specific to the minimum service line validation process. Where the model performance does not meet benchmarks or the sampling results did not validate the material, model predictions are not used in decision making. Rather, the data captured is used for additional model training and further sampling requirements are identified. The process is repeated until the necessary requirements for the validation process and performance metrics are met or exceeded for the specific census tract.

Prior to 2023, the predictive model was used to prioritize enrollment in the Filter Program, prioritize replacement of LSLs and focus investigations for uncertainty in the model coupled alongside disproportionately impacted areas to improve model performance. Beginning in 2023, the predictive model has been used as a component of a multi-source analysis (including historical records, model predictions, and randomized statistical sampling) to designate service line materials (i.e., make p-value changes) to the lead service line inventory, thus removing unknowns in preparation for the LCRR inventory due date.

The predictive model is used to confirm the service line material designation when there is agreement with the lead service line inventory material designation at a property and provides opportunities to better understand material designations when there is less certainty or disagreement with a lead service line inventory material designation by identifying needed investigations or multi-source analysis.

The properties evaluated for p-value changes using the predictive model in 2023 were grouped by census tracts and evaluated for areas that met or exceeded a target negative or positive predictive metric threshold 95% confidence bound, while also considering census tract prevalence of lead, and verification sampling of unknowns.[30] After a review of validation data against material recommendations and ensuring there are no conflicting data for the material

[29] See Appendix LSL-11 Predictive Model Technical Memorandum.
[30] For detailed explanations of predictive modelling terms such as "negative predictive value" and "confidence", see Appendix LSL-11 Predictive Model Technical Memorandum.

designation change to lead or non-lead through the multi-source analysis approach, this evaluation led to 54,845 material designation changes to known non-lead and 9,022 material designation changes to known lead.

Properties that do not yet meet the criteria defined above, are evaluated for additional investigation opportunity to further improve model performance prior to making service line material change recommendations. Service lines intended to be investigated within the census tract are selected through a spatially balanced randomized sampling process and include additional properties that achieve opportunistic sample capturing based on contractor mobilization to achieve adequate and efficient sampling. The additional properties aim to achieve adequate sampling results to measure performance of the properties in the entire recommended group. While water quality sampling alone cannot be used to determine non-lead services, the combination of randomized water quality sampling and the predictive model, which integrates MSLMV sampling from throughout the service area to identify service line materials based on property characteristics, provides verifiable performance in a manner comparable to that outlined in Section 2.4.2.b of the CDPHE SLID Policy.

SUMMARY

The efforts involved in the five methods of investigation described above are summarized below in Table 22 for 2023.

TABLE 22. NUMBER OF INVESTIGATIONS PERFORMED TO DETERMINE THE MATERIAL OF THE SERVICE LINE (JULY 1 AND DEC. 31, 2023)

	Count
Number of Potholing Investigations	5,140
Number of Interior Inspections	1,306
Number of Water Quality Samples	1,201
Number of Desktop Investigations	687
Number of Predictive Model Investigations	56,574
Total Number of Investigations Completed in the Second Six Months of 2023	64,908
Number of Investigations Not Previously Reported in 2023[1]	9,065

[1]Includes 1,362 pothole investigations, 1,474 interior inspections, 498 water quality investigations and 5,875 predictive model investigations that were not included in the semi-annual report. 144 desktop investigations reported during in the semi-annual report were later found to be replaced and have been removed from the investigation totals.

Table 23 calculates the unknown service lines investigated for 2023 and the cumulative annual average percent since program inception. Per the LCRR Variance, Denver Water must investigate a cumulative annual average of 1.4% of all unknowns (likely and unlikely LSLs) based on the September 2019 baseline lead service line inventory.

TABLE 23. YEAR OVER YEAR COMPARISON OF UNKNOWN SERVICE LINES INVESTIGATED

	2020	2021	2022	2023
Annual Unknown Service Lines Investigated				
Annual Regulatory Target	1,169	1,169	1,169	2,420
Total Number of Unknown Service Lines Investigated	3,326	4,562	4,918	71,776
Number of Service Lines Investigations Reported after Submission of the Annual Report[1]	2,034	0	- 825	0
Cumulative Unknown Service Lines Investigated				
Cumulative Unknown Service Lines Investigated[2]	5,360	9,922	14,015	85,791
Cumulative Annual Average of Unknown Service Lines Investigated	5,360	4,961	4,672	21,448
Cumulative Annual Average Percent of Unknown Service Lines Investigated[3]	3.1%	2.9%	2.7%	12.4%

[1] Investigations not previously reported occurred at properties confirmed after the data cut-off used to prepare the annual reports. Includes properties removed from the investigation counts due to replacements occurring later in the same program year.

[2] This number represents the distinct number of service lines investigated since program inception. If a property was counted in a previous year for one type of investigation and then in the current year as another type of investigation, it would only be counted once in the cumulative unknown service lines investigated.

[3] Per the LCRR Variance, Denver Water must investigate a cumulative annual average of 1.4% of all unlikely and likely LSLs (unknowns) from the September 2019 inventory (172,868).

Updated LSL Inventory Map [7.B.ii.c]

On March 5, 2020, the LSL Inventory was made publicly available on the Denver Water lead website (https://www.denverwater.org/your-water/water-quality/lead).

On Jan. 23, 2024, the publicly available map was updated and reposted, incorporating the Dec. 31, 2024, LSL Inventory. An updated inventory summary table is provided with each semi-annual report.[31] The website map is updated quarterly to reflect these changes to the LSL Inventory and will be updated and re-posted in the spring.

Summary of Changes to the LSL Inventory [7.B.ii.d]

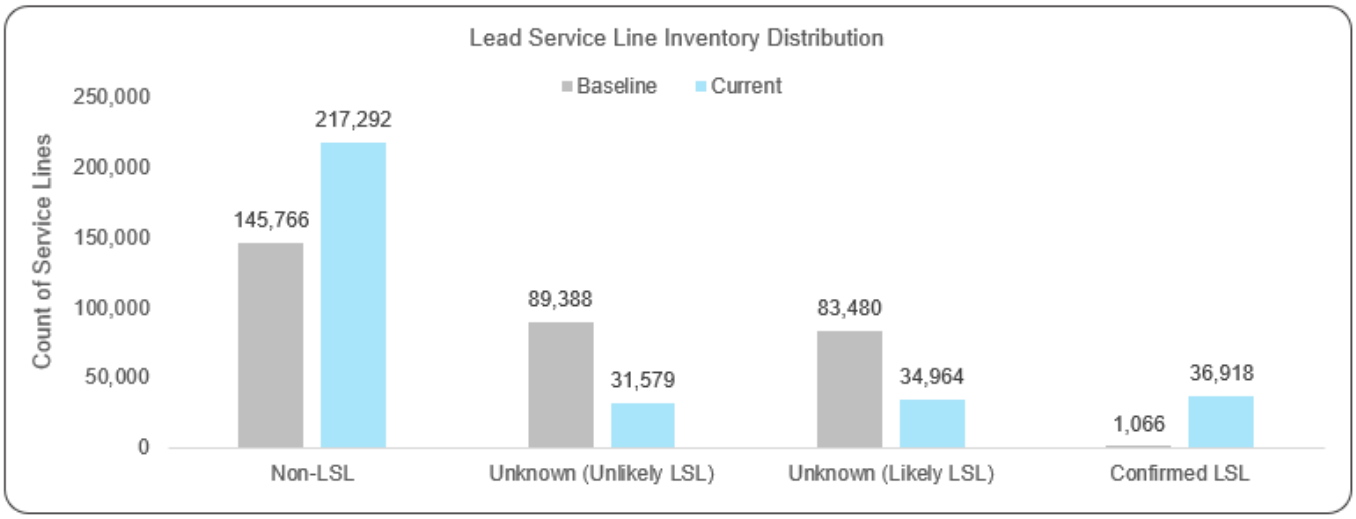
Between July 1 and Dec. 31, 2023, updates to the LSL Inventory continued as additional data were gathered and reviewed. During this period, 69,416 changes were made to the LSL Inventory of which 67,121 were changes to the status of the service line (i.e., p-value).[32] This included changes based on confirmation from Denver Water, customers, and distributors; review of historical data; direct evidence such as water quality and/or potholing; and replacements. In addition to material status changes, 118 service lines were removed from the inventory as tap

[31] See Appendix INV-6 Summary of Service Line Status and p-Value (Second Six-Month Period of 2023).

[32] See Appendix INV-7B Line by Line p-Value Changes by Status (Second Six-Month Period of 2023).

cuts or non-potable service connections. Service lines previously deemed inactive were added back to the inventory upon review of the data, affecting 187 properties in this reporting period.[33] These changes are shown in Figure 3 and are accounted for in Table 15.

FIGURE 3. CHANGES IN THE BASELINE AND CURRENT INVENTORY (JULY 1 TO DEC. 31, 2023, USING DATA FROM COLUMNS 2 AND 5 FROM TABLE 15)[1]



[1] Confirmed LSL is the count of the Current Inventory in Table 15 for "Confirmed LSLs" plus "GRRs" (32,864 + 4,054 = 36,918).

LCRR INVENTORY PREPARATION

The LCRR requires an initial lead service line inventory to be submitted by Oct. 16, 2024, with all properties classified as unlikely LSL and likely LSL to be classified as unknown. To prepare for this submittal and reduce the number of unknowns in the lead service line inventory, Denver Water conducted over 80,000 investigations in 2023, equating to 71,776 distinct service lines investigated. The cumulative number of unknown service lines investigated since program inception is about 50% of the unknown service lines from Denver Water's baseline LSLI submitted in 2019. In the first half of 2024, Denver Water will continue to focus on identifying service line materials prior to submittal of the LCRR lead service line inventory.

[33] See Appendix INV-7B Line by Line p-Value Changes by Status (Second Six-Month Period of 2023).

7.B.iii LSL Replacements

Section 7.B.iii of the Variance requires that Denver Water report and maintain records of LSL replacements, including the following:

> *iii. LSL Replacements.*
>
> *a. the address and date of all LSL replacements occurring during the variance, including by year;*
>
> *b. the type of LSL replacement (as outlined in paragraph 4.B);*
>
> *c. the unique customer identification number of Customer Premises on the refusal list and documented attempts to contact the property owner; and*
>
> *d. those Customer Premises where Denver Water performed a partial LSL replacement and property owner consent could not be obtained.*
>
> *Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.*

Replacements under the ALSLR Program started on March 5, 2020, and results from July 1 to Dec. 31, 2023, are described in this section. An overview of the LSL replacement requirements is shown in Table 24.

TABLE 24. OVERVIEW OF 7.B.III REQUIREMENTS

Paragraph Reference	Description	Refer to
4.E	Offer post-LSL replacement sampling within six months.	Ongoing.
7.B.iii.a	Address and date of all replacements.	See Appendix.[1]
7.B.iii.b	Type of replacement.	See Table 25 and Appendix.[2]
7.B.iii.c **4.H**	Refusal list with service point ID and documented attempts for customer contact. Track changes in customer account holders against Service Line Refusal List.	See Appendix.[3]
LRPP III.D (p 62)	Provide education and filters to residents of multi-family properties on the Service Line Refusal List.	Not applicable for this reporting period.[4]
7.B.iii.d	Number of properties where a partial replacement was performed, and consent was not granted by the property owner to replace a lead service line in full.	See Table 25 and Appendix.[3]
LRPP III.D (p 57)	Replace LSL at properties with consistently high lead release and critical customers.	Described in this section.
LRPP III.D (p 58)	Complete approximately 2,000 investigations per year in the first five years of the Lead Reduction Program to update the predictive model and improve the quality of information in the LSL Inventory.	See Table 22.
LRPP III.D (p 60)	Property owners will be reminded via English and Spanish signage placed at the limits (ends of streets) within geographic work areas four to five weeks in advance of construction.	Implemented July 20, 2020.
LRPP III.D (p 60)	Provide flushing instructions following LSL replacement.	Provided to all customers in post-LSL replacement education package.[5]

[1] See Appendix LSL-6 Addresses and Types of Replacement (Second Six-Month Period of 2023).

[2] See Appendix LSL-7 LSL Replacement Refusal List (Second Six-Month Period of 2023).

[3] See Appendix LSL-8 Properties with a Partial Replacement (Cumulative since Program Inception).

[4] There were 64 multi-unit properties added to the Refusal List in 2023. These customers are in the Filter Program, received mailed educational materials (both with the replacement filters and via the annual filter reminder postcard), and will receive sampling kits in early 2024.

[5] See Appendix COE-21 Updated Post-Replacement Flushing Instructions from the 2022 Annual Report.

Summary of LSL Replacement Activity during the Reporting Period including Address and Date of Replacement [7.B.iii.a]

Denver Water T&D crews started LSL replacements in the fourth program year on Jan. 4, 2023, and ALSLR contractors started on Feb. 27, 2023. The ALSLR contractors focused primarily on geographic task order work areas that also included newly consented properties from adjacent task orders from previous program years. Newly consented properties include properties that had an ownership change that resulted in the new owner providing consent, or properties that were either a refusal or no response that recently changed to consented. A total of eight geographic task orders each with approximately 500 to 600 properties each were developed and issued to three ALSLR contractors. A total of six work areas each with approximately 300 to 400 properties each were developed and issued to three Federal

contractors. Additional work areas will be issued in the second half of 2023. A list of addresses and dates for each replacement can be found in the appendices.[34]

Denver Water crews completed LSL replacements as part of water main replacement work and emergency repairs and assisted with geographic area LSL replacements. Denver Water crews continue to target critical customers at schools, daycare centers, and child care facilities within City and County of Denver to confirm the status of the service line and replace lead where found. The properties originally included in previous ALSLR Plans that required additional follow-up to make three reasonable attempts at contact were included in the 2023 ALSLR Plan. Any daycare or child care facility added to CDPHE's licensed child care facility dataset since 2020 was added to the 2023 ALSLR Plan. At the start of the year, the critical customer list included 769 properties verified as critical customers within the City and County of Denver.[35] Most of these were properties from previous ALSLR Plans with a small number of newly identified critical customers for the 2023 ALSLR Plan. Since the start of the year, nine properties were removed from the critical customer list upon confirmation of a non-LSL via investigation and two LSLs were replaced in the 2023 ALSLR Plan. At the end of this reporting period, 63 critical customers remain with either likely or confirmed LSLs. For these remaining properties, all contact attempts have not resulted in a response or the property is slated for future activities. Investigation of service line materials and replacement (as needed) will be completed as consent is received.

As part of the Elevated Lead Response Plan, Denver Water crews perform prioritized individual replacements at properties where lead is measured above 150 µg/L and at properties where lead is measured above 25 µg/L, the properties shall be prioritized as they are added to task orders as part of the 2023 or future ALSLR Plan.

Type of LSL Replacements Completed during this Reporting Period [7.B.iii.b]

Section 4.A of the Variance provides that "[e]ach Program Year, Denver Water shall achieve a minimum replacement rate of at least 7.0% of the estimated number of LSLs and GRRs in its distribution system based on a cumulative average." The overall intention of this requirement is to ensure that all LSLs are replaced within 15 years following the effective date of the Dec. 16, 2019, Variance.

