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Economic Analysis Appendices for the Final Lead and Copper Rule Improvements

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List of Exhibits

List of Acronyms

µg/dL	Micrograms per deciliter
µg/L	Micrograms per liter
ABLES	Adult Blood Lead Epidemiology and Surveillance
ADHD	Attention-deficit/hyperactivity disorder
AL	Action level
ALAD	Delta-aminolevulinic acid dehydratase
ALE	Action level exceedance
ALS	Amyotrophic lateral sclerosis
ASCE	American Society of Civil Engineers
ASDWA	Association of State Drinking Water Administrators
ATSDR	Agency for Toxic Substances and Disease Registry
AWWA	American Water Works Association
BIL	Bipartisan Infrastructure Law
BLS	Bureau of Labor Statistics
CCR	Consumer Confidence Reports
CCT	Corrosion control treatment
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CHD	Coronary heart disease
CoSTS	Costs of State Transactions Study
CVD	Cardiovascular disease
CWS	Community Water System
CWSS	Community Water System Survey
DF	Design flow
DHHS	United States Department of Health and Human Services
DSM	Diagnostic and Statistical Manual of Mental Disorders
DSSA	Distribution System and Site Assessments
DTH	Delayed-type hypersensitivity
DWINSA	Drinking Water Infrastructure Needs Survey and Assessment
DWSRF	Drinking Water State Revolving Fund
EA	Economic analysis
EKG	Electrocardiogram
ENR	Engineering News Record
EP	Entry point
EPA	United States Environmental Protection Agency
FRN	Federal register notice
FSIQ	Full Scale Intelligence Quotient
GCI	General Cognitive Index
GFR	Glomerular filtration rate
GRR	Galvanized requiring replacement
HH	Household
HRRCA	Health Risk Reduction and Cost Analysis
IARC	International Agency for Research on Cancer
ICC	Indian Childhood Cirrhosis
ICR	Information Collection Request
ICT	Idiopathic Copper Toxicosis

IQ	Intelligence quotient
ISA	Integrated Science Assessment for Lead
LCR	Lead and Copper Rule
LCRI	Lead and Copper Rule Improvements
LCRR	Lead and Copper Rule Revisions
LSL	Lead service line
LSLR	Lead service line replacement
MCLG	Maximum contaminant level goal
MDI	Mental Development Index
mg/L	Milligrams per liter
MMSE	Mini-Mental State Examination
MRL	Minimal Risk Level
NHANES	National Health and Nutrition Examination Survey
NLSY	National Longitudinal Survey for the year
NOAEL	No observed adverse effect level
NTNCWS	Non-transient non-community water system
NTP	National Toxicology Program
OCCT	Optimal corrosion control treatment
OMB	Office of Management and Budget
OWQP	Optimal water quality parameter
P90	Lead 90th percentile level
PE	Public education
POU	Point-of-Use
PWS	Public Water System
QA	Quality Assurance
SBAR	Small Business Advocacy Review
SDWA	Safe Drinking Water Act
SDWIS/Fed	Safe Drinking Water Information System/Federal version
SHEDS	Stochastic Human Exposure and Dose Simulation
SL	Service line
SLR	Service line replacement
TL	Trigger Level
TLE	Trigger level exceedance
UK	United Kingdom
USEPA	United States Environmental Protection Agency
USPS	United States Postal Service
WIFIA	Water Infrastructure Finance and Innovation Act
WIIN	Water Infrastructure Improvements for the Nation
WISC	Wechsler Intelligence Scale for Children
WQP	Water quality parameter

Appendix A: Service Line Replacement Unit Costs

A.1 Introduction

Appendix A presents estimated costs for replacing lead service lines (LSLs) and galvanized requiring replacement (GRR) service lines under the final Lead and Copper Rule Improvements (LCRI). Note that this appendix provides costs for physical replacements of LSLs and GRR service lines. Costs for additional water system activities related to service line replacement are discussed in Chapter 4, Section 4.3.4.

For the proposed LCRI, the Environmental Protection Agency (EPA) used the 7th Drinking Water Infrastructure Needs Survey and Assessment (DWINSA) as the source of lead service line replacement (LSLR) unit costs and included a review of other data sources in this appendix. In the comments to the proposed LCRI, the EPA received new compiled cost data submitted by National Resource Defense Council (NRDC) as part of their public comments. The EPA did not use these cost data to update LSLR unit costs, as discussed in A.3.2, but did add this information to this appendix. This appendix also includes an updated analysis of CDM Smith LSLR unit cost data that was provided by the American Water Works Association (AWWA) prior to the proposed LCRI and referenced in their comments on the proposed rule.

Section A.2 begins with a discussion of the data sources for service line replacement selected for this economic analysis (EA) and the derivation of the EPA's unit cost estimates for service line replacement. For the final LCRI, the EPA modeled costs using the reported costs of LSLRs submitted and accepted for the 7th DWINSA. The EPA selected the 7th DWINSA as the primary source of data for unit cost estimates because the source provided detailed project-level data that met the DWINSA data quality criteria. The dataset also contained responses from small, medium, and large systems and from urban and rural systems. The EPA adjusted the reported costs to account for regional differences in prices to produce a national average. Each service line replacement cost estimate, from a given system replacement project, is weighted by the DWINSA survey sample weights, which reflect the probability that each system is included in the sample. Each project was also weighted by the number of service lines included in the project to capture the relative importance of the project cost estimate in comparison with the total dataset. The weighted values were then used to estimate descriptive statistics for the cost of service line replacement per line. Overall, the 7th DWINSA provided the most complete picture of the range of possible service line replacement costs in the nation for the final LCRI.

Section A.3 provides a discussion of other data sources and how they compare to the 7th DWINSA results. References are listed in Section A.4.

A.2 DWINSA Lead Service Line Replacement Unit Costs

Every four years, the EPA works with States and community water systems (CWSs) to conduct the DWINSA to estimate the Drinking Water State Revolving Fund (DWSRF)-eligible needs of systems by State. The assessment of need is for the next 20 years from the time of the survey. This assessment is the basis for allocating DWSRF grant monies to States, and the EPA presents the results in a report to Congress (USEPA, 2023). The EPA has been working closely with water systems and States for over 25 years to conduct the DWINSA, and the survey and its methodology are widely accepted and often cited in various literature and studies. The DWINSA collects actual project and asset data from a stratified

random statistical sample of water systems, which minimizes bias and uncertainty in the survey and results. A description of the DWINSA's survey methodology can be found in Chapter 3, Section 3.2.5[1].

For the final LCRI, the EPA reviewed the reported costs of submitted and accepted LSLR projects from the 7th DWINSA that contain documentation that could be used to estimate the national cost of replacing service lines[2]. The EPA also reviewed other non-lead service line replacement projects, such as copper and plastic service lines, alongside LSLR projects. In past assessments, the DWINSA estimated that the costs of replacing non-lead and LSLs were similar. After review of the current data, the EPA decided to exclude non-lead service line replacement unit costs for purposes of the final LCRI because they contained several very low costs and the EPA was unable to verify the reasons for the low reported values.

For a project to be accepted by the DWINSA, water systems must provide information that supports that they are committed to completing the project and that the project is both feasible and necessary. All LSLR projects that were submitted under the 7th DWINSA were deemed feasible and necessary, and the EPA assumes that systems are committed to them. To be further considered for use in the cost model for the final LCRI, accepted service line projects must include independent documentation of the project cost (*e.g.*, costs documented through a Capital Improvement Plan or master plan), the month and year of the cost estimate, and the number of service lines to be replaced, so that the EPA could calculate the average cost per line.

Under the 7th DWINSA, systems provided information on 275 LSLR projects. Of these, 50 projects provided sufficient documentation with information on both the number of service lines and their replacement costs. The EPA excluded six additional projects because either (1) their cost was less than $700 per line and the documentation did not include any explanation for the low values or (2) they included activities other than service line replacement (*e.g.*, water main replacement or service line inventory development) that could not be separated from the costs for the service line replacement activities. Additionally, the EPA combined five Pittsburgh projects into one because each project stemmed from the same primary project.

The EPA reviewed the project documentation to determine whether the project was a "full" or "partial" service line replacement.[3] In seven cases, the documentation did not provide enough information to

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[1] As described in Section 3.2.5, the EPA initiated a one-time effort to update the service line data from the 7th DWINSA. This update allowed previously surveyed water systems and States to revise their original response based on new service line inventory information or to provide responses if they had not participated earlier. This update did not impact the SLR project data nor did it change the original sample weights used in this analysis of lead service line replacement costs.

[2] Acceptable forms of documentation for cost estimates include capital improvement plans, master plans, preliminary engineering reports, facility plans, bid tabulations, and engineer's estimates. For each project with an associated cost, the EPA needed the month and year of the cost estimate in order to allow an adjustment of the cost to January 2020 dollars for this final LCRI EA.

[3] For purposes of this analysis, "full" replacement means the system is replacing the service line from the main to the building. "Partial" replacement means the system is only replacing the service line from the main to the curb stop or meter, or the meter or curb stop to the building.

determine the extent of replacement, and the EPA classified the projects as "unknown." The EPA did not differentiate between utility-side or customer-side for partial replacement because many of the projects did not specify if the service line was on private or public property. As such, the costs of utility-side and customer-side replacement are assumed to be the same. The EPA also did not differentiate between "planned" [4] and "unplanned" projects for purposes of this analysis because the projects reviewed were presented under a variety of different scenarios and it was unclear if costs under the varied project scenarios were different.

The final dataset for the LCRI analysis included 33 LSLR projects across 31 water systems; in 13 States; across EPA Regions 1, 2, 3, 5, 7, and 8; and representing States in the Northeast, the Midwest, and the West. These systems served populations ranging from 3,000 to over 2,000,000 people. Detailed information from these projects is provided in the worksheet titled "DWINSA Project Data" in the file "LSLR Unit Cost_Final.xlsx." The file is available in the LCRI docket EPA-HQ-OW-2022-0801 at www.regulations.gov. The EPA converted all costs from 2021 to 2020 dollars using the Construction Cost Index produced by Engineering News Record (ENR), which measures changes in construction costs over time. The EPA then adjusted the data for regional differences to ensure costs were reflecting a national estimate using the regional construction cost index produced by RSMeans[5]. The EPA weighted the resulting summary statistics by the number of service lines and the final DWINSA system-sampling weight.[6,7] See Chapter 3, Section 3.2.5 for more information on the DWINSA system sampling weights.

Exhibit A-1 provides summary statistics for full and partial LSLR unit costs based on utility estimates, using data from the 33 LSLR DWINSA projects. Detailed information on the costs of LSLR and non-lead service line replacement projects combined are provided in the worksheet titled "DWINSA Data Analysis" in the file "LSLR Unit Cost_Final.xlsx," available in docket number EPA-HQ-OW-2022-0801 at www.regulations.gov.

[4] For purposes of this analysis, "planned" replacement means the system is replacing service lines at the same time that it replaces a distribution main.

[5] RSMeans produces a unit price guide for building construction estimators across North America. The index of regional costs is applied to the individual project cost estimates using the zip code of the system adjusting project costs for regional differences.

[6] DWINSA's system sampling weight ensures that small and medium system costs are represented in a national average. Large systems serving over 100,000 people receive a sample weight of one because the 7th DWINSA surveyed all large systems serving over 100,000 people. Therefore, each large system only represents itself in the population. Small systems serving 3,300 or fewer and medium systems serving 3,301-100,000 people receive a sample weight that is the inverse of the selection probabilities. These weights are greater than one and are a measure of the number of systems that each surveyed small or medium system represents. The final sampling weights are adjusted to account for non-response.

[7] To generate percentiles weighted by the number of service lines and the system sampling weight, the EPA first converted the dataset from the project level to the service line level, creating a dataset that has a single record for each service line replaced. Each record contained the cost per line, the type of line replaced, the sampling weight, and whether the replacement is full or partial. The EPA then calculated the weighted mean and percentiles by applying the system sampling weights.

Exhibit A-1: Summary of LSLR Costs Using Data from the 7th DWINSA ($/SLR, 2020$)[1,2]

Statistic	SLR Unit Costs	
	Full	Partial
Number of Cost Estimates	23	10
Min	$1,180	$1,677
25th percentile value (used for economic analysis, low scenario)	**$6,507**	**$1,920**
Median	$7,232	$3,273
Mean	$6,930	$3,803
75th percentile value (used for economic analysis, high scenario)	**$8,519**	**$5,400**
Max	$14,966	$8,099

Acronyms: SLR = service line replacement.
Source: "LSLR Unit Cost_Final.xlsx," worksheet "DWINSA Data Analysis", available at EPA-HQ-OW-2022-0801 at www.regulations.gov.
Notes:
1. 25th and 75th percentile values shown in bold are used in the final LCRI EA as a low and high estimate.
2. Estimated LSLR unit costs shown in this exhibit are slightly different than the range of LSLR costs reported in Section 2.4 of the *Drinking Water Infrastructure Needs Survey and Assessment: Seventh Report to Congress (USEPA, 2023) (DWINSA Report)* for several reasons. First, costs shown here are in 2020 dollars, whereas the 7th DWINSA Report presents LSLR costs in 2021 dollars. The DWINSA Report also combines partial and full replacement projects, as well as non-lead and LSL replacement projects. The analysis for the final LCRI EA considered only LSL projects where it could be determined with confidence that costs applied to either full or partial replacement. In addition, the analysis for the DWINSA Report did not exclude LSLR projects with ancillary activities such as conducting outreach and preparing an inventory. For the purposes of this EA, the EPA excluded projects with ancillary activities since these activities are costed separately. See the file "LSLR Unit Cost_Final.xlsx," worksheet "DWINSA Data Analysis", available at EPA-HQ-OW-2022-0801 at www.regulations.gov for a full list of projects excluded for this analysis.

For the estimates in this analysis, the EPA used the 25th and 75th percentile for full and partial replacement as the "low" and "high" values for the final LCRI cost analysis. The low and high cost estimates for full replacement are $6,507 and $8,519, and the low and high cost estimates for partial replacement are $1,920 and $5,400. The EPA used the same costs for replacement of lead and GRR service lines. See Chapter 4, Section 4.3.4.3 for a summary of how the cost data are used in the SafeWater LCR model to estimate costs for the final LCRI.

A.3 Additional Service Line Replacement Cost Data

This section provides a discussion of additional data sources and how they compare to the LSLR unit cost estimates derived from the 7th DWINSA. Section A.3.1 provides analyses of LSLR unit cost data provided in a 2022 report by CDM Smith (CDM Smith, 2022), referenced by AWWA in their comments on the proposed LCRI (available in the LCRI docket EPA-HQ-OW-2022-0801 at www.regulations.gov). This section discusses limitations in the CDM Smith dataset and provides the reasons why the EPA did not use this dataset to model national costs.

Section A.3.2 summarizes additional data presented in a 2024 Safe Water Engineering (SWE) report on *LSLR Costs and Strategies for Reducing Them* (Betanzo and Spieght, 2024), which was provided as an attachment to the NRDC's comments on the proposed LCRI (available in the LCRI Docket EPA-HQ-2022-

0801 at www. regulations.gov). The purpose of the SWE report was to "…assist with evaluation of LSLR costs, for the purposes of developing Safe Drinking Water Act regulations and implementing local LSLR programs." The authors present two new cost estimates: 1) results of a literature review to understand current and reasonable cost ranges for LSLR unit costs, and 2) an independent construction cost estimate using RS Means Online Construction Cost Database, Year 2024 edition (www.rsmeans.com) to identify major cost drivers. The report also analyzes the CDM Smith Report (CDM Smith, 2022) and the EPA's estimates based on the 7th DWINSA and compares them to the two new cost estimates. Section A.3.2 summarizes of the authors' findings related to cost estimates for the final LCRI.

The EPA received additional SLR cost data in responses to the proposed LCRI. For example, the New England Interstate Water Pollution Control Commission provided data that the State of New York had found that SLR costs ranged from $5,000-10,000 per line; Aurora Water in Aurora, CO, reported paying $11,500 for full replacement; and the Philadelphia Water Department reported they pay $12,000 to $15,000 per SLR. For these complete comments, see the LCRI Docket EPA-HQ-2022-0801 at www. regulations.gov. The EPA considered these new costs and found them to be in the range of costs reported in the 7th DWINSA, the CDM Report, and the SWE Report datasets.

A.3.1 CDM Smith Report and Related AWWA Comments

This section compares the EPA's service line replacement cost estimate in Exhibit A-1 to the 2022 CDM Smith report on *Considerations when Costing Lead Service Line Identification and Replacement* (CDM Smith, 2022). To estimate LSLR unit costs, CDM Smith conducted a phone interview with nine utilities across five States in EPA Regions 2, 3, and 5 that either have previously or are currently conducting LSLRs. The population served among these nine utilities varied from 10,000 to almost 6,000,000 people. The study also conducted an expanded literature review to determine additional average LSLR costs; however, the report did not indicate from which States these projects stemmed.

The initial dataset included 45 projects, with 31 projects obtained through the phone survey and 14 projects obtained through the literature review. The report dropped one full project due to "limited scope" as well as six projects from the Massachusetts Water Resources Authority that were labeled as both utility-side and private-side replacement. For estimates provided as a range, the study used the midpoint. The final dataset included 38 projects, where 31 projects were obtained through the phone survey of nine systems and seven projects obtained through the literature review of six studies. The CDM study converted all projects to 2022 dollars using ENR's Construction Cost Index. In cases where the month of the reported cost was not known, the study averaged the indices across the reported year for the cost estimate.

Exhibit A-2 provides summary statistics for full, utility-side, and customer-side LSLR construction unit costs. The EPA adjusted this dataset to 2020 dollars and compared the results against the weighted EPA estimates calculated using 7th DWINSA data as presented in Exhibit A-1. Results for full LSLR show that the mean value from the CDM Smith dataset is higher at $8,717 compared to the EPA's weighted mean of $6,930. The median of the CDM Smith dataset is $8,045 and the EPA's estimate is $7,232. the CDM Smith 25th and 75th percentile estimates for full replacement are $6,837 and $9,246, respectively. The EPA's weighted estimates are $6,507 and $8,519, respectively. The CDM Smith estimates for customer-side replacement are between $3,572 (25th) and $4,905 (75th). The 25th percentile for partial replacement is higher than the EPA's estimate of $1,920 but the 75th percentile is lower than the EPA's

estimate of $5,400. The estimates for utility-side replacement are between $4,613 and $6,997. Both percentiles are higher than the EPA's estimate of $1,920 and $5,400, respectively.

Exhibit A-2: Summary of LSLR Costs from CDM Smith Report ($/LSLR, 2020$)

Statistic	LSLR Unit Costs		
	Full	Customer-Side	Utility-Side
Number of Cost Estimates	**18**	**8**	**12**
Min	$5,634	$2,512	$3,658
25th percentile value	**$6,837**	**$3,572**	**$4,613**
Median	$8,045	$4,155	$5,295
Mean	$8,717	$4,399	$6,300
75th percentile value	**$9,246**	**$4,905**	**$6,997**
Max	$19,835	$6,612	$15,427

Acronyms: LSLR = lead service line replacement.
Source: *Considerations when Costing Lead Service Line Identification and Replacement*, pp. 45-47, available at EPA-HQ-OW-2022-0801 at www.regulations.gov.
Note: The EPA converted all costs to 2020 dollars using ENR's Construction Cost Index. The EPA also calculated the 25th percentile, median, and 75th percentile. For estimates provided as a range, the EPA used the midpoint.

These summary statistics from the CDM Smith report only include "construction costs"[8] associated with LSLR. The report further estimates that, with auxiliary costs[9] factored in, the average full LSLR unit cost is approximately $11,019 in 2020 dollars, with a range falling between $6,700 and $33,322. The report did not provide the average LSLR unit cost with auxiliary costs factored in for customer-side or utility-side replacements. The EPA did not utilize the CDM Smith auxiliary cost data due to potential issues with double counting because some auxiliary costs are already accounted for elsewhere in the EPA estimated rule costs for the final LCRI. The agency estimates separate auxiliary costs for SLR-related activities that are specifically required by the LCRI:

- service line replacement plan development and updates,
- developing and updating the inventory,
- notifications to customers and all persons served by the water system at the service connection served by lead, GRR, and unknown service lines,

[8] For purposes of this study, "Construction costs" refer to costs associated with the actual physical replacement of the service line that would typically be included in a contractor's bid, including mobilization, excavation, pipe installation, backfill, some restoration, or traffic control.

[9] "Auxiliary costs" in this study refer to planning, design, bidding, data management, permitting, engineering services, utility labor, construction management, customer outreach, filters, follow-up sampling and any costs or labor associated with the replacements that is not included in the contractor's bid.

- contacting customers, working to schedule SLRs, and doing site visits prior to replacements,
- providing filters and replacement cartridges following replacement, and
- taking a follow-up tap sample and notifying customers of results.

Other auxiliary costs discussed in the CDM Smith report are included in the 7th DWINSA estimated replacement costs used by the agency, presented in Exhibit A-1.The 7th DWINSA costs represent estimates used by utilities for planning and budgeting purposes and are understood to be comprehensive and include the necessary permitting, engineering, design, and bidding costs. The 7th DWINSA Report to Congress (USEPA, 2023) states “Cost estimates reflect comprehensive infrastructure costs like engineering and design, purchase of raw materials and equipment, and construction labor.”

There are several possible reasons why the CDM Smith report’s findings are generally higher than weighted results calculated from the 7th DWINSA data. First, the CDM Smith data were derived from fewer systems and regions, with 31 projects from nine systems in five States and three regions, as well as 14 projects from five American studies and one Canadian study via literature review. The 7th DWINSA data derived their 33 projects from 31 systems in 13 States and six regions comprising more than 166,000 LSLRs, which include the States and regions observed in the CDM Smith phone survey. Therefore, the DWINSA data represent a wider geographic range of responses and potential project costs, whereas the CDM Smith estimates are largely the result of oversampling nine utilities.

Additionally, the survey data collected from the CDM Smith study were only from systems that served populations over 10,000 and, therefore, may not be factoring in LSLR unit costs for smaller systems. The utilities surveyed by CDM Smith may represent more dense, urban areas that have higher costs for traffic coordination and pavement removal or replacement compared to more rural areas. The 7th DWINSA captured systems serving populations ranging from 3,000 to 2,000,000. In their comments on the proposed rule, AWWA noted that using only data from systems serving more than 10,000 people is appropriate since the majority of lead content service lines are in CWSs serving more than 10,000 people. The EPA agrees that based on the results of the 7th DWINSA, a higher percentage of the lead content service lines are in systems serving more than 10,000 people[10]. The EPA’s average cost per LSLR is weighted in the 7th DWINSA dataset by the number of service lines to be replaced. Nearly all of the more than 138,000 individual full or partial replacements in the 7th DWINSA LSLR dataset are in systems serving more than 10,000 people (see the derivation file, “LSLR Unit Costs_Final.xlsx,” worksheet “Large vs. Small Compare", available at EPA-HQ-OW-2022-0801 at www.regulations.gov). When the data are weighted by the system sampling weight (*i.e.*, when each replacement is then multiplied by the system sample weight), the percentage of replacements in systems serving more than 10,000 people continues to be very high at 97 percent. The EPA’s 7th DWINSA cost dataset is therefore heavily weighted toward large system replacement cost values with 97 percent of the dataset’s replacement costs coming from systems serving more than 10,000 people, compared to 88 percent of potential lead content service

[10] Based on the service line data reported in Chapter 3, Exhibit 3-18, a total of 8,592,603 projected lead content service lines (*i.e*., reported lead content service lines and unknowns predicted to be lead) are in systems serving more than 10,000 people, compared to an estimated 9,791,351 total projected lead content service lines for all system sizes (88 percent).

lines. However, unlike the CDM Smith data, the agency's dataset includes 3 percent of replacement cost estimates from small systems. The EPA dataset over-weights large system cost estimates compared to small system estimates when considering the number of potential replacements occurring in the two system size categories; however, the EPA dataset is more representative of the potential national distribution of large versus small system service line replacement costs than the CDM Smith data.

A third factor that may account for differing costs is that CDM Smith used both a survey and a literature review to generate their estimates, and the identified literature cases may represent larger, more expensive projects.

Finally, the CDM Smith report did not use a weighted average, and as a result a high-cost project for either a low or an unknown quantity of LSLRs has equal weight to a low-cost project that was averaged over several replacements. Conversely, the 7th DWINSA is weighted by the number of service lines replaced per project, and also applies a system sampling weight to ensure that small- and medium-system costs are represented in a national value. In addition, it does not appear that the CDM Smith report regionally indexed estimates to reflect a national cost, whereas the 7th DWINSA estimates calculated under this analysis are adjusted to reflect both inflation and regional construction cost differences among States.

Since CDM Smith's report does not describe the survey sample criteria used in its phone survey, the EPA is unable to comment on the survey's selection process and understand how the final data points were selected. The EPA is also unable to contextualize the cost data or compare them to other LSLR programs because the data provided do not show the population served, and some projects do not include a number of service lines (likely stemming from the combined data pool with some values coming from a literature review). By comparison, the 7th DWINSA data are from a survey of a statistical sample of public water systems that the EPA has been conducting in close cooperation with water systems and States for over 25 years. Its methodology has been peer reviewed and is widely accepted and often cited in literature. The DWINSA collects projects from a representative stratified random sample of water systems, which is designed to produce unbiased and precise estimates of infrastructure need and the number of LSLs in the United States. Rigorous water system project documentation is required to demonstrate that a project is necessary, feasible, and has commitment. The EPA recognizes that systems often did not provide cost data that met the documentation requirements for inclusion in the 7th DWINSA LSLR cost dataset, so only a subset of surveyed systems are represented in the final LSLR dataset. The EPA has no information that indicates that the lack of cost data/documentation in some survey responses is systematically related to estimated LSLR project costs. Therefore, although the total number of LSLR projects in the 7th DWINSA LSLR cost dataset is relatively small compared with the number of responses for the larger 7th DWINSA, the data are representative of LSLR costs. (USEPA, 2023).

To further compare the two datasets, the EPA conducted a difference-in-mean test between the DWINSA and CDM samples, assuming unequal variances. Because the CDM Smith dataset does not provide sample weights and it is not possible to weight their results by number of replacements, the EPA removed all weights from the 7th DWINSA dataset to treat the samples consistently. With weights removed, the mean full LSLR cost for DWINSA was calculated to be $7,419, compared to a mean full LSLR cost of $8,717 for the CDM Smith data. To formally test the difference in the mean values, the EPA conducted a two-sample t-test with unequal variances. The test statistic is a t statistic with 36 degrees of

freedom. The difference in the means is not statistically significant at the five percent level. For more details of this analysis see The Cadmus Group, Inc. (2024).

In a simplified analysis to determine the potential impact to total annual incremental cost and net benefits if the EPA were to use the CDM Smith unit cost estimates. The EPA developed SLR cost multipliers by taking the CDM Smith full SLR cost with ancillary cost maximum value ($33,322) and dividing by the 25th and 75th percentile DWINSA estimated costs ($6,507 and $8,519), which are used in the low and high cost scenarios. These calculations produced multipliers of 5.12 and 3.91 for the SLR costs in the low and high cost scenarios, respectively. The EPA used the multipliers to inflate the total estimated annualized SLR costs for the low and high scenarios, resulting in annualized incremental SLR costs of $6.0 and $6.4 billion, respectively. Note these values are gross overestimates of the true cost of SLR given known double counting in ancillary costs (explained above) and the fact that the use of multipliers to inflate total estimated SLR costs dramatically inflates the estimated cost of all line-item cost components (e.g., the cost of a pitcher filter provided to the household post SLR will be inflated from $64 (EPA estimate under both scenarios) to $250 under the low scenario and $330 under the high scenario). Adding the inflated SLR cost values to the other final LCRI cost categories, results in total annualized incremental costs that range from $6.3 to 6.7 billion across the low and high scenarios. Despite the use of the grossly overestimated SLR costs based on the CDM Smith estimates the final LCRI would still result in positive incremental annualized net benefits of between $7.2 billion under the low scenario and $18.4 billion under the high scenario. Given these significant monetized annualized incremental net benefits and considering the other quantified and non-quantified costs and benefits discussed in Chapter 6, the EPA would reaffirm that the benefits justify the cost of the final LCRI.

A.3.2 Safe Water Engineering Report

This section summarizes LSLR cost analyses from the 2024 SWE report on *LSLR Costs and Strategies for Reducing Them* (Betanzo and Spieght, 2024), which was provided as an attachment to NRDC's comments on the proposed LCRI. The SWE report provided two different cost estimates, with one based on a literature review (presented in Section A.3.2.1) and one based on the RS Means Online Construction Cost Database (presented in Section A.3.2.2). Section A.3.2.3 summarizes the conclusions made by Betanzo and Spieght (2024) with respect to the service line replacement costs used by the EPA in the LCRI EA.

A.3.2.1 Independent Literature Review

The SWE report presents results of a literature review to explore the range of published costs for LSLR projects and compares them to costs previously presented by AWWA and the EPA. Literature used in this review included previous AWWA publications, CDM Smith publications, the EPA analyses, court testimony, and media reports regarding cities with publicized LSLR programs. The final dataset yielded 56 projects. The authors converted all projects to 2020 dollars using ENR's Construction Cost Index. The report does not identify from which utilities these costs stem or the State/region.

Exhibit A-3 provides summary statistics from the SWE report for full LSLR construction unit costs, which the EPA compared against its calculated estimates based on the 7th DWINSA data. Using the 25th and 75th percentiles, the SWE report estimates full replacements are between $4,495 and $9,783 in 2020 dollars, which is a wider range than the EPA's estimates of $6,507 and $8,519, respectively. However, the median of $6,143 and the mean of $8,247 are closer to the 7th DWINSA-based estimates of $7,232 and

$6,930, respectively. The distribution of costs between the two datasets are slightly different in that the mean is lower than the median for the EPA dataset, indicating that the data are slightly skewed toward lower costs (although the mean and median differ by only approximately $200). Conversely the mean is higher than the median for the SWE dataset, indicating that the data are skewed towards higher costs.

Exhibit A-3: Summary of Literature Review Results from Safe Water Engineering Report ($/LSLR, 2020$)

Statistic	LSLR Unit Costs (Full)
Number of Cost Estimates	56
Min	$1,173
25th percentile value	$4,495
Median	$6,143
Mean	$8,247
75th percentile value	$9,783
Max	$30,655

Acronyms: LSLR = lead service line replacement
Source: *Lead Service Line Replacement Costs and Strategies for Reducing Them* pp. 25-26, available at EPA-HQ-OW-2022-0801 at www.regulations.gov.
Note: The EPA converted all costs to 2020 dollars using ENR's Construction Cost Index. The EPA also calculated the 25th percentile, median, mean, and 75th percentile.

A.3.2.2 RS Means Construction Cost Estimates

In addition to the literature review, Betanzo and Spieght (2024) present construction cost estimates for a range of LSLR cost scenarios which are compared against other cost estimates and used to identify major cost drivers. Each scenario represents typical construction costs[11] but differs by:

- the pipe materials (polyethylene vs. copper),
- the length of the pipe replaced, the number of replacements per day,
- the type of construction (open trench excavation which differed by depth of trench vs. directional drilling/trenchless),
- replacement vs. restoration of the curb stop/corp stop/water meter/sod/fill material, and
- whether the sidewalks/roadways were demolished and/or restored.

The authors used RS Means Online Construction Cost Database, Year 2024 edition (www.rsmeans.com) for all costs except for directional drilling that were not available. Instead, the authors estimated a cost of $20 per foot for directional drilling based on literature and a web search for similar household-sized service line or communication (cable, phone) line installation. This directional drilling estimate was

[11] These estimates represent construction costs only, and do not include ancillary items such as inventories, permits, traffic control, and program management.

conservatively used for all trenchless options, although the authors acknowledged that other options could be less expensive. The report provides estimated hours for field engineers and project managers but did not provide the specific labor rate used to convert these costs to dollars.

Exhibit A-4 provides summary statistics for scenario testing of full and partial LSLR. Note that the SWE report projected these data forward to $2024 costs, so the EPA adjusted the reports results to 2020 dollars for comparison to the 7th DWINSA analysis[12]. For purposes of cost comparison for full and partial LSLRs, the EPA compared the SWE report "low scenario" costs against the 7th DWINSA's minimum and 25th percentile, the "medium scenario" costs against the 7th DWINSA's mean estimate, and the "high scenario" costs against the 7th DWINSA's 75th percentile and maximum values.

For full LSLR, the "low cost" scenarios presented in the SWE report range in costs from $1,777 to $5,313, which are comparable with the 7th DWINSA-based minimum cost of $1,180 and 25th percentile of $6,507. The SWE report has a "medium cost" scenario equal to $9,073, which is higher than the 7th DWINSA-based mean cost of $7,232. The SWE report provides only one "high cost" scenario value of $28,320, which is much higher than the 7th DWINSA-based 75th percentile cost of $8,519 or max cost of $14,966. The partial LSLR cost scenarios from the SWE report range in value from $1,482 to $2,471. The lower estimate of $1,482 is comparable to the 7th DWINSA-based minimum partial cost estimate of $1,677 and 25th percentile of $1,920. The SWE report higher partial estimate of $2,471 is notably lower than the 7th DWINSA-based 75th percentile of $5,400 and maximum partial cost estimate of $8,099.

[12] Historical ENR costs can only be to the nearest ENR historical cost index time period, which at the time this report was published was December 2023. Since that time, ENR's historical cost index has updated the monthly historical cost index to May 2024. The EPA therefore took an average of the past five available months' worth of index values for 2024 to convert the data to 2020 costs.

Exhibit A-4: Summary of LSLR Scenario Costs from Safe Water Engineering Report ($/LSLR, 2020$)

Scenario	High or Low Cost?	Partial or Full?	LSLR Unit Costs
Low Short DD PE	Low	Full	$2,046
Low Short DD Cu	Low	Full	$2,839
Low Short Open PE	Low	Full	$1,777
Low Short Open Cu	Low	Full	$2,569
Low Long DD PE	Low	Full	$2,769
Low Long DD Cu	Low	Full	$3,980
Low Long Open PE	Low	Full	$4,047
Low Long Open Cu	Low	Full	$5,313
Medium Open Cu	Medium	Full	$9,073
High Open Cu	High	Full	$28,320
DD PE	N/A	Partial	$1,831
DD Cu	N/A	Partial	$2,471
Open PE	N/A	Partial	$1,482
Open Cu	N/A	Partial	$2,122

Acronyms: Cu = copper; DD = directional drilling; LSLR = lead service line replacement; PE = polyethylene.
Source: *Lead Service Line Replacement Costs and Strategies for Reducing Them* pp. 31-37, available at EPA-HQ-OW-2022-0801 at www.regulations.gov.
Note: The EPA converted all costs to 2020 dollars using ENR's Construction Cost Index.

A.3.2.3 Safe Water Engineering Report Conclusions

The SWE report made the following conclusions (paraphrased):

- Overall, there is a large degree of consistency across the EPA estimates (based on the results of the 7th DWINSA) and the SWE report's literature review and construction cost estimates.
- The CDM Smith cost estimates are higher but "…when the CDM Smith data are adjusted to avoid selective inclusion of projects and more accurately reflect fixed auxiliary costs they are also consistent with the other unit cost estimates presented here."
- Construction costs vary substantially. There is a small set of construction conditions that can drive up costs, but based on the literature review and engineering cost estimates in the SWE report, these conditions are not experienced in the majority of replacements.

A.4 References

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Appendix B: Modeling Costs in the SafeWater LCR Model for the Final LCRI, 2021 LCRR, and the Pre-2021 LCR

B.1 Introduction

In order to estimate the compliance costs (and benefits) of the final Lead and Copper Rule Improvements (LCRI), the United States Environmental Protection Agency (EPA) updated the SafeWater Lead and Copper Rule (LCR) model, which it developed for the analysis of the 2021 Lead and Copper Rule Revisions (LCRR). SafeWater LCR is designed to estimate the costs and benefits of a treatment technique rule and focuses on water contamination in the distribution system. Appendix B, Sections B.2 through B.4 describe in detail how the SafeWater LCR model develops a model system structure to account for baseline and compliance characteristic variability and how these system characteristics are used in conjunction with the 2021 LCRR and pre-2021 LCR compliance requirements to simulate model system compliance actions and develop costs estimates over the 35-year period of analysis under both scenarios. Because of limited data, to assess the costs (and benefits) and characterize uncertainty, the EPA estimated 2021 LCRR and pre-2021 LCR compliance costs (and benefits) under high and low bracketing scenarios.

Appendix B describes how the SafeWater LCR model works incorporating appropriate data. Specifically, in this appendix, the EPA provides detail on how the SafeWater LCR model estimates the incremental compliance costs of the final LCRI. To calculate the incremental impact of the final LCRI, each model-public water systems' (PWSs') costs must first be estimated separately under both the final LCRI and the baseline rule (either the 2021 LCRR or pre-2021 LCR). Then, for each model-PWS, the SafeWater LCR model subtracts the estimated costs under the baseline rule from the model-PWS's estimated costs under the final LCRI to determine the incremental costs of the final LCRI. The same is done for costs borne by States.

In its primary analysis in Chapter 4, the EPA calculates the incremental costs of the final LCRI above the costs of the 2021 LCRR. In Section B.3, the EPA provides an overview of its approach to estimate the cost of the final LCRI. The same information for the 2021 LCRR is provided in Section B.4. In Section B.5, the EPA provides the detailed data and algorithms used to calculate the cost of each compliance activity PWSs will undertake to comply with the 2021 LCRR (like the information provided in Chapter 4, Section 4.2 for the final LCRI).

The EPA has also estimated the incremental costs of the LCRI above the costs of the pre-2021 LCR for informational purposes. In Section B.6, the EPA provides an overview of its approach to estimate the cost of the pre-2021 LCR. In Section B.7, the EPA provides the detailed data and algorithms used to calculate the cost of each compliance activity PWSs will undertake to comply with the pre-2021 LCR. The EPA's estimates of the incremental costs of the final LCRI above the costs of the pre-2021 LCR are provided in Appendix C.

Before describing the detailed approach for estimating costs under the final LCRI, 2021 LCRR, and pre-2021 LCR, in Section B.2, the EPA first describes the PWS characteristics and modeling assumptions that are held constant to ensure consistency among the final LCRI, 2021 LCRR, and pre-2021 LCR cost estimates.

B.2 Baseline Conditions and Modeling Assumptions for the Final LCRI, 2021 LCRR, and Pre-2021 LCR

B.2.1 Model-PWSs

In constructing the sample of model-PWSs for the cost analysis in the SafeWater LCR model, the EPA began with the 49,529 community water systems (CWSs) and 17,418 non-transient non-community water systems (NTNCWS) in Safe Drinking Water Information System/Federal version (SDWIS/Fed) fourth quarter 2020 dataset. As described in Chapter 3, from SDWIS/Fed, the EPA knows each PWS's:

- System type (CWS or NTNCWS);
- Primary water source (surface water or ground water);
- Population served;
- Corrosion control treatment (CCT) status (yes/no);
- Ownership (public or private); and
- Number of service connections.

Many additional baseline and compliance characteristics of each model-PWS are needed to estimate the costs of the pre-2021 LCR, 2021 LCRR, and final LCRI. Therefore, the EPA draws from additional data sources to assign the characteristics to each model-PWS. Because many model-PWS baseline characteristics are assigned from distributional information, the EPA needed to ensure that the sample size was large enough to generate results that were stable for each of the 36 PWS categories. In other words, every time the EPA assigned a set of baseline characteristics and estimated the costs of the final LCRI for a model-PWS in a PWS category, the model should have generated similar results for the PWS category. If a PWS category had too few model-PWSs, the model would not produce stable results due to the large number of distributional variables in the analysis.

Therefore, the EPA oversampled the SDWIS/Fed inventory to increase the number of model-PWSs in each PWS category. For every PWS category, the EPA set the target minimum number of model-PWSs to 5,000.[13] Consider the example of privately-owned CWSs serving 3,301-10,000 people with ground water as their primary water source. This PWS category has 336 systems. To ensure the model includes at least 5,000 model-PWSs, the EPA replicated each PWS in the SDWIS/Fed inventory. So, for this example PWS category, the sample will be replicated 15 times and there would be 5,040 model-PWSs in this category. Continuing with this example, when the EPA estimated the costs for this PWS category, each model-PWS would have a weight of 0.067 (336 divided by 5,040). To calculate the costs for this PWS category, the

[13] Testing of the model showed that the model results remained stable (within 2 percent) between a category sample size of 5,000 and 20,000. Once the EPA was certain that the results were sufficiently stable at the sample size of 5,000 per category, the EPA was able to achieve complete stability (no random model variability) between model runs by assigning a fixed random number seed for each PWS. The fixed seed ensures that each PWS received the same data value from the distributional information each time the model was run. This allowed the EPA to evaluate differences between options or sensitivity analyses with greater confidence.

EPA multiplied the cost for each model-PWS by 0.067 to get the model-PWS's weighted cost, and then sums the weighted costs for all 5,040 model-PWSs in the sample to get the total cost for the PWS category.

Once the model-PWSs were created, the EPA assigned all baseline characteristics to each model-PWS in the sample, so that the estimate of costs for the final LCRI and the baseline rule are based on the same baseline characteristics. In Exhibit B-1, the EPA provides the list of baseline characteristics assigned to each model-PWS that are critical to understanding how the model estimates costs.

Exhibit B-1: Select Baseline Characteristics Assigned from Distributional Information to Model-PWSs

Baseline Characteristic	Data Description
Number of entry points to the distribution system	Chapter 3, Section 3.3.6; "Baseline CCT Characteristics.xlsx"
Model-PWS has service lines with lead contents in baseline (yes/no)	Chapter 3, Section 3.3.4
Percent of connections that are lead (if any)	Chapter 3, Section 3.3.4
Type of CCT in place (if any)	Chapter 3, Section 3.3.3, and Chapter 4, Section 4.3.2.2.1, " Baseline CCT Characteristics.xlsx"
Current pH level	"Baseline CCT Characteristics.xlsx"
Current PO_4 dose	"Baseline CCT Characteristics.xlsx"
Lead 90th percentile placement (above or below the AL) under final LCRI	Chapter 3, Exhibit 3-26
Lead 90th percentile placement under 2021 LCRR (above the AL, above the TL but not above the AL, or below the TL)	Chapter 3, Exhibit 3-25
Lead 90th percentile placement (above or below the AL) under the pre-2021 LCR	"Initial P90 Categorization_5 bins_LCR_Final.xlsx"
Tap sampling frequency in baseline	Chapter 3, Section 3.3.7
Source water change (y/n) each year of analysis	Chapter 3, Exhibits 3-53 and 3-54
Treatment technology change (y/n) each year of the analysis	Chapter 3, Exhibits 3-55 and 3-56

Acronyms: AL = action level; CCT = corrosion control treatment; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; LSL = lead service line; PO_4 = orthophosphate; PWS = public water system; TL = trigger level.

Many other data elements are assigned to the model-PWSs to maintain consistency among the estimation of costs for the pre-2021 LCR, the 2021 LCRR, and final LCRI (*e.g.*, the expected likelihood that a tap water sample will be invalidated). Chapter 4, Section 4.3, discusses how each data element is used in the estimation of costs and provides an explanation of, or a reference to, how these data were developed. Sections B.5 and B.7 provide the same information for the 2021 LCRR and pre-2021 LCR respectively.

B.2.2 Model PWS 90th Percentile Tap Sample-Range

The SafeWater LCR model first assigns a 90th percentile lead tap sample (P90)-range to each model-PWS for the 2021 LCRR, as shown in Chapter 3, Exhibit 3-25.[14] The final LCRI requires systems to take first- and fifth-liter tap samples at service line (SL) locations with lead content (*i.e.*, lead and galvanized requiring replacement (GRR) service lines) and use the higher of the first- or fifth-liter samples in calculating the PWSs 90th percentile value, which the EPA anticipates will also increase the likelihood that a PWS would have a P90 greater than the action level (AL) when compared to the 2021 LCRR (see Chapter 3, Exhibit 3-26 for the estimated 90th percentile values for lead tap samples under the final LCRI). However, rather than simply assigning each model-PWS a P90-range under the final LCRI using the percentages in Chapter 3 directly, in order to maintain consistency between the 2021 LCRR and the final LCRI for each PWS, the SafeWater LCR model uses the model-PWS's initial P90-range under the 2021 LCRR to determine whether the model-PWS's initial P90-range under the final LCRI is as follows (see Step 1 in Exhibit B-4):

1. If the model-PWS has no SLs with lead content, the P90-range under the final LCRI is the same as under the 2021 LCRR.
2. If the model-PWS has lead service lines (LSLs) and the P90 is greater than the AL under LCRR, then the P90-range under the final LCRI is the same as under the 2021 LCRR.
3. If the model-PWS has LSLs and the P90 is greater than the 2021 LCRR Trigger Level (TL) but not greater than the AL under the LCRR, then randomly select the P90-range for the final LCRI using the following probabilities:
    a. Prob(P90 greater than the AL under final LCRI) = (Prob(P90 greater than the AL under final LCRI) – Prob(P90 greater than the AL under LCRR)) / Prob(P90 greater than the TL but not greater than the AL under LCRR)
    b. Prob(P90 greater than the TL but not greater than the AL under final LCRI) = 1- (((Prob(P90 greater than the AL under final LCRI) – Prob(P90 greater than the AL under LCRR)) / Prob(P90 greater than the TL but not greater than AL under LCRR))
4. If model-PWS has LSLs and P90 is at or below the TL under the 2021 LCRR, then randomly select the P90-range for the final LCRI using the following probabilities:
    a. Prob(P90 greater than the TL but not greater than the AL under LCRR) = (Prob(P90 greater than the TL but not greater than the AL under final LCRI) – Prob(P90 greater than the TL but not greater than the AL under LCRR)) / Prob(P90 Less than or equal to the TL under LCRR)
    b. Prob(P90 Less than or equal to the TL under final LCRI) = 1-((Prob(P90 greater than the TL but not greater than the AL under final LCRI) – Prob(P90 greater than the TL but not greater than the AL under LCRR)) / Prob(P90 Less than or equal to the TL under LCRR))

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[14] The SafeWater LCR model does not track PWSs' P90. Rather, it tracks the regulatory range within which the PWS's P90 falls. A P90 can be in the following regulatory ranges: not greater than TL, greater than TL but not greater than AL, and greater than AL. For ease of exposition, the EPA refers in this chapter to a PWS's P90-range.

B.2.3 Very Large Systems

There are 24 very large systems serving more than one million people. Because of the small number of systems in this size category, as well as the large costs these systems could face due to their size, the EPA collected additional PWS-specific information on baseline characteristics from these systems and used a modified model-PWS approach for estimating the compliance costs for this category of PWSs. Very large systems are potentially cost drivers because they serve more than one million people. Utilizing SafeWater to select their baseline conditions can potentially generate erroneous compliance cost estimates. The set of such systems is relatively small (24) compared to systems in other system size categories. Therefore, collecting system-specific information about relevant baseline characteristics is feasible and preferable to estimating compliance costs through a modeling process. For these very large systems, the EPA attempted to collect information on their number of SLs with lead content, entry point (EP)-specific orthophosphate practices and chemical doses, pH measurements and pH adjustment practices, service populations, and average annual daily and design flow (DF) rates. The EPA gathered this information from SDWIS/Fed, and from publicly available information such as Consumer Confidence Reports (CCRs) and water system websites. In addition, the American Water Works Association (AWWA), in 2017 and 2018, provided data from member systems to fill data gaps.

When PWS-specific CCT data were available for very large systems, the SafeWater LCR model calculated the CCT costs at each EP individually using the information about the EPs' baseline CCT practices and doses. If data were not available, the EPA assigned baseline CCT characteristics using the model-PWS approach described above. Likewise, if system-specific SL with lead content inventory data were available, the SafeWater LCR model used the data to calculate the costs but if system-specific SL with lead content inventory data were not available, the SafeWater LCR model assigned the number of SLs with lead content using the same model-PWS approach for smaller system size categories. Exhibit B-2 provides a summary of the data collected for each of the very large systems. All other baseline and cost characteristic data were assigned in the same manner as the systems serving 100,001 to 1 million size category.

Exhibit B-2: Summary of AWWA Data for PWS Systems Serving more than 1M People

PWS Name	Phosphate Inhibitor Use for Sequestration	pH Adjustment Data	SL with lead content Inventory	Flow Data Provided
Charlotte Water System	No data provided			
Chicago	No data provided			
City of Austin	No data provided			
City of Baltimore	No data provided			
City of Houston	No	Yes, EP level data provided	Both Public and Private unknown	EP level data provided
City of Phoenix	No	Yes, EP level data provided	Public replaced, Private unknown	EP level data provided
City of San Diego	No data provided			
Cleveland Public Water System	No data provided			
Columbus Public Water System	No data provided			
Dallas Water Utility	No data provided			
Denver Water Board	No data provided			
East Bay Mud	No	Yes, EP level data provided	All replaced	EP level data provided
Fairfax County Water Authority	Yes, dose provided	Yes, EP level data provided	None present	EP level data provided
Las Vegas Valley Water District	No	No	None present	EP level data provided
Los Angeles-City, Dept. Of Water & Power	No data provided			
Massachusetts Water Resources Authority	No	Yes, EP level data provided	Both Public and Private present	EP level data provided
Miami-Dade Water and Sewer Authority - Main System	No	No	Some Public replaced, Private unknown	EP level data provided
MO American St Louis Co. & St Charles Co.	No	Yes, EP level data provided	Public replaced, Private present	EP level data provided
New York City System	Yes, dose provided	Yes, EP level data provided	Public replaced, Private present	EP level data provided
Philadelphia Water Department	Yes, dose provided	Yes, EP level data provided	Both Public and Private present	EP level data provided
San Antonio Water System	No data provided			
San Jose Water System	No data provided			
Suffolk County Water Authority	No	No	Specific EPs with LSL Identified	EP level data provided
Washington Suburban Sanitary Commission	Yes, dose provided	Yes, EP level data provided	Public replaced, Private unknown	EP level data provided

Acronyms: AWWA = American Water Works Association; EP = entry point; LSL = lead service line; PWS = public water system; SL = service line.

B.2.4 Analysis Period and Discount Rates

The EPA estimated the incremental cost of the final LCRI over a 35-year period to fully capture the costs of the rule since it may take over 30 years for many CWSs to complete their service line replacement (SLR) program under the 2021 LCRR. In accordance with EPA policy and based on guidance from the Office of Management and Budget (OMB), when calculating social costs and benefits, the EPA discounted future costs (and benefits) under a social discount rate of 2 percent.

When evaluating the economic impacts on PWSs and households (not social costs and benefits), the EPA uses the estimated PWS cost of capital to discount future costs, as this best represents the actual costs of compliance that systems will incur over time. The EPA used data from the 2006 Community Water System Survey (CWSS) to estimate the PWS cost of capital (USEPA, 2009a; 2009b). The survey defined the following categories of funding sources:

- Current revenue;
- Equity or other funds from private investors;
- Government grants;
- Drinking Water State Revolving Fund (DWSRF), including loans and Principal Repayment Forgiveness;
- Other borrowing from public sector sources; and
- Borrowing from private sectors sources.

The EPA calculated the overall weighted average cost of capital (across all funding sources and loan periods) capital for each CWS size category and ownership type is shown in Exhibit B-3. Since similar cost of capital information is not available for NTNCWSs, the EPA used the CWS cost of capital when calculating the annualized cost per NTNCWS.

Exhibit B-3: Weighted Average Cost of Capital by PWS Ownership and Size Category

Size Category	Publicly Owned CWS	Privately Owned CWS
≤100	3.8%	7.8%
101-500	5.5%	8.2%
501-1,000	4.0%	8.6%
1,001-3,300	4.7%	7.1%
3,301-10,000	5.8%	7.0%
10,001-50,000	6.1%	7.0%
50,001-100,000	4.9%	6.9%
100,001-500,000	4.7%	3.9%
Over 500,000	3.7%	7.8%

Acronyms: CWS = community water system; PWS = public water system.

As mentioned above, these cost of capital estimates are derived from the 2006 CWSS. Since 2006, Congress has established several new programs, and expanded other existing programs, that PWSs can access to lower their cost of capital. These include the DWSRF, the Water Infrastructure Finance and Innovation (WIFIA) Program, and the Water Infrastructure Improvements for the Nation Act of 2016 (WIIN Act).