For the period of Jan. 1 through Dec. 31, 2023, Denver Water fully achieved this metric replacing 6,891 LSLs. The data for the year-end inventory[36] are summarized as follows:

- Replacements completed by ALSLR contractors between Feb. 27 and Dec. 29, 2023, the last day of the year that contractors worked in the field.[37]

[34] See Appendix LSL-6 Addresses and Types of Replacement (Second Six-Month Period of 2023).
[35] This number includes all critical customers within the service area, regardless of p-value.
[36] See Appendix INV-7B Line by Line p-Value Changes by Status (Second Six-Month Period of 2023) and previous semi-annual reports.
[37] Properties with a p-value ≥ 0.5 in the 2023 ALSLR Plan are verified prior to replacement and are not counted as replaced if copper is observed upon full excavation or pulling the entire service.

- Replacements completed by T&D between Jan. 3 and Dec. 29, 2023, including from water main projects, emergency repairs, and critical customers (such as schools and child care facilities).[38]
- Replacements completed by third parties, including tap cuts (cut and reactivated in 2023), reimbursements and properties inspected by Denver Water completed between Jan. 4 and Sept. 27, 2023.[39]
- There were 22 replacements documented in areas served by distributors.

Based on the base LSL Inventory set forth in Table 15, 7% is equivalent to 4,477 LSL replacements per year and this was maintained as the target for 2023. The number and dates of replacements are used as an input to the equivalency model. The total number of and types of replacements completed between July 1 and Dec. 31, 2023 are presented in Table 25 and the total replacements for 2023 are summarized in Table 26. Denver Water maintains a detailed list of the type of LSL replacements completed and the associated addresses.[40]

[38] The last replacement of 2023 was on Dec. 30, 2023. T&D replacements are counted as an LSL replacement if i) the initial p-value is ≥ 0.5 regardless of what field crews report for the "prior" material or ii) documentation from another source indicates that lead or galvanized is observed.

[39] The last tap cut and reactivation replacement was on Sept. 27, 2023. The last reimbursement and the last inspection of a third-party replacement was on April 24, 2023, and July 15, 2023, respectively.

[40] See Appendix LSL-6 Addresses and Types of Replacement (Second Six-Month Period of 2023).

TABLE 25. TYPE OF LSL REPLACEMENTS (JULY 1 TO DEC. 31[1], 2023)

Type of LSL Replacement July 1 to Dec. 31, 2023	Denver Water (Water Main, Emergency, and ALSLR)[2]	Third Party (Developer, Homeowner, and Other)[3]	Total
Full Lead Replacement[4]	2,005	2	2,007
Partial Lead Replacement, such that no Lead Remains After Replacement[5]	1,247	1	1,248
Full Galvanized Replacement	12	0	12
Partial Galvanized, such that no Lead or Galvanized Remains After Replacement[6]	294	0	294
TOTAL REPLACEMENTS in Reporting Period, with no Lead Remaining After Replacement	**3,558**	**3**	**3,561**
TOTAL REPLACEMENTS Not Previously Reported[7]	65	5	70
TOTAL REPLACEMENTS completed since LRP Inception	**21,105**	**1,301**	**22,406**
Emergency Repair, Partial Replacement (i.e., where consent was NOT granted and lead may remain in the ground)[8]	124	3	127

[1] Properties that had a replacement on or before Dec. 31, 2023, may not have been captured in the database for this report due to the time necessary to QA the data following the replacement date. Replacements affected by this time lag will be reported in the First Semi-Annual Report of 2024.

[2] Includes LSL replacements completed as part of water main projects, emergency repairs, scheduled repairs, and ALSLR individual and geographic replacements completed by Denver Water or its contractors.

[3] Includes LSL replacements completed by developers, property owners and other government agencies as identified in Appendix LSL-6 (Addresses and Types of Replacement (Second Six-Month Period of 2023)).

[4] Includes replacements of service lines described as lead-lead, lead-galvanized, lead-unknown and galvanized-unknown. This also includes service lines designated as either unknown-unknown or copper-copper with p-value ≥ 0.5 at properties where a service line replacement was completed by someone other than the ALSLR contractors (such as third party).

[5] Includes replacements of service lines described as lead-copper, lead-PEX, lead-PVC and copper-unknown. If verification reveals copper at three or more locations, the service line is counted as replaced if the p-value is ≥ 0.5. See Appendix LSL-6 (Addresses and Types of Replacement (Second Six-Month Period of 2023)).

[6] Includes replacements of service lines described as copper-galvanized, galvanized-copper, and galvanized-PEX.

[7] This includes replacements completed since Program Inception but not previously reported (70 added); see Appendix LSL-9 (Addresses and Types of Replacements for Properties Not Previously Counted and Duplicates (Since Program Inception)).

[8] Includes all properties cumulative since program inception; see Appendix LSL-8 (Properties with a Partial Replacement (Cumulative since Program Inception)).

The cumulative average annual replacement rate, defined in the Nov. 30, 2022, Variance Order, that was achieved in 2023 is calculated in Table 26.

TABLE 26. LSL REPLACEMENT RATES FOR 2023

	2023
Total Number of Replacements	6,891
Cumulative Total Number of Replacements[1]	22,406
Cumulative Average Annual Replacement at End of Program Year[2]	5,601
Cumulative Average Annual Replacement Rate	8.8% of 63,955

[1] The Cumulative Total Number of Replacements includes all reportable replacements from previous reports, including any not previously reported replacements captured outside their respective reporting periods, and subtracting any removals reported during all periods. Removals are due to further review and are deemed not to be reportable.

[2] Per the Order, the cumulative average must be calculated using the total number of LSLs replaced during the term of the Order divided by the total estimated number of confirmed and likely LSLs, consistent with the initial LSL inventory. The average of 22,406 replacements over four years is 5,601 replacements per year. As a percentage, 5,601 of 63,955 is 8.8%.

Customer Consent and Refusal List for LSL Replacement [7.B.iii.c]

Per Section 7.B.iii.c of the LCRR Variance, Denver Water must provide "the unique customer identification number of Customer Premises on the refusal list and documented attempts to contact the property owner." Distribution of notification letters, including consent forms, was initiated in October 2022, to property owners included in the 2023 ALSLR Plan. Since then, notifications were mailed to all properties identified in the geographic work areas of the 2023 ALSLR Plan, after which multiple contacts are made to obtain signed consent forms.[41] Reconnaissance or pre-construction meetings are conducted with each property owner to plan the LSL replacement work and schedule the replacement.

A summary of the number of property owners contacted and number of signed consent forms returned is presented in Table 27. Between July 1 and Dec. 31, 2023, a total of 811 property owners refused to participate in the ALSLR Program or were non-responsive following multiple attempts at contact. At least three attempts to obtain voluntary consent from a property owner are undertaken before work can start to replace the LSL.

[41] See Appendix LSL-7 LSL Replacement Refusal List (Second Six-Month Period of 2023).

TABLE 27. SUMMARY OF CONSENT AND LSL REFUSAL LIST (JULY 1 TO DEC. 31, 2023)

Description	Customer Consented[1]	Customer Refused[2]
Total Number of Properties during the Second Six Months of 2023	4,813	811
Total Number of Properties Year-to-Date	11,300	1,163

[1] The total number of signed consent forms represent the ALSLR contractors and Denver Water crew work. A revised procedure to track all Denver Water crew consents was implemented in 2023.

[2] The total number of refusals year-to-date includes attempts made by the ALSLR contractors (642 properties), Federal contractors (476 properties) and Denver Water crew efforts (45 properties). These include properties with descriptions of "consent not granted due to refusal" and "non-responsive" after at least three attempts were made and the task order goes through administrative close out. When a customer refuses or is non-responsive, the service point ID is provided to the COE team for follow-up. See explanations in Appendix LSL-7 LSL Replacement Refusal List (Second Six-Month Period of 2023).

A range of outreach methods is used to contact property owners.[42] Denver Water sends at least two attempts at contact by mail plus one attempt at contact using a different method, such as email, phone calls or door-to-door canvassing. A property is described as "pending" while the task order for the affected work order remains open (i.e., there is ongoing construction activity). A property is considered "non-responsive" and added to the Refusal List as task orders for a work area are closed out (i.e., the construction crew demobilizes). This process is part of administrative closeout of the task order. "Non-responsive" properties, in addition to the two mailers and one door-to-door canvas, will receive two to three more door-to-door attempts as well as an email and/or phone call for additional outreach attempts.

While the ALSLR contractors are in an area with active construction activity, additional attempts such as door-knocking, phone calls and emails may be made to contact the property owner to seek consent. If an owner refuses to participate in the ALSLR Program, the property is added to the LSL Replacement Refusal List, along with an explanation for refusal, if available. If a property owner declines due to a previous undocumented service line replacement, additional information may be requested from the owner to document a past replacement to support the removal of the property from the LRP.

When a property owner declines to participate, Denver Water is committed to continuing engagement with the property owner to encourage participation. A database is maintained to track attempted contacts at properties where consent to replace the LSL has not been provided.[43] An outreach approach was identified for customers with properties on previous Refusal Lists who have not had an ownership change and therefore have not been contacted through the ownership change follow-up process. Denver Water conducts investigative potholes at properties from previous years' Refusal Lists within or adjacent to identified 2023 task orders, provided there is no conflict, no street moratoriums or the property is already identified as lead as part of 2023 task orders. At non-responsive properties, Denver Water conducts a four-point investigation (two potholes main-to-meter and two potholes meter-to-building), and, at refusal properties, Denver Water conducts two main-to-meter potholes where possible to identify the

[42] See Appendix COE-15 2023 COE Plan included with the Annual Report for 2022.

[43] See Appendix LSL-7 LSL Replacement Refusal List (Second Six Months of 2023).

service line material. Previous refusals that could be identified as non-lead under a four-point investigation were removed from the inventory. Denver Water will continue outreach to previous refusals where lead was found to gain consent and perform a replacement despite previous contact attempts and refusal. Additionally, any change to the property ownership triggers additional outreach to obtain consent to replace the LSL. Between July 1 and Dec. 31, 2023, 21 changes in ownership occurred at properties on the Refusal List. Follow-up is underway to gain consent for replacement from the new owner within a year of the change of ownership.[44]

There are circumstances where consent has been given, but an inspection of the property reveals a safety or security hazard that prevents the LSL replacement from being performed. The property owner is informed, both verbally and in writing, that the hazard must be addressed within 14 days of receiving the notification. If the problem is not fixed within that timeframe, the property is treated as not responsive and is added to the list of "non-responsive" until the issue is resolved, and the LSL can be replaced.[45]

Emergency Repairs Resulting in a Partial LSL Replacement [7.B.iii.d]

During this reporting period, 14 partial replacements occurred as a result of emergency repair, water main replacement, or third-party contractor work (i.e., some lead may remain in the ground). This affected a total of 127 properties since program inception in January 2020 as a result of:[46]

- No consent or no available contact information for the property owner and therefore consent could not be obtained at the time of the work (this affected six properties).
- The property owner declined replacement at the time of the work (this affected 29 properties).
- No consent to perform the full replacement due to no response from the property owner (this affected 72 properties).
- Restricted access due to the interior plumbing arrangement or unsafe working conditions (this affected nine properties).
- Property redevelopment (four properties).
- To be rescheduled because property owner was not comfortable with replacement during COVID-19 (two properties).
- Restricted access due to gas station logistical constraints (one property).

[44] See Appendix LSL-10 Ownership Changes for Properties on the Refusal List (First Six-Month Period of 2023).
[45] See Appendix COE-D.12 Safety or Repairs Needed Notification Letter of Second Quarter Report (2020).
[46] See Appendix LSL-8 Properties with a Partial Replacement (Cumulative since LRP Inception).

- Meter to main replaced, meter to building potholing and/or replacement scheduled for a later date (four properties).

Attempts to obtain consent to complete the replacement in full were made and outreach with the property owner continues to seek consent or address any safety issues that currently bar entry to the property.

7.B.iv Filters

Section 7.B.iv of the Variance requires that Denver Water report and maintain records related to its filter distribution program. Specifically, Section 7.B.iv requires reporting and recordkeeping of the following:

iv. Filters.

a. *summary of addresses of Customer Premises where filters and replacement cartridges have been provided, and certification of the number of homeowners with confirmed or likely LSLs that are not part of filter program because they use their own filter or bottled water. Detailed records must be retained by Denver Water and provided to EPA or CDPHE upon request;*
b. *the total number of filters and replacement cartridges distributed per Program Year;*
c. *the percent filter adoption for each year of the variance[47], and the method used to determine this rate;*
d. *a list of unique customer identification numbers reporting the use of bottled water or a filter certified NSF/ANSI (53) for removal of lead, and any changes in the list;*
e. *a list of unique customers identification numbers for customers enrolled in the filter program who have refused a filter or replacement cartridges or have opted out of enrollment in the filter program;*
f. *filter lead sampling results collected under paragraph 5.F above;*
g. *information about filter use under paragraph 5.E; and*
h. *Denver Water shall notify CDPHE and EPA within 30 Days if data indicate lead levels are about 5 ppb in filtered drinking water and shall provide the measured levels of lead in filtered water. All other levels shall be reported in the semi-annual and yearly reports.*

Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.

Denver Water provides pitcher filters and filter cartridges to all customers within the service area that have the potential for a lead service line. Every six months, per the manufacturer's recommendations, customers receive filter cartridge replacements. The initial pitcher filter distribution was launched in 2020, and any customers that are added to the program are promptly sent a filter pitcher and cartridge. Customers can request a pitcher or cartridge replacement, read about the Filter Program, and watch a video on proper filter usage through Denver Water's filter webpage.

[47] The LCRR Variance requires a filter adoption survey every other year, rather than every year, as previously required in the LCR Variance. As stated in the LRPP technical amendment, Denver Water will use the adoption rate of the previous year's survey on non-survey years for the purposes of the equivalency model.

The Filter Program includes the distribution of pitcher filters, ongoing outreach and education to encourage pitcher filter use and the distribution of filter cartridge replacements. The Filter Program targets properties with confirmed and likely LSLs (i.e., with p-values 0.5 and higher). Using the current LSL Inventory from Table 15, it is estimated that Filter Program participants consist of approximately 68,514 Denver Water household units.

This section summarizes the milestones of the Filter Program to date, including filter refusals/opt-outs, six-month supply of replacement filters distributed post-LSL replacement, filter survey results from the ALSLR Program, and filter performance testing in the field. An overview of the filter reporting requirements is shown in Table 28.

TABLE 28. OVERVIEW OF 7.B.IV REQUIREMENTS

Paragraph Reference	Description	Refer to
7.B.iv.a	Summary of addresses of all customers enrolled in the Filter Program and provided with filters and cartridges. Certification of number of customers with a confirmed or likely LSL that use their own filter or bottled water.	See Table 29.
7.B.iv.b	Total number of filters and cartridges distributed per year.	See Table 29.
7.B.iv.c	Percent filter adoption rate during a survey year.[1] Description of method to determine the filter adoption rate.	See this section.
7.B.iv.d	Maintain list of addresses and Service Point Identification that use a filter or bottled water and any changes to the list.	See Appendix.[2]
7.B.iv.e **5.A**	Maintain Filter Refusal or Opt-Out List. Maintain list of addresses and SP IDs that have refused enrollment in the Filter Program or opted out.	See Appendix.[3]
7.B.iv.f **7.B.iv.g** **5.F.ii**	Confirmation of filter performance in the field (50+ locations included in the LCR compliance sampling). Collect samples using a protocol approved by EPA and CDPHE. Collect additional information regarding the use and operation of the filter.	See Appendix for sample results from Sept. 11 to Dec. 21, 2023.[2] Protocol for filter sample collection approved July 17, 2020, by EPA. Included in this section.
7.B.iv.h	Notify CDPHE and EPA within 30 days of receiving sample results indicating measurable lead in filtered samples.	See Appendix.[4]
5.B	Distribute replacement cartridges to customers enrolled in the Filter Program per the filter manufacturers' recommended replacement rate and until six months after LSL replacement.	See this section. Distribution as part of Filter Program since March 24, 2020.
5.C	Provide education materials within two weeks of a change in customer account. Provide filters and replacement cartridges within 35 days of a change in customer account.	See Appendix.[5,6]
5.D	Offer filters to 1983 to 1987 households with a child up to 24 months of age and lead > 3 µg/L in the first bottle of the 3-bottle test. Develop COE plan to focus on this audience.	See this section and results in section 7.B.i CCT. See 2023 COE Plan.

Paragraph Reference	Description	Refer to
5.E.i	Survey enough customers enrolled in the Filter Program to receive a minimum of responses from remaining program participants that is consistent with a 95% confidence level and 3% margin of error. Seek approval from CDPHE and EPA for the filter adoption survey questions prior to distribution.	See this section. Approved on Sept. 10, 2020.[7]
5.G	Document contact to provide lead outreach and education materials to at least 95% of customers enrolled in the Filter Program each year.	See this section.
LRPP Executive Summary (p 9) and III.C (p 56)	If the localized filter adoption rate is less than 65%, additional outreach and education will be provided to that area.	Not applicable for this reporting period.
LRPP III.C (p 55)	Survey filter use as part of ALSLR Program following LSL replacement.	See this section and Appendix.[8]

[1] The LCRR Variance requires a filter adoption survey every other year (starting in 2023), rather than every year, as previously required in the LCR Variance. As stated in the LRPP technical amendment, Denver Water will use the adoption rate of the previous year's survey on non-survey years for the purposes of the equivalency model.

[2] See Appendix FIL-9 Filter Program Opt-Outs (Second Six-Month Period of 2023).

[3] See Appendix FIL-10 Filter Program Refusals (Second Six-Month Period of 2023).

[4] See Appendix FIL-11 Confirmation of Filter Performance in Field Results (Second Six-Month Period of 2023).

[5] See Appendix FIL-12 Occupancy Changes – COE Distribution (Second Six-Month Period of 2023).

[6] See Appendix FIL-13 Occupancy Changes – Pitcher Filter Distribution (Second Six-Month Period of 2023).

[7] See Third Quarter Report of 2020 (Appendix FIL-29 OMB Approved Filter Adoption Survey Questions).

[8] See Appendix FIL-14 Informal Filter Adoption Survey Results Summary (Second Six-Month Period of 2023).

Initial Filter Distribution to All Customers Enrolled in the Filter Program [7.B.iv.a]

Per Section 7.B.iv.a of the LCRR Variance, Denver Water must provide a "summary of addresses of Customer Premises where filters and replacement cartridges have been provided, and certification of the number of homeowners with confirmed or likely LSLs that are not part of the filter program because they use their own filter or bottled water. Detailed records must be retained by Denver Water and provided to EPA or CDPHE upon request." Denver Water began filter distribution on Feb. 12, 2020, with distribution to customers included in the ALSLR Program in 2020 (year 1). Denver Water initiated broader filter distribution on March 28, 2020, to all customers enrolled in the Filter Program. Initial filter distribution was completed on Sept. 21, 2020.

Pitcher filter distribution continues for occupancy changes and customer-requested replacements for broken or missing pitcher filters, as shown in Table 29 for pitcher filter distribution.

TABLE 29. SUMMARY OF FILTER DISTRIBUTION (JULY 1 TO DEC. 31, 2023)

Description	Count	Comment
Initial Pitcher Distribution for Customers Enrolled in 2023	48	
Total Number of Households Provided with a Filter Kit between July 1 and Dec. 31, 2023	4,806	
Number of Households that Use their own NSF-Certified Filter or Bottled Water between July 1 and Dec. 31, 2023	6	See Appendix.[1]
Number of Households that Declined to Use a Filter or Bottled Water between July 1 and Dec. 31, 2023	53	See Appendix.[2]
Total Number of Households Provided with a Filter Kit in 2023	9,008	
Number of Households that Use their own NSF-Certified Filter or Bottled Water in 2023	9	
Number of Households that Declined to Use a Filter or Bottled Water in 2023	100	

[1] See Appendix FIL-9 Filter Program Opt-Outs (Second Six-Month Period of 2023).

[2] See Appendix FIL-10 Filter Program Refusals (Second Six-Month Period of 2023).

New customers enrolled in the Filter Program in 2023 are included in the count for initial distribution of pitcher filters in Table 29, along with customers that were previously enrolled in the Filter Program but that failed to receive their initial pitcher filter. Together, this represents less than 1% of the current 68,514 customers enrolled in the Filter Program. In general, the customers did not receive a pitcher filter due to either missing or erroneous address or unit number information:

1) At residential properties with a general address to allow customers to receive filters.

2) At multi-unit commercial properties with a general address to allow customers to receive filters. Some of these were identified from customers calling in to alert Denver Water of additional units or through review of unit numbers for completeness.

Addresses where filters could not be delivered were investigated for accuracy and a filter kit and program introduction booklet were sent once the address could be confirmed. Corrective actions have been implemented to reconcile all known addresses, identify incorrect addresses, and distribute pitcher filters as required. As part of this exercise, 165 properties were reviewed during the second six-month period of 2023.

An analysis of return-to-sender addresses was performed in 2020 and described in the Third Quarterly Report for 2020; this exercise has not been repeated since. However, throughout 2023, return-to-sender addresses continued to be investigated and upon reconciliation, a filter kit is re-sent to the correct address or if vacant, the property is removed from the LRP.

Replacement Filter and Replacement Filter Cartridge Distribution to Customers Enrolled in the Filter Program [7.B.iv.b]

Per Section 7.B.iv.b of the LCRR Variance, Denver Water must report “the total number of filters and replacement cartridges distributed per Program Year.”

Between July 1 and Dec. 31, 2023, filter kits were distributed to an additional 4,431[48] customers enrolled in the Filter Program, bringing the total distribution amount for 2023 to 9,008.

During this same period, 91,268 replacement filter cartridges were distributed to 88,552 addresses of customers enrolled in Filter Program in accordance with the manufacturer's recommendation for replacement within six months. Following the improvements made in July 2021 to address late filter distribution, all properties enrolled in the Filter Program received replacement filter cartridges within the six-month replacement interval.[49] Of the 94,637 replacement filter cartridges distributed, however, 3,369 attempted replacement cartridge deliveries were unsuccessful and returned to sender.[50] An unsuccessful delivery prompts an investigation, and, upon reconciliation, a replacement filter is re-sent to the correct address or if vacant, the property is removed from the LRP. A summary of distribution of post-LSL replacement filters is provided in Table 30.

TABLE 30. SUMMARY OF SIX-MONTH SUPPLY POST-LSL REPLACEMENT FILTER DISTRIBUTION (JULY 1 TO DEC. 31, 2023)

Description	Count	Comment
Number of Households Provided with Six-Month Supply of Filter Replacements Post-Lead Service Line Replacement between July 1 and Dec. 31, 2023[1,2]	5,491	This includes emergency repairs and replacements performed by Denver Water and third parties.

[1] This value may not match the number of LSL replacements completed between July 1 and Dec. 31, 2023: for example, if a customer received their initial filter pitcher and replacement filters within two months of having their LSL replaced, additional replacement filters are provided on the six-month replacement schedule and not as part of the LSL replacement activities.
[2] This value includes filter distribution to properties where the LSL replacement was completed by a third party, as identified in Table 25.

Occupancy Changes [5.C]

Section 5.C of the LCRR Variance states "If a change in the customer name of the water account associated with a customer enrolled in the filter program occurs at any time, Denver Water must provide the new customer with educational materials as soon as possible but no later than 30 Days following the change in customer account. If the Customer Premise or a residential unit at the Customer Premise is enrolled in the filter program, Denver Water must distribute a new filter and replacement cartridges per manufacturers' recommended replacement rate to the new customer within 35 Days of the change in customer account. Denver Water will also make filters available for pick-up at the customers' election."

Denver Water was notified of 2,737 occupancy changes which include both property owners and tenants between July 1 and Dec. 31, 2023.[51] Of those occupancy changes, 2,075

[48] This number refers to the number of properties that received a new filter based on occupancy changes, high-capacity, broken filters, lost filters, etc. The number of filters distributed to these properties totals 4,431.
[49] See the First Semi-Annual Report of 2021 for more details.
[50] See Appendix FIL-15 Filter Program Replacement Cartridge Returns (Second Six-Month Period of 2023).
[51] See Appendix FIL-13 Occupancy Changes - Pitcher Filter Distribution (Second Six-Month Period of 2023).

property owners were alerted of these occupancy changes and received an introductory booklet.[52] Occupancy changes are tracked daily to provide multiple mailings per week to allow new occupants to receive their LRP Introductory Letter and LRP Overview Booklet within 14 days of the change in occupancy. Occupancy changes are added to weekly filter distribution batches to allow new occupants to receive a pitcher filter within 35 days of notice of new occupancy. Both the introductory materials and the filters were distributed within 14 and 35 days respectively, at all properties where a change in occupancy occurred for this reporting period.[53]

Filter Distribution to Formula-fed Infants in Select Households [5.D]

Section 5.D of the LCRR Variance states, "Upon request, Denver Water will provide lead water quality sampling at no cost to any customer within its service area. If a child up to 24 months of age resides in a Select Household and the water quality results in the first draw sample show lead concentrations above 3 ppb, Denver Water must offer a filter and enough replacement filters and cartridges, at no cost, to the customer until the child exceeds the age of 24 months."

No 1983 to 1987 households with children under 24 months of age requested enrollment in the Filter Program during the second six-month reporting period of 2023 (i.e., a select household as identified in paragraph 5.D of the LCRR Variance).[54]

Formal Filter Adoption Survey [7.B.iv.c]

Under Section 5.E.i of the LCRR Variance, "Denver Water must conduct a survey in 2023 and every other program year of randomly selected customers enrolled in the Filter Program to receive a minimum of responses from remaining program participants that is consistent with a 95% confidence level and 3% margin of error. The survey must inquire whether the customer has used the filter for water to make infant formula (if applicable); cooking and drinking; or is using bottled water or a filter device that is certified NSF/ANSI (53) for lead removal not provided by Denver Water for infant formula, cooking and drinking." Per Section 7.B.iv.c of the LCRR Variance, Denver Water must report "the percent filter adoption for each year of the variance, and the method used to determine this rate."

Filters are used to reduce exposure to lead before the lead service line is replaced and for six months following LSL replacement. The rate of filter adoption by customers enrolled in the LRP is used as an input in the equivalency model.

Filter adoption assumes customers are accepting, installing, using, and maintaining their pitcher filter properly, including replacing the filter cartridge at the appropriate time and using the pitcher filter for drinking, cooking, and infant formula, as applicable. The minimum filter adoption

[52] Property owners can have multiple occupancy changes within one week. Rather than sending multiple introductory booklets, one introduction booklet will be sent to the property owner.
[53] See Appendix FIL-12 Occupancy Changes – COE Distribution (Second Six-Month Period of 2023).
[54] See Appendix CCT-8 Summary of Water Quality Sampling Results from Select Households (1983 to 1987 Homes, Cumulative since Program Inception).

rate identified in the Lead Reduction Program Plan necessary to match the performance of the orthophosphate alternative is 65%.

ESTIMATED FILTER ADOPTION RATE

Under section 5.E.i of the LCRR Variance, "Denver Water must conduct a survey in 2023 and every other program year of randomly selected customers enrolled in the Filter Program to receive a minimum of responses from remaining program participants that is consistent with a 95% confidence level and 3% margin of error. The survey must inquire whether the customer has used the filter for water to make infant formula (if applicable); cooking and drinking; or is using bottled water or a filter device that is certified National Sanitation Foundation/American National Standards Institute 53 for lead removal not provided by Denver Water for infant formula, cooking and drinking."

It was previously determined that for a filter adoption rate of at least 60%, a minimum of 1,054 filter adoption survey responses are required to estimate the filter adoption rate with at least 95% confidence and no more than 3% error.[55]

FILTER ADOPTION RATE SURVEY QUESTIONS

The formal Filter Adoption Survey was approved by EPA on Sept. 10, 2020. The survey for 2023 was distributed on Aug. 1, 2023, to 15,000 properties or about 18% of customers enrolled in the Filter Program.[56] The Filter Adoption Survey participants submitted survey responses online or mailed in hard copy responses. Survey respondents had to answer questions one through three (regarding filter adoption for filter water used for drinking, cooking, and infant formula) to be included in the analysis and calculation of the overall percent adoption. A total of 1,737 survey responses were received between Aug. 1 and Oct. 10 (Table 32). Below are the approved survey questions sent to customers.

1. Do you always, or most of the time, use your pitcher provided by Denver Water for drinking water?
    - Yes.
    - No – I use unfiltered tap water.
    - No – I use bottled water, or a different type of filtration system certified to remove lead in accordance with NSF/ANSI 53 standards (e.g., fridge, under the sink filter, sink mounted filter).
2. Do you always, or most of the time, use your pitcher filter when you are cooking foods where water is a base ingredient (examples: making rice, beans, soup)?
    - Yes
    - No

2a. If your answer to No. 2 above is no, why are you not using the pitcher for cooking?

- Prefer to use unfiltered tap water.

[55] See Appendix III.C.1 (Filter Adoption) of the Lead Reduction Program Plan.
[56] See Appendix FIL-16 Formal Filter Adoption Survey Detailed Responses.

- Prefer to use bottled water for cooking food.
- Prefer to use a different type of filtration system certified to remove lead in accordance with NSF/ANSI 53 standards (e.g., fridge filter, under the sink filter, sink-mounted filter).
- Do not cook.
- Other

3. Do you have a formula-fed infant (under 24 months of age) in your household?
    - Yes
    - No

3a. If yes, what water do you always use to mix the formula (select all that apply)?

- Not applicable (I don't feed formula to my infant, or use pre-mix/ready mix)
- Water from the pitcher filter
- Bottled water
- Water filtered by an alternative filter device (fridge filter, under the sink filter, sink-mounted filter or other filter) certified to remove lead in accordance with NSF/ANSI 53 standards
- Unfiltered tap water

DEFINITIONS USED TO CALCULATE THE FILTER ADOPTION RATE

Definitions are provided in Table 31 to describe the consistent application of the data from the filter adoption survey when measuring the filter adoption rate. The percentage filter adoption for drinking and/or cooking and infant formula is used as a single input in the equivalency model.

TABLE 31. DEFINITIONS FOR FILTER ADOPTION RATE AS USED IN THE EQUIVALENCY MODEL

YES to filter use for drinking water = Q1 yes pitcher filter
+ Q1 alternative filter/bottled water

YES to filter use for cooking = Q2 yes
+ [Q2 no and one of Q2a bottled water
+ Q2a alternative filter + Q2a do not cook + applicable Q2a other]

YES to formula-fed infant[1] = Q2 yes
+ [and one or more of Q3a N/A + Q3a pitcher filter
+ Q3a bottled + Q3a alternative filter]

TOTAL Filter Adoption Rate = 1 x (yes drinking, yes cooking, yes formula-fed infant)
(as defined in the Order) + 0.5 x (yes drinking, yes formula-fed infant only)
÷ total eligible responses

Percent filter adoption for drinking = (YES to filter use for drinking water)
÷ total eligible responses

Percent filter adoption for cooking = (YES to filter use for cooking)
÷ total eligible responses

Where total eligible responses = mailed responses with answers to Q1, Q2 and Q3
+ electronic responses using the "submit" button

[1] Includes customers that responded that they do not have a formula-fed infant in their household and customers that are not expecting.