Through the DWSRF Program, the EPA allocates annual capitalization grants to States. The funds, along with a 20 percent State match, are placed into a dedicated loan fund to finance eligible water system infrastructure improvement projects. States are permitted to use funding from their DWSRF to facilitate SLR projects and are taking steps to modify their DWSRF programs to prioritize SLR. The Infrastructure Investment and Jobs Act, also referred to as the Bipartisan Infrastructure Law (BIL), appropriated $30.7 billion in supplemental DWSRF funding and reemphasized the importance of lead service line replacement (LSLR) under the DWSRF program by including $15 billion specifically appropriated for "lead service line replacement projects and associated activities directly connected to the identification, planning, design, and replacement of lead service lines." The dedicated LSLR appropriation and the General Supplemental appropriation under the BIL as well as annual base appropriations for the DWSRF can pay for LSLR and related activities. The BIL requires that States provide 49 percent of their LSLR and General Supplemental capitalization grant amounts as additional subsidization in the form of principal forgiveness and/or grants to disadvantaged communities, as defined under SDWA 1452(d)(3). The WIFIA program provides creditworthy PWSs access to low-interest direct federal loans that can be used to finance capital improvements including SLRs. Under the WIIN Act, three new grant programs were established related to reducing lead in drinking water (assistance for small and disadvantaged communities, reducing lead in drinking water, and lead testing in school and childcare program drinking water). For additional information on other financial resources see the Federal Register Notice for this rulemaking. Therefore, the actual cost of capital faced by some water utilities may be lower than those used in this analysis.

B.3 Estimating Compliance Activity under the Final LCRI

Many compliance activities are required only if the PWS has a lead P90-range above the AL. Therefore, the SafeWater LCR model must keep track of each model-PWS's lead P90-range throughout the period of analysis. For simplicity of the modeling, the EPA assumes that many compliance activities undertaken by PWSs will not affect a PWS's P90-range. These include, for example, developing/updating a SL inventory, CWS sampling at schools and child-care facilities, and public education (PE). In fact, for modeling purposes, the EPA assumes that the only compliance activities that will change a model-PWS's P90-range are:

- Installation of CCT;
- Re-optimization of existing CCT;
- Removal of all lead content SLs; and
- A system-wide distribution system corrective action triggered by a distribution system and site assessment (DSSA) (assumed in the cost modeling to be a system-wide increase in pH and to occur infrequently).

In addition to these rule compliance activities changing a PWS's P90-range, changing a water source or treatment technology can also result in a change in P90-range.[15]

This section describes the modeling framework for the final LCRI employed by the SafeWater LCR model to determine whether a model-PWS will take an action that will change its P90-range, which in turn will change other actions the PWS will be required to take.

Rule implementation activities under the final LCRI will begin immediately after rule promulgation. These activities will include one-time State and PWS costs for staff to read the rule, become familiar with its provisions, and train employees on the new rule. PWSs will also comply with the inventory and SLR initial planning requirements of the final rule in years 1 through 3 of the analysis, as well as associated PE. The EPA expects that systems will begin complying with all other final rule requirements three years after promulgation, or in Year 4 of the analysis.

The SafeWater LCR model works on an annual time step which the EPA calls the "year-loop." At the beginning of the first year that the final LCRI's tap sampling requirements take effect (Year 4 of the period of analysis), the model-PWS's initial $P90_{y}$-range is set as explained above. As the SafeWater LCR model progresses through the year-loop, it continually updates its projection of the starting P90-range for the following year ($P90_{y+1}$-range) based on:

1. The current year's starting P90-range ($P90_{y}$-range);
2. Changes in source water and treatment technology in the current year;
3. Installation or re-optimization of CCT in the current year;
4. Replacement of lead content SLs in the current year; and
5. A system-wide distribution system corrective action triggered by a DSSA (assumed in the cost modeling to be a system-wide increase in pH and to occur infrequently).
6. The EPA assumed that 100% of property owners would provide access to the water system to conduct a full service line replacement. This is a reasonable assumption for purposes of the economic analysis in order to develop a conservative estimate of costs. Moreover, there are many water systems that have already completed at or near 100% LSLR (e.g., Madison, WI; Lansing, MI; Green Bay, WI; Newark, NJ; Flint, MI; Framingham, MA), demonstrating that achieving this level of customer participation in service line replacement programs is possible. In addition, the final LCRI contains many requirements and incentives to facilitate water systems gaining access for full replacement (see section IV.B.3.b of the final LCRI *Federal Register* Notice (USEPA, 2024)). Further, the availability of significant funding from the Bipartisan Infrastructure Law and other sources can reduce or eliminate direct costs to property owners for service line replacement (where water systems do not pay for the full service line replacement) (see section III.G of the final LCRI *Federal Register* notice (USEPA, 2024).

[15] There can be sample variability of a PWS's P90 over time. The SafeWater LCR model assumes, however, that this variability will not result in a change in a PWS's status with regard to being above the AL.

7. Some systems have reported lower property owner participation rates in their service line replacement programs in the past. The EPA does not believe these rates are comparable to those projected under the LCRI, given the rule's requirements and incentives for systems to gain access to complete the full replacement, as well as the significant external funding to support full replacement. Given the rule provisions allowing the water system to avoid replacing the service line where the property owner refuses access (when customer consent is required), the EPA does anticipate that some property owners may refuse access for the system to complete full replacement; however the agency does not expect these refusals to be widespread. When property owners refuse replacement, the final LCRI's estimated benefits are expected to decrease. The rule's costs are also expected to decrease because the systems would not incur service line replacement costs for each replacement not conducted.

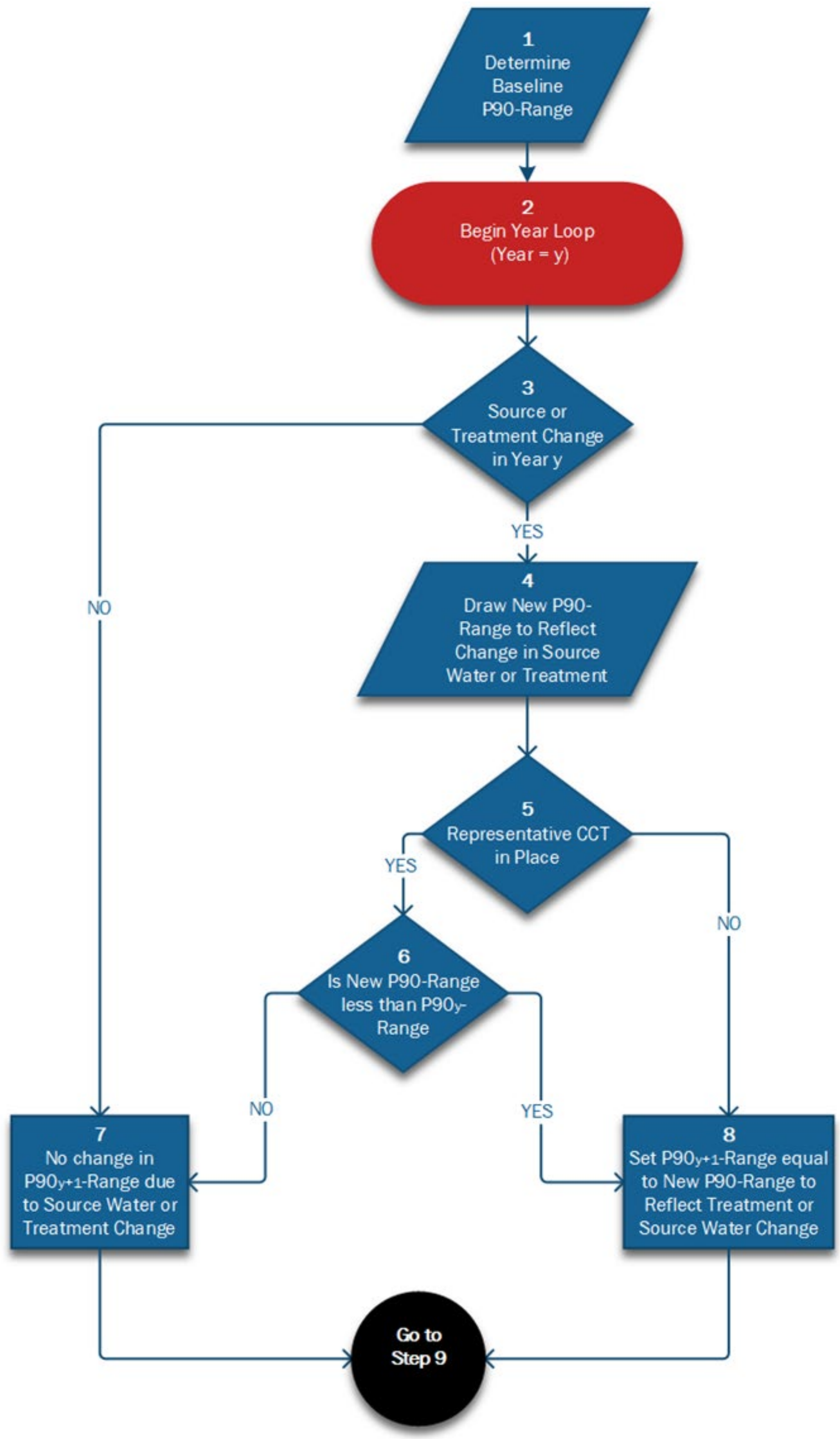
B.3.1 Change in Source Water or Treatment Technology

As mentioned above, a change in source water or treatment technology can affect a model-PWS's projected $P90_{y+1}$-range. The first step within the year-loop is to determine whether the model-PWS has a significant change in source water or a change in treatment technology during the year (Step 3 in Exhibit B-4). If the model-PWS does not, then their projected $P90_{y+1}$-range is not affected by a significant source water change or treatment change (Step 7), and the model-PWS moves on to the next component of the year-loop (Step 9).

However, if the model-PWS does have a significant change in source water or a treatment technology change (Step 3), it is possible that this change could affect its $P90_{y+1}$-range. Therefore, the SafeWater LCR model draws a new P90-range for the model-PWS, which represents the possible $P90_{y+1}$-range associated with the new source water or treatment technology, as shown in Exhibit B-4 (Step 4).

If the model-PWS has installed or re-optimized CCT prior to the current year (Step 5), the EPA assumed that the CCT is adequate to mitigate any increase in lead concentration associated with the significant source water change or treatment technology changes. Therefore, if the newly drawn P90-range is higher than the current $P90_{y}$-range (Step 6), the SafeWater LCR model will keep the $P90_{y+1}$-range the same as the $P90_{y}$-range, as there will be no change in lead concentrations associated with the change in source water or treatment technology (Step 7). On the other hand, if the newly drawn P90-range is lower than the current $P90_{y}$-range (Step 6), SafeWater will set the $P90_{y+1}$-range equal to the newly drawn P90-range, in effect lowering the model-PWS's $P90_{y+1}$-range (Step 8). If the model-PWS has not installed or re-optimized CCT prior to the current year (Step 5), then the SafeWater LCR model will set the $P90_{y+1}$-range equal to the newly drawn P90-range (which may result in either an increase or decrease of the $P90_{y+1}$-range). In all three cases, the model-PWS will move on to the next component of the year-loop (Step 9).

Exhibit B-4: Simulating Change in Source Water or Treatment Technology in SafeWater LCR



B.3.2 Small CWS and NTNCWS flexibility

The final LCRI includes flexibility for CWSs that serve 3,300 or fewer people, and all NTNCWSs. If these PWSs have a P90-range greater than the AL, they can choose to provide point-of-use (POU) devices to all customers rather than install or re-optimize CCT.[16]

For modeling purposes, the EPA assigns a compliance cost to small CWSs and all NTNCWS systems that exceed the AL in the SafeWater LCR model. The EPA uses a cost minimization assumption in the model and assigns the least cost alternative between CCT and POU compliance alternatives.

B.3.3 Corrosion Control and Point-Of-Use Technology

After the SafeWater LCR model determines whether a model-PWS's $P90_{Y+1}$-range will be affected by a change in source water or treatment technology, the model continues within the year-loop and begins the process of determining whether the model-PWS will install CCT, re-optimize CCT, or install POU devices (in the case of small CWSs or all NTNCWSs). The SafeWater LCR model uses the model-PWS's $P90_{Y+1}$-range rather than the current year-loop's initial P90-range ($P90_{Y}$-range) to determine if the PWS will install CCT, re-optimize CCT, or install POU. This is because the EPA assumes that if a PWS proposes a significant change in water source or a change in treatment technology, the State will require the PWS to determine the impact of the change on lead levels, and take any corrective measures (installing CCT, re-optimizing CCT, or installing POU) before making the change in source water or treatment technology. Therefore, the SafeWater LCR model assumes that a change of water source or treatment technology would never lead to an action level exceedance (ALE), as the PWS would implement, if needed, appropriate CCT or POU (if eligible) prior to the change.

The SafeWater LCR model keeps track of the model-PWS's CCT status throughout the period of analysis. Once a model-PWS with existing CCT[17] re-optimizes its CCT, or a model-PWS without CCT installs CCT, the EPA assumes that the CCT is optimized and no further changes to CCT will be needed.[18,19] Therefore, as the SafeWater LCR model continues within its year-loop (see Exhibit B-5), it determines whether the model-PWS has already re-optimized its existing CCT, or installed new CCT, and therefore has optimized CCT in place (Step 10). If it does, then the SafeWater LCR model makes no change to CCT in place and to

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[16] Small CWSs and NTNCWSs that have control over their entire plumbing system may choose to remove all lead-bearing plumbing material. The EPA lacks the system characteristic data that would allow the agency to determine a small system's cost for replacement of lead-bearing plumbing materials because of the significant variability among systems and the plumbing materials in the buildings they serve. Therefore, this option was not included in the cost estimation. The EPA assumes that systems selecting this compliance alternative would have lower costs than if they had changed their CCT or provided POU devises.

[17] The population served by PWSs with existing CCT at the beginning of the period of analysis is assumed to be exposed to lead concentrations associated with "partial" CCT in the EPA's benefit analysis (see Chapter 5).

[18] The EPA assumes, for modeling purposes, that once CCT is optimized, no further CCT changes will be required unless the model PWS has multiple individual tap samples above the AL and is required to take corrective action based on the DSSA. This will be covered later in this appendix in Section B.3.5.

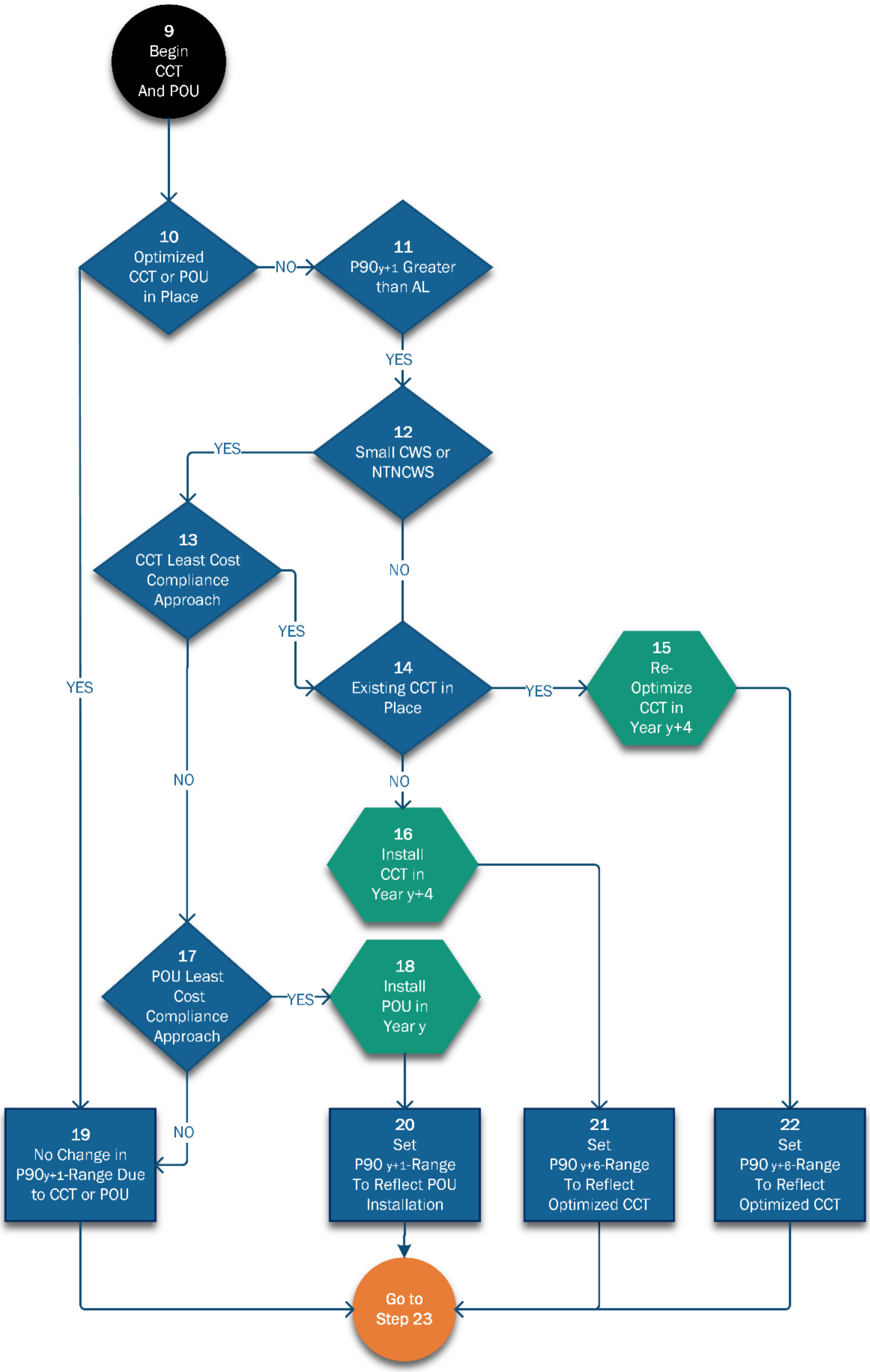
[19] When evaluating an alternative AL of 5 µg/l, the EPA assumed that 15 percent of PWS would not be able to avoid ALEs after installing or re-optimizing CCT.

the model-PWS's $P90_{y+1}$-range due to CCT (Step 19) and the model-PWS moves on to the next stage of the year-loop (Step 23).

Model CWSs serving more than 3,300 people with a $P90_{y+1}$-range greater than the AL (Step 11) and existing CCT in place (Step 14) will re-optimize their existing CCT (Step 15). If they do not have existing CCT in place (Step 14), they will install CCT (Step 16). The EPA assumes that both re-optimization of and installation of CCT due to an ALE will occur four years after the ALE (y+4) because of the time required to conduct a pipe loop study. The same is true for small model CWSs and all NTNCWS (Step 12) if CCT is their least costly compliance strategy (Step 13). However, if POU is their least costly compliance strategy (Step 17), the model-PWS will install POU (y+1) (Step 18).

Once a model-PWS re-optimizes existing CCT, installs CCT, or installs POU, SafeWater will adjust its P90-range to reflect the reduced lead levels (Steps 20, 21, and 22) before moving on to the next stage of the year-loop (Step 23). The EPA assumes it will take two years after CCT installation or re-optimization for the PWS's P90-range to fall (y+6 for CCT installation or re-optimization due to an ALE).

Exhibit B-5: Simulating Corrosion Control and Point-of-Use Technology under Final LCRI in SafeWater LCR



B.3.4 Replacements of Lead Content Service Lines

The SafeWater LCR model keeps track of the number of SLs with lead content a model-PWS still has in place at the beginning of each year-loop. If a model-PWS does not have any SLs with lead content in place (Step 24 in Exhibit B-6), then the SafeWater LCR model will make no change to the model-PWS's $P90_{y+1}$-range due to SLRs (Step 28), and the model-PWS moves on to the next stage of the year-loop (Step 30).

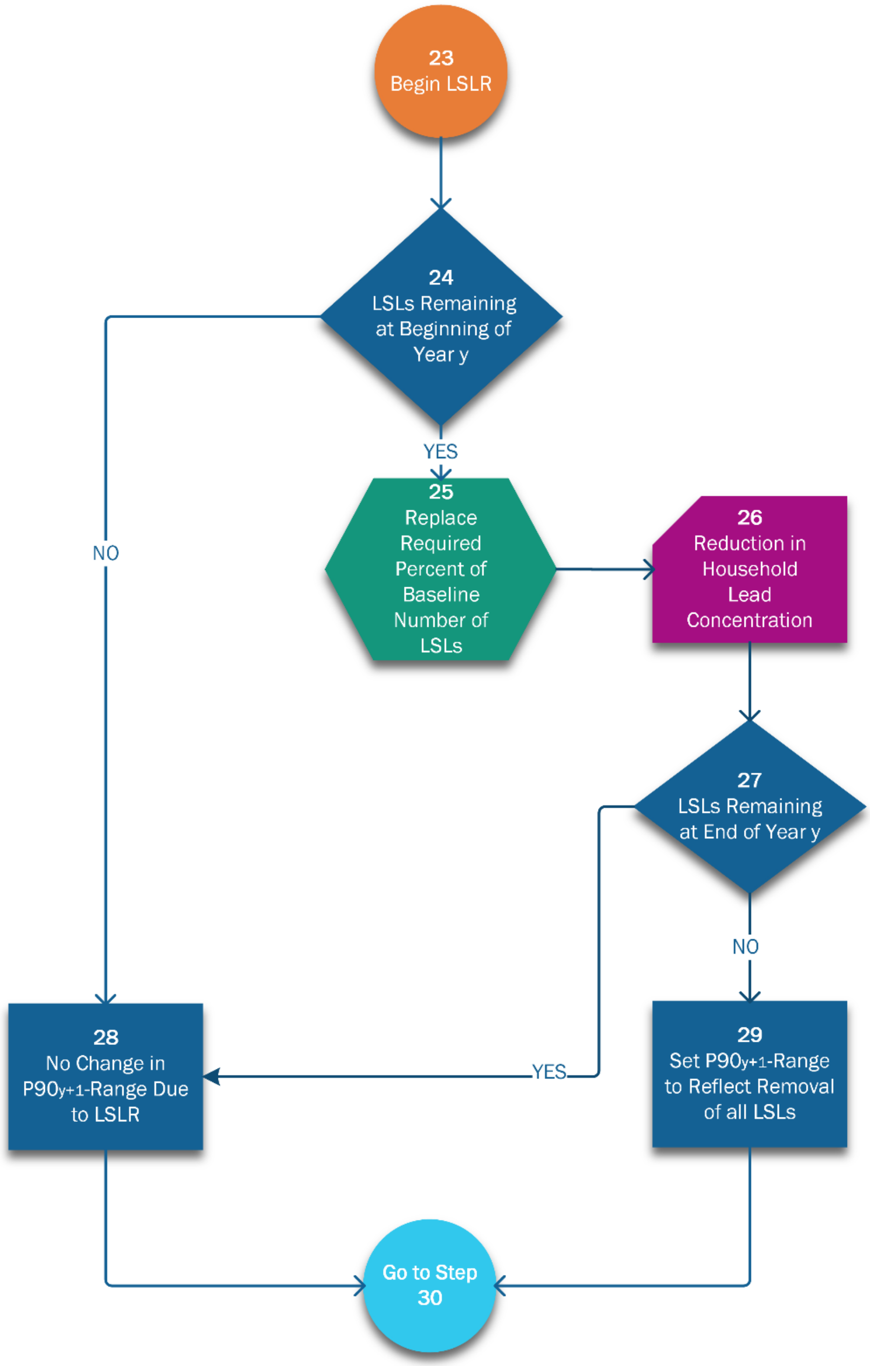
If a model-PWS has SLs with lead content in place at the beginning of the year-loop (Step 24) it must begin replacing SLs with lead content in Year 4 (Step 25). While most PWSs will be required to replace all known and unknown SLs with lead content within 10 years beginning in Year 4, some PWSs may be granted a deferred deadline or may be required to replace SLs on a shortened deadline determined by the State. Systems exceeding 0.039 replacements per household per year would be eligible for deferred deadlines beyond the 10-year replacement period. Because the EPA does not have information on the annual variation in replacement rates which systems may experience when required to conduct replacement, the agency has assumed an annual replacement rate. For modelling purposes, the EPA assumes each PWS will replace the lowest of the following number of service lines each year:

- 10 percent of SLs with lead content
- 0.039 SL with lead content for each household served.

When a model-PWS replaces any SLs with lead content during the year (Step 25), the SafeWater LCR model determines whether, at the end of the year, the model-PWS has no more SLs with lead content remaining (Step 27). If this is the case, the SafeWater LCR model assigns a new $P90_{y+1}$-range from the distribution of P90 values for PWSs without lead content SLs (Step 29)[20] and the model-PWS moves on to the next stage of the year-loop (Step 30). If, at the end of the year, the model-PWS still has SLs with lead content in place (Step 27), the SafeWater LCR model will make no change to the model-PWS's $P90_{y+1}$-range due to SLR (Step 28), and the model-PWS moves on to the next stage of the year-loop (Step 30).

[20] Under the final LCRI, when PWSs replace an LSL at a tap water sampling location, they are required to replace that sampling location with a new sampling location that has an LSL. Therefore, it is likely that a PWS will not see a decrease in their P90 until most LSLs are removed. As a modeling assumption, the SafeWater LCR model changes a PWS's P90 only after all LSLs are removed.

Exhibit B-6: Simulating Lead Service Line Replacements under Final LCRI in SafeWater LCR



B.3.5 Distribution System and Site Assessments (DSSA)

In addition to requiring PWSs to take compliance actions to reduce lead concentrations when their system-wide P90-range exceeds the AL, the final LCRI will also require PWSs to address distribution system issues that cause a single lead tap water sample to exceed 10 µg/L. Although the final LCRI requires any PWS with tap water samples exceeding 10 µg/L to identify and address localized elevated lead concentrations, the EPA assumes, for modeling purposes, that CCT-related DSSA requirements will

be addressed only after a PWS has optimized CCT in place. Therefore, if a model-PWS does not have optimized CCT (Step 31 in Exhibit B-8) in place or does not have at least one lead tap sample above 10 µg/L in the year (Step 32), then it is assumed to not make any CCT adjustments, and the SafeWater LCR model will make no change to the model-PWS's $P90_{y+1}$-range due to DSSA (Step 40). The model-PWS will simply move to the next year-loop (Step 2, Exhibit B-4).

If a model-PWS does have optimized CCT in place, the SafeWater LCR model calculates the number of tap samples that will be above 10 µg/L in the current year of the analysis as a binomial distribution defined by the number of samples taken by the model-PWS during the year and the likelihood that any given sample will be greater than 10 µg/L (Step 32). The number of tap samples a model-PWS will take in a year depends on the model-PWS's tap sampling frequency (semi-annual, or once every one, three, or nine years) and the system size.[21] Exhibit B-7 provides the likelihood that a single lead tap sample will be above 10 µg/L, which varies by the model-PWS's $P90_y$-range and lead content SL status.

Exhibit B-7: Likelihood That a Single Tap Water Sample Will be in Each of the Five Bins Used for Modelling Purposes under the Final LCRI

LSL Status	**P90 >15 µg/L**	**12 µg/L < P90 ≤ 15 µg/L**	**10 µg/L < P90 ≤ 12 µg/L**	**5 µg/L < P90 ≤ 10 µg/L**	**P90 ≤ 5 µg/L**
	pp90above al10_1	*pp90above al10_2*	*pp90above al10_3*	*pp90above al10_4*	*pp90above al10_5*
Has LSLs	25.2%	16.8%	13.8%	6.5%	1.8%
No LSLs	22.2%	23.1%	21.1%	6.5%	0.5%

Acronyms: LCRI = Lead and Copper Rule Improvements; LSL = lead service line; P90 = lead 90th percentile level.
Source: "Likelihood_Sample_Above_AL_LCRI_DSSA_Final.xlsx." Also see Chapter 3, Section 3.3.5.3.2 for addition detail.

The causes of, and associated solutions to, localized elevated lead concentrations within a distribution system are varied and location-specific. To estimate model-PWS costs, the EPA developed the following assumptions about how model-PWSs would respond to the final LCRI DSSA requirements:

1. The first year, after CCT installation or CCT re-optimization, that a model-PWS has a tap sample above 10 µg/L, the PWS will investigate but take no corrective action.
2. The second year, after CCT installation or CCT re-optimization, that a model-PWS has a tap sample above 10 µg/L, it will flush the distribution system in the affected area to reduce water age, improving CCT, and lower lead concentration levels.
3. The third year, after CCT installation or CCT re-optimization, that a model-PWS has a tap sample above 10 µg/L, it will adjust pH at one EP to the distribution system. This is the final action a model-PWS with only one EP will take in response to the DSSA requirement.

[21] See Chapter 4, Section 4.3.2.1.1 for a discussion of sampling frequencies and monitoring schedules.

4. The fourth year, after CCT installation or CCT re-optimization, if a model-PWS, with more than one EP, has a tap sample above 10 µg/L, it will adjust pH at its remaining EPs. This is the final action any model-PWS will take in response to the DSSA requirement.

Therefore, within the SafeWater LCR model, if a model-PWS with re-optimized CCT in place (Step 31) has at least one lead tap sample above 10 µg/L in a given year (Step 32), its response will depend on the DSSA activity it took in prior years:

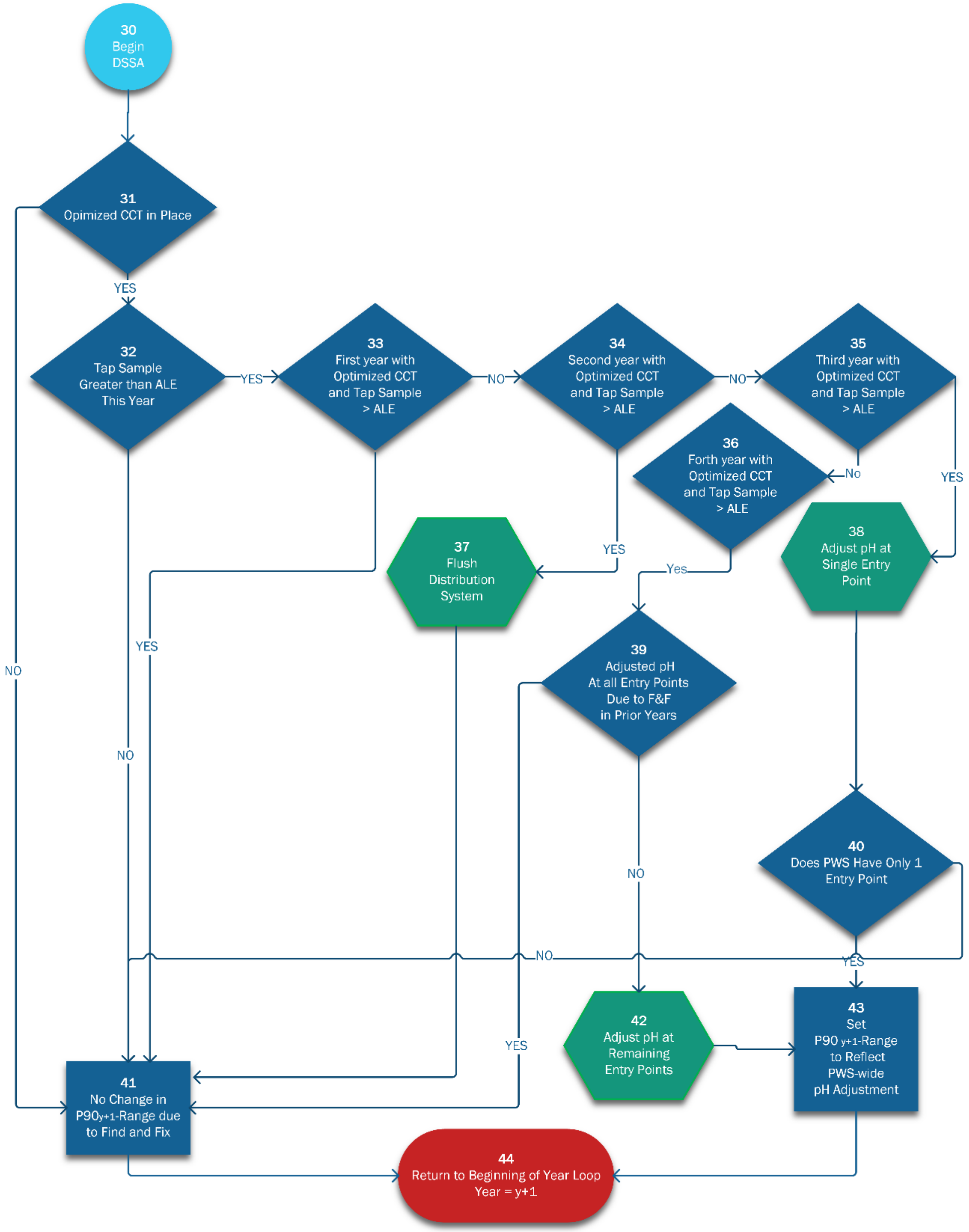
If this is the first year the model-PWS has at least one lead tap sample above 10 µg/L (Step 33), it will investigate the issue but take no corrective actions. The SafeWater LCR model will make no change to the model-PWS's P90y+1-range due to DSSA (Step 41). The model-PWS will move to the next year-loop (Step 44).

If this is the second year the model-PWS has at least one lead tap sample above 10 µg/L (Step 34), it will flush its distribution system once to reduce lead levels (Step 37). The SafeWater LCR model will make no change to the model-PWS's P90y+1-range due to DSSA (Step 41). The model-PWS will move to the next year-loop (Step 44).

If this is the third year the model-PWS has at least one lead tap sample above 10 µg/L (Step 35), it will adjust the pH at one EP (Step 38). If the model-PWS has multiple EPs, the SafeWater LCR model will make no change to the model-PWS's P90y+1-range due to DSSA (Step 41). If, on the other hand, the model-PWS has only one EP (Step 40), then the SafeWater LCR model will set the model-PWS's P90y+1-range to reflect the improved system-wide corrosion control (Step 44). In both cases, the model-PWS will move to the next year-loop (Step 44).

If this is the fourth year the model-PWS has at least one lead tap sample above 10 µg/L (Step 36), and the model-PWS has not yet modified pH at all EPs (Step 39), then the model-PWS will adjust pH at its remaining EPs (Step 42). The SafeWater LCR model will set its P90y+1-range to reflect the improved corrosion control system-wide (Step 43). The model-PWS will then move to the next year-loop (Step 44).

Exhibit B-8: Simulating DSSA Requirements under the final LCRI in SafeWater LCR



B.4 Estimating Compliance Activity Under the 2021 LCRR

In order to maintain consistency between how the SafeWater LCR model estimates the costs for the final LCRI and the 2021 LCRR, certain parts of the cost model remain constant across rule scenarios, including the baseline characteristics of the model-PWSs, the analysis period and discount rates, how very large systems are modeled, the assignment of the model-PWS's initial P90, the likelihood a single sample is greater than the AL of (10 µg/L under the final LCRI and 15 µg/L under the 2021 LCRR), and how changes in source water or treatment changes impact the PWS's $P90_{y+1}$. Therefore, these elements are not repeated in this section.

In addition, the EPA estimated the costs of the 2021 LCRR under the same low cost and high scenarios used to estimate the final LCRI costs. The low scenario and high scenario differ in their assumptions made about: 1) the number of PWS above the AL (or TL under the 2021 LCRR); 2) the cost of installing and optimizing CCT; and 3) the cost of replacing SL with lead content.

This section describes the modeling framework for the 2021 LCRR that the SafeWater LCR model employs to determine if a model-PWS will take an action that will change its P90-range, which in turn will change other actions the model-PWS will be required to take.

B.4.1 Small CWS and NTNCWS Flexibility

The 2021 LCRR included flexibility for CWSs that serve 10,000 or fewer people, and all NTNCWSs. If these PWSs have a P90-range greater than the AL, they can choose from three options to reduce the concentration of lead in their water:[22]

1. Replace 7 percent of their baseline number of SLs with lead content per year until all SLs with lead content are replaced.[23]

2. Optimize existing CCT or install new CCT.

3. Provide POU devices to all customers.

For modeling purposes, the EPA assigns a compliance cost to all systems that exceed the ALE in the SafeWater LCR model. The EPA uses a cost minimization assumption in the model, and assigns the least cost alternative between the SLR, CCT, and POU compliance alternatives.

[22] The fourth option is available to CWSs serving 3,300 or fewer people and NTNCWSs that have control over their entire plumbing system. These systems may choose to remove all lead-bearing plumbing material. The EPA did not include this option in the cost analyses due to data constraints. The EPA lacks the system characteristic data that would allow the agency to determine a small system's cost for replacement of lead-bearing plumbing materials because of the significant variability among systems and the plumbing materials in the buildings they serve. Therefore, this option is not included in the model. The EPA assumes that systems selecting this compliance alternative would have lower costs than if they had changed their CCT or provided POU devises.

[23] States may, under the LCRR, require small CWSs to remove more than 7 percent of LSLs per year. However, for modeling purposes, the EPA assumed 7 percent per year.

B.4.2 Corrosion Control and Point-of-Use Technology

After the SafeWater LCR model determines whether a model-PWS's $P90_{y+1}$-range will be affected by a change in source water or treatment technology, the model continues within the year-loop and begins the process of determining whether the model-PWS will install CCT, re-optimize CCT, or install POU devices (in the case of small CWSs or all NTNCWSs). The SafeWater LCR model uses the model-PWS's $P90_{y+1}$-range rather than the current year-loop's initial P90-range ($P90_y$-range) to determine if the PWS will install CCT, re-optimize CCT, or install POU. This is because the EPA assumes that if a PWS proposes a significant change in water source or a change in treatment technology, the State will require the PWS to determine the impact of the change on lead levels, and take any corrective measures (installing CCT, re-optimizing CCT, or installing POU) before making the change in source water or treatment technology. Therefore, the SafeWater LCR model assumes that a change of water source or treatment technology would never lead to an ALE, as the PWS would implement, if needed, appropriate CCT or POU (if eligible) prior to the change.

The SafeWater LCR model keeps track of the model-PWS's CCT status throughout the period of analysis. Once a model-PWS with existing CCT[24] re-optimizes its CCT, or a model-PWS without CCT installs CCT, the EPA assumes that the CCT is optimized and no further changes to CCT will be needed.[25] Therefore, as the SafeWater LCR model continues within its year-loop (see Exhibit B-9), it determines whether the model-PWS has already re-optimized its existing CCT, or installed new CCT, and therefore has optimized CCT in place (Step 10). If it does, then the SafeWater LCR model makes no change to CCT in place and to the model-PWS's $P90_{y+1}$-range due to CCT (Step 22) and the model-PWS moves on to the next stage of the year-loop (Step 27).

Model CWSs serving more than 10,000 people with a $P90_{y+1}$-range greater than the AL (Step 11) and existing CCT in place (Step 16) will re-optimize their existing CCT (Step 17). If they do not have existing CCT in place (Step 16), they will install CCT (Step 19). The EPA assumes that both re-optimization of and installation of CCT, due to an ALE, will occur four years after the ALE (y+4) because of the time required to conduct a pipe loop study. The same is true for small model CWSs and all NTNCWS (Step 13) if CCT is their least costly compliance strategy (Step 15). However, if POU is their least costly compliance strategy (Step 20), the model-PWS will install POU (y+1) (Step 21). If POU and CCT are both not the model-PWS's least costly compliance strategy, then the SafeWater LCR model makes no change to the model-PWS's $P90_{y+1}$-range due to CCT or POU (Step 22), and the model-PWS moves on to the next stage of the year-loop (Step 27).

All model-PWSs that do not have optimized CCT (Step 10), have a $P90_{y+1}$-range greater than the TL but not greater than the AL (Steps 11 and 12), and have existing CCT in place (Step 14), will re-optimize their CCT (Step 18). The EPA assumes re-optimization due to a trigger level exceedance (TLE) will occur three years after the ALE (y+3) due to the time required to conduct a coupon study. If the model-PWS does

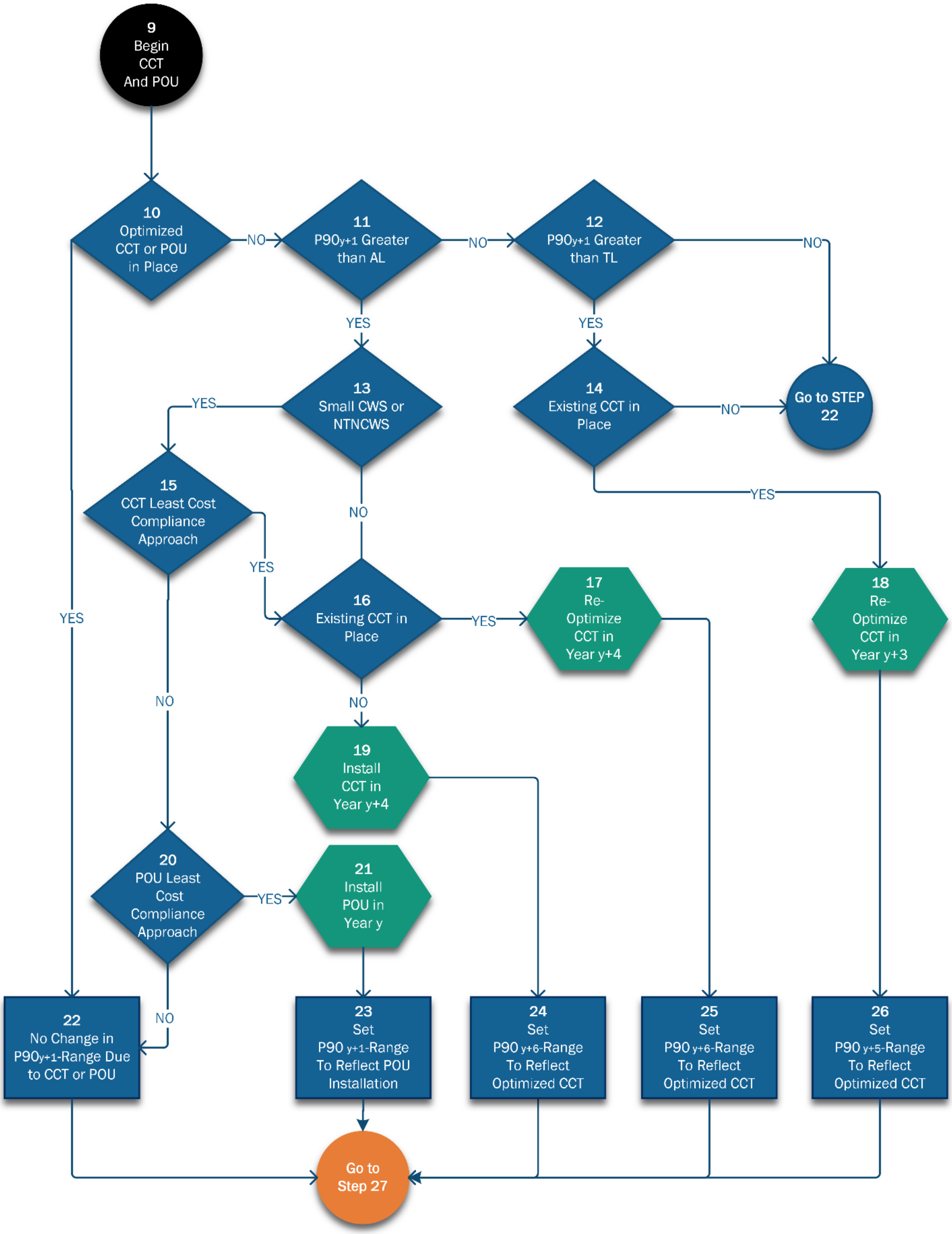
[24] The population served by PWSs with existing CCT at the beginning of the period of analysis are assumed to be exposed to lead concentrations associated with "partial" CCT in the EPA's benefit analysis (see Chapter 5).

[25] EPA assumes, for modeling purposes, that once CCT is optimized, no further CCT changes will be required unless the model PWS has multiple individual tap samples above the AL and is required to conduct DSSA the issues leading to the exceedances, as discussed in this appendix in Section B.3.5.

not have existing CCT (Step 14), it will take no action that results in the SafeWater LCR model changing the PWS's $P90_{y+1}$-range due to CCT (Step 22), and the model-PWS will move on to the next stage of the year-loop (Step 27).

Once a model-PWS re-optimizes existing CCT, or installs CCT, SafeWater will adjust its P90-range to reflect the effectiveness of the CCT in reducing lead levels (Steps 24, 25, and 26) before moving on to the next stage of the year-loop (Step 27). The EPA assumes it will take two years after CCT installation or re-optimization for the PWS's P90 levels to fall (y+6 for CCT installation or re-optimization due to an ALE; y+5 for CCT re-optimization due to a TLE). The EPA further assumes that a PWS's P90 level will fall immediately upon installation of POU (y+1).

Exhibit B-9: Simulating Corrosion Control and Point-of-Use Technology under the 2021 LCRR in SafeWater LCR



B.4.3 Replacements of Lead Content Service Line under the 2021 LCRR

The SafeWater LCR model keeps track of the number of lead content SLs a model-PWS still has in place at the beginning of each year-loop. If a model-PWS does not have any SLs with lead content in place (Step 28 in Exhibit B-10), then SafeWater will make no change to the model-PWS's $P90_{Y+1}$-range due to SLRs (Step 28), and the model-PWS moves on to the next stage of the year-loop (Step 46).

If a model-PWS has SLs with lead content in place at the beginning of the year-loop (Step 28), the requirements it faces depend on system size and type (Step 29). If the model-PWS is a CWS serving 10,000 or fewer people, or a NTNCWS (Step 29), its P90y-range is greater than the AL (Step 30), and SLR is its least costly compliance option (Step 33), then it is required to replace 7 percent of its baseline number of SLs with lead content each year (Step 34).[26] If its $P90_Y$-range is not greater than the AL (Step 30), or SLR is not the least costly compliance option (Step 33), it will be required to replace SLs with lead content when the system becomes aware that a household has replaced their side of the service line (Customer Initiated SLR, see Step 40).[27]

If the model-PWS is not a CWS serving 10,000 or fewer people, or a NTNCWS (Step 29), its SLR requirements depend on the model-PWS's $P90_Y$-range. If the model-PWS's $P90_Y$-range is greater than the AL (Step 31), it is required to implement a mandatory SLR program replacing a rolling two-year average of 3 percent of the unknown and known SLs with lead content per year. This rolling average allows systems that experience SLR rate fluctuation to still meet a 3 percent replacement rate on average for each two-year period while the water system is required to implement the SLR program. The regulation also requires that a cumulative number of replacements be reached equal to 3 percent of the sum of known lead, GRR, and lead status unknown service lines in the initial inventory, times the number of years that elapsed between the system's first ALE and the date on which the system's lead P90-range levels are at or below the AL for two years (four consecutive 6-month monitoring periods). Because the EPA does not have information on the annual variation in replacement rates which systems may experience when required to conduct mandatory replacement, the agency has assumed an annual replacement rate of 3 percent (which equals a 3 percent rolling average value across all two-year time periods)(Step 35).[28] If its P90y-range is greater than the TL but not greater than the AL (Steps 31 and 32),

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[26] Under the 2021 LCRR, LSLR requirements (either mandatory or goal-based) do not allow PWSs to count test-outs or partial LSLR. Therefore, the SafeWater LCR model assumes that model-PWSs required to conduct mandatory SLR will replace 3 percent of their baseline LSL inventory annually (which includes only actual full physical SLRs), and that model-PWSs subject to goal-based LSLR goals must meet these goals by replacing actual full physical LSLs. The SafeWater LCR model does account for the cost associated with test-outs in the pre-2021 LCR cost estimation.

[27] Under the 2021 LCRR, PWSs are required to replace the public side of the LSL if a homeowner replaces the customer portion of the LSL. If a PWS has a mandatory or goal-based SLR program, this removal would count towards their required or goal-based SLRs. If the PWS does not have an active SLR program, the PWS would still incur the cost to replace the system side of the LSL.

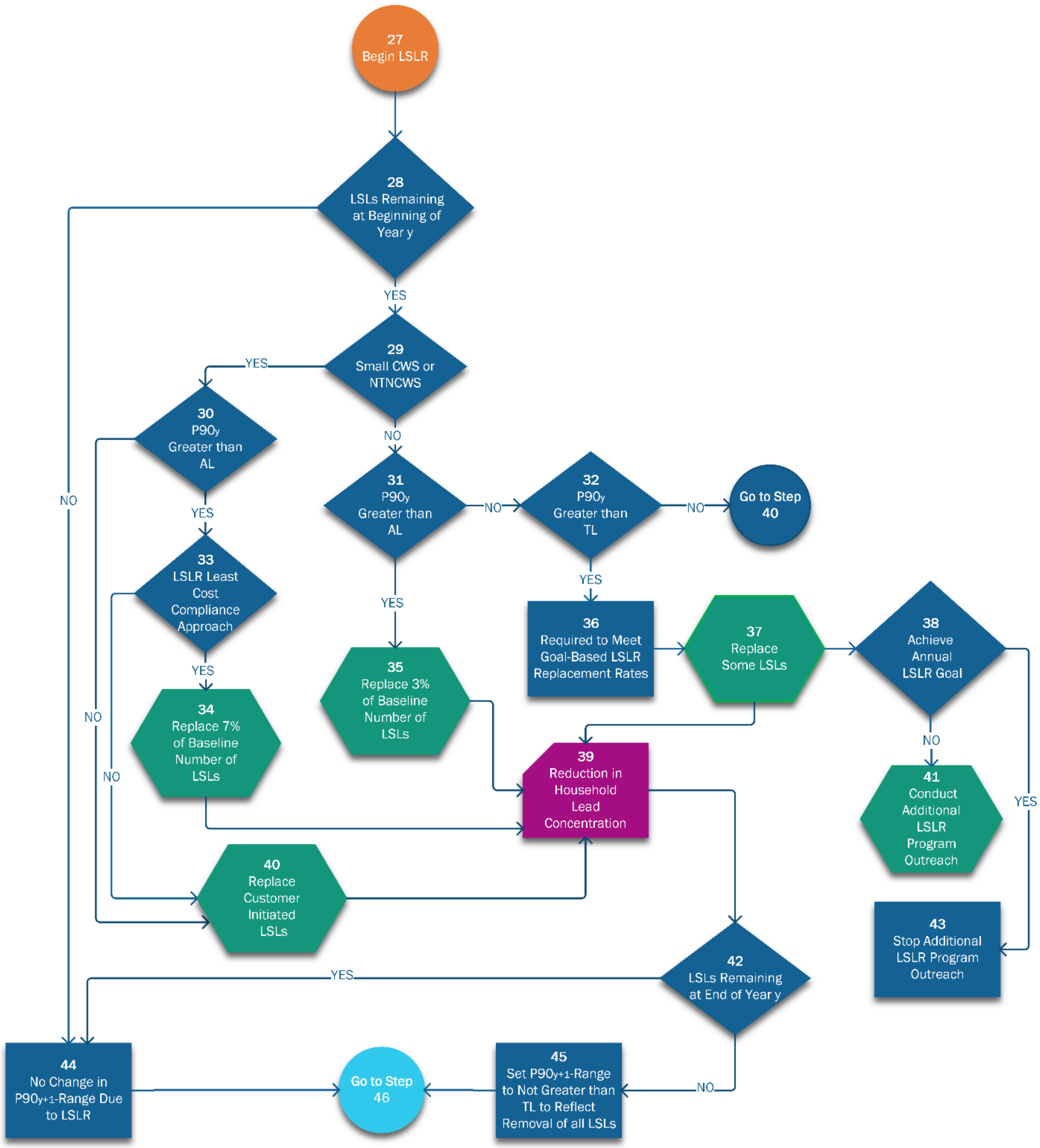
[28] The EPA's LSLR costs capture all estimated replacements required under the rule but because the assumed 3 percent annual rate may not capture the variation in SL replacement rate at water systems which could experience higher rates of replacement in the first of any two-year period for the rolling average or could experience lower rates of replacement in the first year of the two year rolling average period, the EPA's estimated discounted costs may be under or over estimated.

it is required to establish an annual SLR goal-based rate in consultation with the State (Step 36) and will replace some number of SLs with lead content each year (Step 37). If the model-PWS fails to meet its annual SLR goal-based rate (Step 38), it is required to undertake additional goal-based SLR program outreach (Step 41). The quantity and types of additional outreach required depend on the number of consecutive periods the model-PWS fails to meet its goal. If it meets its annual SLR goal-based rate (Step 38), it may stop the additional SLR program outreach (Step 41). If the model-PWS's $P90_{y}$-range is not greater than the TL (Step 32), it will be required to replace SLs with lead content when the system becomes aware that a household has replaced their side of the service line (Step 40).