Using the definitions of Table 31 and in accordance with paragraph 5.E.ii of the Order, the total filter adoption rate for 2023 is calculated at 83%, as shown in Table 32. This percentage is used in the equivalency model and shown with the year-over-year comparison shown in Table 33. Filter adoption rates for drinking, cooking and formula preparation are provided in Table 32.

TABLE 32. 2023 FILTER ADOPTION RATE ESTIMATED FROM FILTER ADOPTION SURVEY

Question	Total Responding Yes	Total Responses to Question	Percent Yes
Q1. Filtered or bottled water used for drinking water	1,608	1,737	93%
Q2. Filtered or bottled water used for cooking[1]	1,289	1,737	74%
Q3. Filtered or bottled water used for formula-fed infant in households that self-identify as an existing or expecting family	27	30	90%
Total Filter Adoption Rate as used in the equivalency model[2]			**83%**

[1] Includes those customers that responded that they do not cook.

[2] As described in paragraph 5.E.ii the Order and the number used in the equivalency model.

TABLE 33. YEAR-OVER-YEAR COMPARISON OF FILTER ADOPTION RATE ESTIMATES

Question	Percent 2020[1]	Percent 2021[2]	Percent 2022[3]	Percent 2023
Q1. Filtered or bottled water used for drinking water	93%	94%	93%	93%
Q2. Filtered or bottled water used for cooking[4]	68%	71%	73%	74%
Q3. Filtered or bottled water used for formula-fed infant in households that self-identify as an existing or expecting family[5]	97%	93%	94%	90%
Total Number of Survey Responses	**3,987**	**2,116**	**1,512**	**1,737**
Total Filter Adoption Rate as used in the equivalency model[6]	**80%**	**81%**	**83%**	**83%**

[1] From the Annual Report for 2020.

[2] From the Annual Report for 2021.

[3] From the Annual Report for 2022.

[4] Includes those customers that responded that they do not cook.

[5] Although the number of respondents using unfiltered tap water for formula preparation remained the same (three every year), the calculated percentage declined since 2020 because the total number of responses to question 3 declined (83 responses in 2020 compared with 44 in 2021 compared with 49 in 2022 compared with 30 in 2023). This had the effect of magnifying the impact of each "no" response.

[6] As described in paragraph 5.E.ii the Order and the number used in the equivalency model.

Informal Filter Adoption Survey

Informal surveys of filter use are conducted during ALSLR pre-construction meetings and during virtual meetings asking customers about filter adoption and use. Responses from 3,246 participants were captured in the LRP database from the pre-construction meetings.[57,58] Of the responses, 1,779 had service line replacements. This accounts for 25% of all customers who had

[57] See Appendix FIL-14 Informal Filter Adoption Survey Results Summary (Second Six-Month Period of 2023).

[58] See Appendix FIL-17 Informal Filter Adoption Survey Detailed Responses (Second Six-Month Period of 2023).

their LSLs replaced in 2023. Below are the results from the 1,779 customers who had a line replacement between July 1 and Dec. 31, 2023:

- 551 customers responded to the informal filter adoption survey. Out of the 551 customers, 514 customers use their pitcher kit for drinking water (93%) and 490 customers use their pitcher kit for cooking (89%).
- 18 of 19 households (95%) who identified having a formula fed infant, indicated the use of filter water when preparing formula.

Informal surveys of overall filter use and barriers to using filtered water for cooking are conducted as part of virtual community meetings when those meetings focus on filter use.

Filter Opt-Out List of Customers using Bottled Water or an Alternate Filter [7.B.iv.d]

Per Section 7.B.iv.d of the LCRR Variance, Denver Water must report "a list of unique customer identification numbers reporting the use of bottled water or a filter certified NSF/ANSI (53) for removal of lead, and any changes in the list."

The number of properties that chose to opt-out of the Filter Program to date is relatively small. Customers that opt-out of the Filter Program are contacted by Denver Water to understand the reason for opting out. Of the 140 customers that have opted out since the launch of the Filter Program, 20 use bottled water as an alternative to the filter and 32 use their own filter certified National Sanitation Foundation (NSF) 53 for lead removal. For the 88 remaining customers, Denver Water was unable to confirm if the customer was using an NSF 53-certified filter.[59] A summary of the Filter Program opt-outs is shown in Table 34. Contact with customers continues to be attempted as part of an annual reminder to customers that have opted out or refused to participate in the Filter Program.[60]

[59] See Appendix FIL-9 Filter Program Opt-Outs (Second Six-Month Period of 2023).

[60] The use of an NSF 53 certified filter could not be confirmed at some properties based on call center records. This affected two customers that indicated that they use their own filter; these properties were moved from the Opt-Out List to the Refusal List.

TABLE 34. SUMMARY OF FILTER PROGRAM OPT-OUTS

Program Year	Number of Properties			
	Total Opt-Outs	Confirmed Using Own Supplied NSF 53 Certified Filter	Confirmed Using Bottled Water	No Confirmation of NSF 53 Certified Filter or Bottled Water
2020 (Jan. 1 to Dec. 31, 2020)	63	9	6	48
2021 (Jan. 1 to Dec. 31, 2021)	43	6	5	32
2022 (Jan. 1 to Dec. 31, 2022)	25	11	6	8
2023 (Jan. 1 to Dec. 31, 2023)	9	6	3	0
Total Removed from LRP due to Non-Lead Designation or LSL Replacement	0	0	0	0
Total Since LRP Inception	140	32	20	88

Filter Refusal List [7.B.iv.e]

Per Section 7.B.iv.e of the LCRR Variance, Denver Water must report "a list of unique customers identification numbers for customers enrolled in the filter program who have refused a filter or replacement cartridges or have opted out of enrollment in the filter program."

From July 1 to Dec. 31, 2023, notice of refusal to participate in the Filter Program was received for 53 properties.[61] The reasons given for refusal included that the pitcher is too heavy to use or that the resident had a water quality test and is not concerned about the low level of lead in their water. This brings the total number of refusals to 361 since the inception of the LRP. A summary of the refusals to date is shown in Table 35.

TABLE 35. SUMMARY OF FILTER REFUSAL LIST

Reporting Period	Number of Properties Refusing to Participate
2020 (Jan. 1 to Dec. 31, 2020)	30
2021 (Jan. 1 to Dec. 31, 2021)	73
2022 (Jan. 1 to Dec. 31, 2022)	158
2023 (Jan. 1 to Dec. 31, 2023)	100
Total Removed from LRP due to Non-Lead Designation or LSL Replacement	5
Total Since LRP Inception	361

[61] See Appendix FIL-10 Filter Program Refusals (Second Six-Month Period of 2023).

Summary of Data to Document Filter Distribution and Filter Program Participation

Additional details related to filter kit distribution are provided in the Appendices:

- List of premise addresses and service point identification numbers for all households that refuse to participate in the Filter Program.[62]
- List of premise addresses that have returned replacement cartridges to sender.[63]
- Filter adoption survey results summary from informal filter use surveys conducted in the field as part of LSL replacement and virtual meeting filter survey summary.[64]
- Detailed responses from the informal filter use field survey responses collected as part of LSL replacement activities.[65]
- Confirmation of pitcher filter performance in the field.[66]
- List of premise addresses and service point identification numbers for all households that opt-out of the Filter Program.[67]
- Occupancy changes for pitcher filter distribution.[68]
- Occupancy changes for filter education information.[69]

Confirmation of Filter Performance in the Field [7.B.iv.f]

Per Section 7.B.iv.f of the LCRR Variance, Denver Water must report filter lead sampling results collected. Field sampling is conducted by Denver Water in conjunction with LCR compliance sampling (see section 7.B.i). All samples collected to meet this requirement for the second six-month compliance period of 2023 are included in this reporting period. Samples were collected from 53 properties between Sept. 11, 2023, and Dec. 21, 2023. Samples are collected using a protocol with three sample bottles to differentiate between lead measured in the first draw LCR compliance sample and lead measured in water used in filter testing and referred to as the filter influent sample. The third sample is collected from filter effluent and used with the filter influent sample to calculate the percentage of lead removal.

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62 See Appendix FIL-10 Filter Program Refusals (Second Six-Month Period of 2023).
63 See Appendix FIL-15 Filter Program Replacement Cartridge Returns (Second Six-Month Period of 2023).
64 See Appendix FIL-14 Informal Filter Adoption Survey Results Summary (Second Six-Month Period of 2023).
65 See Appendix FIL-17 Informal Filter Adoption Survey Detailed Responses (Second Six-Month Period of 2023).
66 See Appendix FIL-11 Confirmation of Filter Performance in Field Results (Second Six-Month Period of 2023).
67 See Appendix FIL-9 Filter Program Opt-Outs (Second Six-Month Period of 2023).
68 See Appendix FIL-13 Occupancy Changes - Pitcher Filter Distribution (Second Six-Month Period of 2023).
69 See Appendix FIL-12 Occupancy Changes - COE Distribution (Second Six-Month Period of 2023).

Lead was measured in the unfiltered tap water at less than 1 µg/L in 14 samples collected on the same day the filter effluent sample was collected. Lead was measured below the detection limit in filtered water at 43 of the 53 properties and below 3 µg/L at all properties with no exceptions[70]. If lead is measured above 10 µg/L from a filter, the filter is removed from the property, the customer is provided with a new filter, and the "old" filter is sent to the Denver Water lab for additional testing (using the water supplied from the lead pipe rack). Zero properties in this reporting period contained lead measured above 10 µg/L in the filter effluent sample.

Results from filter testing in the field are also reviewed to identify properties with elevated lead in the first bottle for inclusion in the Elevated Lead Response Plan. There were zero properties with lead measured above 15 µg/L in the first bottle.

Information About Filter Usage and Maintenance Collected during Filter Performance Testing [7.B.iv.g]

Per Section 7.B.iv.g of the LCRR Variance, Denver Water must report information about filter use. Observations of filter use during filter performance testing in the field are reported with sampling results. When there are customers who are identified for inclusion in the filter performance testing in the field that do not use their filter, a sample is not collected from the filter. For this reporting period, four customers indicated that they did not use the filter provided by Denver Water.

Confirmation of Direct Contact with 95% of All Customers Enrolled in the Filter Program [5.G]

Per Section 5.G of the LCRR Variance, "Denver Water must make direct contact with lead outreach and education materials to 95% of all customers enrolled in the filter program in every Program Year." In 2023, proof of contact with customers enrolled in the LRP is measured based on the mailing of filter reminder postcards. The postcards were mailed in October and are discussed in Section 7.B.vi.[71]

[70] See Appendix FIL-11 Confirmation of Filter Performance in Field Results (Second Six-Month Period of 2023).

[71] See Appendix COE-17 Filter Use Reminder Postcard.

7.B.v Compliance Metrics per Paragraphs 2.C, 3.D, 4.I, 5.G, 6.B, and 6.C

Section 7.B.v of the Variance requires that Denver Water report and maintain records of the following compliance metrics:

> *v. Compliance Metrics. Results achieved under the compliance metrics in paragraphs 2.C [CCT Metric], 3.D [LSL Inventory Compliance Metric], 4.I [Accelerated LSL Replacement Compliance Metric], 5.G [Filter Communication Compliance Metric], 6.B [Comprehensive LRPP Performance Metric], and 6.C [Health Equity and Environmental Justice Metric] above.*
>
> *Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.*

A summary of the performance metrics that will ultimately be used to evaluate the overall performance of the LRP is presented in Table 36.

TABLE 36. SUMMARY OF COMPLIANCE

Paragraph	Description	Comment
2.C	**C. Corrosion Control Treatment Metric.** Denver Water must maintain pH and alkalinity within the ranges designated by CDPHE. For the entry points to the distribution system, pH must fall within a range of 8.6 to 9.0 and a minimum alkalinity of 20 mg/L as CaCO3; for distribution system location, pH must fall within a range of 8.5 to 9.1 and a minimum alkalinity of 20 mg/L as CaCO3. CDPHE may modify these required water quality parameter ranges through a modification decision under 5 CCR 1002-11.26(3)(d)(ii).	**See Section 7.B.i**
3.D	**D. LSL Inventory Compliance Metric.** Denver Water must Investigate a cumulative average of 1.4% of the total estimated number of unknown service lines in the inventory each Program Year from January 1, 2020, to the Variance End Date. By the Variance End Date there must be no remaining sites in the inventory categorized as a lead, galvanized requiring replacement, or lead status unknown, as defined in paragraph 1.	**See Section 7.B.ii**
4.I	**I. Accelerated LSL Replacement Compliance Metric.** Denver Water must annually achieve at least a 7.0% cumulative average Program Year LSL replacement rate as determined based on reporting required in paragraph 7.B. If not achieved, Denver Water shall provide public notice within 30 Days to all customers enrolled in the filter program, as required under paragraph 1.T.ii.	**See Section 7.B.iii**
5.G	**G. Filter Communication Compliance Metric.** Denver Water must make direct contact with lead outreach and education materials to 95% of all customers enrolled in the Filter Program in every Program Year. . . Compliance shall be tracked by mailing lists and mail receipts, lists of customer email addresses for customers who elect to receive email communication, or other forms of documentation approved by CDPHE.	**See Section 7.B.vi**
6.B	**B. Comprehensive LRPP Performance Metric.** Denver Water must demonstrate to EPA's satisfaction, using the updated equivalency model results as reported under paragraph 7.C, that the combined actual	**See Part 3 of this report.**

Paragraph	Description	Comment
	performance of the LRPP as implemented continues to be "at least as efficient as" OCCT as that term is used in 40 C.F.R § 141.82(e) and as it relates to CDPHE's March 2018 designation of OCCT as orthophosphate treatment for Denver Water, in reducing lead exposure on an annual basis.	
6.C	**C. Health Equity and Environmental Justice (HE and EJ) Compliance Metric.** i. Denver Water must annually achieve a cumulative Program Year LSL replacement rate in areas with HE and EJ concern that is equal to or greater than the total replacement rate. This calculation is the number of LSLs replaced per year in areas with HE and EJ concerns divided by total number of LSLs in areas with HE and EJ concerns must be equal to or greater than the average number of LSLs replaced per year overall divided by total number of LSLs as of the variance effective date. ii. Denver Water must make direct contact with lead outreach and education materials to more than 95% of customers as identified in areas with HE and EJ concerns enrolled in the filter program in every Program Year.	**See Section 7.B.vii**

7.B.vi Communications, Outreach and Education

Section 7.B.vi of the LCRR Variance requires that Denver Water report and maintain records for COE activities:

> *vi. Communications, Outreach and Education. A summary of activities conducted under the Communications, Outreach and Education program, including the updated communications, outreach and education plan for the new Program Year. The summary will include, at a minimum:*
>
> *a. a description of outreach activities conducted, including copies of the outreach materials provided; and*
>
> *b. a list of any partner organizations who conducted, or were involved in the implementation of the communications, outreach and education plan.*
>
> *Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.*

During the last six months of 2023, Denver Water continued its public outreach and engagement efforts based on the strategies described in the 2023 COE Plan. This included hosting four virtual community meetings on proper filter use, construction preparedness and an overview of the Lead Reduction Program, convening the Stakeholder Advisory Committee for two quarterly meetings and continuing efforts to encourage customers to use filtered water. COE efforts specific to each LRP element are also included in those element sections of this report and are detailed in Table 37.

TABLE 37. OVERVIEW OF 7.B.VI REQUIREMENTS

Paragraph	Description	Comment
7.B.vi	2020 COE Plan 2021 COE Plan 2022 COE Plan 2023 COE Plan 2024 COE Plan	See First Quarter Report of 2020. See Fourth Quarter Report of 2020. See Second Semi-Annual Report of 2021. See 2022 Annual Report. See Appendix.[1]
7.B.vi.a	Description of COE activities conducted. Copy of materials.	Discussed in this section. See Appendices for copies of materials included.[2]
7.B.vi.b	Ambassador Program Overview.	See Section 7.B.vii.
7.B.vi.c	Response, date and time of in-person surveys of filter adoption and use.	See Section 7.B.iv. See Appendix.[3]
8.G	Notify customers enrolled in Filter Program of LRP and launch multi-media campaign.	Multi-media campaign launched March 23, 2020.
LRPP III.E (p 64)	Targeted messaging to homes with copper piping and lead solder to flush the tap after periods of non-use.	See 2020, 2021, 2022, 2023 COE Plans.
LRPP III.F (p 74)	Stakeholder Advisory Committee	Discussed in this section.

[1] See Appendix COE-14 2024 COE Plan.

[2] See Appendices COE-15 through COE-18, and COE-20 through COE-24 for a copy of materials.

[3] See Appendix FIL-14 Informal Filter Adoption Survey Detailed Responses (Second Six-Month Period of 2023).

Outcomes of COE Activities between July 1 and Dec. 31, 2023 (unless otherwise noted) [7.B.vi.a]

- Denver Water hosted four bilingual, one-hour virtual community meetings in July, October and November focused on preparing customers for lead service line replacement, proper filter use and providing an overview of the LRP. To promote the meetings, 46,685 outbound calls were made to customers during this reporting period the day before and the day of the events, with 30,520 bilingual voicemail messages left for those who did not answer. In total, 2,422 customers participated in a virtual community meeting during the last six months of the year and 3,943 participated in a meeting in 2023.

- In addition, Denver Water received requests for LRP presentations and/or attendance at community and stakeholder events from eight local, state and national organizations and held these presentations at various times during this reporting period.

- In October, a filter use reminder postcard was mailed to all Filter Program enrollees to encourage proper filter use and maintenance, fulfilling the requirements for direct

contact with at least 95% of Filter Program enrollees, including those identified as being in areas with HE&EJ concerns, each program year.[72]

- The Stakeholder Advisory Committee convened for two quarterly meetings July 26 and Oct. 12, 2023. The meetings included progress updates on the LRP, updates from committee members on work from their organizations related to lead and/or public health and an overview of new program metrics included in the new LRP Variance. The next meeting will be held in the first quarter of 2024. The previous quarterly meetings were held Feb. 23 and June 1 and are described in the Semi-Annual Report for 2023.
- In this reporting period, contact was made on 45 occasions with Denver City Council and Mayor's Office and officials in suburban jurisdictions to proactively share information and updates on the LRP. During 2023, contact was made on 68 occasions with these stakeholders, with the majority of engagement happening during the second half of the year to communicate about program progress and expectations for 2024.
- The LRP website received 437,509 visits and 738,075 page views since the launch of comprehensive LRP information on March 5, 2020. In 2023 alone, the website received 112,741 visits and 162,453 page views.[73]
- LRP TAP stories published on denverwater.org/TAP received 275 views in this reporting period, totaling 2,749 views during 2023.[74]
- Denver Water social media activity reached approximately 98,080 individuals in this reporting period, totaling 124,343 individuals reached during 2023.
- The LRP was mentioned in 61 news media stories, with a potential aggregate readership of 164 million across online news, blogs and television, totaling 116 stories with a potential aggregate readership of 169 million during 2023.[75]

In addition to these outreach activities, Denver Water developed its 2024 COE Plan. The plan identifies goals, target audiences and strategies/tactics that will guide COE outreach efforts in the following year of the LRP.[76]

The following section highlights COE program activities carried out in 2023 from July 1 through Dec. 31 (unless otherwise noted), organized by strategy type.

[72] See Appendix COE-17 Filter Use Reminder Postcard.
[73] See Appendix COE-24 Website Traffic.
[74] See Appendix COE-23 TAP Stories Published.
[75] See Appendix COE-22 Earned Media Reports.
[76] See Appendix COE-14 2024 COE Plan.

Public Outreach

Overview of activity grouped by outreach component:

- Virtual Meetings
    - Denver Water hosted four bilingual, one-hour virtual community meetings on July 18, July 20, Oct. 3 and Nov. 7, 2023. Both July meetings focused on sharing tips and tricks for proper filter use for all customers in the Filter Program. The October meeting focused on construction preparedness for customers slated to receive a service line replacement in 2023. The November meeting provided an overview of the LRP for all customers, with targeted promotion to customers in underserved communities and neighborhoods identified for upcoming investigation activity.
    - To promote the meeting on construction preparedness, 1,721 outbound calls were made and 1,594 emails[77] sent to customers identified for service line replacement the day before and the day of the event, with bilingual voicemail messages left for those who did not answer. To promote the meetings on filter use, 40,682 outbound calls were made and 24,470 emails sent to all customers enrolled in the Filter Program, with bilingual voicemail messages left for those who did not answer. To promote the meeting to overview the LRP, 4,282 outbound calls were made and 4,352 emails sent to customers identified for upcoming investigation activity. 2,422 customers participated in these virtual community meetings.
- Presentations to organizations were given upon request to provide an overview of the LRP, gather feedback and identify areas for potential coordination. These meetings included the following:
    - CDPHE and NAACP Community Event re: Water (June 1).
    - AWWA-ACE Annual Conference Panel: Moving Forward with Lead Service Line Replacements (June 14).
    - Watershed Summit: Denver Water LRP Overview, focusing on partnerships (June 22).
    - Near Northeast Area Plan and Resource Fair (June 22).
    - IAP2 2023 North American Conference: Partnering for Possibility (Sept. 14).
    - Lead Service Line Collaborative Membership Meeting: Shovels, Software and Soft Skills…Setting Up Crews for Success (Oct. 5).
    - Historic Montclair Community Association Meeting (Oct. 18).

[77] See Appendix COE-16 Virtual Community Meeting Email Invitations.

- 2023 CDC Childhood Lead Poisoning Prevention Program Annual Recipients Meeting (Dec. 6).

- Stakeholder Advisory Committee
  - The Stakeholder Advisory Committee met for its third and fourth quarterly meetings of 2023 on July 26 and Oct. 12.
    - Representatives reflected a diverse group of organizations, including health care, education, nonprofit and government.[78]
    - At the July meeting, Denver Water hosted a lead service line replacement site visit for the committee. Members observed a replacement in-progress and heard from the construction team about the process and typical opportunities and challenges involved. Two representatives from community partner organizations also attended. Committee members noted the experience of seeing a replacement firsthand and meeting community partners deepened their understanding of the program and confidence in speaking about it with their networks.
    - At the October meeting, committee members toured Denver Water's new water quality lab at the new CSU Spur complex, followed by dinner. Denver Water provided an update on LRP progress to-date, shared preliminary filter adoption survey results and overviewed what to expect in 2024.

- Government Relations
  - 45 proactive contacts and/or meetings were held with local government officials and staff, including Denver City Council and Mayor's Office and officials in suburban jurisdictions, to share information and updates for the LRP.
    - Now that the LRP is well underway, most of these updates included information on upcoming work areas and construction in respective Denver City Council Districts as well as updates on issues potentially impacting customers.
  - Outside of the proactive updates, staff continued to be responsive to questions from government officials, as needed.

- Distributor Communications
  - An update on the LRP and overview of 2024 work areas was provided at the Sept. 19 distributor forum meeting.

[78] See 2023 Semi-Annual Report, Appendix COE-1 Stakeholder Advisory Committee 2023 Membership List.

- An update on the LRP and 2024 work areas was published in the October distributor newsletter.
- Distribution of water quality sampling kits and results continues when requested by distributors' customers. Distributor LRP customers also receive replacement filters and, when there is a change in occupancy, a new filter kit.
- Denver Water also sends distributor customers the same program removal mailings as for City and County of Denver customers. Mailings are sent when a property is removed from the LRP either due to investigation confirming a non-lead service line or six months after a lead service line has been replaced.
- On a bimonthly basis, distributors with properties in the LRP are provided an inventory update, which reflects any changes made to the status of properties in their area as a result of investigations or service line replacement.
- In 2023, investigation potholing was undertaken in 10 distributor districts. Distributor customers received the same notifications and communications related to potholing as City and County of Denver customers, and distributors were provided with talking points to support answering any customer inquiries. A digital fact sheet outlining the potholing efforts was also developed for distributors to use as reference.
- In December 2023, CDPHE approved a Consolidated Mutual Water Company request to directly manage customers with suspected lead service lines. These customers are no longer be part of Denver Water's LRP. Notifications were sent to these customers on Dec. 28, to inform them of the change and what to expect.

- Paid Media
  - The successful paid media strategy implemented since program launch was continued during this reporting period to promote the LRP with focus on areas where residents may not be using filtered water as commonly as others.
  - An initial campaign ran from July 10 through Sept. 17, generating 6 million impressions through digital ads and over 10,800 visits to the LRP website. A second campaign ran from Oct. 10 through Dec. 10, generating 6.4 million impressions through digital ads and 14,000 visits to the LRP website.[79]
- Earned Media
  - The LRP was covered in digital, print and broadcast news, including CBS, The American Prospect, American Society of Civil Engineers and El Comercio de Colorado and Water Finance & Management, among others.[80]

[79] See Appendix COE-21 Paid Media Reports.
[80] See Appendix COE-22 Earned Media Reports.

- There were 238 posts about the LRP on social media channels in this reporting period, resulting in 98,080 impressions. Ambassador Program partners also shared Denver Water social media posts on their own networks.
- Denver Water also provided content for organization and neighborhood newsletters on request.

- Digital Communications
  - Denver Water distributed emails Aug. 9 and Nov. 3 to a database of over 50,000 subscribers. The emails promoted upcoming virtual community meetings and shared how to access meeting recordings, information on 2024 work areas, an overview of program progress to-date, reminders about proper filter use and a link to the online filter request form.[81]
  - During 2023, five TAP stories were published on denverwater.org/TAP that included content related to the LRP. As of Dec. 31, these stories received a total of 2,749 views.
  - The LRP website, denverwater.org/Lead (English) and denverwater.org/Plomo (Spanish), was updated with the recordings of the construction preparedness virtual community meetings, dashboards, an updated lead service line inventory and an updated pipe replacement map with the work areas for 2024. Since the launch of the LRP, denverwater.org/Lead has received 437,509 visits and 738,075 page views. There were 77,544 unique website visits from July 1 to Dec. 31, 2023. Since launching in October 2021, denverwater.org/Plomo (the Spanish version of the website) has received 5,530 visits and 8,229 page views. There were 1,410 unique website visits from July 1 to Dec. 31, 2023.[82]

Material Development and Owned Media [7.B.vi.a]

The following materials were developed from July 1 to Dec. 31, 2023:

- The public-facing dashboard was updated to share progress and key metrics for the LRP through November 2023, with the December 2023 dashboard to be posted in early January 2024.[83] The updated dashboard is posted monthly to denverwater.org/Lead and is available in both English and Spanish.
- Information on the LRP was included in the October, November and December issues of WaterNews, the monthly bill insert included with the bills of more than 180,000 customers who receive a bill from Denver Water. The information covered what

[81] See Appendix COE-20 Subscriber Emails (August and November).
[82] See Appendix COE-24 Website Traffic.
[83] See Figure 1.

customers in the LRP need to know and do regarding filter use, construction and water testing, as well as how upcoming rate changes support the LRP.[84]

- A potholing fact sheet was created for distributors to reference in communication with their customers as investigation activity increases in those districts.[85]
- A filter use reminder postcard was mailed to all enrollees in the Filter Program to emphasize the importance of and encourage proper filter use and maintenance.[86]

Internal Communications and Coordination

The following summarizes efforts to continue to educate Denver Water's employees and contractors about the components and messaging of the LRP. This ongoing engagement supports Denver Water staff and representatives to provide customers with accurate information and enhances efforts to make the LRP accessible by all.

- Internal trainings and information-sharing sessions continued to be held as needed or requested to update Denver Water teams and departments on the LRP and prepare them for handling customer or community inquiries as appropriate. Two sessions were held between July 1 and Dec. 31.
- Talking points continue to be developed and updated for Customer Care and other customer-facing groups to support consistent and timely responses to customer inquiries. A comprehensive review and update, where needed, of all talking points was undertaken in this reporting period.

Above and Beyond Stories

- In July 2023, contractors who had replaced a service line responded to a customer reporting a leak under their kitchen sink. Even though the leak was not caused by the contractor's work and the service line replacement, and instead by a faulty valve under the kitchen sink, the contractor went ahead and fixed the valve for the customer at no cost.
- In September 2023, contractor crews helped make a customer's driveway accessible again after asphalt disruption from a main break. The contractor and their paving subcontractor added a ramp from the private driveway to the street that provided the resident access to their garage. The crews also backfilled settling portions around the site and smoothed out the remaining heaving asphalt from the main break.

[84] See Appendix COE-15 Issues of WaterNews (October, November and December).
[85] See Appendix COE-18 Potholing Fact Sheet.
[86] See Appendix COE-17 Filter Use Reminder Postcard.

7.B.vii Health Equity and Environmental Justice

Section 7.B.vii of the LCRR Variance requires Denver Water to report and maintain records related to activities implemented to achieve its Health Equity and Environmental Justice principles:

> *vii. Health Equity and Environmental Justice. A summary of activities conducted and designed to address HE and EJ principles set forth in the LRPP, including:*
>
> *a. a description of how the HE and EJ principles are being incorporated into the accelerated LSL replacement program, lead filter program, and communications, outreach and education plan;*
>
> *b. socioeconomic or demographic data collected from outside sources (e.g., census data, local public health agencies) to target communications, outreach and education programs to specific neighborhoods, demographic cohorts, or non-English speaking groups;*
>
> *c. description of the values used to calculate compliance with the HE and EJ compliance metric for LSLR and lead outreach and education materials, as described in paragraph 6.C.i; and*
>
> *d. summary of information showing that outreach and education materials have been provided to at least 95% of the households in He and EJ areas of concern enrolled in the filter program in 6.C.ii. Detailed records must be retained by Denver Water and provided to EPA or CDPHE upon request.*
>
> *Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.*

A commitment to HE&EJ informs all aspects of the LRP, supporting accessibility, awareness and equitable participation for all customers. An overview of HE&EJ reporting requirements is presented in Table 38.