When a model-PWS replaces any SLs with lead content during the year (Steps 34, 35, 37, and 40), the SafeWater LCR model determines whether, at the end of the year, the model-PWS has no more SLs with lead content remaining (Step 42). If this is the case, the SafeWater LCR model sets the $P90_{y+1}$-range to not greater than the TL to reflect the impact of SLRs on lead concentrations (Step 45)[29] and the model-PWS moves on to the next stage of the year-loop (Step 46). If, at the end of the year, the model-PWS still has SLs with lead content in place, the SafeWater LCR model will make no change to the model-PWS's $P90_{y+1}$-range due to SLR (Step 44), and the model-PWS moves on to the next stage of the year-loop (Step 46).

[29] Under the 2021 LCRR, when PWSs replace an LSL at a tap water sampling location, they are required to replace that sampling location with a new sampling location that has an LSL. Therefore, it is likely that a PWS will not see a decrease in their P90-range until most LSLs are removed. As a modeling assumption, the SafeWater LCR model reduced a PWS's $P90_{y+1}$-range only after all LSLs are removed.

Exhibit B-10: Simulating Lead Service Line Replacements under the 2021 LCRR



B.4.4 Distribution System and Site Assessment (Find and Fix under the LCRR)

In addition to requiring PWSs to take compliance actions to reduce lead concentrations when their system-wide P90 exceeds the TL or AL, the 2021 LCRR requires PWSs to find-and-fix distribution system issues that cause a single lead tap water sample to exceed 15 µg/L. Although the 2021 LCRR requires any PWS with tap water samples exceeding 15 µg/L to identify and address localized elevated lead

concentrations, the EPA assumes, for modeling purposes, that CCT-related find-and-fix[30] requirements will be addressed only after a PWS has optimized CCT in place. Therefore, if a model-PWS does not have optimized CCT in place (Step 48 in Exhibit B-12) or does not have at least one lead tap sample above 15 µg/L in the year (Step 49), then it is assumed to not make any CCT adjustments, and the SafeWater LCR model will make no change to the model-PWS's $P90_{y+1}$-range due to find-and-fix (Step 57). The model-PWS will simply move to the next year-loop (Step 60, Exhibit B-12)

If a model-PWS does have optimized CCT in place, the SafeWater LCR model calculates the number of tap samples that will be above 15 µg/L in the current year of the analysis as a binomial distribution defined by the number of samples the model-PWS takes during the year and the likelihood that any given sample will be greater than 15 µg/L (Step 49). The number of tap samples a model-PWS will take in a year depends on the model-PWS's tap sampling frequency (semi-annual, or once every one, three, or nine years) and the system size.[31] Exhibit B-11 provides the likelihood that a single lead tap sample will be above 15 µg/L, which varies by the model-PWS's $P90_{y}$-range and lead content SL status.

Exhibit B-11: Likelihood that a Single Tap Water Sample Will be in Each of the Five Bins Used for Modelling Purposes under the 2021 LCRR

LSL Status	P90 >15 µg/L	12 µg/L < P90 ≤ 15 µg/L	10 µg/L < P90 ≤ 12 µg/L	5 µg/L < P90 ≤ 10 µg/L	P90 ≤ 5 µg/L
	pp90above al15_1	*pp90above al15_2*	*pp90above al15_3*	*pp90above al15_4*	*pp90above al15_5*
Has LSLs	16.9%	9.3%	5.3%	3.1%	0.7%
No LSLs	22.2%	10.0%	7.9%	3.0%	0.4%

Acronyms: LCRR = Lead and Copper Rule Revisions; LSL = lead service line; P90 = lead 90th percentile level.
Notes:
For additional detail, see file "Likelihood_Sample_Above_AL_LCRR_Find_Fix_Final.xlsx," available in the docket at EPA-HQ-OW-2022-0801 at www.regulations.gov. Also see Chapter 3, Section 3.3.5.3.1.

The causes of, and associated solutions to, localized elevated lead concentrations within a distribution system are varied and location-specific. In order to estimate model-PWS costs, the EPA developed the following assumptions about how model-PWSs would respond to the 2021 LCRR find-and-fix requirements:

1. The first year, after CCT installation or CCT re-optimization, that a model-PWS has a tap sample above 15 µg/L, the PWS will investigate but take no corrective action.

[30] Note the 2021 LCRR rule refers to the assessment of individual locations in the distribution system with lead tap samples exceeding the lead AL as find-and-fix. The final LCRI has updated the name of these requirements to Distribution System and Site Assessment (DSSA) to better match the intent of the required actions.

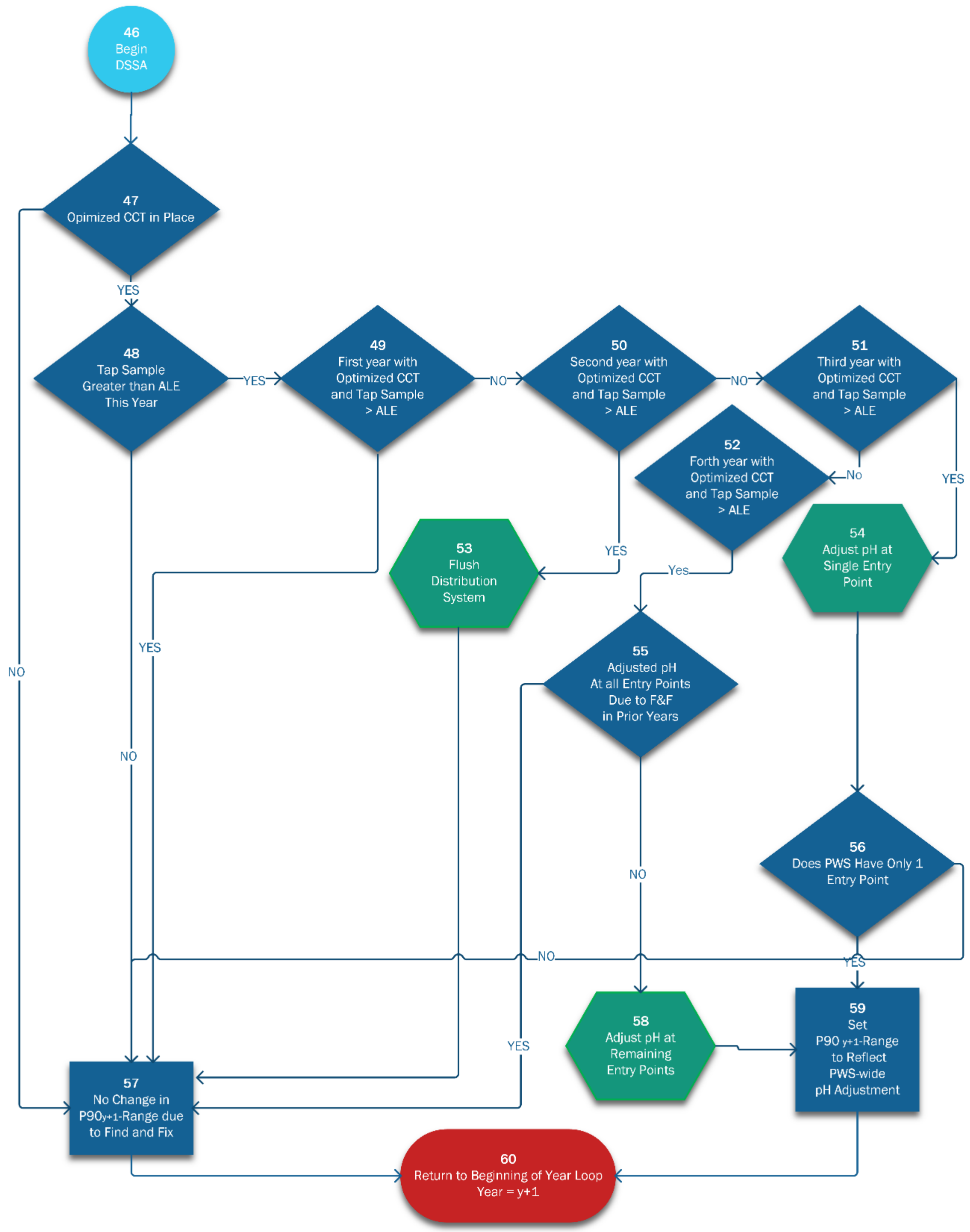
[31] See Chapter 3, Section 3.3.7 for a discussion of sampling frequencies and monitoring schedules.

2. The second year, after CCT installation or CCT re-optimization, that a model-PWS has a tap sample above 15 µg/L, it will flush the distribution system in the affected area to reduce water age, improving CCT, and lower lead concentration levels.
3. The third year, after CCT installation or CCT re-optimization, that a model-PWS has a tap sample above 15 µg/L, it will adjust pH at one EP to the distribution system. This is the final action a model-PWS with only one EP will take in response to the find-and-fix requirement.
4. The fourth year, after CCT installation or CCT re-optimization, if a model-PWS, with more than one EP, has a tap sample above 15 µg/L, it will adjust pH at its remaining EPs. This is the final action any model-PWS will take in response to the find-and-fix requirement.

Therefore, within the SafeWater LCR model, if a model-PWS with re-optimized CCT in place (Step 48 in Exhibit B-12) has at least one lead tap sample above 15 µg/L in a given year (Step 49), its response will depend on the find-and-fix activity it took in prior years:

1. If this is the first year the model-PWS has at least one lead tap sample above 15 µg/L (Step 49), it will investigate the issue but take no corrective actions. The SafeWater LCR model will make no change to the model-PWS's P90y+1-range due to find-and-fix (Step 57). The model-PWS will move to the next year-loop (Step 60).
2. If this is the second year the model-PWS has at least one lead tap sample above 15 µg/L (Step 50), it will flush its distribution system once to reduce lead levels (Step 53). The SafeWater LCR model will make no change to the model-PWS's P90y+1-range due to find-and-fix (Step 57). The model-PWS will move to the next year-loop (Step 60).
3. If this is the third year the model-PWS has at least one lead tap sample above 15 µg/L (Step 51), it will adjust the pH at one EP (Step 54). If the model-PWS has multiple EPs, the SafeWater LCR model will make no change to the model-PWS's P90y+1-range due to find-and-fix (Step 57). If, on the other hand, the model-PWS has only one EP, then the SafeWater LCR model will set the model-PWS's P90y+1-range to reflect the improved system-wide corrosion control (Step 59). In both cases, the model-PWS will move to the next year-loop (Step 60).
4. If this is the fourth year the model-PWS has at least one lead tap sample above 15 µg/L (Step 52), and the model-PWS has not yet modified pH at all EPs (Step 55), then the model-PWS will adjust pH at its remaining EPs (Step 58). The SafeWater LCR model will set its P90y+1-range to reflect the improved corrosion control system-wide (Step 59). The model-PWS will then move to the next year-loop (Step 60).

Exhibit B-12: Simulating Distribution System Assessment Costs under the 2021 LCRR in SafeWater



B.5 Detailed Public Water System Costing Approach for the 2021 LCRR

This section details how the EPA estimated the cost of water system compliance for each major rule component of the LCRR. To more easily compare the costing approaches between the 2021 LCRR and final LCRI, Section B.5 is organized similarly to Section 4.3 in Chapter 4 and includes the following sections:

- B.5.1: PWS Implementation and Administrative Costs
- B.5.2: PWS Sampling Costs
- B.5.3: PWS Corrosion Control Costs
- B.5.4: PWS Lead Service Line Inventory and Replacement Costs
- B.5.5: PWS POU-Related Costs
- B.5.6: PWS Lead Public Education, Outreach, and Notification Costs

For most activities, water systems will incur costs in the form of burden (*i.e.,* hours). The burden is multiplied by the labor rate ($/hr), as presented in Chapter 3, Section 3.3.11.1, to estimate labor unit costs. Systems will also incur capital and operation and maintenance (O&M) costs for some activities. Exhibit B-13 shows all the components, subcomponents, and activities from Exhibit 4-6 in Chapter 4 for the final LCRI. For each major rule component, each activity has a unique letter identification (ID). The differences in activities costed for the final LCRI and the 2021 LCRR are identified as follows: 1) *gray shading italicized text* indicates new activities under the final LCRI that are not part of the 2021 LCRR requirements; and 2) **yellow shaded activities in bold** are specific to the 2021 LCRR and are not included in the final LCRI requirements.

Exhibit B-13: PWS Cost Components, Subcomponents, and Activities Organized by Section for the 2021 LCRR[1]

Component	Subcomponents	Activities[2]
B.5.1: PWS Implementation and Administrative Costs under the 2021 LCRR	None.	*a) Read and understand the rule.* *b) Assign personnel and resources for rule implementation.* *c) Participate in training and technical assistance provided by the State during rule implementation.* *d)* Provide small system flexibility option recommendation to the State.
B.5.2: PWS Sampling Costs under the 2021 LCRR	B.5.2.1: PWS Lead Tap Sampling under the 2021 LCRR	a) Update sampling instructions for lead tap sampling and submit to the State. b) Contact homes to establish new 100 percent LSL tap sampling pool. c) Submit tap sampling plan to the State. d) Report any changes in sampling locations to the State. e) Confer with the State on initial lead sampling data and status under the rule. f) Obtain households for each round of lead tap sampling. g) Offer incentives to households to encourage participation in lead tap sampling program.

Component	Subcomponents	Activities[2]
		h) Ship tap sampling material and instructions to participating households. i) Collect lead tap samples. j) Determine if a sample should be rejected and not analyzed. k) Analyze lead tap samples in-house or commercially. l) Prepare and submit sample invalidation request to the State. m) Inform consumers of tap sample results. n) Certify to the State that results were reported to consumers. o) Submit request to renew 9-year monitoring waiver to the State. p) Submit sampling results and 90th percentile calculation to the State. q) *Oversee the customer-initiated lead sampling program.* r) *Ship tap sampling material and instructions to participating households for customer-initiated lead sampling program.* s) *Collect lead tap samples for customer-initiated lead sampling program.* t) *Analyze lead tap samples in-house or commercially for customer-initiated lead sampling program.* u) *Inform customers of lead tap sample results for customer-initiated lead sampling program.*
B.5.2: PWS Sampling Costs (continued)	B.5.2.2: PWS Lead Water Quality Parameter Monitoring under the 2021 LCRR	v) Collect lead WQP samples from the distribution system. w) Analyze lead WQP samples from the distribution system. x) Collect lead WQP samples from entry points. y) Analyze lead WQP samples entry points. z) Report lead WQP sampling data and compliance with OWQPs to the State.
	B.5.2.3: PWS Copper Water Quality Parameter Monitoring under the 2021 LCRR	aa) Collect copper WQP samples from the distribution system. bb) Analyze copper WQP samples from the distribution system. cc) Collect copper WQP samples from entry points. dd) Analyze copper WQP samples from entry points. ee) Report copper WQP sampling data and compliance with OWQPs to the State.
	B.5.2.4: PWS Source Water Monitoring under the 2021 LCRR	ff) Collect source water samples. gg) Analyze source water samples. hh) Report source water monitoring results to the State.
	B.5.2.5.1: CWS School and Child Care Lead Sampling Costs under the 2021 LCRR– First Five-Year Cycle	ii) Create a list of schools and child care facilities served by CWS and submit to State. jj) Develop lead outreach materials for schools and child care facilities. kk) Prepare and distribute initial letters explaining the sampling program and the EPA's 3Ts Toolkit. ll) Contact elementary school or child care facility to determine and finalize its sampling schedule (one-time)

Component	Subcomponents	Activities[2]
		or contact secondary school to offer sampling (annual). mm) Contact school or child care facility to coordinate sample collection logistics. nn) Conduct walkthrough at school or child care facility before the start of sampling. oo) Travel to collect samples. pp) Collect samples. qq) Analyze samples. rr) Provide sampling results to tested facilities. ss) Discuss sampling results with the school or child care facility. tt) Conduct detailed discussion of high sampling results with school and child care facilities. uu) *Report school and child care facility sampling results to the State.* vv) Prepare and provide annual report on school and child care facility sampling program to the State.
B.5.2: PWS Sampling Costs under the 2021 LCRR (continued)	B.5.2.5.2: CWS School and Child Care Facility Lead Sampling Costs under the 2021 LCRR – Second Five-Year Cycle On	ww) Update the list of schools and child care facilities and submit to the State. xx) Contact schools and child care facilities to offer sampling. yy) Contact the school or child care facility to coordinate sample collection logistics. zz) Conduct walkthrough at school or child care facility before the start of sampling. aaa) Travel to collect samples. bbb) Collect samples. ccc) Analyze samples. ddd) Provide sampling results to tested facilities. eee) Discuss sampling results with the school and child care facility. fff) Conduct detailed discussion of high sampling results with schools and child care facilities. ggg) *Report school and child care facility sampling results to the State.* hhh) Prepare and provide annual report on school and child care facility sampling program to the State.
B.5.3: PWS Corrosion Control Costs under the 2021 LCRR	B.5.3.1: CCT Installation	a) Conduct a CCT study. b) Install CCT (PO_4, PO_4 with post treatment, pH adjustment, or modify pH).
	B.5.3.2: Re-optimization of Existing Corrosion Control Treatment	c) Revise CCT study. d) Re-optimize existing CCT.
	B.5.3.3: Find-and-Fix Costs	e) Contact customers and collect follow-up tap sample. f) Analyze follow-up lead tap sample. g) Collect distribution system WQP sample. h) Analyze distribution system WQP sample. i) Review incidents of systemwide event and other system conditions. j) Consult with the State prior to making CCT changes.

Component	Subcomponents	Activities[2]
		k) Report follow-up sample results and overall "find-and-fix"[3] responses to the State.
	B.5.3.4: System Lead CCT Routine Costs	l) Review CCT guidance. m) Provide WQP data to the State and discuss during sanitary survey. n) Notify and consult with the State on required actions in response to source water change. o) Notify and consult with the State on required actions in response to treatment change.
B.5.4: PWS Lead Service Line Inventory and Replacement Costs under the 2021 LCRR	B.5.4.1: Service Line Inventory-Related Activities	a) *Conduct records review for connector materials.* b) *Compile and submit connector updated LCRR initial inventory information (baseline inventory) to the State.* c) Identify material for unknown service lines. d) Report annual inventory updates to the State. e) *Conduct field investigations for inventory validation.* f) *Report validation results to State.*
	B.5.4.2: Service Line Replacement Plan	g) Develop initial SLR plan and submit to the State for review. h) Identify funding options for full SLRs. i) *Include information on deferred deadline and associated replacement rate in the SLR plan.* j) *Update SLR plan annually or certify no changes.* k) *Provide an updated recommendation of the deferred deadline and associated replacement rate.*
	B.5.4.3: Physical Service Line Replacements	l) System replaces lead and GRR service lines.
	B.5.4.4: Ancillary Service Line Replacement Activities	m) Contact customers and conduct site visits prior to service line replacement. n) Deliver filters and 6 months of replacement cartridges at time of service line replacement. o) Collect tap sample post-service line replacement. p) Analyze post-service line replacement tap sample. q) Inform customers of tap sample result. r) Submit annual report on service line replacement program to the State.
	B.5.4.5: Goal-Based Replacement Program Activities	s) **Consult with the State and develop targeted SLR program outreach materials.** t) **Distribute targeted SLR program outreach materials.** u) **CWS replaces its portion of lead or GRR service line.** v) **Household replaces privately-owned portion of the lead or GRR service line.** w) **Consult with State on activities to satisfy additional goal-based SLR program outreach requirements if CWS > 10,000 fails to meet goal.** x) **Conduct activities in response to the first failure to meet SLR goal.** y) **Conduct activities in response to each additional failure to meet SLR goal.**
B.5.5: PWS POU-Related Costs under the 2021 LCRR	B.5.5.1: POU Device Installation and Maintenance	a) Provide, monitor, and maintain POU devices.

Component	Subcomponents	Activities[2]
	B.5.5.2: POU Ancillary Activities	b) Develop POU plan and submit to the State. c) Develop public education materials and submit to the State. d) Print POU education materials. e) Obtain households for POU monitoring. f) Deliver POU monitoring materials and instructions to participating households. g) Collect tap samples after POU installation. h) Determine if sample should be rejected and not analyzed i) Analyze POU tap samples. j) Prepare and submit sample invalidation request to the State. k) Inform customers of POU tap sample results. l) Certify to the State that POU tap results were reported to customers. m) Prepare and submit annual report on POU program to the State.
B.5.6: PWS Lead Public Education, Outreach, and Notification Costs under the 2021 LCRR	B.5.6.1: Consumer Notice	a) Develop lead consumer notice materials and submit to the State for review. b) Provide a copy of the consumer notice and certification to the State.
	B.5.6.2: Activities Regardless of Lead 90th Percentile Level	c) Update CCR language. d) Develop new customer outreach plan. e) Develop approach for improved public access to lead health-related information and tap sample results. f) Establish a process for public access to information on known or potential lead content SL locations and tap sample results. g) Maintain a process for public access to lead health information, known or potential lead content SL locations, and tap sample results. h) Respond to customer request for known or potential lead content SL information. i) Respond to requests from realtors, home inspectors, and potential home buyers for known or potential lead content SL information. j) Develop a list of local and State health agencies. k) Develop lead outreach materials for local and State health agencies and submit to the State for review. l) Deliver lead outreach materials for local and State health agencies. m) Develop public education materials for known or potential lead content SL disturbances and submit to the State. n) Deliver public education for SL disturbances. o) Deliver filters and 6 months of replacement cartridges during disturbances of SLs. p) Develop inventory-related outreach materials and submit to the State for review.

Component	Subcomponents	Activities[2]
B.5.6: PWS Lead Public Education, Outreach, and Notification Costs under the 2021 LCRR (continued)		q) Distribute inventory-related outreach materials. r) *Provide translation services for public education materials.* s) Certify to the State that lead outreach was completed.[4]
	B.5.6.3: Activities in Response to Lead ALE	t) Update mandatory language for lead ALE public education and submit to the State for review. u) Deliver lead ALE public education materials to all customers. v) Post notice to website. w) Prepare press release. x) Contact public health agencies to obtain additional organizations and update recipient list. y) Notify public health agencies and other organizations. z) Consult with State on other public education activities. aa) Implement other public education activities.
	Public Education Activities in Response to Multiple Lead ALEs	bb) *Develop plan for making filters available and submit to the State for review.* cc) *Develop outreach materials for systems with multiple lead ALEs and submit to the State for review.* dd) *Conduct enhanced public education for systems with multiple lead ALEs.* ee) *Consult with State on filter program for systems with multiple lead ALEs.* ff) *Administer filter program for systems with multiple lead ALEs.* gg) *Make filters available due to multiple lead ALEs.*

Acronyms: ALE = action level exceedance; CCR = Consumer Confidence Report; CCT = corrosion control treatment; CWS = community water system; DSSA = Distribution System and Site Assessment; EPA = Environmental protection Agency; GRR = galvanized requiring replacement; LCRR = Lead and Copper Rule Revisions; LSL = lead service line; OCCT = optimal corrosion control treatment; OWQPs = optimal water quality parameters; POU = point-of-use; PO_4 = orthophosphate; PWS = public water system; SDWIS/Fed = Safe Drinking Water Act Information System/Federal version; SL = service line; SLR = service line replacement; WQP = water quality parameter.

Notes:

[1] Systems will also incur burden for recordkeeping activities under the 2021 LCRR, such as retaining records of decisions, supporting documentation, technical basis for decisions, and documentation submitted by the system. The EPA has included burden for recordkeeping with each activity when applicable and opposed to providing separate burden estimates.

[2] The EPA assigned a unique letter ID for each activity under a given rule component. Activities are generally organized with upfront, one-time activities first followed by ongoing activities. The lettering follows that used for the final LCRI, in Chapter 4, Exhibit 4-6, with the exception of activities that apply to the 2021 LCRR but not the final LCRI.

[3] Under the final LCRI, the term "find-and-fix" is replaced with Distribution System and Site Assessment.

[4] This certification is inclusive of outreach activities in Sections B.5.6.1 through B.5.6.3.

As was done in Chapter 4, Appendix B includes at the end of each subsection, a summary exhibit showing the SafeWater LCR modeling approach for each water system activity (*e.g.*, Exhibit B-15). The exhibits follow the organization of the corresponding exhibits in Chapter 4 (*e.g.*, Exhibit B-15 mirrors Chapter 4, Exhibit 4-8) and are organized as follows:

- The first and second columns show how unit burden and labor rate information is combined to estimate a CWS and NTNCWS cost per activity, respectively.
- The third and fourth columns indicate the conditions under which the water system activity occurs. The columns indicate if the system activity is dependent on:
  - The system's 90th percentile range. See Appendix B, Section B.4 for a detailed discussion of how the SafeWater LCR model tracks a water system's 90th percentile level and accounts for changes in the 90th percentile level over the 35-year analysis period.
  - Other characteristics of the system such as presence or absence of SLs with lead content and/or CCT, and frequency of monitoring.
- The fifth column indicates the frequency of the activity (*e.g.*, one-time, annually, every 3 years).

In those instances where the costing approach for a specific activity is the same under the 2021 LCRR and final LCRI, the exhibit directs the reader to the corresponding final LCRI exhibit in Chapter 4.

The SafeWater LCR uses the information from these exhibits to calculate total annualized water system cost for each activity. See Sections B.2 and B.4 for detail on the cost modeling methodology.

B.5.1 PWS Implementation and Administrative Costs under the 2021 LCRR

The EPA has developed costs for system implementation and administrative activities under the 2021 LCRR, as shown in Exhibit B-14. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden or cost, and SafeWater LCR data variable are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.1.1. The assumptions that differ for the 2021 LCRR from final LCRI are provided in notes to the exhibit. Note that for activity d), the unit burden to provide a small system flexibility option to the State is the same under the 2021 LCRR as the final LCRI; however, the activity occurs in Year 1 of the 35-year analysis period under the 2021 LCRR and Year 4 under the final LCRI. Also, the requirement is for the subset of CWSs serving 10,000 or fewer people and NTNCWSs exceeding the TL of 10 µg/L under the LCRR. Under the final LCRI, this requirement applies to CWSs serving 3,300 or fewer people and NTNCWSs that exceed the final lead AL of 10 µg/L.

The EPA recognizes that systems would also incur administrative burden related to specific requirements under the 2021 LCRR. In these cases, the system burden is estimated under that rule requirement.

Exhibit B-14: PWS One-Time Administration Activities and Unit Burden Estimates under the 2021 LCRR

Activity	Unit Burden and/or Cost (hours/system)	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Read and understand Rule	*N/A. Occurred prior to the start of the 35-year analysis period.*		
b) Assign personnel and resources for rule implementation	*N/A. Occurred prior to the start of the 35-year analysis period.*		
c) Participate in training and technical assistance provided by the State during rule implementation	*N/A. Occurred prior to the start of the 35-year analysis period.*		
d) Provide small system flexibility option recommendation to the State	12 hrs/CWSs serving ≤10,000 and all NTNCWSs	*hrs_sm_flex_option_op*	No.[1]

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; NTNCWS = non-transient non-community water system; PWS = public water system

Sources:

a)- c): The EPA assumes systems will already have incurred the burden for these activities prior to the start of the 35-year analysis period of the final LCRI. Based on implementation burden estimated for the EPA's 2012, *Economic Analysis for the Final Revised Total Coliform Rule* (USEPA, 2012). Available in the docket at EPA-HQ-OW-2022-0801 at www.regulations.gov.

d): Association of State Drinking Water Administrators (ASDWA) 2024 Costs of States Transactions Study (CoSTS) model (ASDWA, 2024).

Notes:

General: These data variables are also provided in "Administrative Burden and Costs_Final.xlsx."

[1] Under the 2021 LCRR, this activity is assumed to occur in Year 1 of the 35-year analysis period and applies to CWSs serving 10,000 or fewer people and NTNCWSs that exceed the lead TL of 10 µg/L. Under the final LCRI, the activity is assumed to occur in Year 4 and applies to CWSs serving 3,300 or fewer people and NTNCWSs that exceed the lead AL of 10 µg/L.

Exhibit B-15 provides the SafeWater LCR model cost estimation approach for system one-time PWS administrative and rule implementation activities including additional cost inputs required to calculate these costs. The gray shaded rows indicate activities that do not apply to the 2021 LCRR because they occurred prior to the 35-year analysis period.

Exhibit B-15: PWS Administration and Rule Implementation Cost Estimation in SafeWater LCR by Activity for the 2021 LCRR

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
a) Read and understand the rule				
N/A. Occurred prior to the start of the 35-year analysis period.				
b) Assign personnel and resources for rule implementation				
N/A. Occurred prior to the start of the 35-year analysis period.				

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
c) Participate in training and technical assistance provided by the State during rule implementation				
N/A. Occurred prior to the start of the 35-year analysis period.				
d) Provide small system flexibility option recommendation to the State				
The total hours per system multiplied by the system labor rate. *(hrs_sm_flex_option_op*rate_op)*[1]	Cost applies as written to NTNCWSs.	Above TL	CWSs serving ≤ 10,000 people and NTNCWSs	One time

Acronyms: CWS = community water system; LCR = Lead and Copper Rule; LCRR = Lead and Copper Rule revisions; NTNCWS = non-transient non-community water system; PWS = public water system; TL = trigger level.
Notes:
[1] See Chapter 3, Section 3.3.11.1 for a definition of PWS hourly labor rate (*rate_op*).

B.5.2 PWS Sampling Costs under the 2021 LCRR

This section provides system unit burden and cost for lead tap sampling, lead water quality parameter (WQP) monitoring, copper WQP monitoring, source water monitoring, and sampling in schools and child care facilities under the 2021 LCRR in Sections B.5.2.1 through B.5.2.5, respectively.

B.5.2.1 PWS Lead Tap Sampling under the 2021 LCRR

The discussion of lead tap sampling costs for water systems is presented in the following subsections:

- B.5.2.1.1: Lead Tap Sampling Schedules and Required Number of Samples
- B.5.2.1.2: Lead Tap Sampling Activities

Activities and costs for tap monitoring associated with the POU program are not included in this section but are provided in Section B.5.5.

B.5.2.1.1 Lead Tap Sampling Schedules and Required Number of Samples

All CWSs and NTNCWSs are subject to lead tap sampling requirements. The frequency and required number of samples depend on the systems' lead 90th percentile level but all systems with LSLs, GRRs, or unknown lines are assumed to conduct one year of semi-annual monitoring at the start of the rule (assumed to be Year 1). Systems with all non-lead service lines that are at or below the lead AL of 15 µg/L and above the lead TL of 10 µg/L are required to begin annual monitoring starting in Year 1. Systems with all non-lead service lines that are above the lead AL of 15 µg/L are required to begin semi-annual monitoring starting in Year 1. For systems at or below the lead TL of 10 µg/L, the EPA assumed systems will retain their monitoring schedule form the pre-2021 LCR from Year 1 onward.

Under the 2021 LCRR after Year 1, only systems with a 90th percentile level at or below the TL of 10 µg/L can qualify to conduct lead tap sampling at the reduced number of sites annually, triennially, or every 9 years. The EPA estimated the percentages of systems with a 90th percentile level at or below 10 µg/L

that would be on semi-annual monitoring,[32] and on a reduced annual *(p_tap_annual)*, triennial *(p_tap_triennial)*, or 9-year *(p_tap_nine)* monitoring schedule based on historical SDWIS/Fed data.

Those with a lead ALE must conduct lead tap sampling every six months at the standard number of sample sites (*i.e.*, standard semi-annual monitoring); those with a lead TLE (*i.e.*, 90th percentile value above 10 µg/L but at or below 15 µg/L) must sample annually at the standard number of sites. In addition, systems must sample for a minimum of two, six-month tap sampling monitoring periods following a change in source water or significant or long-term change in treatment. Because the number of required sampling sites and sampling schedules can vary, costs are estimated separately for systems on the different lead tap sampling monitoring schedules. Chapter 3, Sections 3.3.7.2 and 3.3.7.3 provides the EPA's approach for determining the initial tap monitoring requirements under the 2021 LCRR and final LCRI, respectively.

The minimum required standard number of tap samples (*numb_samp_customer*) or reduced number of samples (*numb_reduced_tap*) is the same under the pre-2021 LCR, 2021 LCRR, and final LCRI. Refer to Exhibit 4-9 in Chapter 4 for the minimum number of tap samples for CWSs and NTNCWSs on standard monitoring and reduced monitoring schedules.

B.5.2.1.2 Lead Tap Sampling Activities

The EPA has developed costs for system activities associated with lead tap sampling under the 2021 LCRR, as shown in Exhibit B-16. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. In a few instances, some of these activities are conducted by the State instead of the water system. These activities are identified in the exhibit and further explained in the exhibit notes. The last column indicates whether the activity, unit burden or cost, and SafeWater LCR data variable are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.2.1.2. The assumptions that differ for the 2021 LCRR from the final LCRI follow the exhibit. The gray shaded rows indicates an activity that is not required under the 2021 LCRR. Note that this section does not pertain to CWSs serving 10,000 or fewer and NTNCWSs that are using the POU provision and maintenance program as their lead compliance option. These systems have some different lead tap sampling requirements that are discussed in Section B.5.5.

Note that the conditions under which the sampling activities occur are different under the 2021 LCRR compared to the final LCRI. The 2021 LCRR tap sampling frequency is a function of whether the 90th percentile lead concentration is above the TL of 10 µg/L or above the AL of 15 µg/L. Under the final LCRI, the tap sampling frequency is based on whether the 90th percentile lead concentration is above the final lead AL of 10 µg/L, as discussed in Chapter 4, Section 4.3.2.1.2.

[32] The likelihood that a system with a 90th percentile value at or below 10 µg/L being on an initial semi-annual monitoring schedule is 1 minus (*p_tap_annual* + *p_tap_triennial* + *p_tap_nine*).

Exhibit B-16: PWS Lead Tap Sampling Unit Burden and Cost Estimates under the 2021 LCRR

Activity	Unit Burden and/or Cost[1]	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Update sampling instructions for lead tap sampling and submit to the State (one-time)	2 hrs/CWS and NTNCWS	*hrs_devel_samp_op*[2]	Yes.
b) Contact homes to establish new 100 percent LSL tap sampling pool (one-time)	5 to 100 hrs/CWS with LSLs	*hrs_add_lsl_samp_op*	Yes.
c) Update and submit tap sampling plan (one-time)	• No LSLs: 2 to 6 hours per PWS • With LSLs: 8 to 20 hours per PWS	*hrs_samp_plan_op*	Yes.
d) Report any changes in sampling locations to the State	3 hrs/CWS	*hrs_chng_tap_op*	Yes.
e) Confer with the State on initial lead sampling data and status under the rule (one-time)	2 hr/PWS	*hrs_initial_tap_confer_op*	Yes.
f) Obtain households for each round of lead tap sampling	Burden per sample (CWSs only) No LSLs: 0.5 hrs With LSLs: 1 hr	*hrs_samp_volunt_op*	Yes.
g) Offer incentives to households to encourage participation in lead tap sampling program	$10 to $100/sample per CWS	*cost_incentive*	Yes.
h) Ship tap sampling material and instructions to participating households	Burden per sample (CWSs only) 0.25 hrs Cost per sample (CWSs only) No LSLs: $8.57 to $11.33 With LSLs: $8.96 to $23.21	Burden *hrs_discuss_samp_op* Cost *cost_5_lt_samp*[3]	Yes
i) Collect lead tap samples	Burden per sample 0.40 to 0.71 hrs per CWS; 0.5 hrs per NTNCWS Cost per sample $5.75 to $10.24 per CWS	Burden *hrs_pickup_samp_op* Cost *cost_pickup_samp*	Yes.
j) Determine if a sample should be rejected and not analyzed	0.25 hrs/rejected sample for CWSs	*hrs_samp_reject_op*	Yes.
k) Analyze lead tap samples in-house or commercially	In-house Analysis (CWSs > 100K only) Burden: 0.44 hrs/sample	In-house Analysis *hrs_analyze_samp_op*[3] *cost_lab_lt_samp*[3]	No. See discussion that follows this exhibit.

Activity	Unit Burden and/or Cost[1]	*SafeWater LCR Data Variable*	Same As Final LCRI?
	Cost: $3.92/sample <u>Commercial Analysis (CWSs ≤100K and all NTNCWSs)</u> $32.20/ sample	<u>Commercial Analysis</u> *cost_5_commercial_lab*[3]	
l) Prepare and submit sample invalidation request to State	2 hrs per sample per CWS and NTNCWS	*hrs_samp_invalid_op*	Yes.
m) Inform consumers of tap sample results	<u>CWS per sample</u> Burden: 0.05 to 0.11 hrs Cost: $0.72 <u>NTNCWS per sample</u> Burden: 1 hr Cost: $0.079	<u>CWS</u> *hrs_inform_samp_op* *cost_cust_lt* <u>NTNCWS</u> *hrs_ntncws_inform_samp_op* *cost_ntncws_cust_lt*	Yes.
n) Certify to the State that results were reported to consumers	0.66 to 1 hr per CWS or NTNCWS	*hrs_cert_cust_lt_op*	Yes.
o) Submit request to renew 9-year monitoring waiver to the State	1 hr/9 years per qualifying CWS or NTNCWS	*hrs_renew_nine_op*	Yes.
p) Submit sampling results and 90th calculation to the State	<u>No LSLs</u>: 2 to 3 hrs per CWS and NTNCWS <u>With LSLs</u>: 2.5 to 3.75 hrs per CWS and NTNCWS	*hrs_annual_lt_op*[3]	Yes.
q) Oversee the customer-initiated lead sampling program	N/A	*hrs_cust_request_oversee_op*	No. Not required under the 2021 LCRR.
r) Ship tap sampling material and instructions to participating households for customer-initiated lead sampling program	N/A	<u>Burden</u> *hrs_discuss_samp_op* <u>Cost</u> *cost_5_lt_samp*[3]	No. Not required under the 2021 LCRR.
s) Collect lead tap samples for customer-initiated lead sampling program	N/A	<u>Burden</u> *hrs_pickup_samp_op* <u>Cost</u> *cost_pickup_samp*	No. Not required under the 2021 LCRR.
t) Analyze lead tap samples in-house or commercially for customer-initiated lead sampling program	N/A	<u>In-house Analysis</u> *hrs_analyze_samp_op*[3] *cost_lab_lt_samp*[3] <u>Commercial Analysis</u> *cost_5_commercial_lab*[3]	No. Not required under the 2021 LCRR.
u) Inform customers of lead tap sample results for customer-	N/A	<u>CWS</u> *hrs_inform_samp_op*	No. Not required under

Activity	Unit Burden and/or Cost[1]	*SafeWater LCR Data Variable*	Same As Final LCRI?
initiated lead sampling program		*cost_cust_lt*	the 2021 LCRR.

Acronyms: CWS = community water system; LCRR = Lead and Copper Rule Revisions; LCRI = Lead and Copper Rule Improvements; LSL = lead service line; NTNCWS = non-transient non-community water system; PWS = public water system.
Source: "Lead Analytical Burden and Costs_Final.xlsx." See Chapter 4, Section 4.3.2.1 for a summary of how the unit burden is derived for each activity.
Notes:
[1] All activities other than one-time activities are per monitoring period. In addition, many of the activities listed above do not apply to NTNCWSs because unlike CWSs they collect their own samples from sampling locations under their control and thus, are unlikely to change sampling sites or reject samples for analysis. They also do not need to solicit sampling participation for customers or travel to their residences to pick up samples.
[2] In Arkansas, Louisiana, Mississippi, Missouri, North Dakota, and South Carolina the State sends sampling instructions to the water systems and thus are assumed to incur the burden to update the sampling instruction in lieu of the system (ASDWA, 2020a).
[3] In Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles, shipping, analysis, and providing sample results to the system. Thus, the State will incur the burden and cost for these activities in lieu of the system (ASDWA, 2020a).

k) ***Analyze lead tap samples in-house or commercially (hrs_analyze_samp_op, cost_lab_lt_samp, cost_5_commercial_lab).*** Under both the 2021 LCRR and final LCRI, the EPA assumed that in-house analyses for lead would only be conducted by CWSs serving more than 100,000 people and that all other CWSs and all NTNCWSs would use a commercial laboratory. Under the 2021 LCRR, systems must analyze a first-liter sample collected from non-lead service line sites and a fifth-liter sample collected from sites served by an LSL for lead. Under the final LCRI, systems must analyze a first-liter sample collected from non-lead service line sites but both a first- and fifth-liter sample from these sites served by LSLs. Thus, the burden and cost for in-house analysis or commercial laboratory cost is for one sample per LSL site under the 2021 LCRR as opposed to two under the final LCRI for LSL sites. For the 2021 LCRR, the EPA assumed a per sample burden and cost for an in-house lead analysis of 0.44 hours (*hrs_analyze_samp_op*) and non-labor costs for analytical materials such as preservatives, calibration standards, and quality assurance (QA) standards of $3.92 per sample (*cost_ lab_lt_samp*). Under the final LCRI the burden and cost for a first- and fifth-liter sample is double at 0.89 hours and $7.84.

    The EPA assumed the per lead sample laboratory cost of $23.50 plus a cost of $8.70 to ship the sample to the laboratory for a total per sample cost of $32.20 *(cost_5_commercial_lab)* for the LCRR. For the final LCRI, the EPA increased this estimate for systems with LSLs to account for the analysis and shipping of a first- and fifth-liter sample of $23.50*2 or $47.00 plus a cost to ship two bottles to the laboratory at $10.20 for a total cost of $57.20 per sample.

Exhibit B-17 shows the SafeWater LCR model cost estimation approach for system lead tap sampling activities under the 2021 LCRR. As shown in the exhibit, the SafeWater LCR model relies upon additional inputs, such as number of samples for lead tap sampling and the likelihood a system is below an AL or TL, to compute the cost per activity. It also indicates for which activities the costing approach is the same as the final LCRI, as provided in Chapter 4, Exhibit 4-16, as well as which final LCRI activities do not apply under the 2021 LCRR in gray shaded rows.

Exhibit B-17: PWS Lead Tap Sampling Cost Estimation in SafeWater LCR by Activity under 2021 LCRR[1,2]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
a) Update sampling instructions for lead tap sampling and submit to the State[3]				
Same as final LCRI (see Exhibit 4-16 in Chapter 4).				
b) Contact homes to establish new 100 percent LSL tap sampling pool				
Same as final LCRI (see Exhibit 4-16 in Chapter 4).				
c) Update and submit tap sampling plan to the State				
Same as final LCRI (see Exhibit 4-16 in Chapter 4).				

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
d) Report any changes in sampling locations to the State [4]				
Total system hours per monitoring period multiplied by the system labor rate. *(hrs_chng_tap_op*rate_op)*	Cost does not apply to NTNCWSs.	At or below TL	Model PWS is not on reduced tap sampling and not doing POU sampling *1 - (p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year
			Model PWS on annual tap sampling and not doing POU sampling *p_tap_annual*	Once a year
			Model PWS on triennial reduced tap sampling and not doing POU sampling *p_tap_triennial*	Every 3 years
			Model PWS is on nine-year reduced tap sampling and not doing POU sampling *p_tap_nine*	Every 9 years
		At or below AL and above TL	All model PWSs not doing POU sampling	Once a year
		Above AL	All model PWSs not doing POU sampling	Twice a year
e) Confer with the State on initial lead sampling data and status under the rule				
Same as final LCRI (see Exhibit 4-16 in Chapter 4).				

<table>
<tr><th rowspan="2">CWS Cost Per Activity</th><th rowspan="2">NTNCWS Cost Per Activity</th><th colspan="2">Conditions for Cost to Apply to a Model PWS</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90th - Range</th><th>Other Conditions[2]</th></tr>
<tr><td colspan="5">f) Obtain households for each round of lead tap sampling</td></tr>
<tr><td rowspan="4">The number of required samples per system multiplied by the hours per sample and the system labor rate. The number of required samples is inflated to include those unreturned, invalidated, and rejected to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement.

(numb_samp_customer+(numb_samp_customer*(1-pp_hh_return_samp))+(numb_samp_customer*pp_samp_invalid)+(numb_samp_customer*pp_samp_reject))*(hrs_samp_volunt_op*rate_op)</td><td rowspan="4">Cost does not apply to NTNCWSs.</td><td rowspan="2">At or below TL</td><td>Model PWS is not on reduced tap sampling and not doing POU sampling

1 - (p_tap_annual + p_tap_triennial + p_tap_nine)</td><td>Twice per year</td></tr>
<tr><td>Model PWS on annual tap sampling and not doing POU sampling

p_tap_annual</td><td>Once a year</td></tr>
<tr><td>At or below AL and above TL</td><td>All model PWSs not doing POU sampling</td><td>Once a year</td></tr>
<tr><td>Above AL</td><td>All model PWSs not doing POU sampling</td><td>Twice per year</td></tr>
<tr><td rowspan="2">The number of required samples per system multiplied by the hours per sample and the system labor rate. The number of required samples is inflated to include those unreturned, invalidated, and rejected to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement.

(numb_reduced_tap+(numb_reduced_tap*(1-pp_hh_return_samp))+(numb_reduced_tap*pp_samp_invalid)+(numb_reduced_tap*pp_samp_reject))*(hrs_samp_volunt_op*rate_op)</td><td rowspan="2">Cost does not apply to NTNCWSs.</td><td rowspan="2">At or below TL</td><td>Model PWS on triennial reduced tap sampling and not doing POU sampling

p_tap_triennial</td><td>Every 3 years</td></tr>
<tr><td>Model PWS is on nine-year reduced tap sampling and not doing POU sampling

p_tap_nine</td><td>Every 9 years</td></tr>
</table>

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
g) Offer incentives to households to encourage participation in lead tap sampling program				
The number of required samples per system multiplied by the cost of the incentive. This number is not inflated by the number of samples deemed invalid or rejected because it is assumed that if a sample is invalid or rejected the system will return to the same customer to resample. The EPA also assumes that unreturned samples would not be eligible for an incentive. *Numb_samp_customer*cost_incentive*	Cost does not apply to NTNCWSs.	At or below TL	Model PWS is not on reduced tap sampling and not doing POU sampling that offers an incentive *[1 - (p_tap_annual + p_tap_triennial + p_tap_nine)] * p_incentive*	Twice per year
			Model PWS on annual tap sampling and not doing POU sampling that offers an incentive *p_tap_annual * p_incentive*	Once a year
		At or below AL and above TL	Model PWS not doing POU sampling that offers an incentive p_incentive	Once a year
		Above AL		Twice per year
The number of required samples per system multiplied by the cost of the incentive. This number is not inflated by the number of samples deemed invalid or rejected, because it is assumed that if a sample is invalid or rejected the system will return to the same customer to resample. The EPA also assumes that unreturned samples would not be eligible for an incentive. *Numb_reduced_tap*cost_incentive*	Cost does not apply to NTNCWSs.	At or below TL	Model PWS is on triennial reduced tap sampling and not doing POU sampling that offers an incentive *p_tap_triennial * p_incentive*	Every 3 years
			Model PWS is on nine-year reduced tap sampling and not doing POU sampling that offers an incentive *p_tap_nine * p_incentive*	Every 9 years

<table>
<tr><th rowspan="2">CWS Cost Per Activity</th><th rowspan="2">NTNCWS Cost Per Activity</th><th colspan="2">Conditions for Cost to Apply to a Model PWS</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90th - Range</th><th>Other Conditions[2]</th></tr>
<tr><td colspan="5">h) Ship tap sample monitoring materials and instructions to participating households[5]</td></tr>
<tr><td rowspan="4">Number of required samples multiplied by the total of the hours per sample to provide instructions times the system labor rate, plus the cost of materials per sample. The number of required samples is inflated to include those unreturned, invalidated, and rejected, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement.

(numb_samp_customer+(numb_samp_customer*(1-pp_hh_return_samp))+(numb_samp_customer*pp_samp_invalid)+(numb_samp_customer*pp_samp_reject))*((hrs_discuss_samp_op*rate_op)+cost_5_lt_samp)</td><td rowspan="4">To calculate the sampling material costs for NTNCWSs this equation is still used. Number of required samples multiplied by the cost of materials per sample. The number of required samples is inflated to include those invalidated to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement.

((numb_samp_customer+(numb_samp_customer*pp_samp_invalid))*cost_5_lt_samp)</td><td rowspan="2">At or below TL</td><td>Model PWS is not on reduced tap sampling and not doing POU sampling

1 - (p_tap_annual + p_tap_triennial + p_tap_nine)</td><td>Twice per year</td></tr>
<tr><td>Model PWS on annual tap sampling and not doing POU sampling

p_tap_annual</td><td>Once a year</td></tr>
<tr><td>At or below AL and above TL</td><td rowspan="2">All model PWSs not doing POU sampling</td><td>Once a year</td></tr>
<tr><td>Above AL</td><td>Twice per year</td></tr>
</table>

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
Number of required samples multiplied by the total of the hours per sample to provide instructions times the system labor rate, plus the cost of materials per sample. The number of required samples is inflated to include those unreturned, invalidated, and rejected, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. (numb_reduced_tap+(numb_reduced_tap*(1 - pp_hh_return_samp))+(numb_reduced_tap*pp_samp_invalid)+(numb_reduced_tap*pp_samp_reject))*((hrs_discuss_samp_op*rate_op)+cost_5_lt_samp)	To calculate the sampling material costs for NTNCWSs this equation is still used. Number of required samples multiplied by the cost of materials per sample. The number of required samples is inflated to include those invalidated to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. ((numb_reduced_tapr+(numb_reduced_tap*pp_samp_invalid))*cost_5_lt_samp)	At or below TL	Model PWS is on triennial reduced tap sampling and not doing POU sampling p_tap_triennial	Every 3 years
			Model PWS is on nine-year reduced tap sampling and not doing POU sampling p_tap_nine	Every 9 years
i) Collect lead tap samples				
The number of required samples per system multiplied by the hours per sample and the system labor rate. The number of required samples is inflated to include those invalidated and rejected to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. (numb_samp_customer+(numb_samp_customer*pp_samp_invalid)+(numb_samp_customer*pp_samp_reject)+ (numb_samp_customer*(1-	Cost applies as written to NTNCWSs.	At or below TL	Model PWS is not on reduced tap sampling and not doing POU sampling 1 - (p_tap_annual + p_tap_triennial + p_tap_nine)	Twice per year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90^{th} - Range	Other Conditions[2]	
pp_hh_return_samp))((hrs_pickup_samp_op*rate_op)+cost_pickup_samp)*				
			Model PWS on annual tap sampling and not doing POU sampling *p_tap_annual*	Once a year
		At or below AL and above TL	All model PWSs not doing POU sampling	Once a year
		Above AL		Twice per year
The number of required samples multiplied by the total of the hours per sample to provide instructions times the system labor rate, plus the cost of materials per sample. The number of required samples is inflated to include those unreturned, invalidated, and rejected, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(numb_reduced_tap+(numb_reduced_tapr*pp_samp_invalid)+(numb_reduced_tap*pp_samp_reject)+ (numb_reduced_tap*(1-pp_hh_return_samp))*((hrs_pickup_samp_op*rate_op)+cost_pickup_samp)*	Cost applies as written to NTNCWSs.	At or below TL	Model PWS is on triennial reduced tap sampling and not doing POU sampling *p_tap_triennial*	Every 3 years
			Model PWS is on nine-year reduced tap sampling and not doing POU sampling *p_tap_nine*	Every 9 years

<table>
<thead>
<tr><th rowspan="2">CWS Cost Per Activity</th><th rowspan="2">NTNCWS Cost Per Activity</th><th colspan="2">Conditions for Cost to Apply to a Model PWS</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90th - Range</th><th>Other Conditions[2]</th></tr>
</thead>
<tbody>
<tr><td colspan="5">j) Determine if a sample should be rejected and not analyzed</td></tr>
<tr><td rowspan="4">The number of samples expected to be rejected (calculated by multiplying the total number of required samples by the likelihood of rejection) multiplied by the hours per sample and the system labor rate.

(numb_samp_customer*pp_samp_reject)*(hrs_samp_reject_op*rate_op)</td><td rowspan="4">Cost does not apply to NTNCWSs.</td><td rowspan="2">At or below TL</td><td>Model PWS is not on reduced tap sampling and not doing POU sampling

1 - (p_tap_annual + p_tap_triennial + p_tap_nine)</td><td>Twice per year</td></tr>
<tr><td>Model PWS on annual tap sampling and not doing POU sampling

p_tap_annual</td><td>Once a year</td></tr>
<tr><td>At or below AL and above TL</td><td rowspan="2">All model PWSs not doing POU sampling</td><td>Once a year</td></tr>
<tr><td>Above AL</td><td>Twice per year</td></tr>
<tr><td rowspan="2">The number of samples expected to be rejected (calculated by multiplying the total number of required samples by the likelihood of rejection) multiplied by the hours per sample and the system labor rate.

(numb_reduced_tap*pp_samp_reject)*(hrs_samp_reject_op*rate_op)</td><td rowspan="2">Cost does not apply to NTNCWSs.</td><td rowspan="2">At or below TL</td><td>Model PWS is on triennial reduced tap sampling and not doing POU sampling

p_tap_triennial</td><td>Every 3 years</td></tr>
<tr><td>Model PWS is on nine-year reduced tap sampling and not doing POU sampling

p_tap_nine</td><td>Every 9 years</td></tr>
</tbody>
</table>

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS: Lead 90th - Range	Conditions for Cost to Apply to a Model PWS: Other Conditions[2]	Frequency of Activity
k) Analyze lead tap samples in-house or commercially[5]				
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. The number of samples is inflated to include those invalidated, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(((numb_samp_customer+(numb_samp_customer*pp_samp_invalid))*pp_lab_samp)*((hrs_analyze_samp_op*rate_op)+cost_lab_lt_samp))+(((numb_samp_customer+(numb_samp_customer*pp_samp_invalid))*pp_commercial_samp)*((hrs_analyze_samp_op*rate_op)+cost_5_commercial_lab))*	Cost applies as written to NTNCWSs.	At or below TL	Model PWS is not on reduced tap sampling and not doing POU sampling *1 - (p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year
			Model PWS is on annual tap sampling and not doing POU sampling *p_tap_annual*	Once a year
		At or below AL and above TL	All model PWSs not doing POU sampling	Once a year
		Above AL		Twice per year
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. The number of samples is inflated to include those invalidated, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(((numb_reduced_tap+(numb_reduced_tap*pp_samp_invalid))*pp_lab_samp)*((hrs_analyze_samp_op*rate_op)+cost_lab_lt_samp))+(((numb_reduced_tap+(numb_reduced_tap*	Cost applies as written to NTNCWSs.	At or below TL	Model PWS on triennial reduced tap sampling and not doing POU sampling *p_tap_triennial*	Every 3 years

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
*pp_samp_invalid))*pp_commercial_samp)*((hrs_analyze_samp_op*rate_op)+cost_commercial_lab))			Model PWS is on nine-year reduced tap sampling and not doing POU sampling p_tap_nine	Every 9 years
I) Prepare and submit sample invalidation request to State				
The number of samples expected to be invalid (calculated by multiplying the total number of required samples by the likelihood of invalidation) multiplied by the hours per sample and the system labor rate. (numb_samp_customer*pp_samp_invalid)*(hrs_samp_invalid_op*rate_op	Cost applies as written to NTNCWSs.	At or below TL	Model PWS not on reduced tap sampling and not doing POU sampling 1 - (p_tap_annual + p_tap_triennial + p_tap_nine)	Twice per year
			Model PWS on annual tap sampling and not doing POU sampling p_tap_annual	Once a year
		At or below AL and above TL	All model PWSs not doing POU sampling	Once a year
		Above AL		Twice per year
The number of samples expected to be invalid (calculated by multiplying the total number of required samples by the likelihood of invalidation) multiplied by the hours per sample and the system labor rate. (numb_reduced_tap*pp_samp_invalid)*(hrs_samp_invalid_op*rate_op)	Cost applies as written to NTNCWSs.	At or below TL	Model PWS is on triennial reduced tap sampling and not doing POU sampling p_tap_triennial	Every 3 years
			Model PWS is on nine-year reduced tap sampling and not doing POU sampling p_tap_nine	Every 9 years

<table>
<tr><th rowspan="2">CWS Cost Per Activity</th><th rowspan="2">NTNCWS Cost Per Activity</th><th colspan="2">Conditions for Cost to Apply to a Model PWS</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90th - Range</th><th>Other Conditions[2]</th></tr>
<tr><td colspan="5">m) Inform consumers of lead tap sample results</td></tr>
<tr><td rowspan="4">The number of required of samples per system multiplied by the total of the hours per sample times the system labor rate plus the material cost per sample.

Numb_samp_customer*((hrs_inform_samp_op*rate_op)+cost_cust_lt)</td><td rowspan="4">Hours per sampling event multiplied by the system labor rate, plus the material cost per sampling event.

((hrs_ntncws_inform_samp_op*rate_op)+cost_ntncws_cust_lt)</td><td rowspan="2">At or below TL</td><td>Model PWS is not on reduced tap sampling and not doing POU sampling

1 - (p_tap_annual + p_tap_triennial + p_tap_nine)</td><td>Twice per year</td></tr>
<tr><td>Model PWS is on annual tap sampling and not doing POU sampling

p_tap_annual</td><td>Once a year</td></tr>
<tr><td>At or below AL and above TL</td><td rowspan="2">All model PWSs not doing POU sampling</td><td>Once a year</td></tr>
<tr><td>Above AL</td><td>Twice per year</td></tr>
<tr><td rowspan="2">The number of required samples per system multiplied by the total of the hours per sample times the system labor rate plus the material cost per sample.

Numb_reduced_tap*((hrs_inform_samp_op*rate_op)+cost_cust_lt)</td><td rowspan="2">Hours per sampling event multiplied by the system labor rate, plus the material cost per sampling event.

((hrs_ntncws_inform_samp_op*rate_op)+cost_ntncws_cust_lt)</td><td rowspan="2">At or below TL</td><td>Model PWS on triennial reduced tap sampling and not doing POU sampling

p_tap_triennial</td><td>Every 3 years</td></tr>
<tr><td>Model PWS is on nine-year reduced tap sampling and not doing POU sampling

p_tap_nine</td><td>Every 9 years</td></tr>
</table>

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
n) Certify to the State that results were reported to consumers				
Total hours per sampling event multiplied by the system labor rate. *(hrs_cert_cust_lt_op*rate_op)*	Cost applies as written to NTNCWSs.	At or below TL	Model PWS is not on reduced tap sampling and not doing POU sampling *1 - (p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year
			Model PWS is on annual tap sampling and not doing POU sampling *p_tap_annual*	Once a year
			Model PWS on triennial reduced tap sampling and not doing POU sampling *p_tap_triennial*	Every 3 years
			Model PWS is on nine-year reduced tap sampling and not doing POU sampling *p_tap_nine*	Every 9 years
		At or below AL and above TL	All model PWSs not doing POU sampling	Once a year
		Above AL		Twice per year

<table>
<tr><th rowspan="2">CWS Cost Per Activity</th><th rowspan="2">NTNCWS Cost Per Activity</th><th colspan="2">Conditions for Cost to Apply to a Model PWS</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90^{th} - Range</th><th>Other Conditions[2]</th></tr>
<tr><td colspan="5">o) Submit request to renew 9-year monitoring waiver to the State[6]</td></tr>
<tr><td colspan="5">Same as final LCRI (see Exhibit 4-16 in Chapter 4).</td></tr>
<tr><td colspan="5">p) Submit monitoring results and 90^{th} percentile calculations to State[5]</td></tr>
<tr><td rowspan="6">Total hours per sampling event multiplied by the system labor rate.

(hrs_annual_lt_op*rate_op)</td><td rowspan="6">Cost applies as written to NTNCWSs.</td><td rowspan="4">At or below TL</td><td>Model PWS is not on reduced tap sampling and not doing POU sampling

1 - (p_tap_annual + p_tap_triennial + p_tap_nine)</td><td>Twice per year</td></tr>
<tr><td>Model PWS is on annual tap sampling and not doing POU sampling

p_tap_annual</td><td>Once a year</td></tr>
<tr><td>Model PWS on triennial reduced tap sampling and not doing POU sampling

p_tap_triennial</td><td>Every 3 years</td></tr>
<tr><td>Model PWS is on nine-year reduced tap sampling and not doing POU sampling

p_tap_nine</td><td>Every 9 years</td></tr>
<tr><td>At or below AL and above TL</td><td rowspan="2">All model PWSs not doing POU sampling</td><td>Once a year</td></tr>
<tr><td>Above AL</td><td>Twice a year</td></tr>
<tr><td colspan="5">q) Oversee the customer-initiated lead sampling program</td></tr>
<tr><td colspan="5">N/A under the 2021 LCRR. New requirement under the final LCRI.</td></tr>
<tr><td colspan="5">r) Ship tap sample monitoring materials and instructions to participating households for customer-initiated lead sampling program[5]</td></tr>
<tr><td colspan="5">N/A under the 2021 LCRR. New requirement under the final LCRI.</td></tr>
<tr><td colspan="5">s) Collect lead tap samples for customer-initiated lead sampling program</td></tr>
<tr><td colspan="5">N/A under the 2021 LCRR. New requirement under the final LCRI.</td></tr>
</table>

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
t) Analyze lead tap samples in-house or commercially for customer-initiated lead sampling program[5]				
N/A under the 2021 LCRR. New requirement under the final LCRI.				
u) Inform customers of lead tap sample results for customer-initiated lead sampling program				
N/A under the 2021 LCRR. New requirement under the final LCRI.				

Acronyms: AL = action level; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LSL = lead service line; NTNCWS = non-transient non-community water system; POU = point-of-use; PWS = public water system; TL = trigger level.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *numb_reduced_tap*: the number of lead tap samples for system on reduced annual, triennial, or 9-year monitoring (Chapter 4, Section 4.3.2.1.1).
- *numb_samp_customer*: the number of lead tap samples for system on standard 6-month tap monitoring (Chapter 4, Section 4.3.2.1.1).
- *p_tap_annual*, *p_tap_triennial*, and *p_tap_nine*: likelihood a systems is collecting the reduced number of lead tap samples on an annual, triennial, or 9-year frequency, respectively (Chapter 4, Section 4.3.2.1.1).
- *rate_op*: PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] Does not apply to CWSs serving ≤ 10,000 people and all NTNCWSs that have selected POU as their compliance option if they exceeded the lead AL. See Chapter 4, Section 4.3.5 and B.5.5 for additional detail. PWSs with lead content or unknown lines are identified using the data variables and approach described in Chapter 3, Section 3.3.4.

[3] In Arkansas, Louisiana, Mississippi, Missouri, North Dakota, and South Carolina the State sends sampling instructions to the water systems and thus are assumed to incur the burden to update the sampling instruction in lieu of the system (ASDWA, 2020a).

[4] For modeling purposes, the EPA assumed that systems would report changes in sampling location during each monitoring period.

[5] The burden and costs to provide sample bottles (*cost_5_lt_samp*) under activity h), conduct analyses under activity k), and provide sampling results under activity p) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

[6] Only systems with 90th percentile values ≤ the AL can quality for a 9-year monitoring waiver.

B.5.2.2 PWS Lead Water Quality Parameter Monitoring under the 2021 LCRR

Under the 2021 LCRR, lead WQP monitoring is required for all systems serving more than 50,000 people with CCT (except systems that meet the criteria in 40 CFR 141.81(b)(3) or "b3" systems) and those serving 50,000 or fewer people that exceed the lead AL of 15 µg/L.[33] WQP samples are collected at representative sites throughout the distribution system (also referred to as WQP tap samples) and at

[33] Note that systems that have CCT but no OWQPs and have a TLE must monitor for two consecutive six-month monitoring periods starting in the month following the end of the tap monitoring period with the exceedance. These costs are not captured in the EPA cost model, thereby underestimating the impacts to systems from the 2021 LCRR WQP monitoring requirements.

each entry point to the distribution system. Systems must conduct WQP monitoring prior to and after CCT installation. The State may designate optimal water quality parameters (OWQPs) after the installation of CCT. Systems with CCT must continue to maintain WQPs at or above minimum values or within OWQP ranges designated by the State. In addition, systems with CCT that have a single sample above 15 µg/L must conduct WQP monitoring in the distribution system at or near the site with the high result and determine if problems with CCT contributed to elevated lead (see Section B.5.3.3 for a discussion of inputs related to this requirement).

The WQP monitoring requirements under the 2021 LCRR are the same as under the final LCRI, with the exception that continued lead WQP monitoring under the final LCRI applies to all systems serving more than 10,000 people with CCT and to those that exceed the final lead AL of 10 µg/L. In addition, WQP monitoring is required at or near any sampling site above 10 µg/L as opposed to 15 µg/L (also see the requirement under the 2021 LCRR that is described in footnote 33).

The remainder of this section is divided into four subsections:

- B.5.2.2.1: Baseline Corrosion Control Treatment
- B.5.2.2.2: Initial Monitoring Schedules
- B.5.2.2.3: Number of Samples
- B.5.2.2.4: Lead WQP Monitoring Activities

Exhibit B-19 at the end of Section B.5.2.2.4 is a summary exhibit that explains how the cost inputs are modeled by the SafeWater LCR model.

B.5.2.2.1 Baseline Corrosion Control Treatment

WQP monitoring requirements vary for systems with and without CCT and by type of CCT. The EPA used the same approach for the pre-2021 LCR, 2021 LCRR, and final LCRI to identify systems with and without CCT (see Chapter 3, Section 3.3.3). For those with CCT, the EPA estimated the percentage of systems that currently have one of the three types of CCT used in the cost model:

- Modify pH (*pbaseph*),
- Add PO_4 without pH post-treatment (*pbasepo4*), and
- Add PO_4 and modify pH (*pbasephpo4*).

Chapter 4, Section 4.3.2.2.1 provides the EPA's approach for developing these percentages. The percentages were used for the pre-2021 LCR, 2021 LCRR, and final LCRI.

B.5.2.2.2 Initial Monitoring Schedules

As described in Section 3.3.8.1 in Chapter 3, systems with CCT can qualify for reduced WQP monitoring in the distribution system under the 2021 LCRR if they are in compliance with State-set OWQP ranges and do not exceed the TL of 10 µg/L. The number of consecutive monitoring periods in which a system meets these criteria determines if a system will collect two samples at a reduced number of sites in the

distribution system on a semi-annual or annually. Under the 2021 LCRR, systems can no longer qualify for triennial WQP tap monitoring.

The EPA assumed only systems serving more than 50,000 people with CCT could qualify for reduced distribution system monitoring because these systems are required to continue WQP monitoring to demonstrate compliance with their OWQPs unlike smaller systems with CCT or systems without CCT. Section 3.3.8.1 in Chapter 3 provides the EPA's approach for determining the estimated percentage of systems with CCT that would be on one of three WQP distribution monitoring schedules at the start of rule implementation based on historical SDWIS/Fed data.

The final LCRI modifies the WQP monitoring requirements for systems serving 10,001 to 50,000 people with CCT. These systems must conduct WQP monitoring irrespective of their lead or copper 90th percentile levels. Those serving 50,000 people or fewer without CCT are only required to monitor for WQPs in those monitoring periods in which they have a lead or copper ALE and to continue such monitoring until they no longer exceed the AL for two consecutive 6-month monitoring periods. However, with the lowering of the lead AL to 10 µg/L, more systems in this size category are expected to exceed the lead AL and would be subject to WQP monitoring requirements. Refer to Chapter 3, Section 3.3.8.2 for additional detail.

B.5.2.2.3 Number of Samples

The minimum number of WQP distribution system samples for CWSs and NTNCWSs on standard (*numb_enhance_wqp*) and reduced monitoring (*numb_reduced_wqp)* are the same under the pre-2021 LCR, 2021 LCRR, and final LCRI and are discussed in Chapter 4, Section 4.3.2.2.3. Under the 2021 LCRR and retained in the final LCRI, systems with a lead tap sample result above the lead AL (15 µg/L under the 2021 LCRR and 10 µg/L under the final LCRI) must conduct WQP monitoring in the distribution system at or near the site with the high lead result. If an existing WQP site does not meet these criteria, the system must identify a new WQP monitoring site and those with CCT must use it for future sampling in addition to the existing number of WQP sites. Refer to Section B.5.3.3 for a more detailed discussion.

Under the 2021 LCRR and retained under the final LCRI, systems must also collect WQP samples at each entry point to the distribution system. The number of entry points samples corresponds to the SafeWater LCR model data input *numb_ep_wqp*. Modeling assumptions for WQP entry point sampling under the 2021 LCRR are as follows:

- Systems without CCT serving 50,000 or fewer people must collect two samples from each entry point to the distribution system during each 6-month monitoring periods in which they have a lead or copper ALE. Under the 2021 LCRR, they must continue this monitoring until they no longer have an ALE during two consecutive 6-month monitoring periods.
- Systems with CCT must collect one sample per entry point every two weeks. This applies to all systems serving more than 50,000 except "b3" systems and those serving 50,000 or fewer people during each 6-month monitoring periods in which they have a lead or copper ALE and subsequent monitoring periods until they no longer have an ALE for two consecutive monitoring periods.

There are no reduced monitoring provisions for WQPs collected at entry points under the 2021 LCRR, as was true under the pre-2021 LCR and remains unchanged under the final LCRI.

The estimated number of entry points per system, which corresponds to the SafeWater LCR model input *numb_ep,* is provided in Chapter 3, Section 3.3.6.1.

B.5.2.2.4 Lead WQP Monitoring Activities

The EPA has developed water system costs for five lead WQP monitoring activities under the 2021 LCRR, as shown in Exhibit B-18. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activities, unit burden or cost, and SafeWater LCR data variables are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.3.2.2.

Note that the conditions under which the WQP monitoring activity costs apply are different under the 2021 LCRR compared to the final LCRI. Under the LCRR, lead WQP monitoring is required for all systems serving more than 50,000 people with CCT except "b3" systems and those serving 50,000 or fewer people that exceed the lead AL of 15 µg/L. Under the final LCRI, system serving 10,001 to 50,000 people with CCT also must conduct WQP monitoring regardless of their lead 90th percentile level and systems serving 50,000 or fewer people without CCT must conduct monitoring if they exceed the final lead AL of 10 µg/L.

Exhibit B-18: PWS Lead WQP Monitoring Unit Burden and Cost Estimates under the 2021 LCRR

Activity	Unit Burden and/or Cost	***SafeWater LCR Data Variable***	Same As Final LCRI?[2]
v) Collect lead WQP samples from the distribution system	Burden per sample per PWS 0.5 hrs (distribution) Cost per sample No CCT: $2.66 (CWS & NTNCWS) pH adjustment: • $1.70 to $2.66 (CWS); • $2.66 (NTNCWS) Orthophosphate: • $2.66 to $2.82 (CWS) • $2.66 (NTNCWS)	Burden *hrs_wqp_op* Cost *No CCT: cost_wqp_material* *pH: cost_wqp_material_ph* *Orthophosphate:* *cost_wqp_material_ortho*	Yes.
w) Analyze lead WQP samples from the distribution system	In-House Burden per sample No CCT: 0.15 hrs (CWS & NTNCWS) pH adjustment: • 0.15 to 0.46 hrs (CWS) • 0.15 hrs (NTNCWS) Orthophosphate: • 0.15 to 1.34 hrs (CWS) • 0.15 hrs (NTNCWS) In-House Cost per sample	In-House Burden *No CCT:* *hrs_wqp_analyze_dist_op* *pH: hrs_wqp_analyze_ph_op* *Orthophosphate:* *hrs_wqp_analyze_ortho_op*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?[2]
	No CCT: \$0.63 (CWS & NTNCWS) pH adjustment: • \$0.63 to \$0.98 (CWS) • \$0.63 (NTNCWS) Orthophosphate: • \$0.63 to \$1.07 (CWS) • \$0.63 (NTNCWS) Commercial Cost per sample No CCT: \$27.24 to 30.55 (CWS & NTNCWS) pH adjustment: \$27.24 to 30.55 (CWS & NTNCWS) Orthophosphate: \$60.34 to \$61.89 (CWS & NTNCWS)	In-House Cost *No CCT: cost_wqp_analyze* *pH: cost_wqp_ph_analyze* *Orthophosphate: cost_wqp_ortho_analyze* Commercial Cost *No CCT: cost_lab_wqp* *pH: cost_lab_ph_wqp* *Orthophosphate: cost_lab_ortho_wqp*	
x) Collect lead WQP samples from entry points	Burden per sample 0.4 hrs for 80 percent of ground water PWSs[1] Cost per sample No CCT: \$2.66 (CWS & NTNCWS) pH adjustment: • \$1.70 to \$2.66 (CWS); • \$2.66 (NTNCWS) Orthophosphate: • \$2.66 to \$2.82 (CWS) • \$2.66 (NTNCWS)	Burden *hrs_ep_wqp_op* Cost *cost_ep_wqp_material* *cost_ep_wqp_ph_material* *cost_ep_wqp_ortho_material*	Yes.
y) Analyze lead WQP samples from entry points	In-House Burden per sample No CCT: 0.15 hrs (CWS & NTNCWS) pH adjustment: • 0.15 to 0.46 hrs (CWS) • 0.15 hrs (NTNCWS) Orthophosphate: • 0.15 to 1.34 hrs (CWS) • 0.15 hrs (NTNCWS) In-House Cost per sample No CCT: \$0.63 (CWS & NTNCWS) pH adjustment: • \$0.63 to \$0.98 (CWS) • \$0.63 (NTNCWS) Orthophosphate: • \$0.63 to \$1.07 (CWS) • \$0.63 (NTNCWS) Commercial Cost per sample No CCT: • \$29.28 to \$30.21 (CWS)	In-House Burden *hrs_wqp_analyze_ep_op* *hrs_wqp_analyze_ph_ep_op* *hrs_wqp_analyze_ortho_ep_op* In-House Cost *cost_wqp_analyze_ep* *cost_wqp_analyze_ph_ep* *cost_wqp_analyze_ortho_ep* Commercial Cost *cost_lab_wqp_ep* *cost_lab_wqp_ph_ep*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?[2]
	• No CCT: $30.55 (NTNCWS) pH adjustment: • $30.58 to $33.30 (CWS) • $33.93 (NTNCWS) Orthophosphate: • $61.90 to $63.49 (CWS) • $63.84 (NTNCWS)	*cost_lab_wqp_ortho_ep*	
z) Report lead WQP sampling data and compliance with OWQPs to the State	No CCT: 4 hrs/PWS With CCT: 5 hrs/PWS	Burden *hrs_report_wqp_op*	Yes.

Acronyms: CCT = corrosion control treatment; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule revisions; NTNCWS = non-transient non-community water system; OWQP = optimal water quality parameters; PWS = public water system; WQP = water qualify parameter.
Source: "WQP Analytical Burden and Costs_Final.xlsx."
Notes:
[1] The EPA assumed the burden to collect WQP samples to be 0.4 hours for all surface water systems and 20 percent of ground water systems based on the 2022 *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 9 (WQP Monitoring - Monitoring, Burden, and Cost Assumptions) (USEPA, 2022).
[2] The SafeWater input variables are the same under the 2021 LCRR and final LCRI; however, the systems to which these requirements apply vary between the two rules. Under the LCRR, lead WQP monitoring is required for all systems serving more than 50,000 people with CCT except "b3" systems and those serving 50,000 or fewer people that exceed the lead AL of 15 µg/L. Under the final LCRI, system serving 10,001 to 50,000 people with CCT also must conduct WQP monitoring regardless of their lead 90th percentile level and systems serving 50,000 or fewer people must conduct monitoring if they exceed the final lead AL of 10 µg/L.

Exhibit B-19 shows the SafeWater LCR model cost estimation approach for water system lead WQP monitoring activities under the 2021 LCRR including additional cost inputs that are required to calculate these costs.

Exhibit B-19: PWS Lead WQP Monitoring Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
v) Collect lead WQP samples from the distribution system				
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_enhance_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material))*	Cost applies as written to NTNCWSs.	Above AL	Model PWSs serving ≤50,000 without CCT	Twice per year
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_enhance_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material_ph))*	Cost applies as written to NTNCWSs.	Above AL	Model PWSs serving ≤50,000 with pH adjustment *pbaseph*	Twice per year
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_enhance_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material_ortho))*	Cost applies as written to NTNCWSs.	Above AL	Model PWSs serving ≤50,000 with PO_4 or both PO_4 and pH adjustment *pbasepo4, pbasephpo4*	Twice per year
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_enhance_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material_ph))*	Cost applies as written to NTNCWSs.	All	Model PWSs serving >50,000 with pH adjustment that do not qualify for reduced WQP monitoring	Twice per year
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_enhance_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material_ortho))*	Cost applies as written to NTNCWSs.	All	Model PWSs serving >50,000 with PO_4 or both PO_4 and pH adjustment that do not qualify for reduced WQP monitoring *pbasepo4, pbasephpo4,* *1 – (p_wqp_annual + p_wqp_six_red)*	Twice per year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_reduced_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material_ph))*	Cost applies as written to NTNCWSs.	All	Model PWSs with pH adjustment on six-month reduced WQP monitoring *pbaseph, p_wqp_six_red*	Twice a year
			Model PWSs with pH adjustment on annual WQP monitoring *pbaseph, p_wqp_annual*	Once a year
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_reduced_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material_ortho))*	Cost applies as written to NTNCWSs.	All	Model PWSs with PO_4 or both PO_4 and pH adjustment on six-month reduced sample WQP monitoring *pbasepo4, pbasephpo4, p_wqp_six_red*	Twice a year
			Model PWSs with PO_4 or both PO_4 and pH adjustment on annual WQP monitoring *pbasepo4, pbasephpo4, p_wqp_annual*	Once a year
w) Analyze lead WQP samples from the distribution system				
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in house times the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in a commercial lab times the system labor rate, plus the material cost of the commercial lab analysis per sample.			Model PWSs serving ≤50,000 without CCT	

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
*(((numb_enhance_wqp*pp_lab_samp)*((hrs_wqp_analyze_dist_op*rate_op)+cost_wqp_analyze))+((numb_enhance_wqp*pp_commercial_samp)*cost_lab_wqp))*	Cost applies as written to NTNCWSs.	Above AL		Twice a year
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in house times the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in a commercial lab times the system labor rate, plus the material cost of the commercial lab analysis per sample. *(((numb_enhance_wqp*pp_lab_samp)*((hrs_wqp_analyze_ph_op*rate_op)+cost_wqp_ph_analyze))+((numb_enhance_wqp*pp_commercial_samp)*cost_lab_ph_wqp))*			Model PWSs serving ≤50,000 with pH adjustment *pbaseph*	
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in house times the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in a commercial lab times the system labor rate, plus the material cost of the commercial lab analysis per sample. *(((numb_enhance_wqp*pp_lab_samp)*((hrs_wqp_analyze_ortho_op*rate_op)+cost_wqp_ortho_analyze))+((numb_enhance_wqp*pp_commercial_samp)*cost_lab_ortho_wqp))*			Model PWSs serving ≤50,000 with PO_4 or both PO_4 and pH adjustment *pbasepo4, pbasephpo4*	

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in house times the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in a commercial lab times the system labor rate, plus the material cost of the commercial lab analysis per sample. (((numb_enhance_wqp*pp_lab_samp)*((hrs_wqp_analyze_ph_op*rate_op)+cost_wqp_ph_analyze))+((numb_enhance_wqp*pp_commercial_samp)*cost_lab_ph_wqp))	Cost applies as written to NTNCWSs.	All	Model PWSs serving >50,000 with pH adjustment that do not qualify for reduced WQP monitoring pbaseph; 1- (p_wqp_annual + p_wqp_six_red)	Twice a year
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in house times the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in a commercial lab times the system labor rate, plus the material cost of the commercial lab analysis per sample. (((numb_enhance_wqp*pp_lab_samp)*((hrs_wqp_analyze_ortho_op*rate_op)+cost_wqp_ortho_analyze))+((numb_enhance_wqp*pp_commercial_samp)*cost_lab_ortho_wqp))			Model PWSs serving >50,000 with PO_4 or both PO_4 and pH adjustment that do not qualify for reduced WQP monitoring pbasepo4; pbasephpo4; 1 – (p_wqp_annual + p_wqp_six_red)	Twice a year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in house times the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in a commercial lab times the system labor rate, plus the material cost of the commercial lab analysis per sample. *(((numb_reduced_wqp*pp_lab_samp)*((hrs_wqp_analyze_ph_op*rate_op)+cost_wqp_ph_analyze))+((numb_reduced_wqp*pp_commercial_samp)*cost_lab_ph_wqp))*	Cost applies as written to NTNCWSs.	All	Model PWSs with pH adjustment on six-month reduced sample WQP monitoring *pbaseph, p_wqp_six_red*	Twice a year
			Model PWSs with pH adjustment on annual WQP monitoring *pbaseph, p_wqp_annual*	Once a year
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in house times the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in a commercial lab times the system labor rate, plus the material cost of the commercial lab analysis per sample. *(((numb_reduced_wqp*pp_lab_samp)*((hrs_wqp_analyze_ortho_op*rate_op)+cost_wqp_ortho_analyze))+((numb_reduced_wqp*pp_commercial_samp)*cost_lab_ortho_wqp))*	Cost applies as written to NTNCWSs.	All	Model PWSs serving > 50,000 with PO_4 or both PO_4 and pH adjustment on six-month reduced WQP monitoring *pbasepo4, pbasephpo4, p_wqp_six_red*	Twice a year
			Model PWSs serving > 50,000 with PO_4 or both PO_4 and pH adjustment on annual WQP monitoring	Once a year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
			pbasepo4, pbasephpo4, p_wqp_annual	
x) Collect lead WQP samples from entry points				
The number of entry points per system multiplied by the number of samples, then multiplied by the total of the labor hours per sample times the system labor rate, plus the cost per sample. *((numb_ep*numb_ep_wqp)*((hrs_ep_wqp_op*rate_op)+cost_ep_wqp_material))*			Model PWSs serving ≤50,000 without CCT	Twice a year
The number of entry points per system multiplied by the number of samples, then multiplied by the total of the labor hours per sample times the system labor rate, plus the cost per sample. *((numb_ep*numb_ep_wqp)*((hrs_ep_wqp_op*rate_op)+cost_ep_wqp_ph_material))*	Cost applies as written to NTNCWSs.	Above AL	Model PWSs serving ≤50,000 with pH adjustment *pbaseph*	Every 2 weeks
The number of entry points per system multiplied by the number of samples, then multiplied by the total of the labor hours per sample times the system labor rate, plus the cost per sample. *((numb_ep*numb_ep_wqp)*((hrs_ep_wqp_op*rate_op)+cost_ep_wqp_ortho_material))*			Model PWSs serving ≤50,000 with PO_4 or both PO_4 and pH adjustment *pbasepo4, pbasephpo4*	
The number of entry points per system multiplied by the number of samples, then multiplied by the total of the labor hours per sample times the system labor rate, plus the cost per sample. *((numb_ep*numb_ep_wqp)*((hrs_ep_wqp_op*rate_op)+cost_ep_wqp_ph_material))*	Cost applies as written to NTNCWSs.	All	Model PWSs serving > 50,000 with pH adjustment *pbaseph*	Every 2 weeks
The number of entry points per system multiplied by the number of samples, then multiplied by the total of the labor hours per sample times the system labor rate, plus the cost per sample.			Model PWSs serving > 50,000 with PO_4 or both PO_4 and pH adjustment *pbasepo4, pbasephpo4*	

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
*((numb_ep*numb_ep_wqp)*((hrs_ep_wqp_op*rate_op)+cost_ep_wqp_ortho_material))*				
y) Analyze lead WQP samples from entry points				
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *((((numb_ep*numb_ep_wqp)*pp_lab_samp)*((hrs_wqp_analyze_ep_op*rate_op)+cost_wqp_analyze_ep))+(((numb_ep*numb_ep_wqp)*pp_commercial_samp)* cost_lab_wqp_ep))*	Cost applies as written to NTNCWSs.	Above AL	Model PWSs serving ≤50,000 without CCT	Twice a year
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *((((numb_ep*numb_ep_wqp)*pp_lab_samp)*((hrs_wqp_analyze_ph_ep_op*rate_op)+cost_wqp_analyze_ph_ep))+(((numb_ep*numb_ep_wqp)*pp_commercial_samp)*cost_lab_wqp_ph_ep))*	Cost applies as written to NTNCWSs.	Above AL	Model PWSs serving ≤50,000 with pH adjustment *pbaseph*	Every two weeks
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *((((numb_ep*numb_ep_wqp)*pp_lab_samp)*((hrs_wqp_analyze_ortho_ep_op*rate_op)+cost_wqp_analyze_ortho_ep))+(((numb_ep*numb_ep_wqp)*pp_commercial_samp)*cost_lab_wqp_ortho_ep))*		Above AL	Model PWSs serving ≤50,000 with PO_4 or both PO_4 and pH adjustment *pbasepo4, pbasephpo4*	
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *((((numb_ep*numb_ep_wqp)*pp_lab_samp)*((hrs_wqp_analyze_ph_ep_op*rate_op)+cost_wqp_analyze_ph_ep))+(((numb_*	Cost applies as written to NTNCWSs.	All	Model PWSs serving >50,000 with pH adjustment *pbaseph*	Every two weeks

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
*ep*numb_ep_wqp)*pp_commercial_samp)*cost_lab_wqp_ph_ep))*				
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *((((numb_ep*numb_ep_wqp)*pp_lab_samp)*((hrs_wqp_analyze_ortho_op*rate_op)+cost_wqp_analyze_ortho_ep))+(((numb_ep*numb_ep_wqp)*pp_commercial_samp)*cost_lab_wqp_ortho_ep))*			Model PWSs serving >50,000 with PO_4 or both PO_4 and pH adjustment *pbasepo4, pbasephpo4*	
z) Report lead WQP sampling data and compliance with OWQPs to the State				
The labor hours for reporting per system multiplied by the labor rate. *(hrs_report_wqp_op*rate_op)*	Cost applies as written to NTNCWSs.	Above AL	Model PWSs serving ≤50,000 without CCT	Twice a year
			Model PWSs serving ≤50,000 with pH adjustment *pbaseph*	
			Model PWSs serving ≤50,000 with PO_4 or both PO_4 and pH adjustment *pbasepo4, pbasephpo4*	
		All	Model PWSs serving >50,000 with pH adjustment *pbaseph*	
			Model PWSs serving >50,000 with PO_4 or both PO_4 and pH adjustment *pbasepo4, pbasephpo4*	

Acronyms: AL = action level; CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; OWQP = optimal water quality parameter; PO_4 = orthophosphate; PWS = public water system; WQP = water quality parameter.

Note:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *numb_enhance_wqp*: number of distribution system samples for systems on standard WQP monitoring (Chapter 4, Section B.5.2.2.3).
- *numb_ep*: number of entry points per systems (Chapter 4, Section B.5.2.2.3).
- *numb_ep_wqp*: number of entry point samples per systems (Chapter 4, Section B.5.2.2.3).
- *numb_reduced_wqp*: number of distribution system samples for systems on reduced WQP monitoring (Chapter 4, Section B.5.2.2.3).
- *pbaseph*: likelihood a system has an existing CCT of modify pH (S Chapter 4, Section B.5.2.2.1).
- *pbasepo4*: likelihood a system has existing CCT of adding PO_4 without pH post treatment (Chapter 4, Section B.5.2.2.1).
- *pbasephpo4*: likelihood a system has existing CCT of adding PO_4 with modify pH (Chapter 4, Section B.5.2.2.1).
- *p_wqp_six_red, p_wqp_annual*: likelihood a system is on reduced distribution system monitoring schedule at a semi-annual or annual schedule, respectively (Chapter 4, Section 0).
- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

B.5.2.3 PWS Copper Water Quality Parameter Monitoring under the 2021 LCRR

This discussion of copper WQP monitoring costs for water systems under the 2021 LCRR is presented in the following subsections:

- B.5.2.3.1: Applicability and Likelihood of a Copper ALE
- B.5.2.3.2: Copper WQP Monitoring Activities

B.5.2.3.1 Applicability and Likelihood of a Copper ALE

As was done for the final LCRI, the SafeWater LCR models Copper WQP Monitoring separately from the Lead WQP Monitoring for the 2021 LCRR. The frequency of Lead WQP Monitoring depends on the lead 90th percentile, with all systems above the AL and all systems serving more than 50,000 people[34] conducting Lead WQP Monitoring under the LCRR.[35] Copper WQP Monitoring is required when a system exceeds the copper AL. To not double count the cost of WQP monitoring for systems experiencing both a copper ALE and a lead ALE simultaneously, the SafeWater LCR models the costs of Copper and Lead WQP Monitoring separately and restricts Copper WQP Monitoring to systems with a copper ALE only and lead 90th percentile not greater than the lead AL of 15 µg/L.

The cost inputs used to estimate WQP costs in response to a copper ALE are identical to those incurred in response to a lead ALE with the following exceptions:

- The likelihood of a system's exceeding the copper ALE, which corresponds to *p_copper_ale,* is used in lieu of system's lead 90th percentile level.
- Systems are not assumed to be on reduced WQP distribution system monitoring in response to a copper ALE, and all systems are assumed to be on a 6-month standard monitoring schedule. Thus, the data inputs associated with reduced monitoring are not applicable. These include the reduced number of WQP monitoring samples per distribution sample site (*numb_reduced_wqp*), and the likelihood that a system will be on a 6-month *(p_wqp_six_red)* or annual *(p_wqp_annual)* WQP sampling schedule.

This approach is also used for the final LCRI and is detailed in Chapter 4, Section 4.3.2.3.1.

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[34] All systems serving more than 50,000 people are required to have CCT and to conduct WQP monitoring with the exception of systems that have naturally non-corrosive water, *i.e.*, "b3" systems. Refer to Chapter 3, Section 3.3.3 for the EPA's approach for deriving the number of "b3" systems (assumed to be 16 CWSs).

[35] As previously discussed in B.5.2.2, under the final LCRI, system serving 10,001 to 50,000 people with CCT also must conduct WQP monitoring regardless of their 90th percentile levels.

B.5.2.3.2 Copper WQP Monitoring Activities

The activities, unit burden and costs, and data variables used to estimate copper WQP monitoring costs under the 2021 LCRR are identical to those for lead, as shown in Exhibit B-20, with the exception that they are triggered in response to a copper ALE.

Exhibit B-20: PWS Copper WQP Monitoring Unit Burden and Cost Estimates under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?[1]
aa) Collect copper WQP samples from the distribution system	*Same as Exhibit B-18, activity v).*		Yes.
bb) Analyze copper WQP samples from the distribution system	*Same as Exhibit B-18, activity w).*		Yes.
cc) Collect copper WQP samples from entry points	*Same as Exhibit B-18, activity x).*		Yes.
dd) Analyze copper WQP samples from entry points	*Same as Exhibit B-18, activity y).*		Yes.
ee) Report copper WQP sampling data and compliance with OWQPs to the State	*Same as Exhibit B-18, activity z).*		Yes.

Acronyms: LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; OWQP = optimal water qualify parameter; PWS = public water system; WQP = water qualify parameter.
Source: "WQP Analytica Burden and Costs_Final.xlsx."
Notes:
[1] Under the final LCRI, system serving 10,001 to 50,000 people with CCT also must conduct WQP monitoring regardless of their 90th percentile levels.

Exhibit B-21 shows the SafeWater LCR model cost estimation approach for system WQP monitoring activities in response to a copper ALE including additional cost inputs that are required to calculate these costs under the 2021 LCRR.

Exhibit B-21: PWS Copper WQP Monitoring Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
aa) Collect copper WQP samples from the distribution system				
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_enhance_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material))*	Cost applies as written to NTNCWSs.	At or below AL	Model PWSs serving ≤50,000 without CCT and have a copper ALE *p_copper_ale*	Twice per event
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_enhance_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material_ph))*			Model PWSs serving ≤50,000 that have pH adjustment and a copper ALE *p_copper_ale, pbaseph*	
Number of samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(numb_enhance_wqp*((hrs_wqp_op*rate_op)+cost_wqp_material_ortho))*			Model PWSs serving ≤50,000 that have PO_4 or both PO_4 and pH adjustment and a copper ALE *p_copper_ale, pbasepo4, pbasephpo4*	

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
bb) Analyze copper WQP samples from the distribution system				
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *(((numb_enhance_wqp*pp_lab_samp)*((hrs_wqp_analyze_dist_op*rate_op)+cost_wqp_analyze))+((numb_enhance_wqp*pp_commercial_samp)*cost_lab_wqp))*	Cost applies as written to NTNCWSs.	At or below AL	Model PWSs serving ≤50,000 without CCT and have a copper ALE *p_copper_ale*	Twice per event
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *(((numb_enhance_wqp*pp_lab_samp)*((hrs_wqp_analyze_ph_op*rate_op)+cost_wqp_ph_analyze))+((numb_enhance_wqp*pp_commercial_samp)*cost_lab_ph_wqp))*			Model PWSs serving ≤50,000 that have pH adjustment and a copper ALE *p_copper_ale, pbaseph*	
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *(((numb_enhance_wqp*pp_lab_samp)*((hrs_wqp_analyze_ortho_op*rate_op)+cost_wqp_ortho_analyze))+((numb_enhance_wqp*pp_commercial_samp)*cost_lab_ortho_wqp))*			Model PWSs serving ≤50,000 that have PO_4 or both PO_4 and pH adjustment and have a copper ALE *p_copper_ale, pbasepo4, pbasephpo4*	

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
cc) Collect copper WQP samples from entry points				
The number of entry points per system multiplied by the number of samples, then multiplied by the total of the labor hours per sample times the system labor rate, plus the cost per sample. *((numb_ep*numb_ep_wqp)*((hrs_ep_wqp_op*rate_op)+cost_ep_wqp_material))*	Cost applies as written to NTNCWSs.	At or below AL	Model PWSs serving ≤50,000 without CCT and have a copper ALE *p_copper_ale*	Every 2 weeks per event
The number of entry points per system multiplied by the number of samples, then multiplied by the total of the labor hours per sample times the system labor rate, plus the cost per sample. *((numb_ep*numb_ep_wqp)*((hrs_ep_wqp_op*rate_op)+cost_ep_wqp_ph_material))*			Model PWSs serving ≤50,000 that have pH adjustment and a copper ALE *p_copper_ale, pbaseph*	
The number of entry points per system multiplied by the number of samples, then multiplied by the total of the labor hours per sample times the system labor rate, plus the cost per sample. *((numb_ep*numb_ep_wqp)*((hrs_ep_wqp_op*rate_op)+cost_ep_wqp_ortho_material))*			Model PWSs serving ≤50,000 that have PO_4 or both PO_4 and pH adjustment and have a copper ALE *p_copper_ale, pbasepo4, pbasephpo4*	

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
dd) Analyze copper WQP samples from entry points				
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *((((numb_ep*numb_ep_wqp)*pp_lab_samp)*((hrs_wqp_analyze_ep_op*rate_op)+cost_wqp_analyze_ep))+(((numb_ep*numb_ep_wqp)*pp_commercial_samp)* cost_lab_wqp_ep))*	Cost applies as written to NTNCWSs.	Above AL	Model PWSs serving ≤50,000 without CCT and have a copper ALE *p_copper_ale*	Every two weeks per event
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *((((numb_ep*numb_ep_wqp)*pp_lab_samp)*((hrs_wqp_analyze_ph_ep_op*rate_op)+cost_wqp_analyze_ph_ep))+(((numb_ep*numb_ep_wqp)*pp_commercial_samp)*cost_lab_wqp_ph_ep))*			Model PWSs serving ≤50,000 that have pH adjustment and a copper ALE *p_copper_ale, pbaseph*	
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *((((numb_ep*numb_ep_wqp)*pp_lab_samp)*((hrs_wqp_analyze_ortho_ep_op*rate_op)+cost_wqp_analyze_ortho_ep))+(((numb_ep*numb_ep_wqp)*pp_commercial_samp)*cost_lab_wqp_ortho_ep))*			Model PWSs serving ≤50,000 that have PO_4 or both PO_4 and pH adjustment and have a copper ALE *p_copper_ale, pbasepo4, pbasephpo4*	

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
ee) Report copper WQP sampling data and compliance with OWQPs to the State				
The labor hours for reporting per system multiplied by the labor rate. *(hrs_report_wqp_op*rate_op)*	Cost applies as written to NTNCWSs.	At or below AL	Model PWSs serving ≤50,000 without CCT and have a copper ALE *p_copper_ale*	Twice per event
			Model PWSs serving ≤50,000 that have pH adjustment and a copper ALE *p_copper_ale, pbaseph*	
			Model PWSs serving ≤50,000 that have PO_4 or both PO_4 and pH adjustment and have a copper ALE *p_copper_ale, pbasepo4, pbasephpo4*	

Acronyms: AL = action level; ALE = action level exceedance; CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; PO_4 = orthophosphate; OWQP = optimal water quality parameter; PWS = public water system; WQP = water quality parameter.

Note:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *numb_enhance_wqp*: number of distribution system samples for systems on standard WQP monitoring (Chapter 4, Section 4.3.2.2.3).
- *numb_ep*: number of entry points per systems (Chapter 4, Section 4.3.2.2.3).
- *pbaseph*: likelihood a system has an existing CCT of modify pH (Chapter 4, Section 4.3.2.2.1).
- *pbasepo4*: likelihood a system has existing CCT of adding PO_4 without pH post treatment (Chapter 4, Section 4.3.2.2.1).
- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

B.5.2.4 PWS Source Water Monitoring under the 2021 LCRR

This discussion of source water monitoring costs for water systems is presented in the following subsections:

- B.5.2.4.1: Applicability and Required Number of Samples
- B.5.2.4.2: Source Water Monitoring Activities

B.5.2.4.1 Applicability and Required Number of Samples

Under the 2021 LCRR, CWSs and NTNCWSs must sample at each entry point if they experience a significant source water change and/or have not already conducted source water monitoring for a previous lead or copper AL. The EPA retained this requirement in the final LCRI. The likelihood of a significant source change as well as the required number of source water samples is the same under the 2021 LCRR and final LCRI and are described in Chapter 4, Section 4.3.2.4.1. The likelihood that a system will exceed the lead and/or copper AL is lower under the 2021 LCRR than the final LCRI because:

- The lead AL under the 2021 LCRR is 15 µg/L and the final LCRI is 10 µg/L.
- LSL systems under the 2021 LCRR use the fifth-liter sample in their 90th percentile calculation but under the final LCRI they would use the higher of the first- and fifth-liter sample.

A discussion of the EPA's approach for estimating the likelihood a system will initially have a lead ALE under the 2021 LCRR is provided in Chapter 3, Section 3.3.5.1.1, with the estimated percentages provided in Exhibit 3-25. The likelihood a system will have a copper ALE is provided in Chapter 4, Section 4.3.2.3.1. Note that this approach may result in an overestimation of cost because the 2021 LCRR allows systems to forego source water monitoring if they previously sampled source water in response to an ALE, the State has not required source water treatment, and they have not added any new water sources that change their primacy source type. For modeling purposes no system is assumed to have source water treatment.

B.5.2.4.2 Source Water Monitoring Activities

The EPA has developed system costs for three source water monitoring activities under the 2021 LCRR, as shown in Exhibit B-22. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden or cost, and SafeWater LCR data variable for the 2021 LCR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.2.4.2.

In a few instances, some of these activities are conducted by the State instead of the water system. These activities are identified in the exhibit and further explained in the exhibit notes.

Exhibit B-22: PWS Source Monitoring Burden and Cost Estimates under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
ff) Collect source water samples	Burden 0.5 hrs/sample Cost $1.12/sample for CWSs serving > 100K	Burden *hrs_source_op* Cost *cost_source_material*[1]	Yes.
gg) Analyze source water samples	In-House Burden 0.44 hrs/sample for CWSs serving > 100K In-House Cost $3.92/sample for CWSs serving > 100K Commercial Cost $31.00/sample for CWSs serving ≤ 100K and NTNCWSs	In-House Burden *hrs_analyze_samp_op*[1] In-House Cost *cost_source_analyze*[1] Commercial Cost *cost_source*[1]	Yes.
hh) Report source water monitoring results to the State	1 hour/report	*hrs_report_source_op*[1]	Yes.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; NTNCWS = non-transient non-community water system; PWS = public water system.
Sources:
ff), hh): 2022 *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 15 (USEPA, 2022); "Lead Analytical Burden and Costs_Final.xlsx," worksheets "Source_Collect_Analyze_CWS" and "Source_Collect_Analyze_NTNCWS."
gg): See file "Lead Analytical Burden and Costs_Final.xlsx," worksheets "Source_Collect_Analyze_CWS" and "Source_Collect_Analyze_NTNCWS."
Note:
[1] The burden and costs for these activities are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina.

Exhibit B-23 provides the SafeWater LCR model cost estimation approach for system source water monitoring activities and indicates that the approach under the 2021 LCRR is the same as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-43.

Exhibit B-23: PWS Source Water Monitoring Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
ff) Collect source water samples[1]				
Same as final LCRI (see Exhibit 4-43 in Chapter 4).				
gg) Analyze source water samples[1]				
Same as final LCRI (see Exhibit 4-43 in Chapter 4).				
hh) Report source water monitoring results to the State[1]				
Same as final LCRI (see Exhibit 4-43 in Chapter 4).				

Acronyms: CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] The burden and cost to provide sample bottles (*cost_source_material*) under activity ff), conduct analyses under activity gg), and report source water sample results to the system under activity hh) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

B.5.2.5 CWS School and Child Care Lead Sampling Costs under the 2021 LCRR

As detailed in Chapter 3, Section 3.3.10, the 2021 LCRR established requirements for CWSs to conduct PE and lead testing in drinking water in K – 12 public and private schools and licensed child care facilities in their service area. CWSs must collect five samples per tested school *(numb_samp_five)* and two samples at each tested child care facility *(numb_samp_two)*. The rule splits this testing program into two phases. The first testing phase occurs at elementary schools and child care facilities during the first 5 years of rule implementation, which is assumed to occur in Years 1 through 5 of the 35-year period of analysis. During the first five-year cycle, systems must schedule and conduct testing at 20 percent of elementary schools and 20 percent of child care facilities *(pp_mand_twenty_partic)* per year such that each would be tested once in the five-year period. The EPA assumed all elementary schools and child facilities would accept sampling. CWSs are also required to annually provide secondary schools with information on how to request sampling and must sample if requested by the school. In Years 6 onward, CWSs are only required to test elementary schools, secondary schools, and child care facilities that request testing. The EPA assumed 5 percent of elementary schools and child care facilities would request testing each year, starting in Year 6 and 5 percent of secondary schools would request testing each year, starting in Year 1 (*pp_voluntary_partic*).

The final LCRI retains the testing and PE requirements of the 2021 LCRR and the costing inputs and approach for estimating costs are the same under both rules with two exceptions. First, the final LCRI adds a new requirement for systems to provide school and child care facility testing results to their State within 30 days of receiving the analytical results. Secondly, the allowance for States to waive testing at a school and/or licensed child care facility is broader under the final LCRI. Under the 2021 LCRR, States cannot waive testing requirements for CWSs based on sampling conducted prior to the 2021 LCRR compliance date of October 16, 2024. Under the final LCRI, States can waive requirements for the first five-year sampling cycle after the final LCRI compliance date in schools and licensed child care facilities

that were sampled between January 1, 2021 and the final LCRI compliance date. See Chapter 3, Section 3.3.10.2 for the EPA's approach for estimating the percentage of schools and child care facilities for which CWSs will receive a waiver under the 2021 LCRR and final LCRI.