TABLE 38. Overview of 7.B.vii Requirements

Paragraph Reference	Description	Refer to
7.B.vii LRPP V (p 77)	Summary of activities conducted and designed to address HE&EJ principles.	Described in this section. See LRPP (p 77).
7.B.vii.a	Description of how HE&EJ principles were incorporated into the implementation of the: • ALSLR Program. • Filter Program. • COE Plan.	See First Quarter Report of 2020 and updates in this section.
7.B.vii.b	Socioeconomic or demographic data collected from other sources to target communications, outreach and education programs to specific neighborhoods, demographic cohorts, or non-English speaking groups.	See this section for how data informed COE activities.
7.B.vii.c	Description of values used to calculate compliance with the HE&EJ compliance metric for LSLR and lead outreach and education materials.	Described in this section.
7.B.vii.d	Summary of information showing that outreach and education materials have been provided to at least 95% of the households in HE&EJ areas of concern enrolled in the Filter Program.	See Section 7.B.vi.a. and this section.
LRPP V (p 77)	Commitment to continue to consult and collaborate with the organizations and HE&EJ experts, stakeholders, community members and customers to continually improve upon integration of the HE&EJ principles with the Lead Reduction Program.	Described in this section.
LRPP V (p 79)	Collaborate with other agencies to address lead exposure from all sources.	Described in this section.

HE&EJ Integration in the Lead Reduction Program

From the beginning discussions that became the Lead Reduction Program, HE&EJ (equity) has been a foundational principle driving planning, decision-making, resource allocation, strategy and tactical development, as well as work culture. Equity is not an additional consideration for these efforts, rather it is the starting point. This commitment to advancing equity comes with a commitment to internal and external collaboration, learning by doing, openness, transparency and communication. In practice, this commitment means researching and talking with subject matter experts and communities to better understand community needs and preferences; it means taking time to build long-term relationships to build trust; it means asking for (and really wanting to hear) constructive feedback to improve; it means an ongoing pledge to persist in the efforts and create progress, not perfection.

As the Lead Reduction Program has evolved, so too have its efforts and activities specific to advancing equity. The Ambassador Program, described below, has expanded to include more community partners focused on both general outreach and activities that support specific program elements. Partners have also become intertwined with the identification of ALSLR work areas to approach engagement in a way most impactful for specific communities. Time and again Denver Water finds that the work of trusted partners results in tangible, positive benefits for the

program, such as the 10-15% increase in consent response rates once partners are involved. Given that Denver Water's efforts around equity are more deeply woven into both general program outreach and specific program elements, this report has been refreshed so that community partner activities are described either under the overall program section and/or within specific element sections, based on the focus of activities completed. Because the nature of equity efforts and best practices are often evolving, key lessons learned are also described at the end of the HE&EJ section.

The terminology within this space is also rapidly changing in continued progress toward best capturing the characteristics of people and communities cumulatively impacted by policies, systems and associated outcomes. Throughout this section, the term "equity" is used in place of "HE&EJ." This both simplifies the language and reflects the broad scope to which the principles of equity can be applied. Similarly, the term "disadvantaged communities" has evolved to "disproportionately impacted communities." This aligns with the definition adopted by the Colorado Legislature. At present, the term best reflects the cumulative impact and challenges faced by some communities.

The following sections describe how equity principles were integrated into the various components of the LRP during the second half of 2023.

Incorporating HE&EJ Principles via Communications, Outreach and Education [7.B.vii.a, 7.B.vi.b and to support 7.B.vii.c]

Ambassador Program

Denver Water's Ambassador Program is a partnership with community organizations to educate customers in disproportionately impacted communities about the LRP. These customized collaborative efforts expand the LRP's reach, build awareness of program requirements and create momentum for behavior change in the appropriate culture and language most valued in harder-to-reach communities. There are three components of the Ambassador Program:

- **Contract Partners**: Conduct extensive on-the-ground outreach using culturally appropriate messaging with tailored outreach strategies to reach enrolled customers in prioritized communities.
- **Sponsorship Awards:** The sponsorship awards initiative launched in 2021 and provides funding to community organizations to either leverage their existing programs/services/events or create new opportunities to promote the LRP in targeted communities.
- **Information Partners**: Community organizations are recruited for their willingness to use their communication channels to promote the LRP.

Contract Partners

- CREA Results is a community organization that specializes in the Latinx community. This group supported community outreach activities in the following neighborhoods:
  - Barnum.
  - Barnum West.
  - Clayton.
  - Elyria-Swansea.
  - Globeville.

- During the second six months of 2023, CREA Results engaged in the following work:
  - Participated in 42 in-person or virtual events to educate residents within targeted neighborhoods about the LRP with an estimated reach of 3,949 people.
  - Conducted email, phone and/or door-to-door outreach to 422 customers in targeted neighborhoods to encourage customers in the LRP to participate in the program, answer questions and help them understand steps needed to complete water test kits.
  - Hosted three radio shows and aired 12 public service announcements about the LRP on KNRV (1150 AM), a Spanish language radio station, with an estimated reach of 10,000 listeners per show.
  - Secured five articles in El Comercio de Colorado, a prominent Spanish-language publication with an estimated circulation of 20,000 readers per issue, expanding to 45,000 readers starting December 2023.[87]
  - Secured three interviews on Estrella TV, a Spanish language television show, with an estimated viewership of 10,000.
  - Posted LRP information on Facebook, including videos 62 times with an estimated 11,326 views.

Sponsorship Awards

During the last six months of 2023, the following community organizations participated in the Ambassador Program as sponsorship awardees:

- Denver Public Schools is the public school system for the City and County of Denver.
  - Shared LRP information with DPS families at three community events reaching 210 people.

[87] See Appendix HEJ-5 Ambassador Program Spanish Language Articles.

- Distributed information at DPS Community Hubs (a total of six) reaching approximately 2,320 people.

- The Center for African American Health offers African American and Black metro-Denver communities culturally responsive resources that support them in overcoming the root causes of health problems so they can maximize their individual and family health.
  - Featured the LRP in its monthly newsletters with a monthly distribution of approximately 3,800 people.
  - Distributed information on and/or discussed the LRP with 1,498 people at seven community events focused on health and wellness.
  - Promoted the LRP on social media platforms including Facebook (3,300 followers), LinkedIn (464 followers), Twitter (501 followers) and Instagram (803 followers).
- The Greater Metro Denver Ministerial Alliance is an 82-year-old African American Civil/Human Rights Clergy organization committed to the fight for community and social justice.
  - Canvassed 171 homes in the Park Hill and Clayton neighborhoods to share program information, raise awareness and answer questions.
  - Hosted two community dinners with approximately 50 attendees to provide an overview of the LRP.
- Tepeyac Community Health Center is a nonprofit community health center whose mission is to inspire health, wellbeing and humanity in the Denver community, through all of life's stages.
  - Promoted the LRP at 64 community events reaching approximately 3,616 people.
  - Integrated LRP content into the rotating digital message board in their clinic's lobby and waiting area.
- Una Mano, Una Esperanza is a community organization that specializes in the Latinx community. This group supported community outreach activities in the Barnum, Barnum West, Swansea, and Westwood neighborhoods.
  - Coordinated a presentation in Spanish targeted to the Grupo de Oro (Golden Group), a senior group, with 38 participants. The presentation (and Q&A session) was a request from this partner specifically to help the elder generation of Latinos better understand the program (and how to engage).
  - Promoted the LRP at 12 community events such as food banks, school events and Una Mano, Una Esperanza service programs, reaching a combined total of 1,985 people.
  - Promoted the LRP on Facebook to their 2,500 followers.

Information Partners

During the last six months of 2023, the following community organizations participated in the Ambassador Program as information partners:

- The Denver Public Library is the public library system of the City and County of Denver.
    - Distributed hard copy materials describing the LRP to their branch locations for placement in public areas.
    - Facilitated a presentation on the LRP to Plaza Program staff. The Plaza Program provides programming to immigrant and refugee community members to support their experience in and navigation of Denver.
- Inner City Health Center is focused on reducing the inequity of health and wellness access and delivery in underserved populations of Denver and the surrounding metro area through two clinic offices – one in Denver, the other in Wheat Ridge.
    - Placed hard copy materials describing the LRP and directing community members to resources at both of its clinic locations (Denver and Wheat Ridge).

Example of Partners in Action:

- CREA Results team has been working closely with local business owner, Abilene Angeles, on spreading awareness about the LRP. Abilene owns La Villareal, a food truck in southwest Denver and her lead line has been replaced. When approached about supporting the program, she shared her appreciation and offered to help spread the word about the LRP through her business. Since then, Abilene has handed out informational flyers at her business and has taken the time to answer questions about the program from her clients.

Materials

All customer-facing materials produced in 2023 have been translated into Spanish. The construction preparedness virtual community meetings presentation, promotional materials and follow-up communications were provided in both Spanish and English. Monthly dashboards for the LRP are available in Spanish and English at denverwater.org/Plomo and denverwater.org/Lead. Nine core program materials have also been translated into Vietnamese.

The Spanish version of the LRP website, denverwater.org/Plomo, continues to be updated and available to customers. To access the Spanish content, customers may simply click on the green “Español” button in the top right-hand corner of denverwater.org/Lead or visit denverwater.org/Plomo.

Early Childhood

Opportunities to spread LRP messaging to the early childhood community and providers continued during the second six months of 2023. Content about the LRP, filtering water, requesting a replacement filter if needed outside of the normal delivery timeframe and how to request a water test kit was included in the September edition of CDPHE's "Our Voice" newsletter which goes out to 1,532 subscribers in Colorado's early childhood community. Additionally, a recorded interview with Denver Water overviewing the LRP and what customers need to know was included in the July issue of a podcast hosted by Early Learning Ventures, a Colorado-based nonprofit focused on helping childcare providers operate more efficiently and reach economies of scale.

In collaboration with Denver Water's Youth Education team, LRP messaging has been more extensively integrated into Denver Water engagements with youth and their families. Community partner, CREA Results, continued to use the Youth Education team's Water Wall, an interactive educational display targeted to children. The Youth Education team also incorporated LRP content on filter use into appropriate classroom visits where they engage students in hands-on learning activities. Content on the LRP and summer construction activities was also included in the September issue of Knowledge Drops, the Youth Education team's e-newsletter distributed to teachers in the Denver Water service area.[88]

Through collaboration with Denver Health, information on the LRP is being included in "Warm Welcome" bags for families with newborns at Denver Health. Approximately 3,600 Warm Welcome bags are distributed annually.

HE&EJ Principles Applied to ALSLR Program [7.B.vii.a]

Denver Water provided its multicultural training program and delivered it to ALSLR field observers and contractors on Nov. 29, 2023. The training included the following topics:

- Denver Water customer journey.
- Multicultural awareness.
- Multicultural principles.
- Self-awareness and working across cultures.
- Audience language discussion.
- Working with customers when English is not a first language and protocol for interpretation.
- Managing behaviors when working in the public sector (in the field and inside homes).

[88] See Appendix HEJ-6 Youth Education Knowledge Drops Newsletter Content.

- Key program messages.
- Review of materials customers receive, including new documents developed since the original training in February 2020.
- A role play scenario working through common customer situations.

A virtual community meeting was held in October targeted toward customers identified for upcoming service line replacement to share what to expect before, during and after construction. The meeting was fully bilingual, from the initial meeting promotion to the meeting presentation, poll questions and Q&A responses. The meeting recording is also available in Spanish and English at denverwater.org/Plomo and denverwater.org/Lead. Two additional meetings on construction preparedness were held earlier in 2023.

To gather more signed consent forms in the Valverde, Baker and Globeville, Elyria and Swansea neighborhoods, community partner CREA Results conducted phone calls, emails and door-to-door canvassing to speak with relevant customers about providing consent. Out of 340 properties canvassed, 28 provided consent, equivalent to a 12% success rate. These are neighborhoods that Denver Water was ready to close out and properties that Denver Water has attempted to reach multiple times with no success, adding additional value to the success rate of CREA Results. Some of these were commercial properties and some were abandoned, which helped Denver Water update their records. Other property owners, some of them elderly, were very appreciative of the visit and after getting their questions answered, they felt comfortable signing the consent forms. Some of the property owners needed help filling out the form electronically, which CREA's team did. Similar outreach was done by CREA Results in the first half of the year, with a 67% success rate.

Additionally, Denver Water and its contractor teams conducted additional outreach efforts beyond the minimum required to seek consent. These efforts included additional mailings, phone calls and emails to reach customers. In 2023, Denver Water took additional efforts via phone calls, emails and door knocking to contact non-response and refusal customers from previous years who were in or near a 2023 work area to gain consent for service line replacement. Similarly, additional phone calls and emails were made to customers where an interior investigation of the service line was needed to confirm service line material.

Construction field crews continued to use the iSpeak poster, which allows customers to select their preferred language from among 64 languages represented in the poster. Crews were then able to work with the customer and Denver Water to provide support in the preferred language.

2024 ALSLR Plan

Planning for 2024 work areas began by using the LRP's prioritization model to target specific neighborhoods and disproportionately impacted communities. The model is a risk-based approach that is used alongside long-term construction planning to account for the likelihood of

LSLs in a given area, potential for health consequences, sociodemographic indicators, and logistical constraints or opportunities related to construction. If a neighborhood which was included in a previous work area aligned with the prioritization model, it was also included in 2024 ALSLR work areas. This continuity allows Denver Water to leverage existing community outreach and education efforts and continue work in neighborhoods with high program awareness and engagement. Additional neighborhoods were added based on the outputs of the prioritization model and construction feasibility.

As a result, 2024 ALSLR work areas include continuing replacements in six neighborhoods (Athmar Park, West Highland, Hale, Sunnyside, Park Hill and Speer) and beginning replacements in five new neighborhoods (Montclair, Chaffee Park, Hilltop, Regis, Highland). Neighborhoods from previous years that are not included in the 2024 ALSLR work areas are either included in the Federally Funded Lead Service Line Program (FFLSLP) or will be monitored via the prioritization model for future years.

It is important to note that, due to logistical and construction constraints, properties from some neighborhoods included in previous ALSLR work areas may not have had their LSL replaced and will therefore require the replacement to be scheduled in the future. These properties are referred to as rollover properties. It is anticipated that the need for individual replacements at rollover properties will increase over time based on constraints, such as paving moratoriums, future paving commitments, owner changes and delayed return of consent forms. These properties, including non-responsive and refusal properties, will continue to be targeted for outreach and added to 2024 work areas when possible. Approximately 5% of all replacements in 2024 are anticipated to be performed as individual replacements at rollover properties.

The 2024 ALSLR work areas were reviewed with stakeholders, including the LRP Stakeholder Advisory Committee. Prior to the start of customer communications, notifications regarding upcoming work areas were communicated to elected officials, distributor partners and other key external stakeholders.

HE&EJ Principles Applied to Filter Program [7.B.vii.a]

Per Section 7.B.vii.a of the LCRR Variance, Denver Water must report “a description of how the HE&EJ principles are being incorporated into the accelerated LSL replacement program, lead filter program, and communications, outreach and education plan.”

All customers enrolled in the Filter Program received their initial filter kit in 2020 with enough replacement filters to last approximately six months. The distribution of additional replacement filters began on Aug. 27, 2020, an approximate five-month cycle, following the same schedule used for the initial filter distribution. This distribution continued throughout 2023.

Two virtual community meetings were held in July targeted toward customers enrolled in the Filter Program to reinforce proper filter use. The meetings were fully bilingual, from the initial meeting promotion to the meeting presentation, poll questions and Q&A responses. The meeting

recordings are also available in Spanish and English at denverwater.org/Plomo and denverwater.org/Lead.