B.5.2.5.1 First Five-Year Testing Cycle

The EPA has developed system burden and costs to implement a lead in drinking water testing program at elementary schools and child care facilities for the first five-year testing cycle under the 2021 LCRR, as shown in Exhibit B-24. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. In a few instances, some of these activities are conducted by the State instead of the CWS. These activities are identified in the exhibit and further explained in the exhibit notes. The last column indicates if the activities, unit burden or cost, and SafeWater LCR data variables for the 2021 LCRR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.2.5.1. The gray shaded row indicates an activity that is not required under the 2021 LCRR.

Exhibit B-24: CWS School and Child Care Facility Sampling Unit Burden and Cost Estimates for the First Five-Year Testing Cycle Phase under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
ii) Create a list of schools and child care facilities served by the CWS and submit to the State (one-time)	0.08 hrs/school or child care facility	*hrs_school_identify_op*	Yes.
jj) Develop lead outreach materials for schools and child care facilities (one-time)	7 hrs/CWS	*hrs_devel_pe_school_op*	Yes.
kk) Prepare and distribute initial letters explaining the sampling program and the EPA's 3Ts Toolkit (one-time)	Burden 0.05 to 0.11 hrs/school or child care facility Cost $0.47 to $0.72/ school or child care facility	Burden *hrs_school_letter_op* Cost *cost_school_letter*	Yes.
ll) Contact elementary school or child care facility to determine and finalize its sampling schedule (one-time) or contact secondary school to offer sampling (annual)	School 0.5 hrs/elementary school (one-time) 0.05 to 0.11/secondary school (annual) School Cost $0.47 to $0.72/secondary school	School *hrs_school_call_op (elementary)* *hrs_school_annual_contact_op (secondary)* School Cost *cost_school_annual_contact (secondary)*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
	Child Care Facility 1 hr/child care facility	Child Care Facility *hrs_childcare_call_op*	
mm) Contact school or child care facility to coordinate sample collection logistics	0.25 hrs/school or child care facility	*hrs_school_coor_sample_op*	Yes.
nn) Conduct walkthrough at school or child care facility before the start of sampling	Burden 1.40 to 1.71 hrs/school or child care facility Cost $5.75 to $10.24/school or child care facility	Burden *hrs_walkthrough_school_op* Cost *cost_walkthrough_school*	Yes.
oo) Travel to collect samples	Burden 0.40 to 0.71 hrs/school or child care facility Cost $5.75 to $10.24/school or child care facility	Burden *hrs_travel_samp_school_op* Cost *cost_travel_samp_school*	Yes.
pp) Collect samples	Burden 0.17 hrs/sample Cost $1.12/sample for CWSs serving > 100,000 people	Burden *hrs_collect_samp_school_op* Cost *cost_collect_samp_school*[1]	Yes.
qq) Analyze samples	In-House Analysis (CWSs > 100K only) Burden: 0.44 hrs/sample Cost: $3.92/sample Commercial Analysis $31.00/sample	In-House Analysis *hrs_analyze_samp_op*[1] *cost_lab_lt_samp*[1] Commercial Analysis *cost_commercial_lab*[1]	Yes.
rr) Provide sampling results to tested facilities	Burden 0.05 to 0.11 hrs/tested facility Cost $0.72/ tested facility	Burden *hrs_inform_samp_pe_school_op* Cost *cost_inform_samp_pe_school*	Yes.
ss) Discuss sampling results with the school and child care facility	1 hr/school or child care facility	*hrs_result_discuss_op*	Yes.
tt) Conduct detailed discussion of high sampling results with schools and child care facilities	5 hr/sample	Burden *hrs_school_help_op*	Yes.
uu) Report school and child care facility	N/A	Burden *hrs_report_sch_cc_results_op*	No. Not required

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
sampling results to the State			under the 2021 LCRR.[2]
vv) Prepare and provide annual report on school and child care facility sampling program to the State	Burden 1 to 8 hrs/CWS Cost $0.72/CWS	Burden *hrs_annual_report_school_prepare_op* Cost *cost_annual_report_school_dist*	Yes.

Acronyms: AL = action level; 3Ts Toolkit = "3Ts for Reducing Lead in Drinking Water Toolkit"; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; PWS = public water system.

Source: "School_Child Care Inputs_Final.xlsx." Other data sources are provided following this exhibit for each activity, as applicable.

Note:

[1] The burden and costs for these activities are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

[2] Under the LCRR, the sampling results are included as part of the annual report (activity vv)). Under the final LCRI, systems would be required to report sampling results within 30 days of receiving the results.

Exhibit B-25 provides the SafeWater LCR model cost estimation approach for each activity under the first five-year cycle including additional cost inputs required to calculate these costs under the 2021 LCRR. The exhibit also indicates if the costing approach for a specific activity is the same as that under the final LCRI, as documented in Chapter 4, Exhibit 4-45. The gray shaded row indicates an activity that is new under the final LCRI and does not apply to the 2021 LCRR.

The main difference between the costing estimation approach for the 2021 LCRR and final LCRI is the likelihood that a CWS will receive a waiver for testing a school or child care facility. Refer to Exhibit 3-72 and Exhibit 3-73 in Chapter 3 for these likelihoods under the 2021 LCRR and final LCRI, respectively.

Exhibit B-25: CWS School and Child Care Facility First Five-Year Testing Cycle Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
ii) Create a list of schools and child care facilities and submit to the State				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
jj) Develop lead outreach materials for schools and child care facilities				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
kk) Prepare and distribute initial letters explaining the sampling program and the 3Ts Toolkit				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
ll) Contact elementary school or child care facility to determine and finalize its sampling schedule and contact secondary school to offer sampling				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
mm) Contact school or child care facility to coordinate sample collection logistics				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
nn) Conduct walkthrough at school or child care facility before start of sampling				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
oo) Travel to collect samples				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
pp) Collect samples[2]				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
qq) Analyze samples[3]				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
rr) Provide sampling results to tested facilities				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
ss) Discuss sampling results with school and child care facilities				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
tt) Conduct detailed discussion of high sampling results with school and child care facilities				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				
uu) Report school and child care facility sampling results to the State				
N/A under the 2021 LCRR. New requirement under the final LCRI.				
vv) Prepare and provide annual report on school and child care facility sampling to State				
Same as final LCRI (see Exhibit 4-45 in Chapter 4).				

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] The first testing cycle is assumed to occur in Years 4 through 8 at elementary schools and child care facilities.

[2] The burden and costs to provide sample bottles (*cost_collect_samp_school*) under activity pp) and conduct analyses under activity qq) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

B.5.2.5.2 Second Five-Year Testing Cycle On

Under the 2021 LCRR and final LCRI, after CWSs complete one five-year cycle of testing at elementary schools and child care facilities, testing at these facilities is on request only. In addition, CWSs are only required to test those secondary schools that request testing. The EPA assumed that five percent of elementary and secondary schools, and licensed child care facilities per year would elect to participate in the sampling program *(pp_voluntary_partic).* This estimate is based on the EPA's discussions with Greater Cincinnati Water Works about their school testing program (available in the docket at EPA-HQ-OW-2022-0801).

The EPA has developed system burden and costs for 12 activities the agency has identified as necessary to implement the on request program for drinking water testing at schools and child care facilities as shown in Exhibit B-26. The exhibit provides the unit burden and/or cost for each activity. The assumptions used in the estimation of each activity follows the exhibit. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. In a few instances, some of these activities are conducted by the State instead of the CWS. These activities are identified in the exhibit and further explained in the exhibit notes. The last column indicates if the activities, unit burden or cost, and SafeWater LCR data variables for the 2021 LCRR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.2.5.2. The gray shaded row indicates an activity that is not required under the 2021 LCRR.

Exhibit B-26: CWS School and Child Care Facility Sampling Unit Burden and Cost Estimates under the Second and Subsequent Five-Year Testing Cycles under the 2021 LCRR

Activity		Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
ww)	Update the list of schools and child care facilities and submit to the State (every five years)	0.08 hrs/school or child care facility	*hrs_school_identify_op*	Yes.
xx)	Contact schools and child care facilities to offer sampling	Burden 0.05 to 0.11 hrs/school or child care facility Cost $0.47 to $0.72	Burden *hrs_school_annual_contact_op* Cost *cost_school_annual_contact*	Yes.
yy)	Contact the school or child care facility to coordinate sample collection logistics	0.25 hrs/school or child care facility	*hrs_school_coor_sample_op*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
zz) Conduct walkthrough at school or child care facility before the start of sampling	Burden 1.40 to 1.71 hrs/school or child care facility Cost $5.75 to $10.24/school or child care facility	Burden *hrs_walkthrough_school_op* Cost *cost_walkthrough_school*	Yes.
aaa) Travel to collect samples	Burden 0.40 to 0.71 hrs/school or child care facility Cost $5.75 to $10.24/school or child care facility	Burden *hrs_travel_samp_school_op* Cost *cost_travel_samp_school*	Yes.
bbb) Collect samples	Burden 0.17 hrs/sample Cost $1.12/sample for CWSs serving > 100K	Burden *hrs_collect_samp_school_op* Cost *cost_collect_samp_school*[1]	Yes.
ccc) Analyze samples	In-house Analysis (CWSs > 100K only) Burden: 0.44 hrs/sample Cost: $3.92/sample Commercial Analysis $31.00/sample	In-House Analysis *hrs_analyze_samp_op*[1] *cost_lab_lt_samp*[1] Commercial Analysis *cost_commercial_lab*[1]	Yes.
ddd) Provide sampling results to tested facilities	Burden 0.05 to 0.11 hrs/tested facility Cost $0.72/ tested facility	Burden *hrs_inform_samp_pe_school_op* Cost *cost_inform_samp_pe_school*	Yes.
eee) Discuss sampling results with the school and child care facility	1 hr/school or child care facility	*hrs_result_discuss_op*	Yes.
fff) Conduct detailed discussion of high sampling results with schools and child care facilities	5 hr/sample	Burden *hrs_school_help_op*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
ggg) Report school and child care facility sampling results to the State	N/A	Burden *hrs_report_sch_cc_results_op*	No. Not required under the 2021 LCRR.[2]
hhh) Prepare and provide annual report on school and child care facility sampling program to the State	Burden 1 to 8 hrs/CWS Cost $0.72/CWS	Burden *hrs_annual_report_school_prepare_op* Cost *cost_annual_report_school_dist*	Yes.

Acronyms: AL = action level; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; PWS = public water system.
Source: "School_Child Care Inputs_Final.xlsx." Other data sources are provided following this exhibit for each activity, as applicable.
Note:
[1] The burden and costs for these activities are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).
[2] Under the LCRR, the sampling results are included as part of the annual report (activity hhh). Under the final LCRI, systems would be required to report sampling results within 30 days of receiving the results.

Exhibit B-27 provides the SafeWater LCR model cost estimation approach for each activity under the second and subsequent five-year cycles of the 2021 LCRR including additional cost inputs required to calculate these costs. The exhibit also indicates if the costing approach for a specific activity is the same as that under the final LCRI, as documented in Chapter 4, Exhibit 4-47. The gray shaded row indicates an activity that is new under the final LCRI and does not apply to the 2021 LCRR.

Exhibit B-27: PWS Second Five-Year Testing Cycle On School and Child Care Facility Sampling Phase Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
ww) Update the list of schools and child care facilities and submit to the State				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
xx) Contact schools and child care facilities to offer sampling				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
yy) Contact the school or child care facility to coordinate sample collection logistics				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
zz) Conduct walkthrough at school or child care facility before start of sampling				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
aaa) Travel to collect samples				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
bbb) Collect samples[3]				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
ccc) Analyze samples[2]				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
ddd) Provide sampling results to tested facilities				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
eee) Discuss sampling results with the school and child care facility				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
fff) Conduct detailed discussion of high sampling results with schools and child care facilities				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				
ggg) Report school and child care facility sampling results to the State				

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
N/A under the 2021 LCRR. New requirement under the final LCRI.				
hhh) Prepare and provide annual report on school and child care facility sampling to State				
Same as final LCRI (see Exhibit 4-47 in Chapter 4).				

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] The second five-year testing cycle on is assumed to start in Year 9.

[2] The burden and costs to provide sample bottles (*cost_collect_samp_school*) under activity bbb) and conduct analyses under activity ccc) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

B.5.3 PWS Corrosion Control Costs under the 2021 LCRR

Under the LCRR, PWSs may be required to install CCT, re-optimize their existing CCT, or perform a "find-and-fix" [36] adjustment to their CCT. CCT installation and re-optimization are triggered based on the system's lead 90th percentile range. The "find-and-fix" requirements are triggered under the 2021 LCRR when an individual lead tap sample is greater than 15 µg/L. Any changes to the status of a system's CCT may result in technology-related costs (capital and/or O&M), as well as ancillary costs for data submission, consultation, and CCT studies.

The unit cost inputs and assumptions for CCT are the same under the 2021 LCRR and final LCRI; however, the conditions under which they apply are different. Both rules require CCT installation for systems without CCT that exceed the lead AL; however, the final LCRI lowers the lead AL from 15 to 10 µg/L and removes CCT requirements associated with the TL under the LCRR. The final LCRI also lowers the eligibility threshold for CWSs seeking a compliance option other than CCT from those serving 10,000 or fewer people to 3,300 or fewer people. Lastly, the final LCRI allows water systems to defer the installation or re-optimization of CCT if they can remove all their LSLs and GRR service lines within five years of initially exceeding the lead AL. This option was not available under the LCRR.

This section presents the following CCT-related costs:

- B.5.3.1: CCT Installation
- B.5.3.2: Re-optimization of Existing Corrosion Control Treatment
- B.5.3.3: Find-and-Fix Costs
- B.5.3.4: System Lead CCT Routine Costs

The derivation and values for baseline pH (*baselineph_wocct*, *baselineph_woph*, *baselineph_wpo4ph*, *baselineph_wph)* and baseline PO_4 dose (*baselinepo4dose*) are the same as those used to calculate the CCT costs for the final LCRI and can be found in Chapter 4, Section 4.3.3.

B.5.3.1 CCT Installation

Under the 2021 LCRR, PWSs without CCT may be required to install CCT if they exceed the lead AL of 15 µg/L. The approach for estimating capital and O&M costs for CCT installation is the same under the 2021 LCRR as under the final LCRI, as described in Chapter 4, Section 4.3.3.1.1.

The EPA has developed system costs for an ancillary activity associated with CCT installation as shown in Exhibit B-28. The exhibit provides the unit burden and/or cost for the activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden or cost, and the SafeWater LCR data variable for the 2021 LCRR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.3.1.2.

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[36] In the final LCRI, the EPA is replacing the term "find-and-fix" with "Distribution System and Site Assessment" to recognize that the fix to address the exceedance may be outside the control of the water system.

Exhibit B-28: PWS CCT Installation-Related Unit Burden and Cost Estimates under the 2021 LCRR

Activity[1]	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Conduct a CCT study	Study • No LSLs (coupon testing): \$30,372 • With LSLs (harvested pipe loop testing): \$307,744 for ≤ 50,000 people; \$376,685 for > 50,000 people	*cost_cct_study_dem*	No. See discussion that follows this exhibit.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; LSL = lead service line; PWS = public water system.

Notes:

[1] Activity b), "Install CCT Treatment (PO_4, PO_4 with post treatment, pH adjustment, or modify pH)" was previously discussed in Chapter 4, Section 4.3.3.1.1.

a) Conduct a study (cost_cct_study_dem). The EPA assumed States will require all systems to conduct either harvested pipe loop testing or a coupon study prior to CCT installation under the 2021 LCRR. The SafeWater LCR model uses the following set of assumptions:

- Systems required to conduct a CCT study will use a contractor.
- Systems without LSLs will use a coupon study at an estimated cost of \$30,372 for systems of all sizes.
- Systems with LSLs will conduct harvested pipe loop testing and will incur a cost of \$307,744 for those serving 50,000 or fewer people and \$376,685 for those serving more than 50,000 people.

Note that these assumptions for the 2021 LCRR differ from the final LCRI in which systems serving 10,000 or fewer people with LSLs will also use a coupon study in lieu of a harvested pipe loop study.

The development of harvested pipe loop and coupon test study costs are detailed in *Technologies and Costs for Corrosion Control to Reduce Lead in Drinking Water* (USEPA, 2023).

Exhibit B-29 indicates that the costing approach for ancillary CCT installation is the same under the 2021 LCRR as under the final LCRI, as documented in Chapter 4, Exhibit 4-55.

Exhibit B-29: PWS Ancillary CCT Installation Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
a) Conduct a CCT study				
Same as final LCRI (see Exhibit 4-55 in Chapter 4).				

Acronyms: CCT = corrosion control treatment; CWS = community water system; LCRI = Lead and Copper Rule Improvements; PWS = public water system; NTNCWS = non-transient non-community water system.

B.5.3.2 Re-optimization of Existing Corrosion Control Treatment

PWSs that have previously installed CCT may be required to re-optimize their treatment if they exceed the lead TL or ALE under the LCRR. The EPA uses the same approach to estimate the costs for re-optimizing existing CCT under the 2021 LCRR as under the final LCRI, as described in Chapter 4, Section 4.3.3.2.1.

The EPA has developed system ancillary costs for an ancillary activity associated with CCT re-optimization as shown in Exhibit B-30. The exhibit provides the unit burden and/or cost for the activity. The assumptions used in the estimation of the unit burden follow the exhibit. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates if the activities, unit burden or cost, and SafeWater LCR data variables are identical for the 2021 LCR to those used for the final LCRI, as described in Chapter 4, Section 4.3.3.2. For this activity, the estimated unit cost for revising the CCT study is different for systems exceeding the TL than those exceeding the AL under the 2021 LCRR. However, the unit costs for systems exceeding the AL is the same for both the 2021 LCRR and final LCRI.

Exhibit B-30: PWS CCT Ancillary Re-optimization Unit Burden and Cost Estimates under the 2021 LCRR

Activity[1]	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
c) Revise CCT study	Systems with TLE but no ALE $6,148 to $11,831/system Systems with ALE[2] No LSLs: $30,372 with LSLs: $307,744 to $376,685	*cost_revise_cct* *cost_cct_study_dem*	No. See explanation following the exhibit.

Acronyms: ALE = action level exceedance, CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; LSL = lead service line; TLE = trigger level exceedance.
Source: “CCT Study and Review Costs_Final.xlsx;” *Technologies and Costs for Corrosion Control to Reduce Lead in Drinking Water* (USEPA, 2023).
Notes:
[1] Activity d), “Re-optimize existing CCT” was previously discussed in Chapter 4, Section 4.3.3.2.1.
[2] The unit cost is the same for systems that exceed the lead AL under the 2021 LCRR and final LCRI.

c) Revise CCT study (cost_revise_cct). The EPA assumes the following for systems that exceed the TL but not the AL under the 2021 LCRR:

- States will require all systems to conduct a study prior to CCT re-optimization.
- Systems will use a contractor to conduct a study.
- Systems will revise their existing CCT (*cost_revise_cct*) that is estimated at $6,148 for systems serving 3,300 or fewer people, $8,756 for systems serving 3,301 to 50,000 people, and $11,831 for systems serving more than 50,000 people. Note that this may overestimate costs because the 2021 LCRR gives States discretion to allow these systems to re-optimize without first conducting a study.

For systems that exceed the AL under the 2021 LCRR, the EPA assumes that systems will conduct a demonstration study with the same unit costs as presented in Chapter 4, Section 4.3.3.2.2 for the final LCRI.

Exhibit B-31 shows the SafeWater LCR model cost estimation approach for system ancillary CCT re-optimization study activities including additional cost inputs required to calculate these costs under the 2021 LCRR.

Exhibit B-31: PWS CCT Ancillary Re-optimization Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
c) Revise CCT study				
Material cost per system for the marginal contractor cost for revision of CCT study. *cost_revise_cct*	Cost applies as written to NTNCWSs.	At or below AL and above TL	Model PWS re-optimizing CCT	One time
Material cost per system for the marginal contractor cost, with the difference between coupon testing and harvested pipe loop testing reflected in the stratification of the data by system LSL status. *cost_cct_study_dem*	Cost applies as written to NTNCWSs.	Above AL[1]	Model PWS re-optimizing CCT	One time

Acronyms: AL = action level; CCT = corrosion control treatment; CWS = community water system; LSL = lead service line; NTNCWS = non-transient non-community water system; PWS = public water system; TL = trigger level.
Notes:
[1] The cost estimation approach is the same for systems that exceed the lead AL under the 2021 LCRR and final LCRI.

B.5.3.3 Find-and-Fix Costs

Under the 2021 LCRR, water systems must undertake the same actions required under the final LCRI but must do so if a single sample exceeds 15 µg/L, as opposed to if a single sample exceeds 10 µg/L under the final LCRI. As noted previously in footnote 36, the EPA is replacing the term “find-and-fix” with “Distribution System and Site Assessment” in the final LCRI. The final LCRI also clarifies the allowable distance from the site with the lead result above 10 µg/L for the WQP monitoring location, but this does not affect the unit cost inputs for find-and-fix activities.

The estimated likelihood that an individual lead sample is above 15 µg/L is presented in Chapter 3, Section 3.3.5.3.1. Similar to the final LCRI, the EPA assumed in the SafeWater LCR model that in response to individual lead tap water samples above 15 µg/L, model-PWSs will take progressively more stringent corrective actions. These assumed actions are:

1. First sampling period with one or more individual tap water samples above 15 µg/L – model-PWS will investigate the cause but not take any corrective action.

2. Second sampling period with one or more individual tap water samples above 15 µg/L – model-PWS will perform spot flushing once in the distribution system.
3. Third sampling period with one or more individual tap water samples above 15 µg/L – model-PWS will increase the pH level at one entry point.
4. Fourth sampling period with one or more individual tap water samples above 15 µg/L – model-PWS will increase the pH at all other entry points (if more than one).

These corrective actions are not meant to encompass the entire suite of find-and-fix compliance options but rather provide a representation of typical actions a PWS might take to correct reoccurring individual lead tap samples over 15 µg/L.

The EPA used the same SafeWater LCR inputs and values under the 2021 LCRR and final LCRI, except as noted for activities g) and h) below in Exhibit B-32.

- Burden *hrs_flush_wqp_op* and costs for systems to conduct flushing *cost_flush_wqp* as provided in Chapter 4, Section 4.3.3.3.1.
- Cost to increase pH described in Chapter 4, Section 4.3.3.3.2.
- Ancillary costs, such as follow-up sampling, WQP sampling, reviewing incidents of system-wide events and other system conditions, consulting with States prior to any CCT adjustments, and reporting to the State. These activities are detailed in Chapter 4, Section 4.3.3.3.3 and shown in Exhibit B-32.

Exhibit B-32: PWS Ancillary Find-and-Fix Unit Burden and Cost Estimates under the 2021 LCRR[1]

Activity	Unit Burden and/or Cost	***SafeWater LCR Data Variable***	Same As Final LCRI?
e) Contact customers and collect follow-up tap sample	Burden per sample CWSs: 3.4 to 3.7 hrs NTNCWSs: 0.5 hrs Costs per sample CWSs: $5.75 to $13.09 NTNCWSs: $0	Burden *hrs_samp_above_al_op* Cost *cost_samp_above_al*	Yes.
f) Analyze follow-up lead tap sample	In-house Analysis (CWSs > 100K only) Burden: 0.44 hrs/sample Cost: $3.92 Commercial Analysis $32.20	In-house Analysis *hrs_analyze_samp_op*[2] *cost_lab_lt_samp*[2] Commercial Analysis *cost_commercial_lab*[2]	Yes.
g) Collect distribution system WQP sample	Burden per sample per PWS 0.5 hrs Cost for per sample No CCT: $2.66 (CWS & NTNCWS) pH adjustment:	Burden *hrs_wqp_dssa_op* Cost No CCT: *cost_wqp_material* pH: *cost_wqp_material_ph*	No.[3]

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
	• $1.70 to $2.66 (CWS); • $2.66 (NTNCWS) Orthophosphate: • $0.63 to $1.07 (CWS) $2.66 (NTNCWS)	Orthophosphate: *cost_wqp_material_ortho*	
h) Analyze distribution system WQP sample	<u>In-House Burden per sample</u> No CCT: 0.15 hrs (CWS & NTNCWS) pH adjustment: • 0.15 to 0.46 hrs (CWS) • 0.15 hrs (NTNCWS) Orthophosphate: • 0.15 to 1.34 hrs (CWS) • 0.15 hrs (NTNCWS) <u>In-House cost per sample</u> No CCT: $0.63 (CWS & NTNCWS) pH adjustment: • $0.63 to $0.98 (CWS) • $0.63 (NTNCWS) Orthophosphate: • $0.63 to $1.07 (CWS) • $0.63 (NTNCWS) <u>Commercial cost per sample</u> No CCT: $27.24 to $30.55 (CWS & NTNCWS) pH adjustment: $27.24 to 30.55 (CWS & NTNCWS) Orthophosphate: $60.34 to $61.89 (CWS & NTNCWS)	<u>In-House Burden</u> No CCT: *hrs_wqp_analyze_dist_op* pH adjustment: *hrs_wqp_analyze_ph_op* Orthophosphate: *hrs_wqp_analyze_ortho_op* <u>In-House Cost</u> No CCT: *cost_wqp_analyze* pH adjustment: *cost_wqp_ph_analyze* Orthophosphate: *cost_wqp_ortho_analyze* <u>Commercial Cost</u> No CCT: *cost_lab_wqp* pH: *cost_lab_ph_wqp* Orthophosphate: *cost_lab_ortho_wqp*	No.[3]
i) Review incidents of systemwide event and other system conditions	CWSs: 4 to 30 hrs/system NTNCWSs: 1 to 14 hrs/system	*hrs_deter_dssa_op*	Yes.
j) Consult with the State prior to making CCT changes	2 hrs per system with CCT	*hrs_consult_dssa_op*	Yes.
k) Report follow-up sample results and overall find-and-fix responses to the State	2 hrs/PWS serving ≤ 50,000 people; 4 hrs/PWS serving > 50,000 people	*hrs_report_dssa_op*	Yes.

Acronyms: CCT = corrosion control treatment; CWS = community water system; DSSA = Distribution System and Site Assessment; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PWS = public water system; WQP = water quality parameter.
Sources: See Chapter 4, Section 4.3.3.3.3.
Note:
[1] Under the LCRR, the requirements triggered by a single sample above the AL are referred to as "find-and-fix." Under the final LCRI, this term has been replaced by Distribution System and Site Assessment.
[2] In Arkansas, Louisiana, Mississippi, Missouri, and South Carolina, the State pays for the cost of bottles, shipping, analysis, and providing sample results to the system. Thus, the State will incur the burden and cost for these activities in lieu of the system (ASDWA, 2020a).

[3] Under the final LCRI, systems without CCT are not required to conduct WQP monitoring, which corresponds to activities g) and h) in the exhibit above.

Exhibit B-33 provides the SafeWater LCR model cost estimation approach for system ancillary find-and-fix activities including additional cost inputs that are required to calculate the total costs under the 2021 LCRR.

Exhibit B-33: PWS Ancillary Find-and-Fix Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1,2]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th – Range	Other Conditions	
e) Contact customers and collect follow-up tap samples[3]				
The number of required samples per system >15 µg/L multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(pp_above_al_bin_three*numb_samp_customer)*((hrs_samp_above_al_op*rate_op)+cost_samp_above_al)*	Cost applies as written to NTNCWSs.	At or below TL	PWSs not on reduced tap sampling and not doing POU sampling *1 – (p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice a year
			PWSs on annual tap sampling and not doing POU sampling *p_tap_annual*	Once a year
The number of required samples per system >15 µg/L multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(pp_above_al_bin_three*numb_reduced_tap)*((hrs_samp_above_al_op*rate_op)+cost_samp_above_al)*			PWSs on triennial reduced tap sampling and not doing POU sampling *p_tap_triennial*	Every 3 years
The number of required samples per system >15 µg/L multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(pp_above_al_bin_two*numb_samp_customer)*((hrs_samp_above_al_op*rate_op)+cost_samp_above_al)*	Cost applies as written to NTNCWSs.	At or below AL and above TL	All PWSs with at least one sample > 15 µg/L	Once a year
The number of required samples per system >15 µg/L multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. *(pp_above_al_bin_one*numb_samp_customer)*((hrs_samp_above_al_op*rate_op)+cost_samp_above_al)*		Above AL	All PWSs with at least one sample > 15 µg/L	Twice a year

<table>
<tr><th rowspan="2">CWS Cost Per Activity</th><th rowspan="2">NTNCWS Cost Per Activity</th><th colspan="2">Conditions for Cost to Apply to a Model PWS</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90th – Range</th><th>Other Conditions</th></tr>
<tr><td colspan="5">f) Analyze follow-up lead tap sample[3]</td></tr>
<tr><td rowspan="2">The number of samples multiplied by the likelihoods for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis.

(((pp_above_al_bin_three*numb_samp_customer)*pp_lab_samp)*((hrs_analyze_samp_op*rate_op)+cost_lab_lt_samp))+(((pp_above_al_bin_three*numb_samp_customer)*pp_commercial_samp)*cost_commercial_lab)</td><td rowspan="3">Cost applies as written to NTNCWSs.</td><td rowspan="3">At or below TL</td><td>PWSs is not on reduced tap sampling and not doing POU sampling

1 – (p_tap_annual + p_tap_triennial + p_tap_nine)</td><td>Twice a year</td></tr>
<tr><td>PWSs on annual tap sampling and not doing POU sampling

p_tap_annual</td><td>Once a year</td></tr>
<tr><td>The number of samples multiplied by the likelihoods for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis.

(((pp_above_al_bin_three*numb_reduced_tap)*pp_lab_samp)*((hrs_analyze_samp_op*rate_op)+cost_lab_lt_samp))+(((pp_above_al_bin_three*numb_reduced_tap)*pp_commercial_samp)*cost_commercial_lab)</td><td>PWSs on triennial reduced tap sampling and not doing POU sampling

p_tap_triennial</td><td>Every 3 years</td></tr>
<tr><td>The number of samples multiplied by the likelihoods for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis.

(((pp_above_al_bin_two*numb_samp_customer)*pp_lab_samp)*((hrs_analyze_samp_op*rate_op)+cost_lab_lt_samp))+(((pp_above_al_bin_two*numb_samp_customer)*pp_commercial_samp)*cost_commercial_lab)</td><td>Cost applies as written to NTNCWSs.</td><td>At or below AL and above TL</td><td>All PWSs with at least one sample > 15 µg/L</td><td>Once a year</td></tr>
</table>

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th – Range	Other Conditions	
The number of samples multiplied by the likelihoods for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *(((pp_above_al_bin_one*numb_samp_customer)*pp_lab_samp)*((hrs_analyze_samp_op*rate_op)+cost_lab_lt_samp))+(((pp_above_al_bin_one*numb_samp_customer)*pp_commercial_samp)*cost_commercial_lab)*	Cost applies as written to NTNCWSs.	Above AL	All PWSs with at least one sample > 15 µg/L	Twice a year
g) Collect distribution system WQP sample				
The number of required samples per system >15 µg/L multiplied by the total of hours per sample times the system labor rate, plus the material cost per sample. A system only needs to collect an additional WQP monitoring sample if there is not existing WQP monitoring done near the site of the >15 µg/L tap sample. *numb_wqp_sites_added *((hrs_wqp_dssa_op*rate_op)+cost_wqp_material_ph)*	Cost does not apply to NTNCWSs.	All	PWSs with existing CCT of pH and not doing POU sampling *pbaseph*	Once per event
The number of required samples per system >15 µg/L multiplied by the total of hours per sample times the system labor rate, plus the material cost per sample. A system only needs to collect an additional WQP monitoring sample if there is not existing WQP monitoring done at or near the site of the >15 µg/L tap sample. *numb_wqp_sites_added*((hrs_wqp_dssa_op*rate_op)+cost_wqp_material_ortho)*	Cost does not apply to NTNCWSs.	All	PWSs with existing CCT of PO_4 or both PO_4 and pH adjustment and not doing POU sampling *pbasepo4, pbasephpo4*	Once per event
The number of required samples per system >15 µg/L multiplied by the total of hours per sample times the system labor rate, plus the material cost per sample. A system only needs to collect an additional WQP monitoring sample if there is not existing WQP monitoring done at or near the site of the >15 µg/L tap sample. *numb_wqp_sites_added*((hrs_wqp_dssa_op*rate_op)+cost_wqp_materia)*	Cost does not apply to NTNCWSs.	All	PWSs without CCT *1 - pws_cct*	Once per event

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th – Range	Other Conditions	
h) Analyze distribution system WQP sample				
The number of samples multiplied by the likelihoods for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. A system only needs to collect an additional WQP monitoring sample if there is not existing WQP monitoring done near the site of the >15 µg/L tap sample. *((numb_wqp_sites_added*pp_lab_samp)*((hrs_wqp_analyze_ph_op*rate_op)+cost_wqp_ph_analyze))+((numb_wqp_sites_added*pp_commercial_samp)*cost_lab_ph_wqp)*	Cost does not apply to NTNCWS	All	PWS with existing CCT of pH and not doing POU sampling *pbaseph*	Once per event
The number of samples multiplied by the likelihoods for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. A system only needs to collect an additional WQP monitoring sample if there is not existing WQP monitoring done near the site of the >15 µg/L tap sample. *((numb_wqp_sites_added*pp_lab_samp)*((hrs_wqp_analyze_ortho_op*rate_op)+cost_wqp_ortho_analyze))+((numb_wqp_sites_added*pp_commercial_samp)*cost_lab_ortho_wqp)*	Cost does not apply to NTNCWS	All	PWSs with existing CCT of PO_4 or both PO_4 and pH adjustment and not doing POU sampling *pbasepo4, pbasephpo4*	Once per event
The number of samples multiplied by the likelihoods for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. A system only needs to collect an additional WQP monitoring sample if there is not existing WQP monitoring done near the site of the >15 µg/L tap sample. *((numb_wqp_sites_added*pp_lab_samp)*((hrs_wqp_analyze_dist_op*rate_op)+cost_wqp_analyze))+((numb_wqp_sites_added*pp_commercial_samp)*cost_lab_wqp)*	Cost does not apply to NTNCWSs.	All	PWSs without CCT 1 - pws_cct	Once per event
i) Review incidents of systemwide event and other system conditions				
The labor hours for review per system multiplied by the system labor rate. *(hrs_deter_dssa_op*rate_op)*	Cost applies as written to NTNCWSs.	All	All PWSs with at least one sample > 15 µg/L	Once per event

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th – Range	Other Conditions	
j) Consult with State prior to making CCT changes				
The labor hours per system multiplied by the system labor *(hrs_consult_dssa_op*rate_op)*	Cost applies as written to NTNCWSs.	All	All PWSs where a second sampling period has at least one sample > 15 µg/L	Once per event
k) Report follow-up sample results and overall "find-and-fix" responses				
Hours for reporting multiplied by the system labor rate. *(hrs_report_dssa_op*rate_op)*	Cost applies as written to NTNCWSs.	All	All PWSs with at least one sample > 15 µg/L	Once per event

Acronyms: AL = action level; CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; PO_4 = orthophosphate; POU = point-of-use; PO_4 = orthophosphate; PWS = public water system; TL = trigger level; WQP = water quality parameter.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *pbaseph, pbasepo4, and pbasephpo4:* Likelihood system has pH adjustment, orthophosphate, or pH adjustment and orthophosphate for their CCT (Chapter 4, Section 4.3.2.2.1).
- *pp_lab_samp* and *pp_commercial_samp*: Likelihood that system will use in-house laboratory or commercial laboratory, respectively (Chapter 4, Section 4.3.2.1.2).
- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] Systems on 9-year monitoring schedules cannot have any lead or copper in their entire distribution system including all buildings they serve and thus, none should have any samples above 15 µg/L and be subject to find-and-fix requirements.

[3] The burden and costs to provide sample bottles (*cost_samp_above_al*) under activity e) and conduct analyses under activity f) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

B.5.3.4 System Lead CCT Routine Costs

The EPA developed routine costs associated with CCT under the 2021 LCRR as shown in Exhibit B-34. The exhibit provides the unit burden each activity. The assumptions used in the estimation of each activity follows the exhibit. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden or cost, and SafeWater LCR data variable for the 2021 LCRR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.3.4.

Exhibit B-34: PWS CCT Routine Unit Burden and Cost Estimates under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
l) Review CCT guidance	1 hr/system with CCT serving > 50K/update[1]	*hrs_rev_cct_op*	Yes.
m) Provide WQP data to the State and discuss during sanitary survey	1.5 to 3 hrs/system with CCT per sanitary survey[2]	*hrs_sanit_surv_op*	Yes.
n) Notify and consult with the State if CCT actions are required in response to source water change	• 10 to 22 hrs/system on reduced tap monitoring • 6 to 12 hrs/system on standard tap monitoring	*hrs_coop_source_chng_red_op* *hrs_coop_source_chng_rout_op*	Yes.
o) Notify and consult with the State if CCT actions are required in response to treatment change	46 to 84 hrs/system	*hrs_coop_treat_chng_op*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; WQP = water quality parameter.

Sources:

[1]Frequency of CCT guidance updates is assumed to be every five years.

[2]Sanitary surveys are conducted at least every five years for NTNCWSs and every three years for CWSs except where ground water CWSs meet special performance criteria and are permitted to conduct sanitary surveys every five years *(p_spec_req)*.

l) & m): "CCT Study and Review Costs_Final.xlsx."

n): "Likelihood_SourceChange_Final.xlsx."

o): "Likelihood_TreatmentChange_Final.xlsx;" ASDWA, 2024.

Note: For the proposed LCRI EA, the EPA assumed a different burden for systems on standard and reduced monitoring. For the final LCRI EA, the EPA used estimates provided by ASDWA in its 2024 CoSTS model (ASDWA, 2024) and assumed systems and States would incur the same burden to provide a report and conduct a review, respectively, regardless of the system's monitoring schedule.

Exhibit B-35 provides the SafeWater LCR model cost estimation approach for routine system activities related to CCT including additional cost inputs required to calculate these costs under the 2021 LCRR. It also indicates if the costing approach is the same for the 2021 LCRR as that under the final LCRI, as documented in Chapter 4, Exhibit 4-71.

Exhibit B-35: PWS Lead CCT Routine Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

<table>
<tr><th rowspan="2">CWS Cost Per Activity</th><th rowspan="2">NTNCWS Cost Per Activity</th><th colspan="2">Conditions for Cost to Apply to a Model PWS</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90^{th} - Range</th><th>Other Conditions</th></tr>
<tr><td colspan="5">l) Review CCT guidance</td></tr>
<tr><td colspan="5">Same as final LCRI (see Exhibit 4-71 in Chapter 4).</td></tr>
<tr><td colspan="5">m) Provide WQP data to State and discuss during sanitary survey[2]</td></tr>
<tr><td colspan="5">Same as final LCRI (see Exhibit 4-71 in Chapter 4).</td></tr>
<tr><td colspan="5">n) Notify and consult with State on response to a change in source water</td></tr>
<tr><td rowspan="2">The total hours per system multiplied by the system labor rate.

(hrs_coop_source_chng_rout_op*rate_op)</td><td rowspan="3">Cost applies as written to NTNCWSs.</td><td>At or below TL</td><td>Model PWS that is not on reduced tap sampling with a change in source water

1 - (p_tap_annual + p_tap_triennial + p_tap_nine) * p_source_chng</td><td rowspan="3">Once per event</td></tr>
<tr><td>Above TL</td><td>Model PWSs with a change in source water

p_source_chng</td></tr>
<tr><td>The total hours per system multiplied by the system labor rate.

(hrs_coop_source_chng_red_op*rate_op)</td><td>At or below TL</td><td>Model PWS that is on reduced tap sampling with a change in source water

(p_tap_annual + p_tap_triennial + p_tap_nine) * p_source_chng</td></tr>
<tr><td colspan="5">o) Notify and consult with State on response to a change in water treatment</td></tr>
<tr><td colspan="5">Same as final LCRI (see Exhibit 4-71 in Chapter 4).</td></tr>
</table>

Acronyms: CCT = corrosion control treatment; CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PWS = public water system; TL = trigger level; WQP = water quality parameter

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *p_tap_annual, p_tap_triennial,* and *p_tap_nine*: Likelihood a system will qualify to collect lead tap samples at an annual, triennial, and nine-year frequency, respectively (Chapter 3, Section 3.3.7.2).
- *p_source_chng*: Likelihood that a system will change sources in a given year (Chapter 3, Section 3.3.9.1).
- *p_treat_chng:* Likelihood that a system will change treatment in a given year (Chapter 3, Section 3.3.9.3).
- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

B.5.4 PWS Lead Service Line Inventory and Replacement Costs under the 2021 LCRR

The cost analysis for inventory and SLR activities under the 2021 LCRR are in the following subsections:

- B.5.4.1: Service Line Inventory-Related Activities

- B.5.4.2: Service Line Replacement Plan
- B.5.4.3: Physical Service Line Replacements
- B.5.4.4: Ancillary Service Line Replacement Activities
- B.5.4.5: Goal-Based Replacement Program Activities

Note that the last section, goal-based program replacement activities, are not included in the final LCRI analysis because the final LCRI requires full replacement of all lead and GRR service lines by a specific time frame and thus, does not include a provision for a goal-based SLR.

A key input to service line inventory and replacement-related costs is the baseline percentage of systems with lead content service lines and the percent of service lines in those systems that are lead content. The economic analysis for the 2021 LCRR (USEPA, 2020) used two datasets to characterize LSLs in CWSs based on surveys done by the AWWA. Since the 2021 LCRR was finalized, LSL survey data from the 7th Drinking Water Infrastructure Survey Assessment (DWINSA), collected primarily from February 2021 – December 2021, have become available. Due to the extensiveness and representativeness of the dataset and the detailed information gathered on service line material, the EPA uses the 7th DWINSA results to characterize service line material for this LCRI economic analysis in place of the two previous AWWA surveys. For additional discussion of the 7th DWINSA dataset and the EPA's decision to use it to characterize service line material for the final LCRI economic analysis, See Chapter 3, Sections 3.2.5 and 3.3.4.

Unlike the datasets used for the 2021 LCRR economic analysis, the 7th DWINSA dataset includes information on GRR and unknown service lines. The EPA used a combined estimate of lead, GRR, and unknowns service lines to estimate the total service lines with known and potential lead content. The EPA used this baseline estimate of known and potential LSLs consistently for the pre-2021 LCR, 2021 LCRR, and final LCRI analyses. For more information, see Chapter 3, Section 3.3.4.1.2.

Where available, the EPA used system-specific information on number of LSLs for PWSs serving greater than 1 million people. For NTNCWSs, the EPA used the same approach for estimating the number of lead content service lines as was used for the 2021 LCRR economic analysis (See Chapter 3, Section 3.3.4.2 for detailed information).

Under all 2021 LCRR replacement programs, a service line is counted toward a system's replacement rate if the entire line is replaced. This includes replacement of both the system- and customer-side of the service line or removing the remaining portion of the service line (assumed to be the customer's portion).

B.5.4.1 Service Line Inventory-Related Activities

As noted in Chapter 4, Section 4.3.4.1, the 2021 LCRR required systems to prepare an initial inventory by October 16, 2024, which is prior to the final LCRI analysis period. Therefore, the cost for preparing the initial inventory is not included in the final LCRI or 2021 LCRR cost analysis. The 2021 LCRR requires systems with lead, GRR, and unknown service lines to prepare and submit inventory updates on the same schedule as a system's tap sampling monitoring, but no more frequently than annually. The final LCRI requires annual inventory updates (see Chapter 4, Section 4.3.4.1.2 for unit costs for these

activities). The EPA made a simplifying assumption that systems would also submit annual inventory updates under the 2021 LCRR as they replace service lines and identify unknowns. This assumption could lead to an overestimate of inventory-related 2021 LCRR costs, although the EPA expects the overestimate to be minor because the unit cost for the activity is small at 1 hour per water system.

The final LCRI has additional requirements for water systems to update their inventories with information on connectors (see Chapter 4, Section 4.3.4.1.2) and to validate the accuracy of the material categorization of a proportion of non-lead service lines (see Chapter 4, Section 4.3.4.1.3), which are not included in the 2021 LCRR cost analysis.

The EPA has developed costs for relevant inventory-related activities under the 2021 LCRR, as shown in Exhibit B-36. The exhibit provides the unit burden and/or cost for each activity and the SafeWater LCR data variable in red/italic font. The last column indicates if the activity, unit burden and/or cost, and SafeWater LCR data variable are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.4.1.2. Gray shaded rows indicate activities that are not required under the 2021 LCRR.

Exhibit B-36: PWS LSL Inventory-Related Unit Burden and Cost Estimates under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Conduct records review for connector materials	N/A	*hrs_updated_initial_inv_op*	No. Not required under the 2021 LCRR.
b) Compile and submit connector updated LCRR initial inventory information (baseline inventory) to the State	N/A	*hrs_report_updated_initial_inv_op*	No. Not required under the 2021 LCRR.
c) Identify material for unknown service lines	$35.94 to $52.55 per unknown service line investigated each year	*cost_update*	Yes.
d) Report annual inventory updates to the State	1 hr per CWS and 1 hr per NTNCWS per year for systems with lead, GRR, or unknown service lines.[1]	*hrs_report_inv_op*	Yes
e) Conduct field investigations for inventory validation	N/A	*cost_valid*	No. Not required under the 2021 LCRR.
f) Report validation results to the State	N/A	*hrs_valid_report_op*	No. Not required Under the 2021 LCRR.

Acronyms: CWS = community water system; GRR = galvanized requiring replacement; LSL = lead service line; NTNCWS = non-transient non-community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions.
Note: The 2021 LCRR requires systems with lead, GRR, and unknown service lines to prepare and submit inventory updates on the same schedule as a system's tap sampling monitoring, but no more frequently than annually. The

EPA assumed systems would submit annual inventory updates under the 2021 LCRR as they replace service lines and identify unknowns.

Exhibit B-37 provides the SafeWater LCR model costing approach for these inventory-related activities and indicates if the activity applies to the 2021 LCRR or is the same as the final LCRI that presented in Exhibit 4-83 in Chapter 4. The gray shaded rows indicate activities that do not apply to the 2021 LCRR.

Exhibit B-37: Lead Service Line Inventory Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR

<table>
<tr><th rowspan="2">CWS Cost Per Activity</th><th rowspan="2">NTNCWS Cost Per Activity</th><th colspan="2">Conditions for Cost to Apply to a Model PWS</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90th - Range</th><th>Other Conditions</th></tr>
<tr><td colspan="5">a) Conduct records review of connector material</td></tr>
<tr><td colspan="5">N/A under the 2021 LCRR. New requirement under the final LCRI.</td></tr>
<tr><td colspan="5">b) Compile and submit connector updated LCRR initial inventory information (baseline inventory) to the State</td></tr>
<tr><td colspan="5">N/A under the 2021 LCRR. New requirement under the final LCRI.</td></tr>
<tr><td colspan="5">c) Identify material for unknown service lines</td></tr>
<tr><td colspan="5">Same as final LCRI (see Exhibit 4-83 in Chapter 4).</td></tr>
<tr><td colspan="5">d) Report annual inventory updates to the State</td></tr>
<tr><td colspan="5">Same as final LCRI (see Exhibit 4-83 in Chapter 4).</td></tr>
<tr><td colspan="5">e) Conduct field investigations for inventory validation</td></tr>
<tr><td colspan="5">N/A under the 2021 LCRR. New requirement under the final LCRI.</td></tr>
<tr><td colspan="5">f) Report validation results to State</td></tr>
<tr><td colspan="5">N/A under the 2021 LCRR. New requirement under the final LCRI.</td></tr>
</table>

Acronyms: CWS = community water system; LCRR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PWS = public water system.

B.5.4.2 Service Line Replacement Plan

All CWSs and NTNCWSs with known or potential lead content service lines are required to prepare a SLR plan under the 2021 LCRR and the final LCRI. The required contents of the plan, however, are different between the two regulations, as explained later in this section. In addition, the LCRI includes new requirements for systems with lead, GRR, or unknown services lines to update their plan annually or to certify no change (see Exhibit B-38, activity j)), as well as additional reviews and consultations for systems seeking or on a deferred replacement schedule (see activities i) and k)). Exhibit B-38 provides the unit burden and/or cost for the service line replacement plan activities under the 2021 LCRR and the SafeWater LCR data variable name in red italics font. The last column indicates if the activity, unit burden and/or cost, and SafeWater LCR data variable name are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.4.1.2. The gray shaded rows indicates activities that are not required under the 2021 LCRR.

Exhibit B-38: PWS Service Line Replacement Plan Unit Burden and Cost Estimates under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same as Final LCRI?
g) Develop initial SLR plan and submit to the State for review (one-time)	12 to 52 hrs/CWS; 12 hrs/NTNCWS	*hrs_slr_plan_op*	No. See discussion following this exhibit.
h) Identify funding options for full SLRs (one-time)	68to 170 hrs/CWS	*hrs_fin_op_op*	Yes.
i) Include information on deferred deadline and associated replacement rate in the SLR plan[1]	N/A	*hrs_slr_plan_defer_op*	No. Not required under the 2021 LCRR.
j) Update SLR plan annually or certify no changes	N/A	*hrs_slr_plan_update_op*	No. Not required under the 2021 LCRR.
k) Provide a recommendation of the deferred deadline and associated replacement rate[2]	N/A	*hrs_defer_update_op*	No. Not required under the 2021 LCRR.

Acronyms: CWS = community water system;; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions. NTNCWS = non-transient non-community water system; SLR = service line replacement.

g) ***Develop initial SLR plan and submit to the State for review (hrs_slr_plan_op).*** Under the 2021 LCRR, all systems with lead, GRR, and/or unknown service lines are required to develop a plan for their SLR program that includes the following elements:

- A strategy for determining the composition of lead status unknown service lines in its inventory.
- A strategy for informing customers before a full or partial SLR.
- Procedures for coordinating the full SLR.
- A funding strategy for conducting SLR that includes ways to accommodate customers that are unable to pay to replace the portion they own.
- A procedure for customers to flush service lines and premise plumbing of particulate lead post-replacement.
- The EPA retained this requirement for the final LCRI but with some modifications, as detailed in Chapter 4, Section 4.3.4.2, activity g) and activity i) for systems eligible for a deferred deadline.

Specific only to the 2021 LCRR for those CWSs serving more than 10,000 people, the plan also must include a recommended goal should the system be triggered into the goal-based program upon having a TLE. This requirement for developing a replacement goal was not retained under the LCRI as the EPA is eliminating the trigger level.

For the 2021 LCRR Economic analysis (USEPA, 2020), the EPA based the PWS burden estimate for preparing the plan on the estimate from the Association of State Drinking Water Administrators (ASDWA) 2020 CoSTS model for States to review it. Specifically, the EPA assumed systems would require twice the burden to prepare the plan as for the State to review it. The burden (*hrs_slr_plan_js*) assumes 6 hrs for States to review the plan for small CWSs and NTNCWSs, 10 for medium CWSs, and 18 for large CWSs (ASDWA, 2020b; 2024). The EPA assumed that the additional elements to be included in the replacement plan compared to the 2021 LCRR requirements would be minimal compared to the other elements of the plan and assumed the same burden for preparing the plan except for the burden to prepare the replacement goal under the LCRR. The EPA assumed that CWSs serving > 10,000 people would spend an additional 16 hours to develop the goal replacement rate and provide justification on why they recommended a certain goal rate. See Exhibit B-39 for the total estimated PWS burden to prepare the plan under the 2021 LCRR that includes developing and justifying the goal rate.

Exhibit B-39: Estimated Burden for Systems to Develop a SLR Plan under the 2021 LCRR

System Size (Population Served)	*hrs_slr_plan_op*	
	CWSs	NTNCWSs
≤3,300	12	12
3,301-10,000	20	12
10,001-50,000	36	12
>50,000	52	12

Acronyms: CWS = community water system; NTNCWS = non-transient non-community water system.
Source: "LSLR Ancillary Costs_Final.xlsx."

Exhibit B-40 provides the SafeWater LCR model costing approach for these activities and indicates that the approach is the same under the 2021 LCRR as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-89.

Exhibit B-40: SLR Plan Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
g) Develop initial SLR plan and submit to State for review				
Same as final LCRI (see Exhibit 4-89 in Chapter 4).				
h) Identify funding options for full SLRs				
Same as final LCRI (see Exhibit 4-89 in Chapter 4).				
i) Include information on deferred deadline and associated replacement rate in the SLR plan				
N/A. New requirement under the final LCRI.				

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
j) Update SLR plan annually or certify no changes				
N/A. New requirement under the final LCRI.				
k) Provide a recommendation of the deferred deadline and associated replacement rate				
N/A. New requirement under the final LCRI.				

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; SLR = service line replacement; NTNCWS = non-transient non-community water system; PWS = public water system.

B.5.4.3 Physical Service Line Replacements

Physical replacement of lead and GRR service lines are required under both the 2021 LCRR and the final LCRI. The unit costs for service line replacement are the same under both regulations. As discussed in Chapter 3, Section 3.3.4.3, several States already require PWSs to replace service lines with lead content. Since these requirements already exist, these State-required replacements[37] are not included in the cost or benefits of the 2021 LCRR. For each PWS in a State with an existing SLR requirement, SafeWater LCR first calculates the number of SLs that would need to be replaced each year under the 2021 LCRR absent any State requirement. These are known as the PWS's Federal SLRs. Next, SafeWater LCR calculates the number of SLs that would need to be replaced each year under the State requirements, absent any federal requirement. These are known as the PWS's State SLRs. SafeWater LCR then determines the PWS's Total SLR as the maximum of the Federal or State Replacements. Finally, SafeWater LCR calculates the PWS's SLRs due to the 2021 LCRR as the difference between the PWS's Total SL replacements and the PWS's State SL replacements. Only the SL replacements due to the 2021 LCRR are included in the cost and benefit estimates of the 2021 LCRR. However, the PWS's Total SL replacements are tracked as they count towards the PWS's SL replacement requirement and total lines replaced in the system. Exhibit B-41 provides the unit burden and/or cost for the activities and the SafeWater LCR data variable name in red italics font. The last column indicates that the activity, unit burden or cost, and SafeWater LCR data variable are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.4.3. (Also see Appendix A for additional details on the unit costs for SLR). Note that both approaches also use the same baseline estimate of service lines with lead content, and the same estimated proportion of those service lines that are full LSLs, partial LSLs, and GRR service lines as presented in Chapter 3, Section 3.3.4.1.2.

Exhibit B-41: Unit Costs for Service Line Replacement under the 2021 LCRR

Activity	Cost Estimate Range (2020$)	*SafeWater LCR Data Variable*	Same as Final LCRI?
l) System replaces lead and GRR service lines	Full: $6,507 - $8,519; Partial: $1,920 - $5,400;	*cost_lslr_lsl_reg_mand_pws;* *cost_lslr_partial_reg_pws;*	Yes.

[37] The States of Illinois, Michigan, New Jersey, and Rhode Island have passed State laws and regulations requiring mandatory service line replacement independent of their tap monitoring results.

Activity	Cost Estimate Range (2020$)	*SafeWater LCR Data Variable*	Same as Final LCRI?
	GRR: $1,920 - $5,400	*cost_lslr_gal_prev_lsl_reg_pws*	

Acronyms: GRR = galvanized requiring replacement; LCRI = Lead and Copper Rule Improvements.
Source: "LSLR Unit Cost.xlsx."

The conditions under which SLR is required are different under the 2021 LCRR compared to the final LCRI. Under the LCRR, SLR requirements are tied to the system's 90th percentile lead concentration or can be a result of customer-initiated activities. Replacement requirements under the 2021 LCRR for systems that exceed the lead AL of 15 µg/L (referred to as "mandatory replacement) are as follows:

- CWSs serving more than 10,000 that exceed the lead AL must fully replace lead and GRR service lines on a rolling two-year average of 3 percent per year using a baseline number of lead, GRR, and unknown service lines at the time the system first exceeds the lead AL.
- CWSs serving 10,000 or fewer people and NTNCWSs can choose among four compliance options: 1) Replace all lead and GRR service lines, 2) install POU treatment, 3) install/re-optimize CCT, or 4) replace all lead-bearing plumbing material.[38] Systems choosing SLR as their approved compliance option must replace lead and GRR service lines at a schedule set by the State not to exceed 15 years and must replace all lead and GRR service lines regardless of their subsequent lead 90th percentile value.

The 2021 LCRR also requires systems to initiate goal-based replacement if they are below the AL but exceed the TL of 10 µg/L. See Section B.5.4.5 for all activities and unit burden and costs related to goal-based replacement.

In addition to requirements for systems that exceed the lead AL or TL, the 2021 LCRR requires all water systems to replace their portion of a lead or GRR service line if a customer notifies them or, through the normal course of business, the system becomes aware that the customer is replacing their side (referred to as "customer-initiated" replacement). The 2021 LCRR cost analysis includes an estimated rate for customer-initiated replacement for those systems not conducting mandatory replacement upon exceeding the lead TL or AL. For the final LCRI, all systems would be required to implement a SLR program, so customer-initiated replacement does not apply.

[38] The EPA uses a cost minimization assumption in the SafeWater LCR cost model and assigns the least cost alternative between the SLR, CCT, and POU compliance alternatives. The EPA lacks the system characteristic data that would allow the agency to determine a small system's cost for replacement of lead-bearing plumbing materials because of the significant variability among systems and the plumbing materials in the buildings they serve. The EPA assumed a system would only select the replacement of lead-bearing plumbing materials compliance option if it cost less than the three other alternative compliance options. By selecting the least cost of the three other options the EPA has accounted for the costs that small water systems would incur but may be overestimating the costs for those systems that find the cost of lead-bearing plumbing replacement to be less than the other three options.

The EPA estimated the likelihood of customer-initiated replacements to be 0.05 percent of lead and GRR service lines per year (*p_cust_init_lslr)* based on a 2020 report titled *Lead Pipes and Environmental Justice: A Study of Lead Pipe Replacement in Washington, DC* (Environmental Defense Fund and American University School of Public Affairs, 2020). The report includes a graph (Figure 7) showing the number of customer-initiated LSLRs each year from 2009 to 2018. The rate was approximately 25 LSLs per year (out of approximately 48,000 LSLs in DC Water's system[39]) from 2009 through 2013. The rate jumped in 2014 to nearly 200 replacements per year, likely because of a new incentive for home renovators to participate in the program before applying for a permit. The number jumped again in 2017 to more than 300 replacements after the highly publicized elevated lead issues in Flint, Michigan and DC Water launched a new online interactive online map which made it easier for customers to see which properties had LSLs. The EPA used the customer-initiated replacement rate from 2009 to 2013 (25 / 48,000 = 0.05 percent) to represent a typical system, although the EPA recognizes that this value may be high for some systems because of the highly publicized case of elevated lead in Washington, D.C.'s water in 2004.

Exhibit B-42 provides the SafeWater LCR model costing approach for these activities including additional cost inputs that are required to calculate the total costs under the 2021 LCRR.

Exhibit B-42: Lead Service Line Replacement Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
I) Systems replace lead and GRR service lines				
Mandatory SLR: The sum of the number of lines replaced for each category of possible types of replacement multiplied by the costs per type of replacement. *((num_lslr_replace*cost_lslr_lsl_reg_mand_pws)+(num_lslr_partial_replace*cost_lslr_partial_reg_pws)+(num_lslr_gal_prev_lsl_replace*cost_lslr_gal_prev_lsl_reg_pws))*	Cost applies as written to NTNCWSs which conduct LSLRs under the small system flexibility program.	Above AL	Model PWS participating in the mandatory LSLR program	Once a year
Customer-Initiated SLR: The number of customer-initiated partial line replacements multiplied but the cost of a partial utility side replacement. *(num_lsl_requested* cost_lslr_partial_reg_pws)*	Cost does not apply to NTNCWSs.	At or below the TL	Model PWS not participating in the goal-based or mandatory LSLR programs	Once a year

[39] The 48,000 LSL estimate is from a September 26, 2018 memorandum from Jeffrey S. DeWitt, Government of the District of Columbia Chief Financial Officer to the Phil Mendelson, Chairman of the Council of the District of Columbia. http://lims.dccouncil.us/Download/38916/B22-0507-Fiscal-Impact-Statement1.pdf.

Acronyms: AL = action level; CWS = community water system; GRR = galvanized requiring replacement; LSLR = lead service line replacement; NTNCWS = non-transient non-community water system; PWS = public water system; SLR = service line replacement; TL = trigger level.

B.5.4.4 Ancillary Service Line Replacement Activities

Exhibit B-43 presents estimated burden and costs for ancillary activities associated with SLR that is triggered under the 2021 LCRR when systems exceed the AL or TL. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden and cost, and SafeWater LCR data variable are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.3.4.4. Note that the activities related to consulting with the State and developing and distributing outreach materials in the event of a TLE are in Section B.5.4.5.

Exhibit B-43: PWS Unit Burden and Cost Estimates

Activity	Unit Burden and/or Cost	***SafeWater LCR Data Variable***	Same as Final LCRI?
m) Contact customers and conduct site visits prior to SLR	Burden per replaced service line 1.70 to 2.07 hrs Cost per replaced service line $11.64 to $16.13/replaced service line	Burden *hrs_replaced_lsl_contact_op* Cost *cost_replaced_lsl_contact*	Yes.
n) Deliver filters and 6 month of replacement cartridges at time of SLR	$64/replaced service line	*cost_filter_hh*	Yes.
o) Collect tap sample post-SLR	Burden per sample CWSs: 0.9 to 1.2 hrs NTNCWSs: 0.5 hrs Cost per sample per CWS Travel: $5.75 to $10.24 Bottle: $0 to $2.85	Burden *hrs_collect_lsl_lslr_op* Cost *cost_pickup_samp* *cost_other_lt_samp*[1]	Yes.
p) Analyze post-SLR tap sample	In-house Analysis (CWSs > 100K only) Burden: 0.44 hrs/sample Cost: $3.92 Commercial Analyses $32.20/sample	In-house Analys*is* *hrs_analyze_lsl_lslr_op*[1] *cost_lab_lsl_lslr*[1] Commercial Analysis *cost_commercial_lsl_lslr*[1]	Yes.
q) Inform customers of tap sample result	Burden CWSs: 0.05 -0.11 hrs/sample NTNCWSs: 1 hr/system Cost	Burden *hrs_inform_samp_op* *hrs_ntncws_cust_lslr_op* Cost *cost_cust_lslr*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same as Final LCRI?
	CWSs: $0.72/sample NTNCWSs: $0.079/system	*cost_ntncws_cust_lslr*	
r) Submit annual report on SLR program to the State	1 to 8 hrs/CWS 1 hr/NTNCWS	*hrs_report_lcr_op*	Yes.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; SLR = service line replacement.
Sources: Data sources for each activity are provided following this exhibit.
Note:
[1] The burden and costs for these activities are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

Exhibit B-44 provides the SafeWater LCR model cost estimation approach for PWS ancillary SLR activities including additional cost inputs that are required to calculate these costs under the 2021 LCRR.

Exhibit B-44: Lead Service Line Inventory Ancillary Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
m) Contact customers and conduct site visits prior to SLR				
The number of lines replaced multiplied by the total of the hours per lead line replacement times the system labor rates, plus the material cost. *num_lsl_replace * (hrs_replaced_lsl_contact_op * rate_op + cost_replaced_lsl_contact)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS participating in the goal-based LSLR program	Once a year
		Above AL	Model PWS participating in the mandatory LSLR program	
n) Deliver filters and 6 months of replacement cartridges at time of SLR				
The number of lines replaced multiplied by the material cost. *num_lsl_replace*cost_filter_hh*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS participating in the goal-based LSLR program	Once a year
	Cost applies as written to NTNCWSs.	Above AL	Model PWS participating in the mandatory LSLR program	

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
o) Collect tap sample post-SLR[3]				
The number of samples per replaced lead line multiplied by the number of lines replaced, multiplied by the total of the hours per lead line replacement times the system labor rates, plus the material cost. *(numb_samp_lslr*num_lsl_replace)*((hrs_collect_lsl_lslr_op*rate_op)+cost_other_lt_samp+cost_pickup_samp)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS participating in the goal-based LSLR program	Once a year
	Cost applies as written to NTNCWSs.	Above AL	Model PWS participating in the mandatory LSLR program	
p) Analyze post-SLR tap sample[3]				
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. *(((numb_samp_lslr*num_lsl_replace)*pp_lab_samp)*((hrs_analyze_lsl_lslr_op*rate_op)+cost_lab_lsl_lslr))+(((numb_samp_lslr*num_lsl_replace)*pp_commercial_samp)*cost_commercial_lsl_lslr)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS participating in the goal-based LSLR program	Once a year
	Cost applies as written to NTNCWSs.	Above AL	Model PWS participating in the mandatory LSLR program	

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
q) Inform customers of the tap sample result				
The number of lines replaced multiplied by the total of the hours per lead line replacement times the system labor rates, plus the material cost. *num_lsl_replace*((hrs_inform_samp_op*rate_op)+cost_cust_lslr)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS participating in the goal-based LSLR program	Once a year
	The total hours per system times the system labor rates, plus the material cost. *(hrs_ntncws_cust_lslr_op*rate_op)+cost_ntncws_cust_lslr)*	Above AL	Model PWS participating in the mandatory LSLR program	
r) Submit annual report on SLR program to the State				
The total hours for reporting per system multiplied by the system labor rate. *.(hrs_report_lcr_op*rate_op)*	Cost applies as written to NTNCWSs.	Above TL	Model PWS participating in either the goal-based or mandatory LSLR program	Once a year

Acronyms: AL = action level; CWS = community water system; LSL = lead service line; LSLR = lead service line replacement; NTNCWS = non-transient non-community water system; PWS = public water system; SLR = service line replacement; TL = trigger level.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *pp_lab_samp* and *pp_commercial_samp*: Likelihood that system will use in-house laboratory or commercial laboratory, respectively (Chapter 4, Section 4.3.2.1.2).
- *rate_op*: PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] PWSs with lead content or unknown lines are identified using the data variables and approach described in Chapter 3, Section 3.3.4.

[3] The burden and costs to provide sample bottles (*cost_other_lt_samp*) under activity i) and conduct analyses under activity m) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

B.5.4.5 Goal-Based Replacement Program Activities

Under the 2021 LCRR, CWSs serving more than 10,000 people with known or potential lead content service lines that exceed the TL but not the lead AL must begin implementing a goal-based SLR program with a goal replacement rate that has been approved by the State. Similar to the mandatory SLR program as described in Section B.5.4.3, only full SLR count towards the system's annual replacement goal. If CWSs serving more than 10,000 people fail to meet their SLR goal, they must conduct additional outreach activities to promote SLR and encourage consumers to participate in the replacement

program. CWSs must continue the outreach activities until one of the following is met: 1) the goal is met, 2) the system is at or below the TL for two consecutive one-year monitoring periods, or 3) the system has made at least two good faith efforts to contact all customers served by a lead or GRR service line about the SLR program. The requirement for a goal-based replacement program and the associated goal-based outreach was not retained under the final LCRI.

Exhibit B-45 shows the EPA's estimated burden and/or costs for all activities related to a goal-based replacement program. The assumptions used in the estimation of the unit burden and costs follow the exhibit. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that these requirements are unique to the 2021 LCRR. Additional detail describing each activity is provided following the exhibit.

Exhibit B-45: Unit Burden and Cost Estimates for Goal-Based Replacement Program Activities under the 2021 LCRR

Activity	Unit Burden and/or Cost	***SafeWater LCR Data Variable***	Same as Final LCRI?
s) Consult with the State and develop targeted SLR program outreach materials (one-time)	9 hrs/CWS with TLE serving > 10,000 people	*hrs_lslr_out_op*	No. Unique to the 2021 LCRR.
t) Distribute targeted SLR program outreach materials	CWSs serving >10,000 with TLE 0.0026 to 0.0111 hrs/HH; $0.35/HH	*hrs_dist_lslr_out_op;* *cost_lslr_out*	No. Unique to the 2021 LCRR.
u) CWS replaces its portion of lead or GRR service line	Partial SLR: $1,920 - $5,400; GRR replacement: $1,920 - $5,400	*cost_lslr_partial_reg_pws; cost_lslr_gal_prev_lsl_reg_pws*	No. Unique to the 2021 LCRR.
v) Household replaces privately-owned portion of the lead or GRR service line	Partial SLR: $1,920 - $5,400 GRR replacement: $1,920 - $5,400	*cost_lslr_partial_reg_pws; cost_lslr_gal_prev_lsl_reg_pws*	No. Unique to the 2021 LCRR.
w) Consult with State on activities to satisfy additional goal-based SLR program outreach requirements if CWS > 10,000 fails to meet goal	2 hrs/CWS serving > 10,000 people	*hrs_consult_fail_op*	No. Unique to the 2021 LCRR.
x) Conduct activities in response to the first failure to meet SLR goal	Burden per HH per CWS serving > 10,000 people: 0.06 hrs Cost per HH per CWS serving > 10,000 people: $3.00 to $3.01	<u>Burden</u> *hrs_fail_hh_op* <u>Cost</u> *cost_fail_hh*	No. Unique to the 2021 LCRR.
y) Conduct activities in response to each	Burden per CWS serving > 10,000 people:54 to 96 hrs	<u>Burden</u> *hrs_fail_sys_op*	No. Unique to the 2021 LCRR.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same as Final LCRI?
additional failure to meet SLR goal	Cost per CWS serving > 10,000 people:$1,259 to $3,085	Cost *cost_fail_sys*	

Acronyms: CWS = community water system; GRR = galvanized requiring replacement; HH = household; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; SLR = service line replacement; TLE = trigger level exceedance.

Sources:
s) & t): "Public Education Inputs_CWS_Final.xlsx."
u) & v): "LSLR Unit Cost.xlsx."
w): "LSLR Ancillary Costs_Final.xlsx."
x) & y): "Failure to Meet LSLR Goal_Final.xlsx."

Note: The system cannot discontinue the activities in this exhibit until they meet one of the following conditions: 1) the goal is met, 2) the system is at or below the TL for two consecutive one-year monitoring periods, or 3) the system has made at least two good faith efforts to contact all customers served by an LSL or GRR service line about the SLR program.

s) Consult with the State and develop targeted SLR program outreach materials (hrs_lslr_out_op). CWSs with known or potential lead content service lines serving more than 10,000 people with a TLE will incur burden to consult with their States and develop outreach materials on their SLR program that invite customers to participate in their goal-based program. The EPA assumed that all CWSs will use an EPA-developed template. The EPA assumed that systems will require 7 hours to develop these materials based on the hours to prepare additional brochure language from the 2022 Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal), Exhibit 33a (USEPA, 2022). The EPA also assumed that systems will require an additional 2 hours to consult with the State for a total of 9 hours.

t) Distribute targeted SLR program outreach materials (hrs_dist_lslr_out_op, cost_lslr_out). CWSs with known or potential lead content service lines serving more than 10,000 people with a TLE will incur burden to distribute targeted SLR program outreach materials to households with lead, GRR, and unknown service lines. The estimated burden and costing assumptions are provided in Exhibit B-46. The rule allows CWSs to discontinue distribution of this outreach material after two consecutive monitoring periods at or below the TL.

Exhibit B-46: Estimated Annual Burden (per household) to Distribute Targeted Outreach Materials about SLR Program for CWSs with Known or Potential Lead Content Serving > 10,000 people with a TLE *(hrs_dist_lslr_out_op)*

System Size (Population Served)	Separate mailing (hrs per CWS)	Bill Stuffer (hrs per CWS)	Average (hrs per CWS)	Average HH per CWS	Separate/ Bill Stuffer (hrs per HH)	Production (hrs per HH)	Total (hrs/HH)
	A	B	C = (A+B)/2	D	E = C / D	F	G = D + F
10,001-50,000	120	30	75	8,688	0.0086	0.0025	**0.0111**
50,001-100,000	120	30	75	27,432	0.0027	0.0025	**0.0052**
100,001-1,000,000	120	30	75	93,284	0.0008	0.0025	**0.0033**
>1,000,000	120	30	75	768,098	0.0001	0.0025	**0.0026**

Acronyms: CWS = community water system; HH = household; SLR = service line replacement; TLE = trigger level exceedance.
Source: "Public Education Inputs_CWS_Final.xlsx."
Notes:
A: The EPA assumption regarding the burden per system to prepare separate mailings.
B: The EPA assumption regarding the burden per system to mail materials with the water bill.
C: The EPA assumed that half of systems will conduct separate mailings and the other half will include targeted outreach materials with the water bill.
D: Based on estimated 2.53 people per household (*numb_hh*) times the average population per system. See Chapter 4, Section 4.3.6.2, activity i) for the derivation of households per CWS.
F: The EPA assumed 0.25 hours per 100 brochures for production. Estimate is based on assumptions for production labor used in the *Economic and Supporting Analyses: Short-Term Regulatory Changes to the Lead and Copper Rule* (Exhibit 17) (USEPA, 2007).

These systems will also incur costs to distribute these materials. The EPA assumed:

- Systems providing the materials in the water bill will incur a cost for a cover letter (paper cost of $0.019 and ink of $0.06) and brochure (paper cost of $0.019 and ink of $0.06) for a total cost of $0.16 per household. See "General Cost Model Inputs_Final.xlsx" for additional information about costs for paper and ink. The EPA assumed that the weight of the cover letter and brochure would not result in additional postage being needed to mail the water bill.

- Systems distributing the materials in a separate mailing will incur the costs for a cover letter and brochure of $0.16 and also the cost of an envelope ($0.092), and bulk rate postage ($0.299) since systems will be sending out more than 200 mailings for a total per household cost of $0.55 for a separate mailing. See "General Cost Model Inputs_Final.xlsx" for additional information about costs for paper, envelopes, and postage.

The EPA assumed half of these systems will include the materials in the water bill and the other half will mail them separately. Thus, the estimated cost is the average of $0.016 and $0.55 or $0.35 per household for data variable *cost_lslr_out*.

u) ***CWS replaces its portion of lead or GRR service line (cost_lslr_partial_reg_pws).*** CWSs serving more than 10,000 people that have a TLE must implement a goal-based SLR program in which they replace lead and GRR service lines at a rate approved by the State. Systems must continue replacing lead and GRR service lines until they no longer exceed the TL for two consecutive annual periods of tap sampling. The EPA assumed that CWSs will only incur costs for the utility side of the LSLR, and that customers will pay for their portion to achieve full replacements. Thus, the unit cost for CWSs for goal-based replacement is the partial SLR cost (*cost_lslr_partial_reg_pws*).

The EPA assumed for modeling purposes that States would set an average replacement rate goal of 2 percent per year (*pp_lsl_replaced_vol_goal*). To recognize that this is a goal and not a requirement, the EPA modeled a range of actual replacement rates of 1 to 5 percent with a most likely value of 2.5 percent (*pp_lsl_replaced_vol_pct*).

v) ***Household replaces privately-owned portion of the lead or GRR service line (cost_lslr_partial_reg_pws; cost_lslr_gal_prev_lsl_reg_pws).*** The EPA assumed for the goal-based program, customers will incur the cost of replacing their portion of the service line. The unit cost for households replacing their portion of the service is the same as the partial SLR unit cost for systems (*cost_lslr_partial_reg_pws*). For more information on the unit costs for service line replacement, see Section B.5.4.3 and Appendix A.

w) ***Consult with States on activities to satisfy additional goal-based SLR program outreach requirements if CWS > 10,000 fails to meet goal (hrs_consult_fail_op)***. The EPA estimates that a certain percent of CWSs serving > 10,000 people would fail to meet their replacement goal and be required to conduct outreach under the 2021 LCRR. To model this scenario, the SafeWater LCR assumes a range of replacement rates from 1 to 5 percent with a most with a most likely value of 2.5 percent (*pp_lsl_replaced_vol_pct*). For each model run, the SafeWater LCR model randomly selects a replacement rate from this distribution. When the rate is less than 2 percent, the system incurs burden and costs for additional outreach activities described in this activity and activities x) and y) below.

The EPA estimates that CWSs will incur an annual burden of 2 hours to consult with their State on needed outreach activities to consumers[40] to promote SLR and encourage consumers to participate in the replacement program. This estimate is based on the burden for systems to consult with their State on PE activities from pg. 60 of the Economic and Supporting Analyses: Short-Term Regulatory Changes to the Lead and Copper Rule (USEPA, 2007).

x) ***Conduct activities in response to the first failure to meet LSLR goal (hrs_fail_hh_op, cost_fail_hh)***. CWSs that fail to meet their replacement goal must select one outreach activity in the first year in which they miss their goal. The possible outreach activities identified in the 2021 LCRR are: 1) send certified mail to customers with lead or GRR service lines, 2) conduct town hall meeting, 3) conduct community event and provide lead outreach materials and information on LSLR program, 4) contact

[40] Systems must provide materials to consumers in which the water system and/or customer's portion of the service line is lead, GRR, or lead status unknown. See Chapter 3, Section 3.3.4 for a more detailed discussion of these types of service lines.

customers via phone, text message, email, or door hanger, or 5) conduct other State-approved methods. To estimate the burden and cost for the initial failure, the EPA assumed that systems would select lower cost methods of contacting customer by mail or by phone, with equal likelihood of each method being selected. The EPA assumed that CWSs would not contact customers via door hanger method due to the higher burden and cost associated with door hanger delivery as compared to a letter or phone call. Similarly, the EPA assumed that systems would not select one of the higher options of community event or town hall meeting for their first activity after not meeting the goal. As shown in Column E of Exhibit B-47, the EPA estimated the average burden per household for *hrs_fail_hh_op*. The burden is applied to *hh_remain_lsl*, which is the number of households served by lead, GRR, or unknown service lines in the specific year of the 35-year analysis period.

Exhibit B-47: Unit Burden and Cost to Conduct Outreach in Response to First Failure to Meet SLR Goal (hrs/household/year)

System Size (population Served)	Using Certified Mail to Contact Customers		Contacting Customers by Phone		Average for Conducting Outreach for First Failure to Meet Goal	
	Burden (hrs/HH)	Cost ($/HH)	Burden (hrs/HH)	Cost ($/HH)	Burden (hrs/HH) *hrs_fail_hh_op*	Cost ($/HH) *cost_fail_hh*
	A	B	C	D	E = Avg(A,C)	F=Avg(B,D)
10,001-50,000	0.11	$5.97	0	$0.053	0.06	$3.01
50,001-100,000	0.11	$5.97	0	$0.045	0.06	$3.01
100,001-1,000,000	0.11	$5.97	0	$0.042	0.06	$3.01
>1,000,000	0.11	$5.97	0	$0.037	0.06	$3.00

Acronyms: HH = household; SLR = service line replacement.
Source: "Failure to Meet LSLR Goal_Final.xlsx."
Notes:
A: Assumed a burden of 1 hour per 9 letters, based on the 2022 *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 29 - Notification of Sampling Results for Customers Whose Taps Are Sampled (Note G) (USEPA, 2022).
B: The costs include a certified letter, paper, ink, and envelopes (See Derivation file "Failure to Meet LSLR Goal_Final.xlsx", worksheet, "Support Tables", Table S-2.)
C: Assumed systems would use a robocalling service and would incur a minimal burden to coordinate with the company who is providing the service. For the proposed LCRI, the EPA incorrectly used an estimate of 1 hour per household instead of 1 hour per system. The estimate of 1 hour per system is assumed to be a minimal per household burden in the final LCRI EA.
D: The cost per household is based on the average cost from three companies (see file," Robocall Pricing Estimates.xlsx").
E: For the proposed LCRI EA, the average burden was estimated as 0.56 hours per household. The EPA revised its estimate to 0.06 hours correct a formula error in the source file listed above

y) ***Conduct activities in response to each additional failure to meet LSLR goal (hrs_fail_sys_op, cost_sys_hh).*** Systems that continue to fail to meet their goal in any subsequent concurrent year must conduct one of the initial outreach activities listed in activity x) and two additional activities

from the following list: 1) social media campaign, 2) distribute information via mail to organizations representing plumbers and contractors, and 3) outreach to newspaper, television, or radio, and 4) visit targeted customers to discuss the SLR program. The EPA estimated that systems would continue the initial outreach activity of contacting customers by phone or by mail using the burden and costs from Exhibit B-47 and select two additional activities with equal probability of selecting a social media campaign; coordination with organizations representing plumbers and contractors, and outreach to newspapers or radios.

Exhibit B-48 shows how the EPA derived the annual burden for each subsequent failure to meet the annual goal. The annual burden per system, *hrs_fail_sys_op*, is provided in Column D.

Exhibit B-48: Burden to Conduct Additional Outreach in Response to Subsequent Failure(s) to Meet LSLR Goal (hrs/system per year)

System Size (Population Served)	Social Media Campaign	Coordinate with organizations representing plumbers and contractors	Outreach to newspaper, television, or radio	Average Burden per System for Second and Additional Failure to Meet Goal *hrs_fail_sys_op*
	A	B	C	D = 2* Avg (A:C)
10,001-50,000	76	4.0	0.5	54
50,001-100,000	136	7.0	0.5	96
100,001-1,000,000	136	7.0	0.5	96
>1,000,000	136	7.0	0.5	96

Source: "Failure to Meet LSLR Goal_Final.xlsx." and "Public Education Inputs_CWS_Final.xlsx."
Notes:
A: Activities include planning, content, community management, and evaluation. See file, "Failure to Meet LSLR Goals_Final.xlsx," worksheet, "Social Media Campaign" for detailed assumptions.
B: The EPA assumed systems reach out to four groups. Assumes systems serving 10,001 to 50,000 people reach out via email (0.5 hrs) and phone (0.5 hrs), and large system reach out via email (0.5 hrs) and webinar (0.25 to post material and 1 hours to schedule webinar).
C: Assumed systems will pay for an ad in the newspaper. The burden is assumed to be the same as that used to estimate the cost of a paid ad as part of other outreach activities that are required for CWSs that exceed the lead AL. See "Public Education Inputs_CWS_Final.xlsx", Table 4 (Column B) in worksheet "Pb ALE_Other Activity Detail."
E: For the proposed LCRI EA, the EPA estimated a burden of 124 to 226 hours. The EPA revised this estimate because 1) it double counted the burden from the first goal failure that is modeled in SafeWater to continue through each subsequent goal failure; and 2) to exclude a townhall meeting as a possible outreach response because it is not listed as one of the activities when a water system has a subsequent goal failure.

Exhibit B-49 shows how the EPA derived the annual cost for the required outreach for each subsequent failure to meet the goal-based replacement rate. The annual cost per system, *cost_fail_sys*, is provided in Column D.

Exhibit B-49: Cost to Conduct Additional Outreach in Response to Subsequent Failure(s) to Meet LSLR Goal ($/system per year)

System Size (Population Served)	Social Media Campaign	Coordinate with organizations representing plumbers and contractors	Outreach to newspaper, television, or radio	Average Cost per System for Second and Additional Failure to Meet Goal *cost_fail_sys*
	A	B	C	D = 2* Avg (A:C)
10,001-50,000	$0	$0	$1,888	$1,259
50,001-100,000	$300	$0	$4,328	$3,085
100,001-1,000,000	$300	$0	$4,328	$3,085
>1,000,000	$300	$0	$4,328	$3,085

Source: "Failure to Meet LSLR Goal_Final.xlsx." and "Public Education Inputs_CWS_Final.xlsx."
Notes:
A: Activities include planning, content, community management, and evaluation. See file, "Failure to Meet LSLR Goals_Final.xlsx," worksheet, "Social Media Campaign" for detailed assumptions.
B: The EPA assumed that outreach is in the form of email, phone calls, and webinars; therefore, there are no costs associated with this activity.
C: Assumed systems will pay for an ad in the newspaper. The cost is assumed to be the same as that used to estimate the cost of a paid ad as part of other outreach activities that are required for CWSs that exceed the lead AL. See "Public Education Inputs_CWS_Final.xlsx," Table 5 (Column B) in worksheet "Pb ALE_Other Activity Detail."
E: For the proposed LCRI EA, the EPA estimated a costs of $1,716 to $43,639. The EPA revised this estimate because 1) it double counted the burden from the first goal failure that is modeled in SafeWater to continue through each subsequent goal failure; and 2) to exclude a townhall meeting as a possible outreach response because it is not listed as one of the activities when a water system has a subsequent goal failure.

Exhibit B-50 provides the SafeWater LCR model costing approach for LSL activities associated with goal-based SLR including additional cost inputs that are required to calculate these costs.

Exhibit B-50: Goal-based Replacement Activities Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR [1,2]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
s) Consult with State and develop targeted SLR program outreach material				
The total consulting hours per system multiplied by the system labor rate. *(hrs_lslr_out_op*rate_op)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS participating in goal-based SLR program	One time

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
t) Distribute targeted SLR program outreach materials				
The number of households with remaining LSLs multiplied by the total of the hours per household times the system labor rate, plus the materials cost. *hh_remain_lsl * (hrs_dist_lslr_out_op * rate_op + cost_lslr_out)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS participating in the goal-based SLR program	Once a year
u) CWS replace system-owned portion of lead or GRR service line				
The sum of the number of lines replaced for each category of possible types of replacement multiplied by the costs per type of replacement. *((num_lslr_replace*cost_lslr_lsl_reg_mand_pws)+(num_lslr_partial_replace*cost_lslr_lsl_reg_mand_pws)+(num_lslr_gal_prev_lsl_replace*cost_lslr_gal_prev_lsl_reg_pws))*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS participating in the goal-based SLR program	Once a year
v) Household replaces privately-owned portion of the lead or GRR service line				
The number of customer-side LSLs and GRR replaced as part of goal-based program each year times the unit cost. *(num_lslr_lsl_replace* cost_lslr_partial_reg_pws)+(num_lslr_gal_prev_lsl_replace*cost_lslr_gal_prev_lsl_reg_pws)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Households served by systems participating in the goal-based SLR program	Once a year
w) Consult with State on activities to satisfy additional goal-based SLR program if CWS > 10,000 fails to meet goal				
The total consulting hours per system multiplied by the system labor rate. *(hrs_consult_fail_op*rate_op)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS serving > 10,000 that does not meet its goal-based SLR rate	Once a year
x) Conduct activities in response to the first failure to meet SLR goal				
The number of households with remaining LSLs multiplied by the total of the hours per household times the system labor rate, plus the material cost per household. *hh_remain_lsl*((hrs_fail_hh_op*rate_op)+cost_fail_hh)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS serving > 10,000 that does not meet its goal-based SLR rate at least once	Once a year
y) Conduct activities in response to each additional failure to meet SLR goal				
The hours per system multiplied by the system labor rate, plus the material cost per system. *((hrs_fail_sys_op*rate_op)+cost_fail_sys)*	Cost does not apply to NTNCWSs.	At or below AL and above TL	Model PWS serving > 10,000 that does not meet its goal-based SLR rate for two or more times	Once a year

Acronyms: AL = action level; CWS = community water system; GRR = galvanized requiring replacement; LSL = lead service line; NTNCWS = non-transient non-community water system; PWS = public water system; SLR = service line replacement; TL = trigger level.

Notes:

[1] The data variables in this exhibit are defined previously in this section with the exception of:

- *rate_op*: PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] The system can discontinue the activities in this exhibit if: 1) the goal is met, 2) the system no longer exceeds the TL for two consecutive one-year tap sampling monitoring periods, or 3) the system has made at least two good faith efforts to contact all customers served by an LSL or GRR about the LSLR program.

B.5.5 PWS POU-Related Costs under the 2021 LCRR

The 2021 LCRR introduced the small system flexibility option for CWSs serving 10,000 or fewer people and all NTNCWSs. If these systems exceed the lead TL of 10 µg/L but not the lead AL of 15 µg/L, they must select one of four options for approval by the State and implement that option if they subsequently exceeds the lead AL: 1) Install and maintain optimal corrosion control treatment (OCCT), replace all LSLs within 15 years, 3) install and maintain POU treatment devices at all service connections, or 4) replace all lead plumbing materials on a schedule specified by the State but not to exceed one year. For modeling purposes, the EPA assumed that systems would choose the least costly option from among the first three alternatives.[41] The SafeWater LCR model calculates the annualized cost the system will face under each of these three options and selects the least costly alternative.

For the final LCRI, the approach is similar but for CWSs, the small system flexibility option is limited to those serving 3,300 or fewer people. In addition, under the final LCRI, the EPA removed service line replacement as a small system compliance option because it is a mandatory requirement for all systems with lead and/or GRR service lines, eliminated the TL, and lowered the AL to 10 µg/L. CWSs serving 3,300 or fewer people and NTNCWSs that exceed the lead AL must evaluate and recommend to their State which compliance option they will implement from among CCT installation/re-optimization, or the compliance alternatives POU device installation and maintenance or replacement of lead-bearing materials. Systems must then implement the State-approved compliance option.

Under the 2021 LCRR and final LCRI, systems implementing the POU option have costs to develop an upfront plan, provide and maintain POU devices, educate customers on them, and conduct sampling. Note that once the POU option is started, the system must continue to implement this program regardless of their subsequent lead 90th percentile levels.

POU-related costs are grouped into two subsections:

- B.5.5.1: POU Device Installation and Maintenance
- B.5.5.2: POU Ancillary Activities

[41] See footnote 38 for the EPA's rationale for excluding replacement of lead plumbing materials from the SafeWater LCR cost model.

B.5.5.1 POU Device Installation and Maintenance

The EPA has developed costs to provide, monitor, and maintain POU devices under the 2021 LCRR, as shown in Exhibit B-51. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden or cost, and SafeWater LCR data variable are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.3.5.1.

Exhibit B-51: PWS POU Device Installation and Maintenance Unit Burden and Cost Estimates under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same as Final LCRI?
a) Provide, monitor, and maintain POU devices	$104 per household per year	*annual_pou_cost_hh*	Yes.

Acronyms: LCRI = Lead and Copper Rule Improvements; POU = point-of-use.
Sources: *Technologies and Costs for Corrosion Control to Reduce Lead in Drinking Water* (USEPA, 2023).

Exhibit B-52 provides the SafeWater LCR model costing approach for installation and maintenance of POU devices and indicates that the approach is the same under the 2021 LCRR as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-101.

Exhibit B-52: Point-of-Use Device Installation and Maintenance Cost Estimation in SafeWater LCR under the 2021 LCRR by Activity

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th – Range[1]	Other Conditions	
a) Provide, monitor, and maintain POU devices				
Same as final LCRI (see Exhibit 4-101 in Chapter 4).				

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; POU = point-of-use; PWS = public water system.

B.5.5.2 POU Ancillary Activities

The EPA has developed costs for one-time ancillary PWS activities related to POU program development and on-going ancillary activities as shown in Exhibit B-53. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden, and SafeWater LCR data variable are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.5.2. As stated above, the differences between the two rules is that under the 2021 LCRR, CWSs serving up to 10,000 people can implement this option with State approval. The other difference is that some of these activities are required when the system exceeds the lead TL under the 2021 LCRR.

Exhibit B-53: PWS Ancillary POU-Related Burden and Cost Estimates under the 2021 LCRR [1]

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
b) Develop POU plan and submit to the State (one-time)[2]	178 to 328 hrs for CWSs; 148 to 388 hrs for NTNCWSs	*hrs_pou_plan_dev_op*	Yes.
c) Develop public education materials and submit to the State (one-time)	7 hrs per CWS and NTNCWS	*hrs_pe_pou_op*	Yes.
d) Print POU education materials	Burden 0.0025 hrs/sample per CWS 1 hr/NTNCWS Cost $0.079 sample per CWS and NTNCWS	Burden *hrs_print_pe_pou_op* *hrs_ntncws_distr_pe_pou_op* Cost *cost_print_pe_pou* *cost_ntncws_distr_pe_pou*	Yes.
e) Obtain households for POU monitoring	0.5 hrs per sample for CWSs only	*hrs_samp_volunt_pou_op*	Yes.
f) Deliver POU monitoring materials and instructions to participating households	Burden 0.25 hrs/sample per CWS Cost $8.57 to 8.77 sample per CWS $0 per NTNCWS	Burden *hrs_discuss_samp_op* Cost *cost_pou_samp*[3]	No[4]
g) Collect tap samples after POU installation	CWS Burden: 0.40 hrs/sample Cost: $5.75 NTNCWS 0.5 hrs/sample	CWS *hrs_pickup_samp_op* *cost_pickup_*samp NTNCWS *hrs_source_op*	Yes.
h) Determine if sample should be rejected and not analyzed	0.25 hrs/rejected sample for CWSs only	*hrs_samp_reject_op*	Yes.
i) Analyze POU tap samples	In-House Burden N/A In-House Cost N/A Commercial Analysis $32.30/ sample per CWS and NTNCWSs	In-House Burden *hrs_analyze_samp_op*[3] In-House Cost *cost_lab_lt_samp*[3] Commercial Analysis *cost_commerical_lab*[3]	Yes.
j) Prepare and submit sample invalidation request to the State	2 hrs per sample per CWS and NTNCWS	*hrs_samp_invalid_op*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
k) Inform customers of POU tap sample results	CWS Burden: 0.05 hrs/sample Cost: $0.72/sample NTNCWS Burden: 1 hr/sample Cost: $0.079/sample	CWS *hrs_inform_samp_op* *cost_cust_lt* NTNCWS *hrs_ntncws_inform_samp_op* *cost_ntncws_cust_lt*	Yes.
l) Certify to the State that POU tap results were reported to customers	0.66 hrs/year per CWS; 0.66 to 1 hr/year for NTNCWS	*hrs_cert_cust_lt_op*	Yes.
m) Prepare and submit annual report on POU program to the State	1 hr per CWS; 1 to 8 hrs per NTNCWS	*hrs_pou_report_ann_prep_op*	Yes.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; POU = point-of-use.

Sources:

b) & m) ”POU Inputs_Final.xlsx”, worksheets “CWS_Cost Model Inputs” and “NTNCWS_Cost Model Inputs”, worksheet, “POU Outreach.”

c) & d) Public Education Inputs_CWS_Final.xlsx; Public Education Inputs_NTNCWS_Update.xlsx.

e) – l): Lead Analytical Burden and Costs_Final.xlsx, worksheets “POU_Collect_Analyze_LCRR_LCRI” and “POU_Sample_Report_LCRR_LCRI.”

[1] Requirements apply only to CWSs serving 10,000 or fewer people and NTNCWS that exceed the AL and have POU provision and maintenance as their approved compliance option.

[2] The rule does not explicitly include a POU plan. However, the EPA assumed most systems would prepare this plan prior to implementing a POU program. This assumption may overestimate costs during the first year the program is implemented.

[3] In Arkansas, Louisiana, Mississippi, Missouri, and South Carolina, the State pays for the cost of bottles, shipping, analysis, and providing sample results to the system (ASDWA, 2020a). Thus, the State will incur the burden and cost for these activities in lieu of the system.

[4] The EPA used the same burden and cost inputs as under the final LCRI; however, the subset of CWSs to which these inputs apply are those serving 10,000 or fewer people (as opposed to 3,300 or fewer under the LCRI). Also, see Note 1 for additional applicability information.

The EPA used the same data variables and inputs for CWSs to discuss proper sampling procedures with customers of 0.25 hours per sample (*hrs_discuss_samp_op*) as under the lead tap program. Exhibit B-54 provides the SafeWater LCR model cost estimation approach for system ancillary POU system cost inputs including additional cost inputs that are required to calculate these costs and those activities in which the costing approach for the 2021 LCRR is the same as the final LCRI, as documented in Chapter 4, Exhibit 4-106.

Exhibit B-54: PWS Point-of-Use Ancillary Costing Estimation in SafeWater LCR by Activity under the 2021 LCRR[1, 2]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range[2]	Other Conditions	
b) Develop POU plan and submit to the State				
The total hours per system multiplied by the system labor rate. *(hrs_pou_plan_dev_op*rate_op)*	Cost applies as written to NTNCWSs.	Above TL	Model PWS selecting POU installation and maintenance as their compliance option	One time
c) Develop public education materials and submit to the State for review				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				
d) Print POU education material				
The hours per household multiplied by the system labor rate and the material cost. *(pws_pop/numb_hh)*((hrs_print_pe_pou_op*rate_op)+cost_print_pe_pou)*	The hours per system multiplied by the system labor rate and the material cost. *((hrs_ntncws_distr_pe_pou_op*rate_op)+cost_ntncws_distr_pe_pou)*	Above TL	Model PWS installing POU device	Once a year
e) Obtain households for POU Monitoring				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				
f) Deliver POU monitoring materials and instructions to participating households				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				
g) Collect tap samples after POU installation				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				
h) Determine if samples should be rejected and not analyzed				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				
i) Analyze POU tap samples				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				
j) Prepare and submit sample invalidation request to the State				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				
k) Inform customers of POU tap sample results				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				
l) Certify to State that POU tap sample results were reported to customers				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				
m) Prepare and submit annual POU program report to the State				
Same as final LCRI (see Exhibit 4-106 in Chapter 4).				

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; POU = point-of-use; PWS = public water system; TL = trigger level.
Notes:
[1] The data variables in this exhibit are defined previously in this section with the exception of:

- *numb_pou*: Number of POU devices per PWSs that elects POU option (Chapter 4, Section 4.3.5.1).
- *pp_lab_samp* and *pp_commercial_samp*: Likelihood that system will use in-house laboratory or commercial laboratory, respectively (Chapter 4, Section 4.3.2.1.2).
- *rate_op*: PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] Once the POU program is started in response to a lead ALE, systems must continue to implement this program regardless of their subsequent lead 90th percentile levels.

B.5.6 PWS Lead Public Education, Outreach, and Notification Costs under the 2021 LCRR

Under the 2021 LCRR, systems will incur labor and non-labor costs to provide consumer notice in response to a single lead sample above 15 µg/L, to conduct additional education and outreach regardless of their lead 90th percentile level, and to conduct PE requirements in response to a lead 90th percentile level. These activities and associated costs are detailed in Sections B.5.6.1 through B.5.6.3, respectively.

Note that PE requirements that is provided to customers when a CWS serving more than 10,000 people exceeds the TL or fails to meet their replacement goal were previously discussed in Section B.5.4.5. PE requirements for systems implementing a POU program were previously discussed in Section B.5.5.2. Enhanced public outreach for systems with a minimum of three lead ALEs in a five-year period *(i.e.*, multiple lead ALEs) is a new requirement under the final LCRI and is not discussed in this appendix (see Chapter 4, Section 4.3.6.4 for these requirements and costing assumptions).

B.5.6.1 Consumer Notice

The EPA has developed costs for water systems to provide consumer notice of an individual's lead tap sampling result within three calendar days if it exceeds 15 µg/L under the 2021 LCR, as shown in Exhibit B-55. This exhibit provides the unit burden and/or cost for this activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden or cost, and SafeWater LCR data variable for the 2021 LCRR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.6.1. Note that under the final LCRI, water systems would be required to provide consumer notice of an individual's lead and copper results, regardless of the level, within three calendar days.

Exhibit B-55: PWS Burden for Consumer Notification of Lead and Copper Tap Sampling Results under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Develop lead consumer notice materials and submit to the State for review (one time)	7 hours/PWS	*hrs_consumer_notice_devel_op*	Yes

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
b) Provide a copy of the consumer notice and certification to the State	0.08 hrs/customer contact	*hrs_samp_notice_op*	No[1]

Acronyms: LCRI = Lead and Copper Rule Improvement; PWS = pubic water system.
Source: “Public Education Inputs_CWS_Final.xlsx,” “Public Education Inputs_NTNCWS_Final.xlsx.”
Note:
[1] The burden and cost estimates are the same under the 2021 LCRR and final LCRI; however, under the 2021 LCRR this notification applies only to lead samples that exceed 15 µg/L. Under the final LCRI, the EPA is requiring water systems to provide lead and copper results to consumers at tested taps within three business days.

B.5.6.2 Activities Regardless of Lead 90th Percentile Level

The EPA has developed CWS costs for activities associated with PE requirements under the 2021 LCRR that are independent of a system’s lead 90th percentile level, as provided in Exhibit B-56. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether or not the activity, unit burden or cost, and SafeWater LCR data variable are identical under the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.3.6.2. The assumptions that differ for the 2021 LCRR from final LCRI follow the exhibit. The gray shaded row indicates an activity that is not required under the 2021 LCRR.

Exhibit B-56: PWS Burden and Cost for Public Education Activities that Are Independent of Lead 90th Percentile Levels under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
c) Update CCR language (one-time)	0.5 hrs/CWS serving ≤3,300 people; 1 hr/CWS serving > 3,300 people	*hrs_update_ccr_op*	Yes.
d) Develop new customer outreach plan (one-time)	4 hrs/CWS with LSLs serving ≤50,000 people; 8 hr/CWS with LSLs serving > 50,000 people	*hrs_cust_plan_op*	Yes.
e) Develop approach for improved public access to lead health-related information and tap sample results (one-time)	10 to 40 hours/CWS	*hrs_pub_access_op*	Yes.
f) Establish a process for public access to information on known or potential lead content SL locations and tap sample results (one-time)	5 hrs/CWS with LSLs serving ≤3,300 people; 10 hrs/CWS with LSLs serving > 3,300 people	*hrs_access_lsl_op*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
g) Maintain a process for public access to lead health information, known or potential lead content SL locations, and tap sample results	No LSLs 2 hrs/CWS serving ≤ 3,300 people 4 hrs/CWS serving > 3,300 people With LSLs 6 hrs/CWS serving ≤ 3,300 people 12 hrs/CWS serving > 3,300 people	*hrs_maint_lsl_op*	Yes.
h) Respond to customer request for known or potential lead content SL information	0.05 hrs/request; $0/request	*hrs_hh_request_op;* *cost_hh_request*	Yes.
i) Respond to requests from realtors, home inspectors, and potential home buyers for known or potential lead content SL information	0.05 hrs/request; $0/request	*hrs_other_request_op;* *cost_other_request*	Yes.
j) Develop a list of local and State health agencies	CWSs 0.08 hrs/ local and State health	*hrs_hc_list_op*	Yes.
k) Develop lead outreach materials for local and State health agencies and submit to the State for review (one time)	7 hrs/CWS	*hrs_pub_devel_hc_op*	Yes.
l) Deliver lead outreach materials for local and State health agencies	CWSs 2 to 36 hrs/local and State health agency; $5.97/ local and State health	*hrs_hc_op;* *cost_hc*	No. See explanation following this exhibit.
m) Develop public education for lead content SL disturbances and submit to the State (one-time)	7 hrs/CWS with LSLs	*hrs_pub_devel_wtr_op*	Yes.
n) Deliver public education for SL disturbances	0.083 hours/delivery; $0.21/delivery	*hrs_pub_deliv_wtr_op;* *cost_pub_deliv_wtr_ed*	No. See discussion following the exhibit
o) Deliver filters and 6 months of replacement cartridges during SL disturbances	$64/household	*cost_filter_hh*	No. See discussion following this exhibit.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
p) Develop inventory-related outreach materials and submit to the State for review (one time)	7 hours per system	*hrs_pe_lsl_gen_develop_op*	Yes.
q) Distribute inventory-related outreach materials	CWS 0.4426 to 0.0026/household per year $0.35 to $ 0.48/household per year NTNCWS 1 hr per system per year $0.79 per system per year	CWS *hrs_pe_lsl_gen_dist_op; cost_pe_lsl_gen* NTNCWS *hrs_ntncws_pe_lsl_gen_dist_op; ntncws_pe_lsl_op*	Yes.
r) Provide translation services for public education materials	N/A	*hrs_translate_phone_op; cost_translate_cws*	N/A. Not required under the 2021 LCRR.
s) Certify to the State that lead outreach was completed	CWSs 2 hrs/CWS serving ≤50,000 people; 3 hrs/CWS serving > 50,000 people NTNCWSs 0.66 hrs/NTNCWS serving ≤50,000 people; 1 hr/NTNCWS serving > 50,000 people	CWSs *hrs_pe_certify_quarterly_op* NTNCWSs *hrs_cert_outreach_annual_op*	Yes.