Tenant Outreach

Introductory program materials and filter kits continue to be provided to apartment complexes for distribution to tenants upon move in. Coordination also continues with property managers to track material distribution.

During the second half of 2023, the LRP team conducted direct outreach to leasing and property management offices with properties in the Filter Program using manually researched contact information to identify the best touchpoint for each property. Phone calls and emails were made to 52 property contacts with a request to coordinate on ensuring all tenants had pitcher filter kits. To raise awareness, the team offered these contacts an LRP overview material to include in welcome packets for new tenants. Of the 52 contacts, 28 (or 54%) requested additional filter kits. This effort will continue in 2024.

The COE team continued to coordinate with Denver Housing Authority to ensure residents had pitcher filter kits upon move-in. Two hand deliveries of filters were made in July and October 2023.

HE&EJ Principles Applied to Water Quality Sampling

In April 2023, Denver Water conducted an extensive training with community partner CREA Results on water testing for customers, with the goal that CREA Results would conduct outreach around this element of the LRP. CREA conducted this work in the second half of 2023, canvassing homes in the Harvey Park, Ruby Hill, Virginia Village, and West Highland neighborhoods to encourage customers to return water samples and answer questions. Out of the 82 homes canvassed, CREA successfully had interactions with 57 properties to encourage them to return their water test kits. Many of them needed a reminder and some needed help with the instructions.

HE&EJ Compliance Metric [7.B.vii.c]

Section 6.C of the LCRR Variance requires Denver Water to ensure that the Program does not result in disproportionate impacts to areas with Health Equity and Environmental Justice concerns:

> *C. Health Equity and Environmental Justice (HE and EJ) Compliance Metric. Denver Water will follow principles of environmental justice and equity in implementing the LRPP overall as reflected in its HE and EJ principles set forth in the LRPP. In addition, Denver Water will ensure that LSLRs are being conducted in a manner that does not result in disproportionate impacts to areas with HE and EJ concerns[1] as of the effective date of this variance. If Denver Water, CDPHE, and EPA determine that the changes in areas with HE and EJ concerns in future program years compared to those identified as of the effective date of the variance are significant, then the variance may be modified under 8.C to update the identified areas with HE and EJ concerns relied upon in this metric.*
>
> *i. Denver Water must annually achieve a cumulative Program Year LSL replacement rate in areas with HE and EJ concern that is equal to or greater than the total replacement rate. This calculation is the number of LSLs replaced per year in areas with HE and EJ concerns divided by total number of LSLs in areas with HE and EJ concerns must be equal to or greater than the average number of LSLs replaced per year overall divided by total number of LSLs as of the variance effective date.*
>
> *ii. Denver Water must make direct contact with lead outreach and education materials to more than 95% of customers as identified in areas with HE and EJ concerns enrolled in the filter program in every Program Year.*
>
> *[1] For the purposes of this Order, areas with HE and EJ concerns are defined as any census block group with, as of the variance effective date, an 80th percentile ranking or above (when compared to either the U.S. or State) in EPA's EJScreen tool for one or more Supplemental Index.*
>
> *Text is taken verbatim from the LCRR Variance, dated Nov. 30, 2022.*

The HE&EJ compliance metric is calculated using the equation below.

$$\frac{average\ number\ of\ LSLs\ replaced\ per\ year}{total\ number\ of\ LSLs} < \frac{average\ number\ of\ LSLs\ replaced\ within\ HE\&EJ\ areas\ per\ year}{total\ number\ of\ LSLs\ within\ HE\&EJ\ areas}$$

An area is defined as having HE&EJ concerns using EPA's EJScreen tool[89] with a state or federal 80th percentile ranking or above for one or more of the following Supplemental Indexes:

- Particulate Matter 2.5
- Ozone
- Diesel Particulate Matter

[89] Refer to https://ejscreen.epa.gov/mapper/ for the EJScreen interactive map.

- Air Toxics Cancer Risk
- Traffic Proximity
- Lead Paint
- Superfund Proximity
- Risk Management Plan Facility Proximity
- Hazardous Waste Proximity
- Underground Storage Tanks
- Wastewater Discharge

Using the definition described above, 33,605 out of 63,955 LSL properties were identified within areas of HE&EJ concerns. Table 39 calculates the HE&EJ compliance metric for the 2023 program year. A total of 6,891 replacements were completed in 2023, with 3,804 (about 55%) of those replacements being within areas of HE&EJ concerns. The cumulative replacement rate within HE&EJ areas of concern is 9.9% and is higher than the overall cumulative replacement rate of 8.8%.

TABLE 39. HE&EJ COMPLIANCE METRIC CALCULATION FOR 2023

	Overall	Within Areas of HE&EJ Concern
Total Number of LSL Replacements Completed[1]	22,406	13,285
Total Number of Properties with LSLs	63,955[2]	33,605[3]
Cumulative Annual Average Replacement Rate	8.8%	9.9%

[1] Total number of LSL replacements as of Dec. 31, 2023, since the inception of the program. Refer to Table 26.
[2] Total number of LSLs as of the 2019 Variance effective date (Jan. 1, 2020).
[3] Calculated using the p-values, from the Sept. 6, 2019, base inventory, of properties that are within areas with HE&EJ concerns, as defined by the EJScreen supplemental indexes as of Jan. 1, 2023.

In addition to replacements within areas of HE&EJ concerns, Denver Water is also required to send outreach to 95% of customers within these areas. As mentioned in Section 5.B, in 2023, proof of contact with customers enrolled in the LRP is measured based on the mailing of filter reminder postcards. The postcards were mailed in October 2023 and met the required 95% outreach metric for both properties within the Filter Program and properties within areas of HE&EJ concern. Additional outreach to areas of HE&EJ concern is described throughout the HE&EJ section of this report, particularly within the update on Ambassador Program activities.

PART 3: LRP PERFORMANCE USING THE EQUIVALENCY MODEL

Section 7.C of the LCRR Variance requires a "comprehensive evaluation of the LRPP performance using the equivalency model described in the LRPP with updated inputs based on actual LRPP implementation for: 90th percentile lead levels at LSL and copper with lead solder sites after operation of increased pH and alkalinity adjustment as CCT, number of LSL replacements conducted, filter adoption rate, and filter performance in the field." The metric is produced using actual performance data for various elements of the LRP to show the program "as implemented continues to be 'at least as efficient as' orthophosphate treatment in reducing lead exposure on an annual basis."

The equivalency model is a statistical model that compares modeled lead concentrations at each service line in the service area for conditions representing LRPP implementation versus the projected performance of orthophosphate, designated as OCCT. LRP conditions include the use of pH and alkalinity adjustment as CCT, accelerated LSL replacement (in addition to replacements routinely carried out as part of water main projects, emergency repairs and by third parties), pitcher filters for lead reduction prior to LSL replacement, and communications, outreach and education. Conditions for OCCT include the use of orthophosphate and the historical average rate of routine LSL replacements.

The equivalency model includes actual data from:

1) Lead concentrations from LCR compliance samples and customer requested samples at properties with copper plumbing and lead solder and other sites after operation of increased pH adjustment as CCT.
2) Number of LSL replacements conducted.
3) Filter adoption rate.
4) Filter performance in the field.

Integrating Data for Lead Levels into the Equivalency Model

The equivalency model uses actual lead levels measured from customer taps to represent lead levels from i) properties with copper plumbing and lead solder and ii) properties with no other known source of lead (i.e., non-lead in the LSL Inventory). Additionally, the model uses actual lead levels from filter performance sampling in the field to represent the reductions to lead levels at LSL homes that use a filter.

For properties with an LSL (i.e., confirmed LSL in the LSL Inventory), lead levels are represented by data collected from the pipe rack studies.[90] This was necessary because the only data available for orthophosphate treatment applied to LSLs were generated by the pipe rack

[90] See Lead Reduction Program Plan for a description of the pipe rack studies.

studies. This is a conservative approximation of lead release, as the pipe rack studies have been shown to release higher concentrations of lead than observed in the field.

Finally, to model lead levels after LSL replacement, the properties are treated as copper plumbing with lead solder because the premise plumbing may still contain lead.

Integrating the LSL Inventory into the Equivalency Model

The initial LSL Inventory and the inventory from Dec. 31, 2023, are used as an input to the equivalency model to evaluate performance. An overview of the LSL Inventory is provided in Table 15.

Integrating Filter Adoption and Performance into the Equivalency Model

The filter adoption rate is used in the equivalency model by randomly selecting the number of remaining LSLs equal to the adoption rate. For example, in 2023, there were an estimated 62,504 LSLs at the beginning of the year[91], with 6,891 being replaced by the end of the year.[92] The adoption rate of 83% is interpreted as 5,720 are filtered and 1,171 are assumed unfiltered.[93] These service lines are assigned lead concentrations randomly drawn from the observed distribution of lead in filter effluent generated from filter performance testing in the field. This reduces lead concentrations assigned to properties with an LSL and protected via the pitcher filter to concentrations far below the expected levels that would have occurred with only the addition of orthophosphate.

The results of the 2023 filter adoption survey were analyzed to identify sociodemographic factors that may correlate to lower or higher filter adoption. Using the survey results, efforts to target communities with lower adoption rates and address key themes from the survey are identified.[94]

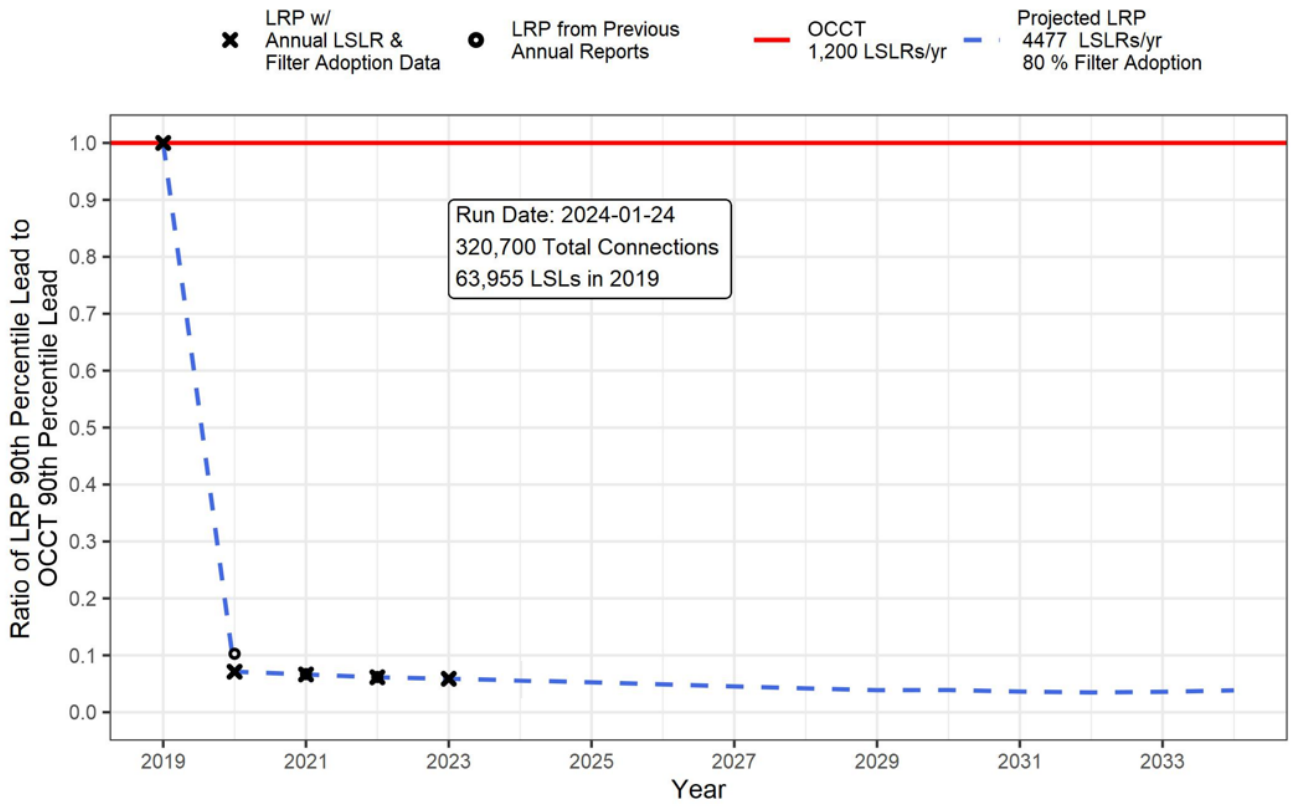
The primary output of the model is an indexed performance of the LRP to the presumed OCCT conditions for each year, as shown in Figure 4. The index is calculated as the 90th percentile lead concentration from the LRP model divided by the 90th percentile lead concentration from the OCCT model. Results less than or equal to 1.0 demonstrate the LRP is “at least as efficient as” OCCT and in compliance with the Order. The points in Figure 4 reflect actual conditions each year (shown as a black X), the lines reflect projected numbers for future years (shown in solid red for the OCCT condition and dashed blue for the LRP condition).

Lead service line replacements for OCCT conditions are based on the historical rate of 1,200 replacements completed annually, which is assumed constant. For the LRP condition, there were 6,891 confirmed LSL replacements in 2023, with future LSL replacements assumed equal to the 7% mandated annual target (7% of 63,955 = 4,477). A filter adoption rate of 80%

[91] See the 2022 Annual Report.
[92] See Table 15.
[93] See Table 32.
[94] See Appendix A-3 Summary of Sociodemographic Indicators from 2022 Formal Filter Adoption Survey in the 2022 Annual Report.

was used for each future year based on the 2020 through 2023 filter adoption rates, and a filter adoption rate of 83% was used for 2023.

FIGURE 4. EQUIVALENCY MODEL OUTPUT FOR 2023



The model outputs of Figure 4 indicate that the LRP approach has resulted in system-wide lead concentrations that are less than 0.10 times the expected OCCT lead concentrations when measured at the 90th percentile. These results indicate that system-wide lead concentrations are lower than they would have been under OCCT conditions. Thus, better performance of the LRPP is demonstrated compared with OCCT for 2023. If the LRP continues to obtain these metrics into the future, the LRP should be more efficient than OCCT for the duration of the program, as shown by the dashed blue line.

The value provided in the past annual reports are shown with the black circles. This value differs from the current prediction because the most current water quality results and LSL replacement data were used. Although the additional LSL replacements were not counted toward the 7% target, they are counted in the model because they were verified to have happened in previous years.

The results of Figure 4 indicate that system-wide lead concentrations are lower than they would have been under OCCT conditions. Thus, Denver Water has again demonstrated better performance of the LRP compared with OCCT for 2023.

PART 4: LEARNING BY DOING

Five of the six elements that together make up the LRP are used to evaluate the overall effectiveness of the program (COE Plan, LSL Inventory, Filter Program, ALSLR Program and CCT). The sixth element is Learning by Doing — presented as a strategy (versus a desired outcome), as quantitative performance metrics were not identified in the Variance.

As part of the Learning by Doing element of the LRP, Denver Water is committed to:

- Evaluating the performance of the LRP to improve outcomes.
- Establishing an Advisory Committee to inform Denver Water on more efficient and effective ways to implement the LRP to achieve the Variance goals.