Acronyms: CCR = consumer confidence report; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LSL = lead service lines; NTNCWS = non-transient non-community water system; SL = service line.
Sources:
c) - n): "Public Education Inputs_CWS_Final.xlsx."
o): *Technologies and Costs for Corrosion Control to Reduce Lead in Drinking Water* (USEPA, 2023).
p), q), s): "Public Education Inputs_CWS_Final.xlsx;" "Public Education Inputs_NTNCWS_Final.xlsx."

l) ***Deliver lead outreach to local and State health agencies (hrs_hc_op, cost_hc).*** Under the 2021 LCRR, CWSs must report the results of school testing to local and State health care agencies annually. This differs from the final LCRI in which the testing results must be reported within 30 days of receiving the results. For both the 2021 LCRR and final LCRI, CWSs are required to report other information to the health department annually, including outreach materials, as well as the results of any activities in response to a sample above the AL (as previously discussed in Section B.5.3.3). The EPA also assumed under the 2021 LCRR and final LCRI that systems will also incur annual burden to make any necessary updates to the list of organizations. The resulting annual burden estimates for conducting outreach to health care agencies are provided in Exhibit B-57**.**

n) ***Deliver public education for SL disturbances (hrs_pub_deliv_wtr_op; cost_pub_deliv_wtr_ed).*** Under the 2021 LCRR, CWSs must provide PE materials if a disturbance to a lead, GRR, or unknown service line results from replacement of an inline water meter, a water meter setter, or a connector. The EPA assumed the same unit burden and cost to provide the PE materials as was assumed for the final LCRI (0.083 hours and $0.21 per delivery). However, the estimated percent of lead, GRR, and unknowns service lines per year that would be disturbed and require delivery of PE material (*perc_hh_water_wrk*) is different because the 2021 LCRR does not require PE if the disturbance results from a water main replacement (this was added to the final LCRI). For the 2021 LCRR, the EPA assumes that ***6.5 percent***[42] of lead, GRR, and unknowns service lines would be disturbed each year and require PE materials based on 6 percent for meter replacements (assuming on an average meter lifespan of approximately 15-20 years based on information from the city of Pasadena, Texas (Pasadena, no date)) plus 0.5 percent based on the estimated percent of service lines that are exposed during water meter reading, service line repair or replacement, backflow prevention inspections, and other street repair or capital projects with open cut excavations. The 0.5 percent may be an overestimate because some activities such as backflow prevention inspection and meter reading may not result in a disturbance.

o) ***Deliver filters and 6 months of replacement cartridges during SL disturbances (cost_filter_hh).*** Under the 2021 LCRR, CWSs must provide filters and six months of replacement cartridges if a disturbance to a lead, GRR, or unknown service lines results from replacement of an inline water meter, a water meter setter, or a connector. The EPA assumed the same unit cost for filters and replacement cartridges as was assumed for the final LCRI ($64/household). However, the estimated percent of service lines per year that would be disturbed (*perc_hh_water_wrk*) is different because the 2021 LCRR does not require PE if the disturbance results from a water main replacement (this was added to the final LCRI). For the LCRR, the EPA assumes that ***6.5 percent*** of lead, GRR, and unknown service lines would be disturbed each year and require filters and replacement cartridges, as discussed in activity n) above.

Exhibit B-57: Annual CWS Burden (per system) to Conduct Outreach to Local and State Health Agencies

System Size (Population served)	# of Organizations per system	Production Time per organization	Distribute Letters per month	Update List of Organizations (annual)	Total (Annual Burden)
	A	B	C = A*B	D	E = C+D
	numb_ha + 1				*hrs_hc_op*
≤3,300	2	1	2	0	2
3,301-100,000	2	1	2	1	3

[42] For the proposed LCRI EA, the EPA assumed that 5.9 percent of households will be impacted annually by water-related work disturbances and would receive PE based on the estimated life of a water main, meter, and other service line replacements provided by Massachusetts Water Resources Authority. Utilizing these data, EPA assumed an average 17-year life of a meter, CWSs would replace a meter at an annual rate of 5.9 percent.

System Size (Population served)	# of Organizations per system	Production Time per organization	Distribute Letters per month	Update List of Organizations (annual)	Total (Annual Burden)
	A	B	C = A*B	D	E = C+D
	numb_ha + 1				hrs_hc_op
100,001-1,000,000	3	1	3	2	5
>1,000,000	17	2	34	2	36

Notes
A: Chapter 4, Exhibit 4-113.
B: The EPA assumed systems would require 1 hour and 2 hours each month to prepare a cover letter and assemble the results of lead in drinking water testing at schools and child care facilities for systems serving 1 million people or fewer and more than 1 million people, respectively. In addition, once per year, the information to local and State health departments will also include actions taken in response to a single sample above 15 µg/L (*i.e.*, find-and-fix activities).
D: The EPA assumed zero burden for systems serving 3,300 or fewer people. For CWSs serving 3,301 to 100,000 people, the EPA assumed an annual burden of 1 hour per system to update the list of organizations. For systems serving more than 100,000 people, the EPA assumed an annual burden of 2 hours per system.

Under the 2021 LCRR, the EPA assumed systems will deliver the information to local and State health departments via certified mail annually at an estimated cost of $5.97 per organization (*cost_hc*) per year that includes paper ($0.019), envelope ($0.092), ink ($0.06), and certified mail ($5.80). Under the final LCRI, these costs are assumed to occur monthly for an annual cost of $71.65.

Exhibit B-58 provides the SafeWater LCR model costing approach for system PE activities and indicates that in general they are the same for the 2021 LCRR as those used for final LCRI, as shown in Chapter 4, Exhibit 4-119.

Exhibit B-58: PWS Lead Public Education Unit Costing Approach in SafeWater LCR by Activity under the 2021 LCRR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
a) Develop lead consumer notice materials and submit to the State for review				
The total hours per system multiplied by the system labor rate. *(hrs_consumer_notice_devel_op*rate_op)*	Cost applies as written to NTNCWS	All	All model All model PWSs with at least one lead sample > 15 µg/L	One time

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
b) Provide a copy of the consumer notice and certification to the State				
The total hours per system multiplied by the system labor rate. *(hrs_samp_notice_op*rate_op)*	Cost applies as written to NTNCWS	All	All model PWSs with at least one lead sample > 15 µg/L	Once per event
c) Update CCR language				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
d) Develop new customer outreach plan				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
e) Develop approach for improved public access to lead health-related information and tap sample results				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
f) Establish a process for public access to information on known or potential lead content SL locations and tap sample results				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
g) Maintain a process for public access on lead health information, known or potential lead content SL locations, and tap sample results				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
h) Respond to customer requests for known or potential lead content SL information				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
i) Respond to requests from realtors, home inspectors, and potential home buyers for known or potential lead content SL information				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
j) Develop list of local and State health agencies				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
k) Develop lead outreach materials for local and State health agencies and submit to the State for review				
The number of State and local health agencies per system times the total hours per health agency multiplied by the system labor rate. *(numb_ha+1)*((hrs_hc_op*rate_op)+cost_hc)*	Cost applies as written to NTNCWSs.	All	All model PWSs	Once a year[3]
l) Deliver lead outreach to local and State health agencies				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
m) Develop public education material for known or potential SL disturbances and submit to the State				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
n) Deliver public education for SL disturbances				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
o) Deliver filters and 6 months of replacement cartridges during SL disturbances				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
p) Develop inventory-related outreach materials and submit to the State for review				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
q) Distribute inventory-related outreach materials				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				
r) Provide translation services for public education materials				
N/A. New requirement under the final LCRI.				
s) Certify to State that lead outreach was completed				
Same as final LCRI (see Exhibit 4-119 in Chapter 4).				

Acronyms: CCR = consumer confidence report; CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PWS = public water system; SL = service line.

Notes:

[1] The data variables in the exhibit are defined previously in Section B.5.6.2 with the exception of:

- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] PWSs with lead content or unknown lines are identified using the data variables and approach described in Chapter 3, Section 3.3.4.

[3] For the LCRR, the burden and costs occur one a year. For the final LCRI, the monthly burden and costs are multiplied by 12 to provide an annual burden and costs. Thus, the costing approach, as shown in Chapter 4, Exhibit 4-119 are the same for the two rules.

B.5.6.3 Activities in Response to Lead ALE

The 2021 LCRR and final LCRI retain the PE requirements of the pre-2021 LCR for systems that exceed the lead AL but add a requirement for systems to update their mandatory PE language. The EPA has developed system costs for PE activities in response to a lead ALE under the 2021 LCRR, as provided in Exhibit B-59. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the unit burden or cost and SafeWater LCR data variable are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.3.6.3.

Exhibit B-59: PWS PE Burden in Response to Lead ALE under the 2021 LCRR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
t) Update mandatory language for lead ALE public education and submit to the State for review (one-time)	7 hrs per CWS and NTNCWS	*hrs_pe_al_devel_op*	Yes.
u) Deliver lead ALE public education materials to all customers	CWSs 0.0025 hours/household; $0.27 to $0.40/CWS	CWSs *hrs_distr_edu_op;* *cost_pe_lcr_delivery*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
	NTNCWSs 1 hr/NTNCWS $0.079/NTNCWS	NTNCWSs *hrs_ntncws_distr_edu_op;* *cost_ntncws_pe_lcr_delivery*	
v) Post notice to website	0.5 hrs/CWSs serving > 50,000 people	*hrs_web_op*	Yes.
w) Prepare press release	10 hrs/press release per CWS serving > 3,300 people; $0/press release	*hrs_pr_op;* *cost_pr*	Yes.
x) Contact public health agencies to obtain additional organizations and update recipient list	0.5 hrs/CWSs serving ≤3,300 people; 1.5 hrs/CWSs serving 3,301 to 100,000 people; 2.5 hrs/CWS serving > 100,000 people	*hrs_ha_op*	Yes.
y) Notify public health agencies and other organizations	0.0025 hours/organization/CWS; $5.97/organization/CWS	*hrs_distr_agencies_pe_op;* *cost_pe_lead_ale*	Yes.
z) Consult with the State on other public education activities	2 hrs/CWS	*hrs_ale_consult_op*	Yes.
aa) Implement other public education activities	2.7 to 1,039.2 hrs/CWS; $38.82 to $297,956/CWS	*hrs_ale_other_op;* *cost_ale_other*	Yes.

Acronyms: ALE = action level exceedance; CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PWS = public water system.
Sources:
t), u): "Public Education Inputs_CWS_Final.xlsx"; "Public Education Inputs_NTNCWS_Final.xlsx."
v)-aa): "Public Education Inputs_CWS_Final.xlsx."

Exhibit B-60 provides the SafeWater LCR model cost estimation approach for system PE requirements in response to a lead ALE and indicates that the approach is the same for the 2021 LCRR as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-126.

Exhibit B-60: PWS Lead ALE Public Education Unit Costing Approach in SafeWater LCR by Activity under the 2021 LCRR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
t) Update mandatory language for lead ALE public education and submit to State for review				
Same as final LCRI (see Exhibit 4-126 in Chapter 4).				
u) Deliver lead ALE public education materials to all customers				
Same as final LCRI (see Exhibit 4-126 in Chapter 4).				
v) Post lead notice on website				
Same as final LCRI (see Exhibit 4-126 in Chapter 4).				
w) Prepare a press release				
Same as final LCRI (see Exhibit 4-126 in Chapter 4).				
x) Contact public health agencies to obtain additional organizations and update recipient list				
Same as final LCRI (see Exhibit 4-126 in Chapter 4).				
y) Notify public health agencies and other organizations				
Same as final LCRI (see Exhibit 4-126 in Chapter 4).				
z) Consult with the State on other public education activities				
Same as final LCRI (see Exhibit 4-126 in Chapter 4).				
aa) Implement other public education activities				
Same as final LCRI (see Exhibit 4-126 in Chapter 4).				

Acronyms: ALE = action level exceedance; CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PWS = public water system.

B.6 Detailed State Costing Approach for the 2021 LCRR

This section details how the EPA estimated the cost of compliance for the 56 primacy agencies (States)[43] for each major rule component of the LCRR, including:

- B.6.1: State Implementation and Administrative Costs under the 2021 LCRR
- B.6.2: State Sampling Related Costs under the 2021 LCRR

[43] The 56 primacy agencies include 49 states (excluding Wyoming), Puerto Rico, Guam, United States Virgin Islands, American Samoa, North Mariana Islands, and Navajo Nation. For cost modeling purposes, the EPA also included the District of Columbia (D.C.) as a primacy agency when assigning burden and costs of the rule although some of these costs are incurred by the actual primacy agency, EPA Region 3. Note that the EPA uses the "State" to denote "primacy agency" in this economic analysis.

- B.6.3: State CCT Related Costs under the 2021 LCRR
- B.6.4: State Service Line Inventory and Replacement Related Costs under the 2021 LCRR
- B.6.5: State POU Related Costs under the 2021 LCRR
- B.6.6: State Lead Public Education, Outreach, and Notification Costs under the 2021 LCRR

For the activities described in Section B.5, State will incur costs in the form of burden (*i.e.*, hours) to provide oversight and review. The State burden is multiplied by the labor rate ($/hr), as presented in Chapter 3, Section 3.3.11.2 to estimate labor unit costs. Exhibit B-61 shows all the components, subcomponents, and activities from Chapter 4, Exhibit 4-141 for the final LCRI. For each major rule component, each activity has a unique letter ID. The differences in activities costed for the final LCRI and the 2021 LCRR are identified as follows: 1) gray shading italicized text indicates new activities under the final LCRI and were not part of the 2021 LCRR requirements; and 2) yellow shaded activities in bold are specific to the 2021 LCRR and are not included in the final LCRI requirements.

Exhibit B-61: State Cost Components, Subcomponents, and Activities Organized by Section for the 2021 LCRR[1]

Component	Subcomponents	Activities[2]
B.6.1: State Implementation and Administrative Costs under the 2021 LCRR	B.6.1.1: State Start-up Implementation and Administrative Activities	a) Adopt rule and develop program. b) Modify data management systems. c) Provide system training and technical assistance. d) Provide staff training. e) Review and approve small system flexibility option.
	B.6.1.2: State Annual Implementation and Administrative Activities	f) Coordinate with the EPA. g) Provide ongoing technical assistance. h) Report to SDWIS/Fed. i) Train staff for annual administration.
B.6.2: State Sampling Related Costs under the 2021 LCRR	B.6.2.1: State Lead Tap Sampling Costs	a) Provide templates for revised sampling instructions and conduct review. b) Review updated sampling plan. c) Review initial lead monitoring data and prepare systems for status under the rule. d) Review change in tap sample locations. e) Review 9-year monitoring waiver renewal. f) Review sample invalidation requests. g) Review consumer notification certifications. h) Review monitoring results and 90th percentile calculations.
	B.6.2.2: State Lead WQP Sampling Costs	i) Review lead WQP sampling data and compliance with OWQPs.
	B.6.2.3: State Copper WQP Monitoring Costs	j) Review copper WQP sampling data and compliance with OWQPs.

Component	Subcomponents	Activities[2]
	B.6.2.4: State Source Water Monitoring Costs	k) Review source water monitoring results.
	B.6.2.5: State School Sampling Costs	l) Review list of schools and child care facilities. m) Provide templates on school and child care facility testing program. n) Review school and child care facility testing program materials. *o) Review school and child care facility sampling results after individual sampling events.* p) Review annual reports on school and child care facility lead in drinking water testing program.
B.6.3: State CCT Related Costs under the 2021 LCRR	B.6.3.1: State CCT Installation Costs	a) Review CCT study and determine type of CCT to be installed. b) Set OWQPs after CCT installation.
	B.6.3.2: State CCT Re-optimization Costs	c) Review CCT study and determine needed OCCT adjustment. d) Reset OWQPs after CCT re-optimization.
	B.6.3.3: State Find-and-Fix Costs	e) Consult with system prior to any find-and-fix CCT adjustments. f) Review report on find-and-fix[3] responses.
	B.6.3.4: State Lead CCT Routine Costs	g) Review CCT guidance and applicability to individual PWSs. h) Review water quality data with PWSs during sanitary survey. i) Consult on required actions in response to source water change. j) Consult on required actions in response to treatment change.

Component	Subcomponents	Activities[2]
B.6.4: State Service Line Inventory and Replacement Related Costs	B.6.4.1: SL Inventory Costs	a) *Review connector updated LCRR initial inventory (baseline inventory).* b) Review service line inventory updates c) *Review inventory validation report*
	B.6.4.2: SLR Plan Review Costs	d) Review initial SLR plan e) *Review information on deferred deadline and associated replacement rate in the SLR plan and determine fastest feasible rate* f) *Review annually updated SLR plan or certification of no change* g) *Conduct triennial review of water system updated recommended deferred deadline and associated replacement rate and determine fastest feasible rate*
	B.6.4.3: SLR Report Review Costs	h) Review annual SLR program report
	B.6.4.4: Goal-Based Replacement Program Activities	i) **Provide targeted LSLR program outreach templates and consults with PWS** j) **Review targeted outreach materials** k) **Determine additional activities for CWSs not meeting their goal-based rate.**
B.6.5: State POU Related Costs under the 2021 LCRR	B.6.5.1: One-Time POU Program Costs	a) Review POU plan. b) Provide templates for POU outreach materials. c) Review POU public education materials.
	B.6.5.2: Ongoing POU Program Costs	d) Review sample invalidation request for POU monitoring. e) Review customer notification certifications. f) Review annual POU program report.
B.6.6: State Lead Public Education, Outreach, and Notification Costs	B.6.6.1: Consumer Notice	a) Provide templates for consumer notice materials. b) Review lead consumer notice materials. c) Review copy of the consumer notice and certification.
	B.6.6.2: Activities Regardless of the Lead 90th Percentile Level	d) Provide templates for updated CCR language. e) Provide templates for local and State health department lead outreach. f) Review lead outreach materials for local and State health departments. g) Participate in joint communication efforts with local and State health departments. h) Provide templates for service line disturbance outreach materials. i) Review public education materials for service line disturbances. j) Provide templates for inventory-related

Component	Subcomponents	Activities[2]
		outreach materials. k) Review inventory-related outreach materials. *l) Provide technical assistance to PWSs for public education materials.* m) Review public education certifications.
	B.6.6.3: Public Education Activities in Response to Lead ALE	n) Provide templates for updated public education materials for systems with a lead ALE. o) Review revised lead language. p) Consult with CWS on other public education activities in response to lead ALE.
	Public Education Activities in Response to Multiple Lead ALEs	*q) Review plan for making filters available.* *r) Provide templates for systems with multiple lead ALEs.* *s) Review outreach materials provided by systems with multiple lead ALEs.* *t) Consult on filter program for systems with multiple lead ALEs.*

Acronyms: ALE = action level exceedance; CCR = Consumer Confidence Report; CCT = corrosion control treatment; CWS = community water system; DSSA = Distribution System and Site Assessment; EPA = Environmental Protection Agency; LCRR = Lead and Copper Rule Revisions; LSLR = lead service line replacement; OWQPs = optimal water quality parameters; POU = point-of-use; PWS = public water system; SDWIS/Fed = Safe Drinking Water Act Information System/Federal version; SL = service line; SLR = service line replacement; WQP = water quality parameter.

Notes:

[1] States will also incur burden for recordkeeping activities under the LCRR, such as retaining records of decisions, supporting documentation, technical basis for decisions, and documentation submitted by the system. The EPA has included burden for recordkeeping with each activity when applicable as opposed to providing separate burden estimates.

[2] The EPA assigned a unique letter of identification (ID) for each activity under a given rule component. Activities are generally organized with upfront, one-time activities first followed by ongoing activities. The lettering follows that used for the final LCRI, with the exception of activities that apply to the 2021 LCRR but not the final LCRI.

[3] Under the final LCRI, the term "find-and-fix" is replaced with distribution system and site assessment (DSSA).

B.6.1 State Implementation and Administrative Costs under the 2021 LCRR

States will incur both one-time and annual burden to implement and administer the requirements under the 2021 LCRR. These one-time activities and associated SafeWater LCR model cost inputs are described in Sections B.6.1.1. Ongoing activities and associated cost inputs are provided in Section B.6.1.2.

Note that State burden estimates for responding to specific requirements of the 2021 LCRR (*e.g.*, review changes in a system's treatment, consult with systems, etc.) are presented in the sections for those particular rule requirements.

B.6.1.1 State Start-up Implementation and Administrative Activities

The EPA has developed costs for State activities associated with start-up implementation and administrative activities under the 2021 LCRR, as shown in Exhibit B-62. The third column provides the

corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether or not the activity, unit burden, and SafeWater LCR data variable are identical under the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.4.1.1. The assumptions that differ for the 2021 LCRR from final LCRI are provided in notes to the exhibit and a more detailed explanation also follows the exhibit.

The EPA recognizes that States would also incur administrative burden related to specific requirements under the 2021 LCRR. In these cases, the system burden is estimated under that particular rule requirement.

Exhibit B-62: State Administration Activities and Unit Burden Estimates (Occur during Years 1 and 2) under the 2021 LCRR[1, 2]

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Adopt rule and develop program	640 hrs/State	*hrs_adopt_rule_js*	Yes.
b) Modify data management systems[1]	740 hrs/State	*hrs_modify_ds_js*	Yes.
c) Provide system training and technical assistance	800 hrs/State	*hrs_initial_ta_js*	Yes.
d) Provide staff training	196 hrs/State	*hrs_train_imp_js*	Yes.
e) Review and approve small system flexibility option	6 per CWSs serving ≤10,000 and all NTNCWSs	*hrs_sm_flex_op_js*	No. See discussion following this exhibit.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system.
Sources: ASDWA 2020 and 2024 CoSTS models (ASDWA, 2020b; 2024). Also see, Administrative Burden and Costs.xlsx for more detailed information on deriving the estimated burden based on ASDWA's 2020 and 2024 CoSTS models.
Notes:
[1] The SafeWater LCR Data Variable input is the same under the 2021 LCRR and final LCRI; however, under the LCRR, the small system flexibility option for CWSs is available to those serving 10,000 or fewer people as opposed to those serving 3,300 or fewer people under the final LCRI.
[2] The EPA assumed that activities a) through d) occur each year over a five-year period (ASDWA, 2020b). However, for the LCRR, three of those years will have occurred prior to the 35-year analysis period; thus, the EPA assumed these activities will occur in Years 1 and 2 of the 35-year analysis period. The EPA assumed activity e) will occur in Year 1 of the 35-year analysis period of the economic analysis.

e) ***Review and approve small system flexibility option (hrs_sm_flex_option_js).*** States will incur burden to review and approve the compliance option recommended by CWSs serving 10,000 or fewer and all NTNCWSs that exceed the lead TL of 10 µg/L under the 2021 LCRR. The EPA assumed a burden of 6 hours based on the burden for States to review and track a system's selected compliance option from the ASDWA 2024 CoSTS model, section "Small System Flexibility" (ASDWA, 2024).

Under the final LCRI, the same costing input and value are used; however, the systems to which this requirement applies and the timing of this requirement varies from the LCRR. Under the final LCRI, the small system flexibility option for CWSs is limited to those serving 3,300 or fewer people. In addition, the requirement to provide a recommended small system flexibility option applies when the system exceed the lead TL of 10 µg/L. Further, under the final LCRI, the EPA assumes States will incur this cost in Year 4 of the analysis period.

B.6.1.2 State Annual Implementation and Administrative Activities

In addition to one-time, upfront activities, States will incur burden to conduct annual activities to administer the 2021 LCRR. The EPA has identified and developed costs for four annual administration activities as shown in Exhibit B-63. The exhibit provides the unit burden estimate for each activity and additional burden for new SDWIS/Fed reporting requirements under the 2021 LCRR. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the unit burden or cost, and SafeWater LCR data variable are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.4.1.2.

Exhibit B-63: State Annual Administration Activities and Unit Burden Estimates under the 2021 LCRR

Activity	Unit Burden (hours/State)	*SafeWater LCR Data Variable*	Same As Final LCRI?
f) Coordinate with the EPA	1,040	*hrs_coord_epa_js*	Yes.
g) Provide ongoing technical assistance	2,367	*hrs_ta_js*	Yes.
h) Report to SDWIS/Fed	1,560	*hrs_sdwis_js*	Yes.
i) Train staff for annual administration	104	*hrs_train_ann_js*	Yes.
Per State Total	5,051		

Acronyms: EPA = Environmental Protection Agency; LCRI = Lead and Copper Rule Improvements; SDWIS/Fed = Safe Drinking Water Information System/Federal version.
Sources:
f), h), and i): "Administrative Burden and Costs.xlsx." Unit burdens are based on implementation burden estimated for the EPA's 2012, *Economic Analysis for the Final Revised Total Coliform Rule*, Exhibit 7.4, available in the docket.
g): ASDWA 2020 and 2024 CoSTS models (ASDWA, 2020b; 2024) and "Administrative Burden and Costs_Final.xlsx."

Exhibit B-64 provides details on how costs are calculated for State administrative and rule implementation activities a) through i) including additional cost inputs that are required to calculate these costs under the 2021 LCRR. It also indicates for which of the activities the costing approach is the same as the final LCRI, as documented in Chapter 4, Exhibit 4-145.

Exhibit B-64: State Administration and Rule Implementation Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

State Agency Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
a) Adopt rule and develop program				
The hours per State multiplied by the State labor rate. *(hrs_adopt_rule_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	All States	Annually for first 2 years
b) Modify data management systems				
The hours per State multiplied by the State labor rate. *(hrs_modify_ds_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	All States	Annually for first 2 years
c) Provide system training and technical assistance				
The hours per State multiplied by the State labor rate. *(hrs_initial_ta_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	All States	Annually for first 2 years
d) Provide staff training				
The hours per State multiplied by the State labor rate. *(hrs_train_imp_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	All States	Annually for first 2 years
e) Review and approve small system flexibility option [2]				
The hours per system multiplied by the State labor rate. *(hrs_sm_flex_option_js*rate_js)*	Cost applies as written to States for NTNCWSs.	Above TL	CWSs without CCT serving ≤ 10,000 and NTNCWSs	One time
f) Coordinate with the EPA				
Same as final LCRI (see Exhibit 4-145 in Chapter 4).				
g) Provide ongoing technical assistance				
Same as final LCRI (see Exhibit 4-145 in Chapter 4).				
h) Report to SDWIS/Fed				
Same as final LCRI (see Exhibit 4-145 in Chapter 4).				
i) Train staff for annual administration				
Same as final LCRI (see Exhibit 4-145 in Chapter 4).				

Acronyms: CCT = corrosion control treatment; CWS = community water system; EPA = Environmental Protection Agency; NTNCWS = non-transient non-community water system; SDWIS/Fed = Safe Drinking Water Information System/Federal version; TL = trigger level.

Notes:

[1] Costs are applied per State as opposed per system. The data variables in the exhibit are defined previously in Section B.6.1 B.6.1 with the exception of:

- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

B.6.2 State Sampling Related Costs under the 2021 LCRR

This section provides State unit burden related to lead tap sampling, lead WQP monitoring, copper WQP monitoring, source water monitoring, and school testing in Sections B.6.2.1 through B.6.2.5, respectively, under the 2021 LCRR. As noted in Subsections B.6.2.1, B.6.2.2, B.6.2.4, and B.6.2.5, as well as Section B.6.5 that pertains to the POU program and Section B.5.4.4 that pertain to SLR, five States incur the cost of bottles, analysis, and providing lead sample results to the system (ASDWA, 2020a). In addition, six States also incur the burden and cost to update lead tap sampling instructions (see Sections B.5.2.1.2 and B.6.2.1). Note that there may be additional State laboratories that incur some analytical and reporting burden and costs in lieu of the system that would result in an underestimation of State costs.

B.6.2.1 State Lead Tap Sampling Costs under the 2021 LCRR

The EPA has identified and developed costs for eight State oversight and review activities associated with lead tap sampling conducted by water systems under the 2021 LCRR, as shown in Exhibit B-65. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the unit burden or cost, and SafeWater LCR data variable are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.4.2.1.

Exhibit B-65: State Lead Tap Sampling Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Provide templates for revised sampling instructions and conduct review (one-time)	0.75 to 1 hr/PWS	*hrs_rev_samp_js*[1]	Yes.
b) Review updated sampling plan	PWSs without LSLs 2 to 4 hrs/PWS PWSs with LSLs 4 to 10 hrs/PWS	*hrs_rev_samp_plan_js*	Yes.
c) Review initial lead monitoring data and prepare systems for status under the rule	2 to 4 hrs/PWS	*hrs_initial_tap_rev_js*	Yes.
d) Review change in tap sample locations[2]	2 hrs/CWS	*hrs_chng_tap_js*	Yes.
e) Review 9-year monitoring waiver renewal	0.5 hrs/PWS for those with 9-year monitoring waiver	*hrs_renew_nine_js*	Yes.
f) Review sample invalidation requests	2 hrs/invalidation request	*hrs_samp_invalid_js*	Yes.
g) Review consumer notification certifications	0.33 to 0.5 hrs/certification	*hrs_cert_cust_lt_js*	Yes.

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
h) Review monitoring results and 90th percentile calculations[3]	PWSs without LSLs 0.5 to 2 hrs/PWS PWSs with LSLs 0.63 to 2.5 hrs/PWS	*hrs_annual_lt_js*	Yes.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvement; LSL = lead service line; PWS = public water system.
Source: "Lead Analytical Burden and Costs_Final.xlsx."
Notes:
[1] As previously discussed in Section B.5.2.1.2, in Arkansas, Louisiana, Mississippi, Missouri, North Dakota, and South Carolina the State sends sampling instructions to the water systems and thus are assumed to incur the burden to update the sampling instruction in lieu of the system (ASDWA, 2020a).
[2] Applies to CWSs only. The EPA assumed 0 hours for NTNCWSs because they collect their own samples from sampling locations under their control and thus, are unlikely to change sampling sites and submit documentation to the State for review.
[3] As previously discussed in Section B.5.2.1.2, in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles, analysis, and providing sample results to the system (ASDWA, 2020a). Thus, the State will incur the burden and cost for these activities in lieu of the system. In this instance, the system burden to provide monitoring results and 90th percentile calculations is applied to these States and *hrs_annual_lt_js* would be 0. Instead, they will incur the system burden of *hrs_annual_lt_op* (see B.5.2.1.2, activity p).

Exhibit B-66 shows the SafeWater LCR model costing approach for these State lead tap sampling activities including additional cost inputs required to calculate these costs under the 2021 LCRR. It also indicates for which of the activities the costing approach is the same as the final LCRI, as documented in Chapter 4, Exhibit 4-148.

Exhibit B-66: State Lead Tap Sampling Unit Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

<table>
<tr><th rowspan="2">State Cost Per Activity for CWSs</th><th rowspan="2">State Cost Per Activity for NTNCWSs</th><th colspan="2">Conditions for Cost to Apply to a State</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90^{th} - Range</th><th>Other Conditions[2]</th></tr>
<tr><td colspan="5">a) Provide templates for revised sampling instructions and conduct review</td></tr>
<tr><td colspan="5">Same as final LCRI (see Exhibit 4-148 in Chapter 4).</td></tr>
<tr><td colspan="5">b) Review updated sampling plan for LSL systems</td></tr>
<tr><td colspan="5">Same as final LCRI (see Exhibit 4-148 in Chapter 4).</td></tr>
<tr><td colspan="5">c) Review initial lead monitoring data and prepare systems for status under the rule</td></tr>
<tr><td colspan="5">Same as final LCRI (see Exhibit 4-148 in Chapter 4).</td></tr>
<tr><td colspan="5">d) Review change in tap sample locations</td></tr>
<tr><td rowspan="3">The hours per system multiplied by the State labor rate.

(hrs_chng_tap_js*rate_js)</td><td rowspan="3">Cost does not apply to States for NTNCWSs.</td><td rowspan="3">At or below TL</td><td>States with any model PWSs not on reduced tap sampling and not doing POU sampling

1 - (p_tap_annual + p_tap_triennial + p_tap_nine)</td><td>Twice a year</td></tr>
<tr><td>States with any model PWSs on annual tap sampling and not doing POU sampling

p_tap_annual</td><td>Once a year</td></tr>
<tr><td>States with any model PWSs on reduced triennial tap sampling and not doing POU sampling

p_tap_triennial</td><td>Every 3 years</td></tr>
<tr><td rowspan="2">The hours per system multiplied by the State labor rate.

(hrs_chng_tap_js*rate_js)</td><td rowspan="2">Cost does not apply to States for NTNCWSs.</td><td>At or below TL</td><td>States with any model PWSs on reduced nine year sampling and not doing POU sampling

p_tap_nine</td><td>Every 9 years</td></tr>
<tr><td>At or below AL and above TL</td><td>States with any model PWSs not doing POU sampling</td><td>Once a year</td></tr>
</table>

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
		Above AL	States with any model PWSs not doing POU sampling	Twice a year
e) Review 9-year monitoring waiver renewal[3]				
The hours per system multiplied by the State labor rate. *(hrs_renew_nine_js*rate_js)*	Cost applies as written to States for NTNCWSs.	At or below TL[3]	States with any model PWSs on reduced nine-year sampling and not doing POU sampling *p_tap_nine*	Every 9 years
f) Review sample invalidation requests				
The number of samples determined to be invalid multiplied by the hours per sample per system and the State labor rate. *(numb_samp_customer*pp_samp_invalid)*(hrs_samp_invalid_js*rate_js)*	Cost applies as written to States for NTNCWSs.	At or below TL	States with any model PWSs not on reduced tap sampling and not doing POU sampling *1 - (p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice a year
			States with any model PWSs on annual tap sampling and not doing POU sampling *p_tap_annual*	Once a year
The number of samples determined to be invalid multiplied by the hours per sample per system and the State labor rate. *(numb_reduced_tap*pp_samp_invalid)*(hrs_samp_invalid_js*rate_js)*	Cost applies as written to States for NTNCWSs.	At or below TL	States with any model PWSs on reduced triennial tap sampling and not doing POU sampling *p_tap_triennial*	Every 3 years
			States with any model PWSs on reduced nine year sampling and not doing POU sampling *p_tap_nine*	Every 9 years
The number of samples determined to be invalid multiplied by the hours per sample per system and the State labor rate. *(numb_samp_customer*pp_samp_invalid)*(hrs_samp_invalid_js*rate_js)*	Cost applies as written to States for NTNCWSs.	At or below AL and above TL	States with any model PWSs not doing POU sampling	Once a year

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
		Above AL		Twice a year
g) Review consumer notification certifications				
The hours per system multiplied by the State labor rate. *(hrs_cert_cust_lt_js*rate_js)*	Cost applies as written to States for NTNCWSs.	At or below TL	States with any model PWSs not on reduced tap sampling and not doing POU sampling 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice a year
			States with any model PWSs on reduced annual tap sampling and not doing POU sampling *p_tap_annual*	Once a year
			States with any model PWSs on reduced triennial tap sampling and not doing POU sampling *p_tap_triennial*	Every 3 years
			States with any model PWSs on reduced nine year sampling and not doing POU sampling *p_tap_nine*	Every 9 years
		At or below AL and above TL	States with any model PWSs not doing POU sampling	Once a year
		Above AL		Twice a year

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
h) Review monitoring results and 90th percentile calculations[4]				
The hours per system multiplied by the State labor rate. *(hrs_annual_lt_js*rate_js)*	Cost applies as written to States for NTNCWSs.	At or below TL	States with any model PWSs not on reduced tap sampling and not doing POU sampling *1 - (p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice a year
			States with any model PWSs on reduced annual tap sampling and not doing POU sampling *p_tap_annual*	Once a year
			States with any model PWSs on reduced triennial tap sampling and not doing POU sampling *p_tap_triennial*	Every 3 years
			States with any model PWSs on reduced nine year sampling and not doing POU sampling *p_tap_nine*	Every 9 years
		At or below AL and above TL	States with any model PWSs not doing POU sampling	Once a year
		Above AL	States with any model PWSs not doing POU sampling	Twice a year

Acronyms: AL = action level; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; LSL = lead service line; NTNCWS = non-transient non-community water system; POU = point-of-use; PWS = public water system; TL = trigger level.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of the following:

- *numb_reduced tap*: the number of lead tap samples for system on reduced annual, triennial, or 9-year monitoring (Chapter 4, Section 4.3.2.1.1).
- *numb_samp_customer*: the number of lead tap samples for system on standard 6-month tap monitoring (Chapter 4, Section 4.3.2.1.1).
- *p_tap_annual, p_tap_triennial, and p_tap_nine*: likelihood a systems is collecting the reduced number of lead tap samples on an annual, triennial, or 9-year frequency, respectively (Chapter 4, Section 4.3.2.1.1).

- *rate_js*: State hourly labor rate (Chapter 3, Section 3.3.11.2).

[2] Does not apply to CWSs serving ≤ 10,000 people and all NTNCWSs that have selected POU provision and maintenance as their compliance option if they exceeded the lead AL. PWSs with lead content or unknown lines are identified using the data variables and approach described in Chapter 3, Section 3.3.4.

[3] Only systems with 90th percentile values ≤ the AL of 10 µg/L can quality for a 9-year monitoring waiver.

[4] As previously discussed in Section B.5.2.1.2, in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles, shipping, analysis, and providing sample results to the system (ASDWA, 2020a). Thus, the State will incur the burden and cost for these activities in lieu of the system. In this instance, the system burden to provide monitoring results and 90th percentile calculations is applied to these States and *hrs_annual_lt_js* would be 0. Instead, they will incur the system burden of *hrs_annual_lt_op* (see Section B.5.2.1.2B.5.2.1.2, activity p).

B.6.2.2 State Lead WQP Sampling Costs under the 2021 LCRR

The EPA has developed State costs for the review of lead WQP monitoring data submitted by systems serving 50,000 or fewer people with a lead ALE and all systems serving more than 50,000 people with CCT[44] under the 2021 LCRR, as shown in Exhibit B-67. The exhibit provides the unit burden. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the unit burden or cost, and SafeWater LCR data variable are identical for the 2021 LCRR to that used for the final LCRI, as described in Chapter 4, Section 4.4.2.2.

Note that States will review fewer submissions under the 2021 LCRR than the final LCRI. This is because under the final LCRI: 1) more systems are expected to exceed the lead AL under the final LCRI due to more stringent tap sampling and 90th percentile protocol requirements for systems with LSLs; and 2) Systems serving 10,001 to 50,000 people with CCT will be required to continue WQP monitoring irrespective of their lead 90th percentile level.

Exhibit B-67: State Lead WQP Monitoring Burden Estimates under the 2021 LCRR

Activity	Unit Burden	***SafeWater LCR Data Variable***	Same As Final LCRI?
i) Review lead WQP sampling data and compliance with OWQPs	No CCT: 5 hrs/system/6-month monitoring period; With CCT: 8.5 hrs/system/6-month monitoring period	*hrs_wqp_js*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; OWQP = optimal water quality parameter; WQP = water quality parameter.
Source: "WQP Analytical Burden and Costs_Final.xlsx."

Exhibit B-68 provides the SafeWater LCR model costing approach for this State lead WQP monitoring activity under the 2021 LCRR. As shown in the exhibit, the SafeWater LCR model relies upon additional inputs, such the likelihood a system has a certain type of CCT in place, to estimate total costs. A description of the data variables and section where they are described in more detail are provided in the footnote to the exhibit.

[44] All systems serving more than 50,000 people except those with naturally non-corrosive water (*i.e.*, "b3" systems") are required to have CCT.

Exhibit B-68: State Lead WQP Monitoring Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR [1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
i) Review lead WQP sampling data and compliance with OWQPs				
The hours per system multiplied by the State labor rate. *(hrs_wqp_js*rate_js)*	Cost applies as written to States for NTNCWSs.	Above AL	States with any PWSs serving ≤50,000 and without CCT	Twice a year
			States with any PWSs serving ≤50,000 and having pH adjustment in place *pbaseph*	
			States with any PWSs serving ≤50,000 and having PO_4 or both PO_4 and pH adjustment in place *pbasepo4, pbasephpo4*	
		All	States with any PWSs serving >50,000 and having pH adjustment in place *pbaseph*	
			States with any PWSs serving >50,000 and having PO_4 or both PO_4 and pH adjustment in place *pbasepo4, pbasephpo4*	

Acronyms: AL = action level; CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; OWQP = optimal water quality parameter; PO_4 = orthophosphate; PWS = public water system; WQP = water quality parameter.

Notes:

The data variables in the exhibit are defined previously in this section with the exception of:

- *pbaseph, pbasepo4, and pbasephpo4:* Likelihood system has pH adjustment, orthophosphate, or pH adjustment and orthophosphate for their CCT (Chapter 4, Section B.5.2.2.1).
- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

B.6.2.3 State Copper WQP Monitoring Costs under the 2021 LCRR

The EPA has developed State costs for the review of copper WQP monitoring data per 6-month monitoring period under the 2021 LCRR as shown in Exhibit B-69. The exhibit provides the unit burden. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. Note that the data variable is the same as for reviewing lead WQP data for the 2021 LCRR, as indicated in the last column to that used for the final LCRI, as described in Chapter 4, Section 4.4.2.3.

As stated in Section B.5.2.3, the SafeWater LCR models copper WQP monitoring separately from lead WQP monitoring to avoid double counting the cost of WQP monitoring for systems experiencing a copper ALE and a lead ALE simultaneously. The SafeWater LCR model restricts copper WQP monitoring to systems serving 50,000 or fewer people without CCT that do not exceed the lead AL but exceed the copper AL of 1.3 mg/L. See Exhibit 4-38 and Exhibit 4-39 in Chapter 4, Section 4.3.2.3.1 for the likelihood a system has a copper only ALE (*p_copper_ale)* [45] for CWSs and NTNCWSs, respectively.

Exhibit B-69: State Copper WQP Monitoring Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
j) Review copper WQP sampling data and compliance with OWQPs	No CCT: 5 hrs/system/6 month monitoring period; With CCT: 8.5 hrs/system/6 month monitoring period	*hrs_wqp_js*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; OWQP = optimal water quality parameter; WQP = water quality parameter.
Source: "WQP Analytical Burden and Costs_Final.xlsx."

Exhibit B-70 shows the SafeWater LCR model costing approach for this State copper WQP monitoring activity under the 2021 LCRR. As shown in the exhibit, the SafeWater LCR model relies upon additional inputs that include the likelihood a system has a certain type of CCT in place and, as discussed above, the likelihood a system has a copper ALE. A description of the data variables and section where they are described in more detail are provided in footnote 1 to the exhibit.

Exhibit B-70: State Copper WQP Monitoring Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR [1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
j) Review copper WQP sampling data and compliance with OWQPs				
The hours per system multiplied by the State labor rate. *(hrs_wqp_js*rate_js)*	Cost applies as written to States for NTNCWSs.	At or below AL	States with any model PWSs serving ≤50,000, without CCT, and having a copper ALE *p_copper_ale*	Twice a year

[45] As described in Chapter 4, Section 4.3.2.3.1, the EPA assumed all systems with CCT would have sufficient CCT such that none would have a copper ALE. Because all systems serving 50,000 or more people have CCT (except for 16 "b3" systems), SafeWater LCR does not assign any copper WQP costs to systems serving more than 50,000 people.

<table>
<tr><th rowspan="2">State Cost Per Activity for CWSs</th><th rowspan="2">State Cost Per Activity for NTNCWSs</th><th colspan="2">Conditions for Cost to Apply to a State</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90th - Range</th><th>Other Conditions</th></tr>
<tr><td rowspan="2">The hours per system multiplied by the State labor rate.

(hrs_wqp_js*rate_js)</td><td rowspan="2">Cost applies as written to States for NTNCWSs.</td><td rowspan="2">At or below AL</td><td>States with any model PWSs serving >50,000, having pH adjustment in place, and having a copper ALE

p_copper_ale, pbaseph</td><td rowspan="2">Twice a year</td></tr>
<tr><td>States with any model PWSs serving >50,000, having PO_4 or both PO_4 and pH adjustment in place, and having a copper ALE

p_copper_ale, pbasepo4, pbasephpo4</td></tr>
</table>

Acronyms: AL = action level; ALE = action level exceedance; CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; OWQP = optimal water quality parameter; PO_4 = orthophosphate; PWS = public water system; WQP = water quality parameter.
Notes:
[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *p_copper_ale:* Likelihood that a system exceeds the copper AL (Chapter 4, Section B.5.2.3.1).
- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

B.6.2.4 State Source Water Monitoring Costs under the 2021 LCRR

The EPA has developed State costs to review source water monitoring data as shown in Exhibit B-71. The exhibit provides the unit burden. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the unit burden, and SafeWater LCR data variable are identical for the 2021 LCRR to that used for the final LCRI, as described in Chapter 4, Section 4.4.2.4.

Exhibit B-71: State Source Monitoring Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
k) Review source water monitoring results	0.5 hrs/system/monitoring period in which source water samples are collected	*hrs_source_js*	Yes.

Source: " Lead Analytical Burden and Costs_Final.xlsx," worksheet, "Source_Reporting_Review."
Notes: In Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles, analysis, and providing sample results to the system. Thus, the State will incur the burden and cost for these activities in lieu of the system (ASDWA, 2020a). In these States, because the State is reporting the results, the burden to review the results (*hrs_source_js*) is 0. Instead, the system burden to report the results (*hrs_report_source_op*) is applied to these States (see Section B.5.2.4.2, activity hh).

Exhibit B-72 details how the data variables are used to estimate State source water monitoring unit costs for the 2021 LCRR and indicates that the approach is the same as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-154.

Exhibit B-72: State Source Water Monitoring Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th – Range	Other Conditions	
k) Review source water monitoring results				
Same as final LCRI (see Exhibit 4-154 in Chapter 4).				

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system.

B.6.2.5 State School Sampling Costs under the 2021 LCRR

The 2021 LCRR establishes requirements for CWSs to conduct PE and lead in drinking water testing in K – 12 public and private schools and licensed child care facilities in their service area. A high-level discussion of these requirements and the differences between the 2021 LCRR and final LCRI are provided in Section B.5.2.5.

The EPA has developed burden for one-time State activities for oversight of CWSs' lead in drinking water testing programs at schools and child care facilities under the 2021 LCRR, as shown in Exhibit B-73. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether or not the unit burden or cost, and SafeWater LCR data variable are identical for the 2021 LCRR to that used for the final LCRI, as described in Chapter 4, Section 4.4.2.5. The gray shaded row indicates an activity that is not required under the 2021 LCRR.

For both the 2021 LCRR and final LCRI, the one-time activities are assumed to occur in Year 4 and the on-going activities to occur under the first and second five-year testing cycles starting in Year 4 onward.

Exhibit B-73: State School Sampling Burden Estimates under the 2021 LCRR[1]

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
l) Review list of schools and child care facilities (every 5 years starting in Year 4)	3 hrs/CWS	*hrs_rev_school_list_js*	Yes.
m) Provide templates on school and child care facility testing program (one time)	0.25 to 0.5 hrs/CWS	*hrs_temp_school_js*	Yes.
n) Review school and child care facility testing program materials (one time)	1 hrs/CWS serving ≤ 50,000; 3 hrs/CWS serving	*hrs_rev_school_info_js*	Yes.

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
	> 50,000		
o) Review school and child care facility sampling results after individual sampling events	N/A	*hrs_sch_cc_results_review_js*	No. Unique to the final LCRI.[2]
p) Review annual reports on school and child care facility lead in drinking water testing program	1 hr/CWS/year	*hrs_annual_report_school_js*	Yes.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements.
Source: "School_Child Care Inputs_Final.xlsx."
Note:
[1] As previously discussed in Section B.5.2.5 in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles, shipping, and analyses associated with lead testing (ASDWA, 2020a). Thus, the State will incur the burden and costs for these activities under the testing program at schools and child cares.
[2] Under the LCRR, the sampling results are included as part of the annual report (activity p)). Under the final LCRI, systems would be required to report sampling results within 30 days of receiving the results.

Exhibit B-74 provides details on how costs are calculated for State school and child care facility sampling-related costs and indicates that in general, they are the same as that used for the final LCRI, as documented in Chapter 4, Exhibit 4-156.

Exhibit B-74: State School and Child Care Facility Sampling Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th – Range	Other Conditions	
l) Review list of schools and child care facilities				
Same as final LCRI (see Exhibit 4-156 in Chapter 4).				
m) Provide templates on school and child care facility testing program				
Same as final LCRI (see Exhibit 4-156 in Chapter 4).				
n) Review school and child care facility testing program materials				
Same as final LCRI (see Exhibit 4-156 in Chapter 4).				
o) Review school and child care facility sampling results after individual sampling events				
N/A under the LCRR. New requirement under the final LCRI.				
p) Review annual reports on school and child care facility lead in drinking water testing program				
Same as final LCRI (see Exhibit 4-156 in Chapter 4).				

Acronyms: CWS = community water system; LCRI = Lead and Copper rule Improvements; LCRR = Lead and Copper Rule Revisions; NTNCWS = non-transient non-community water system.

B.6.3 State CCT Related Costs under the 2021 LCRR

State oversight and review activities related to CCT are grouped into four major subcomponents:

- CCT Installation
- Re-optimization
- Find-and-Fix
- Routine

The unit burden and costs for CCT-related activities are generally the same for the 2021 LCRR as for the final LCRI; however, the conditions under which the costs apply are different due to the requirements in response to a TLE under the 2021 LCRR. Unit costs and modeling assumptions for each activity related to these four subcomponents are presented in Sections B.6.3.1 through B.6.3.4, respectively.

B.6.3.1 State CCT Installation Costs under the 2021 LCRR

The EPA has developed State cost for two one-time activities associated with CCT installation under the LCRR, as shown in Exhibit B-75. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variables in red/italic font. The last column indicates that the unit burden for the 2021 LCRR is the same as for the final LCRI, as presented in Chapter 4, Section 4.4.3.1.

Exhibit B-75: State CCT Installation Related Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Review CCT study and determine type of CCT to be installed	27 to 52 hrs/system	*hrs_review_cct_study_lead_js*	Yes.
b) Set OWQPs after CCT installation	2 to 12 hrs/system serving ≤ 50,000 people	*hrs_set_owqp_js*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule improvements; OWQP = optimal water quality parameter.
Source: a), b): “CCT Study and Review Costs_Final.xlsx.”

Exhibit B-76 provides the SafeWater LCR model costing approach for the two State activities related to CCT Installation and indicates that the approach is the same for the 2021 LCRR as that used for the final LCRI, as described in Chapter 4, Exhibit 4-160.

Exhibit B-76: State CCT Installation Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
a) Review CCT study and determine type of CCT to be installed				
Same as final LCRI (see Exhibit 4-160 in Chapter 4).				
b) Set OWQPs after CCT installation				
Same as final LCRI (see Exhibit 4-160 in Chapter 4).				

Acronyms: CCT = corrosion control treatment; CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; OWQPs = optimal water quality parameters.

B.6.3.2 State CCT Re-optimization Costs under the 2021 LCRR

The EPA has identified and developed State cost for two oversight and review activities associated with a system's re-optimization of existing CCT under the 2021 LCRR, as shown in Exhibit B-77. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activities, unit burden or cost, and SafeWater LCR data variables are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.4.3.2.

Exhibit B-77: State CCT Re-Optimization-Related Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
c) Review CCT study and determine needed CCT adjustment	28 to 50 hrs/system	*hrs_review_cct_study_lead_js*	Yes.
d) Reset OWQPs after CCT re-optimization	2 to 20 hrs/system	*hrs_reset_owqp_js*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; OWQP = optimal water quality parameter.
Source: "CCT Study and Review Costs_Final.xlsx."

Exhibit B-78 details how the data variables are used to estimate State activities related to CCT re-optimization including additional cost inputs that are required to calculate the total costs under the 2021 LCRR.

Exhibit B-78: State CCT Re-optimization Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

<table>
<tr><th rowspan="2">State Cost Per Activity for CWSs</th><th rowspan="2">State Cost Per Activity for NTNCWSs</th><th colspan="2">Conditions for Cost to Apply to a State</th><th rowspan="2">Frequency of Activity</th></tr>
<tr><th>Lead 90th - Range</th><th>Other Conditions</th></tr>
<tr><td colspan="5">c) Review CCT study and determine needed CCT adjustment</td></tr>
<tr><td>The hours per system multiplied by the State labor rate.

(hrs_review_cct_study_lead_js*rate_js)</td><td>Cost applies as written to States for NTNCWSs.</td><td>Above TL</td><td>States with model PWS conducting a study prior to re-optimizing CCT</td><td>One time</td></tr>
<tr><td colspan="5">d) Reset OWQPs after CCT re-optimization</td></tr>
<tr><td>The hours per system multiplied by the State labor rate.