Methodology

The Learning by Doing element uses data in recurring cycles of collective inquiry and action to achieve improved LRP results. The process used in the Learning by Doing approach involves the following steps:

1) Gather evidence of current results and collaboratively evaluate with stakeholders.
2) Develop strategies and ideas to build on strengths and improve results in challenging areas.
3) Implement the strategies and ideas.
4) Analyze the impact of the changes to discover what was effective and what was not.
5) Apply new knowledge in the next cycle of continuous improvement.

A Learning by Doing Log is maintained to document the performance of the LRP and identify efficient and effective ways to implement the program. The approach requires collection and logging of data followed by review of which aspects of the program are working or need refinement.

External stakeholders are used to apply the Learning by Doing process programmatically via the LRP Stakeholder Advisory Committee.

The outcomes tracked in the Learning by Doing Log and the activities of the Stakeholder Advisory Committee are presented in this document. Preliminary Learning by Doing ideas were presented in the first semi-annual report of 2023. Efforts continue to use the Learning by Doing approach to address challenges and improve the effectiveness of the LRP.

Examples of Learning by Doing

Examples from Learning by Doing are organized by LRP element with examples related to HE&EJ identified separately. Each Learning by Doing example is presented by title, by the type of desired impact, and a description of the issue and opportunity for learning or change. As shown in Table 40, nine examples of Learning by Doing are included in this submission in addition to the examples included in the First Semi-Annual Report for 2023.[95] The nine examples address improvements related to improving the customer experience, protecting public health and/or improving the efficiency of the LRP.

TABLE 40. OVERVIEW OF LEARNING BY DOING EXAMPLES

LRP Element	Number	Description	Desired Impact
Corrosion Control Treatment	LBD-1	Offering pre-LSLR water quality kits for multi-family properties.	Improve customer experience.
LSL Inventory	LBD-2	Investigating galvanized service lines.	Improve program efficiency.
	LBD-3	Working around constraints encountered during investigations to identify service line materials.	Improve program efficiency.
	LBD-4	Using different investigation techniques based on service type and distributor areas.	Improve program efficiency.
ALSLR Program	LBD-5	Conducting contractor performance reviews with the three Federal contractors.	Improve program efficiency.
	LBD-6	Including contractor safety managers and consultants in quarterly safety audits.	Improve program safety.
Filter Program	LBD-7	Providing clarity on the difference between filter pitchers and cartridges.	Improve customer experience.
Communications, Outreach and Education	LBD-8	Encouraging water test kit returns.	Improve customer experience. Improve program efficiency.
Health Equity and Environmental Justice	LBD-9	Leveraging community partners to increase water test kit returns.	Improve customer experience. Improve program efficiency.

Corrosion Control Treatment

LBD-1: Offering Pre-LSLR Water Quality Kits for Multi-Family Properties.

A 3-bottle water quality sampling kit is used at single-family homes to understand the profile of the service line material from the faucet to the water main. The first bottle is meant to represent the home's internal plumbing, whereas the second and third bottles are meant to represent the service line in the yard and street. This technique for understanding the service line's profile does not transfer to multi-family homes, as the internal plumbing is more complex and water most likely travels a farther distance before arriving at a customer's faucet. Additionally, conducting water quality sampling at multi-family properties can be difficult, as it

[95] See First Semi-Annual Report for 2022 submitted on July 8, 2022, and the Annual Report for 2022 submitted on Feb. 10, 2023.

requires a six-hour stagnation period prior to the test to obtain accurate results. Therefore, water quality testing was not historically used as a method to investigate multi-unit properties prior to replacement and instead the program focused on potholing and other forms of investigations. However, Denver Water does receive customer-requested water quality kits from multi-family properties, and to provide these customers with the same resources as customers at single-family homes, the program team decided in 2023 to send 1-bottle sampling kits to these properties. The 1-bottle sampling technique, although not as thorough as the 3-bottle technique, can inform the program team of what the customer's water quality is typically like. Sampling these properties is important for community outreach and the data is used for predictive model training.

LSL Inventory

LBD-2: Investigating Galvanized Service Lines.

At the inception of the Lead Reduction Program, the decision was made to treat galvanized service lines as lead services lines and therefore replace all galvanized service lines encountered. The Lead and Copper Rule Revisions require replacement of all galvanized service lines that are or have ever been downstream of lead. To understand the trends and characteristics of galvanized service lines within Denver Water's service area, rather than halt all investigations once galvanized is found, it was decided in 2023 to continue to investigate the rest of the service line. Although in 2023 Denver Water still replaced all galvanized service lines, regardless of whether it was downstream of lead or not, the program is moving toward understanding more about galvanized service lines so that later in the program, not all galvanized service lines will require replacement.

LBD-3: Working Around Constraints Encountered During Investigations to Identify Service Line Materials.

Denver Water has tens of thousands of service lines with unknown materials in the lead service line inventory and therefore prioritizes conducting investigations to change properties' material designations from unknown to known. Some investigations efforts, such as desktop reviews, do not require a field crew to be present at the property. Other investigations, however, must be in-person and heavily rely on customer participation. Denver Water is constantly working toward ensuring successful investigations and identifying service line materials. When locating the service line during potholing, there can be "missed locates" or "no finds" that delay the contractor. Because of this, field crews have increased communications with Denver Water and have established monthly meetings with the Locates Department, as well as assigned three dedicated "locators" to the contractors. For interior inspections, since service lines tend to come into buildings through the basement and occasionally crawl spaces, the contractors inform the customer of the need to access this area and ask the customer to prepare for their visit by removing any obstructions. This reduces the amount of time a contractor requires at a customer's home, resulting in improved program efficiency, improved customer experience, and higher success rates with interior inspections. For water quality sampling, Denver Water has

catered its educational materials based on customer feedback, has short instructional videos on the website, and has translated the educational materials into multiple languages. These efforts are crucial in allowing all customers to have equal access to participate fully in the program and help the LRP team identify their service line material. When situations arise where Denver Water cannot identify a service line's material through a specific investigation technique, the team utilizes the other four techniques to arrive at a known material.

LBD-4: Using Different Investigation Techniques Based on Service Type and Distributor Areas.

The investigation techniques for different regions of Denver Water's service area evolved in response to records being integrated into the lead service line inventory and as the predictive model began predictions in the surrounding distributor areas. The first effort was to perform desktop reviews and capture information from the various distributors that included records for known service line materials and additional information to incorporate into the lead service line inventory and predictive model. This data included information such as install date, size, or construction date of the property. Once available information from distributor records or investigations were organized, the information was incorporated into the predictive model training database for model training and validation. The results were interpreted to identify the confidence of historic records, and to look at spatial relationship patterns of the training data compared to expected predictions. The results of this analysis were organized to evaluate opportunities within each distributor contract boundary and understand the extent of investigation opportunities. The first phase of investigations included water quality sampling and expanded to include potholing as the understanding of unknown service lines was further refined using the predictive model. The second phase of the investigation effort involved evaluation each distribution areas into three investigation scenarios:

1. The first scenario consisted of predictions that did not infer confident predictions to service line material compared to the baseline data or sub-optimal performance metrics. These areas were identified for spatially balanced randomized water quality to capture additional data for uniform non-lead sampling or lead sampling results. The lead data was incorporated into the model to develop more precise predictions.

2. The second scenario consisted of total service or master meter districts that did not have enough validation data to confirm model predictions to support a multi-source analysis of non-lead service lines. In this instance, properties were selected through spatially balanced randomized water quality or pothole approach to validate non-lead sampling.

3. The third scenario included deviations between initial training and service lines where more granular investigation results were needed based on original data or from the first phase of water quality sampling conducted between 2020 through 2022. Master meter or total service distributor boundaries included were identified to coordinate investigations techniques to identify investigation options including water quality sampling and pothole

investigations to further refine unknowns based on initial water quality screening and initial model predictions.

ALSLR Program

LBD-5: Conducting Contractor Performance Reviews with the Three Federal Contractors.

With federal funding, additional contractors and their field crews were brought into the program. To allow for a smooth transition, face-to-face meetings began in 2023 with the three federal contractors and the Program Lead, Construction Manager, and Deputy Construction Manager. The meeting focused on the contractors' performances and potential ways to improve methods of work and to remedy any issues encountered. This effort further establishes trust and a willingness to improve efforts on both sides.

LBD-6: Including Contractor Safety Managers and Consultants in Quarterly Safety Audits.

Prior to 2023, quarterly safety audits only included the field crews. This observation was made by the Deputy Construction Manager and brought to the attention of the safety managers, the construction manager, the field staff, and the four ALSLR/FFSLP contractor project managers. Since the Contractor's Master Contract states all contractor's crews shall be observed during the quarterly field audit, the consensus was that the contractor safety managers and consultants should attend moving forward. During the audit, the ALSLR safety team was able to get a better understanding of where the different contractors were with the involvement from their safety managers or consultants in real time. The ALSLR safety team will encourage the contractor safety managers or consultants to provide additional support and input to help the contractor's weakest crews improve their safety performance, meet the ALSLR safety goals, and their company safety goals.

Filter Program

LBD-7: Providing clarity on the difference between filter pitchers and cartridges.

The filter survey within MMFIT includes a question for the customers on if they received "filters". This led to confusion both on the customer side and the data processing side on what is defined as a filter. To avoid confusion and ensure the customer is provided with the filter component they require, the question was split into two, with one asking the customer if they received a pitcher kit and one asking the customer if they received a replacement cartridge.

Communications, Outreach and Education

LBD-8: Encouraging Water Test Kit Returns.

To encourage customers to return water quality samples for analysis, an incentive was put in place in 2022 wherein customers would be entered into a quarterly random drawing to win a gift card if they completed a water test kit. Information promoting the opportunity was placed on the sticker on the outside of the water test kit box and on the materials inside the kit. After a year

and a half of putting the incentive in place, analysis of return rates showed little difference between return rates with the incentive and without the incentive. Therefore, the incentive will be removed in 2024 as the team continues to explore other methods of increasing return rates.

Health Equity and Environmental Justice

LBD-9: Leveraging Community Partners to Increase Water Test Kit Returns.

Community partners have been successfully used to increase consent form return rates across multiple neighborhoods in the LRP. Given this success, Denver Water identified the opportunity to test community partner impact on increasing water test kit return rates, with a focus on disproportionately impacted communities. Denver Water trained community partner CREA Results on water testing for customers. CREA then canvassed homes in the Harvey Park, Harvey Park South, Ruby Hill, Virginia Village, and West Highland neighborhoods to encourage customers to return water samples and answer questions. Out of the 82 homes canvassed, CREA successfully had interactions with 57 properties to encourage them to return their water test kits. Many of them needed a reminder and some needed help with the instructions. This work will continue in 2024.

Stakeholder Advisory Committee

The LRP Stakeholder Advisory Committee was launched in 2020 to serve as a sounding board and critical conduit of information between the broader community and the LRP. The committee is composed of members from health care organizations, government agencies, civic groups and utility partners who assist in sharing information with their communities and also provide key insights into external communications and engagement strategies to support the success of the LRP.

A list of 2023 committee members was included in the First Semi-Annual Report for 2023. The Stakeholder Advisory Committee was convened quarterly in 2023. An outline of meeting dates, primary topics and outcomes is shown in Table 41.

TABLE 41. SUMMARY OF 2023 STAKEHOLDER ADVISORY COMMITTEE MEETING TOPICS

Meeting Date	Primary Topics	Outcomes and LRP Modifications
Feb. 23, 2023	• Overview of LRP progress in 2022. • Update on LRP progress in 2023. • Recap of the White House Summit on Lead Pipe Replacement. • Committee member updates on lead testing in schools and Lead and Copper Rule Revisions and inventory updates.	In addition to hearing from Denver Water about LRP progress, committee members were able to hear from each other about work their organizations are doing related to lead and public health. Committee members also expressed interest in a lead service line replacement site visit, which was subsequently planned for later in the year.
June 1, 2023	• Update on LRP progress since start of 2023.	Committee members asked questions about filter program outreach and education for commercial entities. During the meeting, members responded to a

Meeting Date	Primary Topics	Outcomes and LRP Modifications
	• Overview of new HE&EJ metric in the new Variance and on the program dashboard. • Committee member update on Lead and Copper Rule Revisions. • Preview of lead service line replacement site visit. • Topics of interest survey.	short survey asking for feedback on topics of interest for upcoming meetings. Members expressed interest in Denver Water's investigation process and in meeting community partners.
July 26, 2023	• Lead service line replacement site visit. • Opportunity to meet and engage with community partner leaders.	Committee members noted seeing a service line replacement firsthand increased their knowledge and understanding of the process, further empowering them to effectively communicate about the LRP with their networks. Similarly, they noted that the opportunity to engage directly with community partner representatives deepened their understanding and appreciation for outreach work done on the program.
Oct. 12, 2023	• Tour of Denver Water's water quality lab, including dinner. • Update on LRP progress since start of 2023. • Overview of 2023 filter adoption survey preliminary results. • Overview of the evolution of the predictive model. • Preview of 2024 activities.	Committee members asked questions about filter adoption survey insights and Denver Water's inventory development which will help to prepare for communications about these program items.

In 2024, the goal for the Stakeholder Advisory Committee is to meet again quarterly for a total of four meetings with at least one meeting held in-person. The makeup of the committee is expected to remain the same, with the potential addition of new organizations as appropriate.

DEVIATIONS AND CLARIFICATIONS

Under paragraph 7.C of the Variance, Denver Water is required to "document any deviations from the LRPP during the most recent Program year." During the 2023 Program Year, input was sought from EPA on clarifications and, in certain instances, permission to deviate from the Order to address the administration of the LRP, as summarized below.

Deviations

- There were no deviations from the Variance in the 2023 Program Year.

Clarifications

- On June 13, 2023, Denver Water sought clarification on what counts toward the 1.4% investigation metric required by the Variance. The following was clarified and approved:

    1. Denver Water will count the use of the predictive model outputs as desktop investigations.
    2. If Denver Water includes pothole/WQ investigations in the first semi-annual report and later replaces said LSL even though it wasn't planned, that investigation still counts and will not be removed from the investigation metric total.
    3. Denver Water considers four types of investigations that can be performed on service lines:
        - Potholing,
        - Desktop review,
        - Interior inspection, and
        - Water quality.
    4. Investigations of "unknown" service line material include any reviews of service lines with p-values between 0.01-0.99.
    5. A property with a p-value between 0.01-0.99 that is scheduled for replacement in the same program year but does not result in a replacement because it is shown to be a copper service line will be counted as an investigation.

- Rather than submit a redlined version of the 2019 Lead Reduction Program Plan, Denver Water developed a LRPP Technical Amendment to highlight the changes. The LRPP Technical Amendment was originally submitted to CDPHE and EPA on May 5, 2023, with a second draft submitted on June 9, 2023, and a final, approved version on July 17, 2023.[96]

- The LCRR requires a lead service line inventory to be submitted by Oct. 16, 2024, and all service lines without an identified material are to be categorized as "unknown" and may count toward the required annual replacement rate. Although the LRP operates under a Variance, to reduce the risk of unknowns, Denver Water is working toward identifying the materials of the unknowns as much as possible before Oct. 16, 2024. Denver Water plans to submit a draft LCRR lead service line inventory in the spring of 2024, and a final LCRR lead service line inventory alongside the first semi-annual report of 2024.

[96] See the LRPP Technical Amendment posted on Denver Water's website for more information.