(hrs_reset_owqp_js*rate_js)</td><td>Cost applies as written to States for NTNCWSs.</td><td>Above TL</td><td>States with model PWS re-optimizing CCT</td><td>One time</td></tr>
</table>

Acronyms: CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; OWQP = optimal water quality parameters PWS = public water system; TL = trigger level.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

B.6.3.3 State Find-and-Fix Costs under the 2021 LCRR

The EPA developed State costs to related to find-and-fix activities [46] under the 2021 LCRR, as shown in Exhibit B-79. The unit burden is the same, although the frequency is different because the 2021 LCRR requires find-and-fix activities for single samples above 15 µg/L, whereas the final LCRI requires an assessment for single samples above 10 µg/L. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activities, unit burden or cost, and SafeWater LCR data variables are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.4.3.3.

Exhibit B-79: State Find-and-Fix Burden under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
e) Consult with system prior to any find-and-fix CCT adjustments	2 hrs per PWS	*hrs_consult_dssa_js*	Yes.
f) Review report on find-and-fix responses	1 hr/PWS serving ≤ 50,000 people; 2 hrs/PWS serving > 50,000 people	*hrs_report_dssa_js*	Yes.

[46] Refer to footnote.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; PWS = public water system.
Source: "Likelihood_Sample_Above_AL_LCRR_Find_Fix.xlsx."

Exhibit B-80 provides details on how total costs for the 2021 LCRR are calculated for this activity including additional cost inputs that are required to calculate the total costs under the 2021 LCRR.

Exhibit B-80: State CCT Find-and-Fix Cost Estimation in SafeWater LCR by Activity for the 2021 LCRR[1,2]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
e) Consult with system prior to any find-and-fix CCT adjustments				
The hours per system multiplied by the State labor rate. *(hrs_consult_dssa_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	All States with model PWS with at least one sample > 15 µg/L	Once a year
f) Review report regarding all find-and-fix activities				
The hours per system multiplied by the State labor rate. *(hrs_report_dssa_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	All States with model PWS with at least one sample > 15 µg/L	Once a year

Acronyms: CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; PWS = public water system.
Notes:
[1] The data variables in the exhibit are defined previously in this section with the exception of:
- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

[2] As previously discussed in Section 4.3.3.2.2 in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles, shipping, and analyses (ASDWA, 2020a). Thus, the State will incur the burden and cost for these activities.

B.6.3.4 State Lead CCT Routine Costs under the 2021 LCRR

The EPA developed State costs to review and consult on system's activities related to review of CCT guidance, submitted water quality data during the sanitary survey, and the notification of a source or treatment change under the 2021 LCRR, as shown in Exhibit B-81. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activities, unit burden or cost, and SafeWater LCR data variables are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.3.4. Note that while the unit burden for activities i) and j) are the same, the conditions under which they apply are different under the 2021 LCRR compared to the final LCRI because of the requirements specific to systems that exceed the TL and not the AL.

Exhibit B-81: State CCT Installation Related Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
g) Review CCT guidance and applicability to individual PWSs	• 40 hrs/State/update	*hrs_cct_review_js*	Yes.
h) Review water quality data with PWSs during sanitary survey	• 2 to 5 hrs/system/sanitary survey	*hrs_sanit_surv_js*	Yes.
i) Consult on required actions in response to source water change	• 6 to 12 hrs/system on reduced tap monitoring • 4 to 7 hrs/system on standard tap monitoring	*hrs_coop_source_chng_red_js* *hrs_coop_source_chng_rout_js*	Yes.
j) Consult on required actions in response to treatment change	46 to 84 hrs/system	*hrs_coop_treat_chng_js*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; PWS = public water system.

Exhibit B-82 details how the data variables are used to estimate State activities related to CCT re-optimization including additional cost inputs that are required to calculate the total costs and indicates for which activities the costing approach for the 2021 LCRR is the same as the final LCRI, as provided in Chapter 4, Exhibit 4-170.

Exhibit B-82: State CCT Re-optimization Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
g) Review CCT guidance and to which PWSs it applies				
Same as final LCRI (see Exhibit 4-170 in Chapter 4).				
h) Review water quality data with PWSs during sanitary survey				
Same as final LCRI (see Exhibit 4-170 in Chapter 4).				
i) Consult on required actions in response to source water change				
The hours per system multiplied by the State labor rate. *(hrs_coop_source_chng_rout_js*rate_js)*	Cost applies as written to States for NTNCWSs.	At or below TL	States with any model PWSs not on reduced tap sampling that have a change in source water *1 - (p_tap_annual + p_tap_triennial + p_tap_nine); p_source_chng*	Once per event

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
		Above TL	States with any model PWSs with a change in source water *p_source_chng*	
The hours per system multiplied by the State labor rate. *(hrs_coop_source_chng_red_js*rate_js)*		At or below TL	States with any model PWSs on reduced tap sampling that have a change in source water *p_tap_annual, p_tap_triennial, p_tap_nine, p_source_chng*	
j) Consult on required actions in response to treatment change				
Same as final LCRI (see Exhibit 4-170 in Chapter 4).				

Acronyms: CCT = corrosion control treatment; CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PWS = public water system; TL = trigger level.

Note:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *p_tap_annual, p_tap_triennial,* and *p_tap_nine*: Likelihood a system will qualify to collect the reduced number of lead tap samples at an annual, triennial, and nine-year frequency, respectively (Chapter 3, Section 3.3.7.2).
- *p_source_chng*: Likelihood that a system will change sources in a given year (Chapter 3, Section 3.3.9.1).
- *p_spec_req*: Likelihood a ground water CWS will meet special conditions to conduct a sanitary survey every 3 years vs. every 5 years (Chapter 4, Section 4.3.3.4 activity m)).
- *p_treat_change:* Likelihood that a system will change treatment in a given year (Chapter 3, Section 3.3.9.3).
- *rate_js*: State hourly labor rate (Chapter 3, Section 3.3.11.2).

B.6.4 State Service Line Inventory and Replacement Related Costs under the 2021 LCRR

States will incur burden to conduct oversight activities related to systems' service line inventory and replacement programs. Section B.6.4.1 describes oversight activities associated with the service line inventory. Section B.6.4.2 includes activities to review the SLR plan, Section B.6.4.3 includes the review of the annual SLR report, and Section B.6.4.4 includes oversight activities related to systems' goal-based replacement activities. Exhibit B-88 at the end of Section B.6.4.4 provides the SafeWater LCR model approach including additional cost inputs that are required to calculate the total costs.

B.6.4.1 SL Inventory Costs

The EPA has identified and developed State costs for one-time activities associated with LSL inventory development under the 2021 LCRR, as shown in Exhibit B-83. The exhibit provides the unit burden for

each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden, and SafeWater LCR data variable are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.4.4.1. The gray shaded rows indicate activities that are not required under the 2021 LCRR.

Exhibit B-83: State LSL Inventory Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Review connector updated LCRR initial inventory (baseline inventory) (one-time)	N/A	*hrs_updated_initial_inv_rev_js*	No. Not required under the 2021 LCRR.
b) Review service line inventory updates	0.5 hrs/CWS or NTNCWS	*hrs_inv_update_rev_js*	Yes.
c) Review validation report (one-time)	N/A	*hrs_inv_valid_rev_js*	No. Not required under the 2021 LCRR.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; NTNCWS = non-transient non-community water system;
Sources:
a): "LCRI Updated Initial Inventory with Connectors_Final.xlsx."
b) & c): "Inventory Updates and Validation_Final.xlsx."

B.6.4.2 SLR Plan Review Costs

The EPA has identified and developed State costs for activities associated with the review of the SLR plan under the 2021 LCRR, as shown in Exhibit B-84. The exhibit provides the unit burden for each activity. The assumptions used in the estimation of the unit burden follow the exhibit. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden, and SafeWater LCR data variable for the 2020 LCRR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.4.2. The gray shaded rows indicate activities that are not required under the 2021 LCRR.

Exhibit B-84: State LSL Plan and Annual Report Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
d) Review initial SLR plan (one-time)[1]	6 to 26 hours/CWS 6 hours/NTNCWS	*hrs_slr_plan_js*	No. See discussion following this exhibit.
e) Review information on deferred deadline and associated replacement rate in the SLR plan and determine fastest feasible rate	N/A	*hrs_slr_plan_defer_js*	No. Not required under the 2021 LCRR.

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
f) Review annually updated SLR plan or certification of no change	N/A	*hrs_slr_plan_update_js*	No. Not required under the 2021 LCRR.
g) Conduct triennial review of water system updated recommended deferred deadline and associated replacement rate and determine fastest feasible rate	N/A	*hrs_defer_update_js*	No. Not required under the 2021 LCRR.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; NTNCWS = non-transient non-community water system; SLR = service line replacement.
Source: "LSLR Ancillary Costs_Final.xlsx."
Notes
[1] Under the 2021 LCRR, this includes burden to negotiate a goal-based replacement rate for CWSs serving more than 10,000 people if they are triggered into the goal-based service line replacement program due to a lead TLE.

d) Review initial SLR plan (hrs_slr_plan_js). States will incur burden to review the SLR plan that water systems with lead, GRR, and/or unknown service lines must prepare. This estimate also includes burden for the State to negotiate a replacement goal with CWSs serving more than 10,000 people, should the systems be triggered into the goal-based replacement program due to a TLE. The State burden (*hrs_slr_plan_js*) is based on the ASDWA 2020 CoSTS model as provided in Exhibit B-85 (ASDWA, 2020b).

Exhibit B-85: One-Time Burden to Review SLR Plan and Negotiate Replacement Goal under the 2021 LCRR (hrs/system)

System size (Population Served)	CWSs	NTNCWSs
	hrs_slr_plan_js	
≤3,300	6	6
3,301-10,000	10	6
10,001-50,000	18	6
> 50,000	26	6

Acronyms: CWS = community water system; NTNCWS = non-transient non-community water system.
Source: ASDWA's "Final CoSTS 2-6-20," worksheet "LSL Inv. and Repl." includes the burden to review the LSLR plan in row 71 of 6, 10, 18 hours for NTNCWS/small CWS, medium CWS, and large CWS, respectively. The EPA assumed large, medium, and small systems corresponded to those size categories defined in the pre-2021 LCR as systems serving more than 50,000 people, 3,301 to 50,000 people, and 3,300 or fewer people, respectively. For CWSs serving more than 10,000 people, the burden also includes hours to negotiate a goal of 8 hours from row 73 (ASDWA, 2020b).

B.6.4.3 SLR Report Review Costs

The EPA has identified and developed State costs for an activity associated with the review of the annual SLR report under the 2021 LCRR, as shown in Exhibit B-86. The exhibit provides the unit burden for this activity. The assumptions used in the estimation of the unit burden follow the exhibit. The third column provides the Exhibit B-86 corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the unit burden, and SafeWater LCR data variable are identical for the 2021 LCRR to that used for the final LCRI, as described in Chapter 4, Section 4.4.4.3.

Exhibit B-86: State LSL Plan and Annual Report Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
h) Review annual SLR program report[1]	1 to 4 hours/CWS; 1 hour/NTNCWS	*hrs_report_lcr_js*	Yes.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system;; SLR = service line replacement.
Source: "LSLR Ancillary Costs_Final.xlsx."
Notes
[1] The EPA assumes that this burden includes review of the system's progress on goal-based replacement when applicable. See Section B.6.4.4 for goal-based activities.

B.6.4.4 Goal-Based Replacement Program Activities

Exhibit B-87 shows the EPA's estimated burden and/or costs for all activities related to a goal-based replacement program for CWSs serving > 10,000 people with known or potential lead content that experience a TLE but not an ALE under the 2021 LCRR. The assumptions used in the estimation of the unit burden and costs follow the exhibit. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that these requirements are unique to the 2021 LCRR. Additional detail describing each activity is provided following the exhibit.

Exhibit B-87: State Goal-Based Replacement Program Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
i) Provide targeted SLR program outreach templates and consults with PWS	2.25 to 2.5 hrs/CWSs serving > 10,000	*hrs_temp_lslr_out_js*	No. Unique to the 2021 LCRR.
j) Review targeted outreach materials	0.5 hours/CWS serving 10,001 - 50,000 people; 2 hours/CWS serving > 50,000 people	*hrs_review_targeted_pe_js*	No. Unique to the 2021 LCRR.
k) Determine additional activities for CWSs not meeting their goal-based rate	2 hours/CWS serving > 10,000 with TLE that fails to meet SLR goal	*hrs_consult_fail_js*	No. Unique to the 2021 LCRR.

Acronyms: CWS = community water system; LCRI = Lead and Coper Rule Improvements; LCRR = Lead and Copper Rule Revisions; PWS = public water system; SLR = service line replacement; TLE = trigger level exceedance.
Sources:

i) & j): "Public Education Input_CWS_Final.xlsx."
k): "LSLR Ancillary Costs_Final.xlsx."

i) ***Provide targeted LSLR program outreach templates and consult with PWS (hrs_temp_lslr_out_js).*** CWSs serving more than 10,000 people with a TLE must provide additional outreach to customers served by lead, GRR, or unknown service lines regarding the system's SLR program. The EPA assumed that the State will incur a one-time burden to provide a template for these outreach materials and consult with the system of 2.25 to 2.5 hours. The estimates are based on responses from Indiana and North Carolina to an ASDWA survey regarding the burden to provide a template for revised sampling instructions. The EPA assumed that the burden to provide the outreach template would be the same as the burden to provide the sampling template *(hrs_rev_samp_js)*, which is based on the North Carolina estimate of 0.25 hours per sampling instructions template and the Indiana estimate of 0.5 hours per template. It includes an additional 2 hours for consultation with the CWS. The questionnaire and each State's responses are available in the docket at EPA-HQ-OW-2022-0801 at www.regulations.gov.

j) ***Review targeted outreach materials (hrs_review_targeted_pe_js).*** The EPA assumed that States will incur a one-time burden to review the SLR program outreach materials described in activity i) above. The EPA assumed that CWSs serving 10,001 to 50,000 people will use a template and States will require 0.5 hours to review the outreach materials. The EPA assumed that systems serving more than 50,000 people will adapt the template and the States will require more time to review these materials of 2 hours. This estimate is consistent with that assumed for the review of other types of consumer outreach and PE materials.

k) ***Determine additional activities for CWSs not meeting their goal-based rate (hrs_consult_fail_js).*** States will also incur burden to determine needed activities for CWSs serving more than 10,000 people with a TLE that fail to meet their goal-based replacement requirements. the EPA assumed States will incur a burden of 2 hours per system *(hrs_consult_fail_js).* The EPA assumed this consultation burden is similar to that used for other activities and is based on the estimated burden for systems to consult with their State on PE activities from pg. 60 of the *Economic and Supporting Analyses: Short-Term Regulatory Changes to the Lead and Copper Rule* (USEPA, 2007).

   To estimate total costs for this activity, the EPA multiplied the burden by the estimated number of systems that fail to meet their SLR goal. For modeling purposes, the EPA assumed that States would set an average replacement rate goal of 2 percent per year (*pp_lsl_replaced_vol_goal*). To recognize that this is a goal and not a requirement, the EPA modeled a range of actual replacement rates of 1 to 5 percent with a most likely value of 2.5 percent (*pp_lsl_replaced_vol_pct*). For each system in the goal-based program, the SafeWater LCR model randomly selects a replacement rate from this distribution and when the rate is less than 2 percent, the State will incur burden to determine additional activities for PWSs.

Exhibit B-88 provides the SafeWater LCR model costing approach including additional cost inputs that are required to calculate the total costs under the 2021 LCRR. It also indicates for which activities the costing approach is the same for the 2021 LCRR as the final LCRI, as provided in Chapter 4, Exhibit 4-177, as well as which final LCRI activities do not apply under the 2021 LCRR in gray shaded rows.

Exhibit B-88: State Lead Service Line Replacement Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR[1,2]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions[3]	
a) Review connector updated LCRR initial inventory (baseline inventory)				
N/A under the 2021 LCRR. New requirement under the final LCRI.				
b) Review updates to service line inventory				
Same as final LCRI (see Exhibit 4-177 in Chapter 4).				
c) Review inventory validation report				
N/A under the 2021 LCRR. New requirement under the final LCRI.				
d) Review initial SLR plan[4]				
Same as final LCRI (see Exhibit 4-177 in Chapter 4).				
e) Review information on deferred deadline and associated replacement rate in the SLR plan and determine fastest feasible rate				
N/A under the 2021 LCRR. New requirement under the final LCRI.				
f) Review annually updated SLR plan or certification of no change				
N/A under the 2021 LCRR. New requirement under the final LCRI.				
g) Conduct triennial review of water system updated recommended deferred deadline and associated replacement rate and determine fastest feasible rate				
N/A under the 2021 LCRR. New requirement under the final LCRI.				
h) Review annual SLR program report				
Same as final LCRI (see Exhibit 4-177 in Chapter 4).				
i) Provide targeted SLR program outreach templates and consult with PWS				
The hours per system multiplied by the State labor rate. *(hrs_temp_lslr_out_js*rate_js)*	Cost does not apply to States for NTNCWSs.	At or below AL and above TL	States with any model PWSs with service lines of lead or unknown content	One Time
j) Review targeted outreach materials				
The hours per system multiplied by the State labor rate. *(hrs_review_targeted_pe_js*rate_js)*	Cost does not apply to States for NTNCWSs.	At or below AL and above TL	States with any model PWSs with service lines of lead or unknown content	One Time
k) Determine additional activities for CWSs not meeting their goal-based rate				
The hours per system multiplied by the State labor rate. *(hrs_consult_fail_js*rate_js)*	Cost does not apply to States for NTNCWSs.	At or below AL and above TL	States with any model PWSs that do not meet their goal-based replacement rate	Once a year

Acronyms: AL = action level; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; NTNCWS = non-transient non-community water system; PWS = public water system; SLR = service line replacement; TL = trigger level.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of the following:

- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

[2] As previously discussed in Section B.5.4.4, in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles and shipping and conducting the analysis for samples following LSLR. Thus, the State will incur the burden and cost for these activities (ASDWA, 2020a).
[3] PWSs with lead content or unknown lines are identified using the data variables and approach described in Chapter 3, Section 3.3.4.
[4] The costing approach is the same for this activity under the 2021 LCRR and final LCRI but as explained in Section B.6.4.2, activity d) the input values are different.

B.6.5 State POU Related Costs under the 2021 LCRR

States will incur both one-time and ongoing burden to conduct oversight activities related to systems' POU programs under the 2021 LCRR. CWSs serving 10,000 or fewer people above the TL and NTNCWSs with a lead 90th percentile above the TL must evaluate and recommend to their State which compliance alternative they would implement if they have a future lead ALE that can include POU device installation and maintenance. State activities and associated SafeWater LCR model cost inputs for one-time and ongoing activities are described in Sections B.6.5.1 and B.6.5.2, respectively.

B.6.5.1 One-Time POU Program Costs

The EPA has developed costs for three one-time State activities related to POU program oversight as under the 2021 LCRR, shown in Exhibit B-89. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden, and SafeWater LCR data variable under the 2021 LCRR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.5.1. As previously stated, the main difference between the two rule is that under the 2021 LCRR, CWSs serving up to 10,000 people can implement this option with State approval as opposed to 3,300 or fewer people under the final LCRI. The other difference is that some of these activities are required when the system exceeds the lead TL under the 2021 LCRR.

Exhibit B-89: State One-Time POU-Related Burden Estimates

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Review POU plan	37 to 67 hrs/CWS serving ≤ 10,000; 29.5 to 67 hrs/NTNCWSs	*hrs_pou_plan_rev_js*	Yes
b) Provide templates for POU outreach materials	0.25 to 0.5 hrs/PWS serving ≤ 10,000	*hrs_temp_pou_js*	Yes
c) Review POU PE materials	0.5 hrs/CWS serving ≤ 10,000; 0.5 to 2 hrs/NTNCWSs	*hrs_review_pe_pou_js*	Yes

Acronyms: CWS = community water system; LCRI = Lead and Copper rule Improvements; NTNCWS = non-transient non-community water system; PE = public education; POU = point-of-use; PWS = public water system.
Source:
a): "POU Inputs_Final.xlsx."
b) & c): "Public Education Inputs_CWS_Final.xlsx"; "Public Education Inputs_NTNCWS_Final.xlsx."
Notes:

a) - c): States will only conduct these activities for the subset of CWS serving ≤10,000 people and NTNCWSs that have a TLE or lead ALE without a prior TLE and for which POU provision and maintenance is their approved lead compliance option. This differs from the final LCRI in which these oversight activities apply to CWS serving ≤3,300 people and NTNCWSs that have a lead ALE and for which POU provision and maintenance is their approved lead compliance option.
c) The rule does not explicitly include a POU plan. However, the EPA assumed most systems would prepare this plan prior to implementing a POU program. This assumption may overestimate costs during the first year the program is implemented.

Exhibit B-91 in Section B.6.5.2 provides the SafeWater LCR model approach including additional cost inputs that are required to calculate the total costs under the 2021 LCRR.

B.6.5.2 Ongoing POU Program Costs

The EPA has developed costs for three ongoing State activities related to POU program oversight under the 2021 LCRR, as shown in Exhibit B-90. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden, and SafeWater LCR data variable for the 2021 LCRR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.5.2.

Exhibit B-90: State Ongoing POU-Related Burden Estimates under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
d) Review sample invalidation request for POU monitoring	2 hrs/request	*hrs_samp_invalid_js*	Yes
e) Review customer notification certifications	0.33 to 0.5/certification	*hrs_cert_cust_lt_js*	Yes
f) Review annual POU program report	0.5 hrs/CWS serving ≤ 10,000 people; 0.5 to 4 hr/NTNCWS	*hrs_pou_report_ann_rev_js*	Yes

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; POU = point-of-use.
Sources:
d) & e): "Lead Analytical Burden and Costs_Final.xlsx."
f): "POU Inputs_Final.xlsx."
Notes:
d) - f): States will only conduct these activities for the subset of CWS serving ≤10,000 people and NTNCWSs that have a TLE or lead ALE without a prior TLE and for which POU provision and maintenance is their approved lead compliance option. This differs from the final LCRI in which these oversight activities apply to CWS serving ≤3,300 people and NTNCWSs that have a lead ALE and for which POU provision and maintenance is their approved lead compliance option.

Exhibit B-91 provides the SafeWater LCR model costing approach for POU-related activities a) through f) including additional cost inputs that are required to calculate the total costs under the 2021 LCRR. It also indicates for which activities the costing approach under the 2021 LCRR is the same as the final LCRI, as provided in Chapter 4, Exhibit 4-182.

Exhibit B-91: State POU Cost Estimation in SafeWater LCR (by Activity)[1,2]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th – Range	Other Conditions	
a) Review POU plan				
The hours per system multiplied by the State labor rate. *(hrs_pou_plan_rev_js*rate_js)*	Cost applies as written to States for NTNCWSs.	Above TL	States with model PWSs installing POU devices or conducting a POU plan	One time
b) Provide templates for POU outreach materials				
The hours per system multiplied by the State labor rate. *(hrs_temp_pou_js*rate_js)*	Cost applies as written to States for NTNCWSs.	Above TL	States with model PWSs installing POU devices or conducting a POU devices	One time
c) Review POU PE materials				
Same as final LCRI (see Exhibit 4-182 in Chapter 4).				
d) Review sample invalidation request for POU monitoring				
Same as final LCRI (see Exhibit 4-182 in Chapter 4).				
e) Review customer notification certifications				
Same as final LCRI (see Exhibit 4-182 in Chapter 4).				
f) Review annual POU program report				
Same as final LCRI (see Exhibit 4-182 in Chapter 4).				

Acronyms: AL = action level; CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PE = public education; POU = point-of-use; PWS = public water system**;** TL = trigger level.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

[2] As previously discussed in Section B.5.5.2, in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles and shipping and conducting the analysis for samples following LSLR (ASDWA, 2020a). Thus, the State will incur the burden and cost for these activities.

B.6.6 State Lead Public Education, Outreach, and Notification Costs under the 2021 LCRR

Under the 2021 LCRR, States will incur burden to conduct oversight and review activities related to consumer notice in response to a single lead sample above 15 µg/L, additional education and outreach regardless of a system's lead 90th percentile level, and PE requirements in response to a system's lead 90th percentile level. These activities and associated costs are detailed in Sections B.6.6.1 through B.6.6.3, respectively. Exhibit B-95 at the end of Section B.6.6.3 provides details on how costs are calculated for PWS PE activities a) through p) including additional cost inputs that are required to calculate these costs.

Note that State PE activities associated with outreach that is provided to customers when a CWS serving more than 10,000 people exceeds the TL or fails to meet their replacement goal were previously discussed in B.6.4. State PE activities associated with the POU program were previously discussion in Section B.6.5. State activities associated with enhanced public outreach for systems with a minimum of three lead ALEs in a five-year period *(i.e.*, multiple lead ALEs) is a new requirement under the final LCRI and is not discussed in this appendix (see Chapter 4, Section 4.4.6.4 for these State requirements and costing assumptions).

B.6.6.1 Consumer Notice

The EPA has developed State costs related to a system's three-day calendar consumer notice in response to a lead sample above 15 µg/L under the 2021 LCRR, as shown in Exhibit B-92. The exhibit provides the unit burden. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden, and SafeWater LCR data variable are identical under the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.4.6.1. However, under the 2021 LCRR this three-day notification applies only to lead samples that exceed 15 µg/L; whereas, under the final it would apply all lead and copper results and must be completed within three business days.

Exhibit B-92: State Burden for Consumer Notification When Sample is > 15 µg/L under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Provide templates for consumer notice materials	0.25 to 0.5 hrs per PWS	*hrs_consumer_notice_temp_js*	Yes.
b) Review lead consumer notice materials	0.5 to 2 hours per PWS	*hrs_consumer_notice_rev_js*	Yes.
c) Review copy of the consumer notice and certification	0.5 hrs/customer contact	*hrs_samp_notice_js*	Yes.[1]

Acronyms: LCRI = Lead and Copper Rule Improvements; PWS = public water system.
Source: "Public Education Inputs_CWS_Final.xlsx," "Public Education Inputs_NTNCWS_Final.xlsx."
Note:
[1] The burden and cost estimates are the same under the 2021 LCRR and final LCRI; however, under the 2021 LCRR this notification applies only to lead samples that exceed 15 µg/L. Under the final LCRI, the EPA is requiring all lead and copper results be provided to consumers at tested taps within three business days.

B.6.6.2 Activities Regardless of the Lead 90th Percentile Level

The EPA has developed State costs for activities associated with PE requirements under the 2021 LCRR that are independent of a system's lead 90th percentile status, as provided in Exhibit B-93. The exhibit provides the unit burden. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden, and SafeWater LCR data variable for the 2021 LCRR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.6.2. The gray shaded row indicates an activity that is not required under the 2021 LCRR.

Exhibit B-93: State Burden for Public Education Activities that Are Independent of Lead 90th Percentile Levels under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
d) Provide templates for updated CCR language (one-time)	0.25 to 0.5 hrs/CWS	*hrs_temp_ccr_js*	Yes
e) Provide templates for local and State health departments lead outreach	0.25 to 0.5 hrs/CWS	*hrs_pub_temp_hc_js*	Yes
f) Review lead outreach materials for local and State health departments	0.5 to 2 hrs/CWS	*hrs_pub_rev_hc_js*	Yes
g) Participate in joint communication efforts with local and State health departments	1 hr/CWS	*hrs_hc_js*	Yes
h) Provide templates for service line disturbance outreach materials	0.25 to 0.5/CWS	*hrs_wtr_temp_js*	Yes
i) Review public education materials for service line disturbances	0.5 to 2 hrs/CWS with LSLs	*hrs_review_wtr_pe_js*	Yes
j) Provide templates for inventory-related outreach materials (one-time)	0.25 to 0.5/CWS or NTNCWS	*hrs_pe_lsl_gen_temp_js*	Yes
k) Review inventory-related outreach materials (one-time)	0.5 to 2 hours/CWS or NTNCWS	*hrs_pe_lsl_rev_js*	Yes
l) Provide technical assistance to PWSs for public education materials	N/A	*hrs_translate_phone_js* *cost_translate_state*	No. Not required under the 2021 LCRR.
m) Review public education certifications[1]	CWSs 1 to 1.5 hrs/CWS NTNCWSs 0.33 to 0.5 hrs/NTNCWS	CWSs *hrs_pe_certify_quarterly_js* NTNCWSs *hrs_cert_outreach_annual_js*	Yes

Acronyms: CCR = consumer confidence report; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; LSL = lead service lines; PE = public education.

Sources:

d) - i): "Public Education Inputs_CWS_Final.xlsx."

j)-k, m): "Public Education Inputs_CWS_Final.xlsx" "Public Education Inputs_NTNCWS_Final.xlsx."

Notes:

[1] The EPA assumed that a system's certification would not only include any outreach conducted in response to a lead ALE but also include lead consumer notice that is conducted in response to a sample exceeding 15 µg/L and other outreach activities that are independent of a system's lead 90th percentile level.

B.6.6.3 Public Education Activities in Response to Lead ALE under the 2021 LCRR

The EPA has developed State costs for activities associated with PE requirements in response to a lead ALE under the 2021 LCRR, as provided in Exhibit B-94. The exhibit provides the unit burden. The third

column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden, and SafeWater LCR data variable are identical for the 2021 LCRR to those used for the final LCRI, as described in Chapter 4, Section 4.4.6.3.

Exhibit B-94: State PE Burden in Response to Lead ALE under the 2021 LCRR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
n) Provide templates for updated public education materials for systems with a lead ALE	0.25 to 0.5/CWS or NTNCWS	*hrs_ale_lang_temp_js*	Yes.
o) Review revised lead language (one-time)	0.5 to 2 hrs/CWS or NTNCWS	*hrs_ale_lang_js*	Yes.
p) Consult with CWS on other PE activities in response to a lead ALE	2 hrs/CWS	*hrs_ale_consult_js*	Yes.

Acronyms: ALE = action level exceedance; CWS = community water system; LCRI = Lead and Copper Rule Improvements; PE = public education; NTNCWS = non-transient non-community water system.
Sources:
n) & o): “Public Education Inputs_CWS_Final.xlsx;” “Public Education Inputs_NTNCWS_Final.xlsx.”
p): “Public Education Inputs_CWS_Final.xlsx.”

Exhibit B-95 provides details on how total costs for the State PE requirements under the 2021 LCRR are calculated for activities a) through p) including additional cost inputs that are required to calculate the total costs. It also indicates that in general they are the same as those used for final LCRI, as shown in Chapter 4, Exhibit 4-189. The gray shaded row indicates an activity that is new under the final LCRI and does not apply to the 2021 LCRR. As previously stated, this exhibit does not include State oversight activities that are related to water systems that have multiple lead ALEs, which is a new requirement under the final LCRI (see Chapter 4, Section 4.4.6.4 for information).

Exhibit B-95: State Lead Public Education Cost Estimation in SafeWater LCR by Activity under the 2021 LCRR [1, 2]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th – Range	Other Conditions	
a) Provide templates for consumer notice materials				
The hours per system multiplied by the State labor rate. *(hrs_consumer_notice_temp_js *rate_js)*	Cost applies as written to States for NTNCWSs.	All	All States with model PWSs with at least one sample > 15 µg/L	Once per event
b) Review lead consumer notice materials				
The hours per system multiplied by the State labor rate. *(hrs_consumer_notice_rev_js *rate_js)*	Cost applies as written to States for NTNCWSs.	All	All States with model PWSs with at least one sample > 15 µg/L	Once per event

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th – Range	Other Conditions	
c) Review copy of the consumer notice and certification				
The hours per system multiplied by the State labor rate. *(hrs_samp_notice_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	All States with model PWSs with at least one sample > 15 µg/L	Once per event
d) Provide templates for updated CCR language				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
e) Provide templates for local and State health departments lead outreach				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
f) Review lead outreach materials for local and State health departments				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
g) Participate in joint communication efforts with local and State health departments				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
h) Provide templates for service line disturbance outreach materials				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
i) Review public education materials for service line disturbances				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
j) Provide templates for inventory-related outreach materials				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
k) Review inventory-related outreach materials				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
l) Provide technical assistance to PWSs for public education materials				
N/A under the 2021 LCRR. New requirement under the final LCRI.				
m) Review public education certifications				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
n) Provide templates for updated public education materials for systems with a lead ALE				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
o) Review revised lead language				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				
p) Consult with CWS on other public education activities in response to lead ALE				
Same as final LCRI (see Exhibit 4-189 in Chapter 4).				

Acronyms: ALE = action level exceedance; CCR = consumer confidence report; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LCRR = Lead and Copper Rule Revisions; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] State oversight burden and costs for systems with LSLs with the exception of those associated with service line disturbances and implementing the POU program are included in Sections B.6.6.2B.6.4 and B.6.5B.6.5.1, respectively.
[2] The data variables in the exhibit are defined previously in this section with the exception of:

- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

B.7 Estimating Compliance Activity Under the Pre-2021 LCR

In the primary economic analysis (EA), the EPA used the final Lead and Copper Rule Revisions (2021 LCRR) regulatory framework as the baseline for the estimated incremental costs and benefits of the final Lead and Copper Rule Improvements (LCRI) (see Chapters 4, 5, and 6). This choice of baseline in the primary EA is consistent with Office of Management and Budget (OMB) guidance in Circular A4 (OMB, 2023). Circular A4 states that the proposed regulations "are generally measured against a no-action baseline: an analytically reasonable forecast of the way the world would look absent the regulatory action being assessed." Absent in the final regulatory changes in this final LCRI rulemaking, the 2021 LCRR would remain in effect and best represents the future regulatory framework and costs faced by public water systems (PWSs) and the resultant social benefits that would accrue to the public free of additional regulatory action.

Because most of the regulatory requirements of the 2021 LCRR have not been implemented as of the date of this final rule the EPA for informational purposes, in this appendix, estimated the incremental costs and benefits of the final LCRI using the pre-2021 Lead and Copper Rule (LCR) as the baseline regulatory framework. The results shown are the incremental costs and benefits of the final LCRI if the requirements of the 2021 LCRR to be implemented after October 24, 2024, had not been promulgated. These results will assist stakeholders that are more familiar with the current, or pre-2021 LCR, state of the world with understanding the potential estimated impacts of the final LCRI.

In order to maintain consistency between how the SafeWater LCR model estimates the costs for the final LCRI and the pre-2021 LCR baseline, certain parts of the cost model remain constant across rule scenarios, including the baseline characteristics of the model-PWSs, the analysis period and discount rates, how very large systems are modeled, the assignment of the model-PWS's initial P90-range and the likelihood that a single sample is greater than the ALE (both of which differ from the final LCRI and 2021 LCRR due to different sampling requirements under each rule), and how changes in source water or treatment changes impact the PWS's $P90_{y+1}$-range.

In addition, the EPA estimated the costs of the pre-2021 LCR under the same low and high scenarios used to estimate the final LCRI costs. The low scenario and high scenario differ in their assumptions made about: 1) the number of PWS above the AL under the pre-2021 LCR; 2) the cost of installing and optimizing CCT; and 3) the cost of SL replacement.

This section describes the modeling framework for the pre-2021 LCR that the SafeWater LCR model employs to determine if a model-PWS will take an action that will change its P90-range, which in turn will change other actions the model-PWS will be required to take.

B.7.1 Corrosion Control Technology

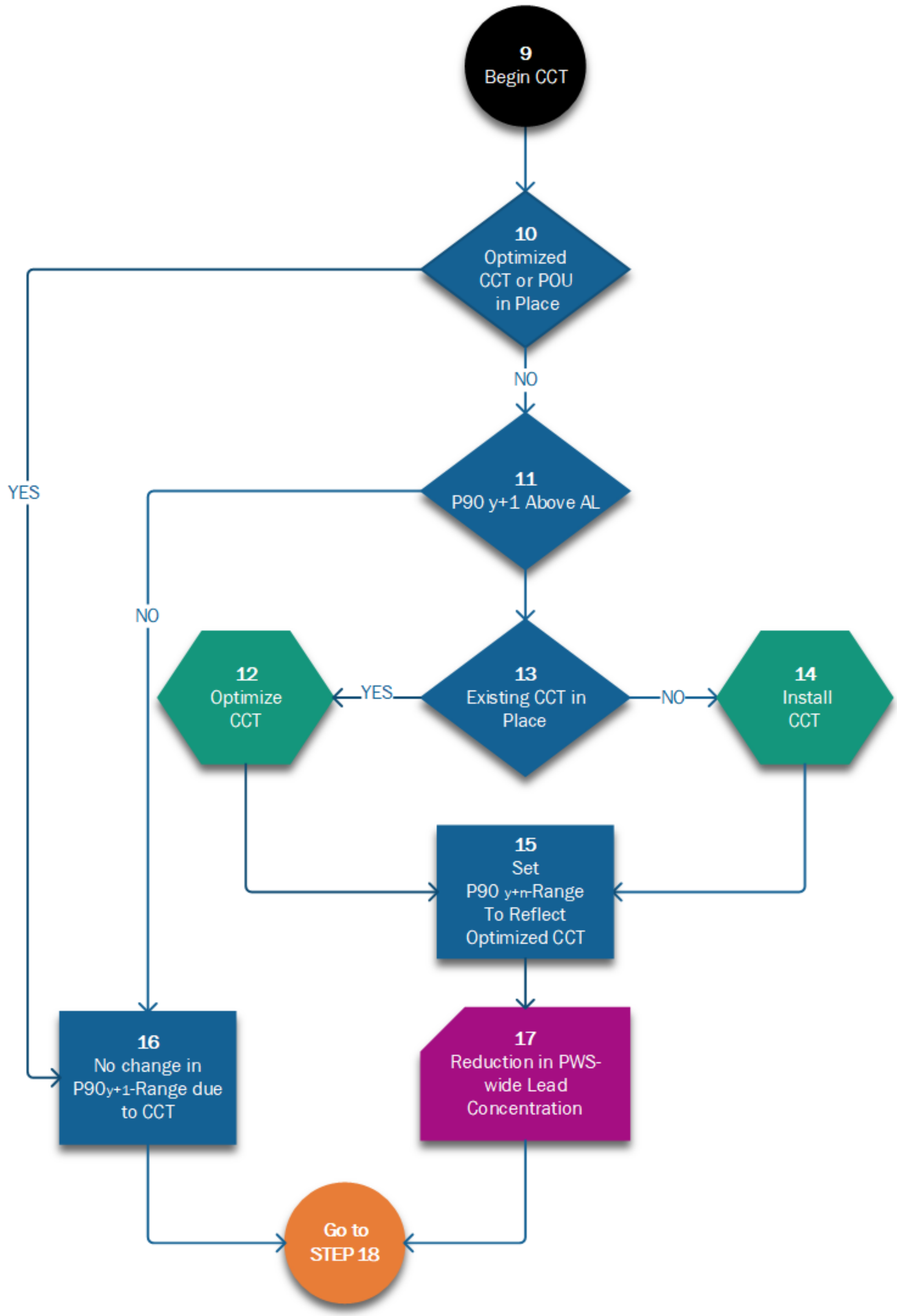
After the SafeWater LCR model determines if a model-PWS's $P90_{y+1}$-range will be impacted by a change in source water or treatment technology (see Section B.3.1), it continues within the year-loop and

begins the process of determining if the model-PWS will install or optimize CCT. The EPA assumes that when a system installs CCT or optimizing existing CCT they will achieve the same standard of efficacy, or lead reduction, as under the final LCRI.

The SafeWater LCR model keeps track of the model-PWS's CCT status throughout the period of analysis. Once a model-PWS with existing CCT re-optimizes its CCT, or a model-PWS without CCT installs CCT, the EPA assumes that the CCT is optimized and no further changes to CCT will be needed. Therefore, as the SafeWater LCR model continues within its year-loop (see Exhibit B-96, which continues the steps presented in Exhibit B-4), it determines whether the model-PWS has already re-optimized its existing CCT, or installed new CCT, and therefore has optimized CCT in place (Step 10). If it does, then SafeWater makes no change to CCT in place and to the model-PWS's $P90_{y+1}$-range due to CCT (Step 16) and the model-PWS moves on to the next stage of the year-loop (Step 18).

Model-PWSs with a $P90_{y+1}$-range greater than the AL (Step 11) and existing CCT in place (Step 13) will re-optimize their existing CCT (Step 12). If they do not have existing CCT in place (Step 16), they will install CCT (Step 14). Once a model-PWS optimizes existing CCT, or installs CCT, SafeWater will adjust its $P90_{y+n}$-range to reflect the effectiveness of the CCT in reducing lead levels (Step 15) before moving on to the next stage of the year-loop (Step 18). In the case of re-optimizing existing CCT, the model-PWS will first make a recommendation to their State regarding CCT optimization and the State will review the recommendation and either require the model-PWS to perform a CCT study or inform the model-PWS of what changes to their CCT treatment are required. Depending on if a CCT study is required or not, this process can take two or three years. The EPA assumes that it will require another year for the model-PWS to optimize their CCT and an additional two years for the model-PWS's P90-range to fall below the AL. In the case of new CCT installation, if the model-PWS has not already conducted a CCT study, the EPA assumes it will take the model-PWS two years to complete the CCT study and an additional two years to install the CCT technology. The EPA assumes that the model-PWS's P90-range will fall below the AL two years after CCT is installed.

Exhibit B-96: Simulating Corrosion Control Under the Pre-2021 LCR in SafeWater LCR Model



B.7.2 Replacement of Lead Content Service Lines

Under the pre-2021 LCR, if a PWS's $P90_y$-range is above the AL, PWSs are required to install CCT. If they already have CCT installed, and their $P90_y$-range is above the AL, they are required to replace 7 percent of their baseline number of LSLs each year until their P90-range falls at or below the AL.[47,48] EPA assumes that it will take three years for PWSs to identify and correct any issues in order to get below the AL for two consecutive six-month monitoring periods, which would allow them to discontinue the SL replacement program under the pre-2021 LCR. Therefore, for modeling purposes, the SafeWater LCR model will require three years of SL replacements. Furthermore, the EPA assumes a PWS will only conduct one three-year period of SL replacements during the period of analysis.

Therefore, the SafeWater LCR model first checks to see if the model-PWS has already conducted three years of SL replacements (Step 19 in Exhibit B-97) and if it has, then the SafeWater LCR model makes no change to the model-PWS's $P90_{y+1}$-range due to SL replacements (Step 26) and the model-PWS returns to the beginning of the year-loop (Step 2 in Exhibit B-4) to determine its compliance actions and costs for the next year of the analysis.

If the model-PWS has not already completed three years of SL replacements (Step 19), but it did conduct SL replacement in the prior year (Step 20), it must already be in a three-year SL replacement period. In this case, the model-PWS will remove 7 percent of its baseline LSLs this year (Step 24). If this is the third year of the model-PWS's SL replacement program, then at the end of the year (Step 27) the SafeWater LCR model will adjust the model-PWS's $P90_{y+1}$-range to reflect the impact of SL replacement and any other corrective actions the model-PWS took on the model-PWS's lead concentrations (Step 28). The EPA assumes that the model-PWS's $P90_{y+1}$-range will be below the AL. The model-PWS will then return to the beginning of the year-loop (Step 2 in Exhibit B-4) to determine its compliance actions and costs for the next year of the analysis.

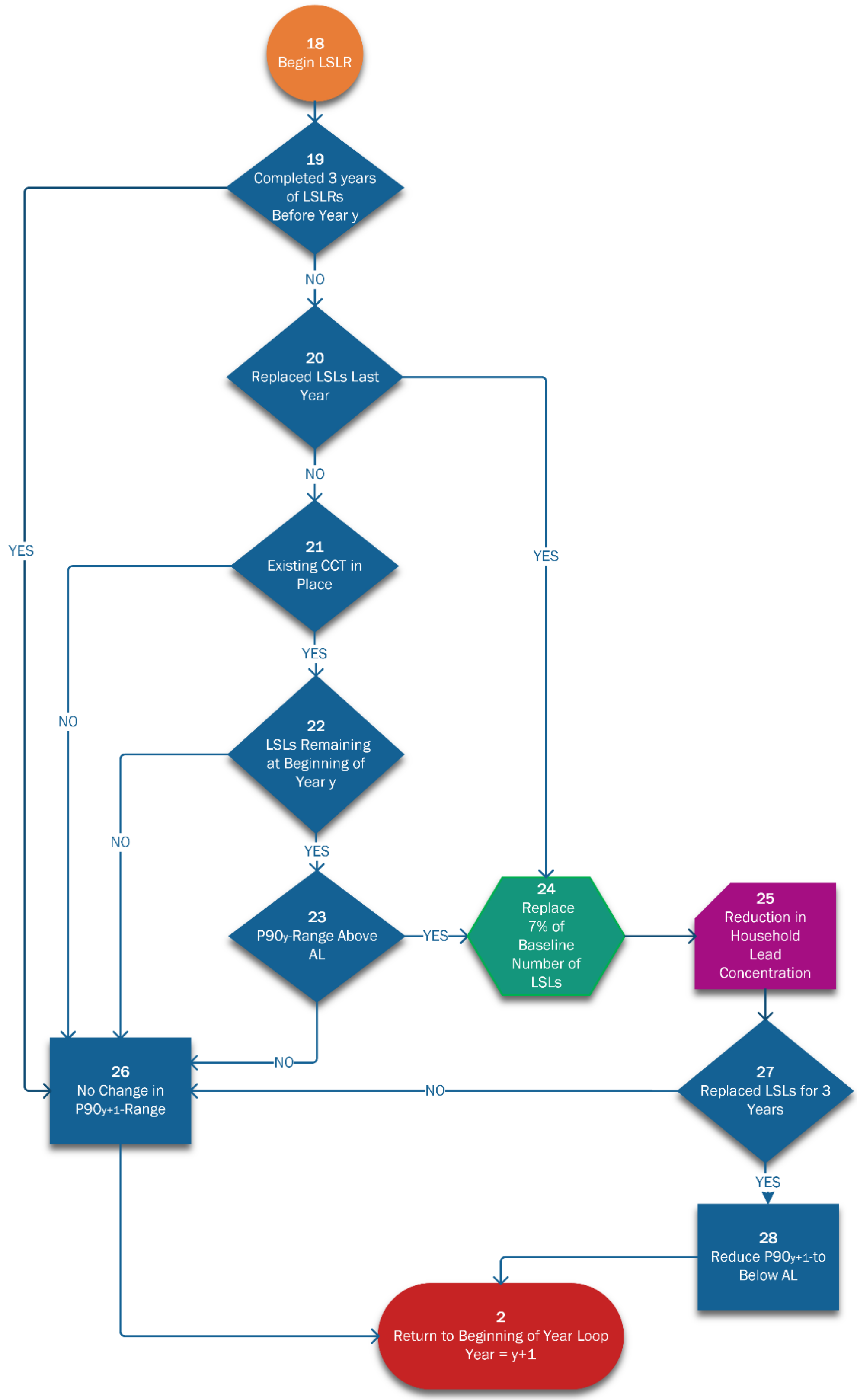
If the model-PWS has not removed any LSLs in prior years (Steps 19 and 20), does not have CCT installed (Step 21), has LSLs in the system inventory (Step 22), and has a $P90_y$-range above the AL (Step 23) it will

[47] Under the pre-2021 LCR, test-outs count towards the 7 percent annual replacement requirement. The cost of replacing actual physical LSLs and the cost of test-outs are both captured by the SafeWater LCR model as described in Section B.3.4. In addition, because test-outs do not provide any actual reduction in lead exposure, when a test-out is completed, the SafeWater LCR model does not adjust the population with LSLs in the benefits analysis (see Chapter 6). Likewise, under the pre-2021 LCR, completion of partial LSLRs count towards the 7 percent annual replacement requirement. Since partial LSLRs provide less reduction in lead exposure than a full LSLR, when a partial LSLR is completed, the SafeWater LCR model accounts for this in the benefits analysis (see Chapter 5).

[48] In the case of a PWS with existing CCT in place, that has an ALE, the PWS may need to make minor adjustments to its existing CCT to return to compliance. At the same time, the PWS would have to conduct LSLRs at a rate of 7 percent every year until their P90 is not greater than the AL for two consecutive 6-month monitoring periods. Since both the changes to the existing CCT that would be required, and the exact time it would take for a PWS to return to compliance, is not known, the EPA modeled the cost of this scenario assuming no incremental CCT costs and a standard 3-year period of LSLRs. The three-year period used for the estimated average number of years of replacements is based on 85 CWSs. For additional details, see the file "LSLR_Time_Span_Analysis_CWS_Final.xlsx," available in the docket at EPA-HQ-OW-2022-0801.

begin its three-year SL replacement program by removing 7 percent of its baseline LSLs (Step 24). Since the model-PWS has not completed its three year SL replacement program (Step 26), the SafeWater LCR model will not make any adjustment to the model-PWS's $P90_{y+1}$-range (Step 27) and the model-PWS will return to the beginning of the year-loop (Step 2 in Exhibit B-4) to determine its compliance actions and costs for the next year of the analysis.

Exhibit B-97: Simulating SL replacement Under the Pre-2021 LCR in SafeWater LCR Model



B.8 Detailed Public Water System Costing Approach for the Pre-2021 LCR

This section details how the EPA estimated the cost of compliance with each major component of the pre-2021 LCR, including:

- B.8.1: PWS Sampling Costs
- B.8.2: PWS CCT-Related Costs
- B.8.3: PWS Lead Service Line Replacement-Related Costs
- B.8.4: PWS Public Education-Related Costs

The final LCRI requirements associated with one-time activities to implement and administer the rule changes, lead in drinking water testing at schools and child cares, DSSA requirements, public outreach requirements other than those required when a system exceeds the lead AL, and the POU program are not applicable to the pre-2021 LCR and thus are not included in this section. However, Exhibit B-98 shows all the components, subcomponents, and activities from Exhibit 4-6 in Chapter 4 for the final LCRI to facilitate comparison between the pre-2021 LCR and final LCRI. For each major rule component, each activity has a unique letter ID. The differences in activities costed for the final LCRI and the 2021 LCRR are identified as follows: 1) gray shading italicized text indicates activities under the final LCRI that were not part of the pre-2021 LCR requirements; and 2) yellow shaded activities in bold are specific to the pre-2021 LCR and are not included in the final LCRI requirements.

Exhibit B-98: PWS Cost Components, Subcomponents, and Activities Organized by Section for the Pre-2021 LCR[1]

Component	Subcomponents	Activities[2]
PWS Implementation and Administrative Costs	PWS One-Time Implementation and Administrative Costs	a) *Read and understand the rule.* b) *Assign personnel and resources for rule implementation.* c) *Participate in training and technical assistance provided by the State during rule implementation.* d) *Provide small system flexibility option recommendation to the State.*
B.8.1: PWS Sampling Costs	B.8.1.1: PWS Lead Tap Sampling	a) *Update sampling instructions for lead tap sampling and submit to the State.* b) *Contact homes to establish new 100 percent LSL tap sampling pool.* c) *Update and submit tap sampling plan to the State.* d) Report any changes in sampling locations to the State. e) *Confer with the State on initial lead sampling data and status under the LCRI.* f) Obtain households for each round of lead tap sampling. g) Offer incentives to households to encourage participation in lead tap sampling program. h) Ship tap sampling material and instructions to participating households. i) Collect lead tap samples.

Component	Subcomponents	Activities[2]
		j) Determine if a sample should be rejected and not analyzed. k) Analyze lead tap samples in-house or commercially. l) Prepare and submit sample invalidation request to the State. m) Inform consumers of tap sample results. n) Certify to the State that results were reported to consumers. o) Submit request to renew 9-year monitoring waiver to the State. p) Submit sampling results and 90th percentile calculation to the State. q) *Oversee the customer-initiated lead sampling program.* r) *Ship tap sampling material and instructions to participating households for customer-initiated lead sampling program.* s) *Collect lead tap samples for customer-initiated lead sampling program.* t) *Analyze lead tap samples in-house or commercially for customer-initiated lead sampling program.* u) *Inform customers of lead tap sample results for customer-initiated lead sampling program.*
	B.8.1.2: PWS Lead Water Quality Parameter Monitoring	v) Collect lead WQP samples from the distribution system. w) Analyze lead WQP samples from the distribution system. x) Collect lead WQP samples from entry points. y) Analyze lead WQP samples from entry points. z) Report lead WQP sampling data and compliance with OWQPs to the State.
B.8.1: PWS Sampling Costs (Continued)	B.8.1.3: PWS Copper Water Quality Parameter Monitoring	aa) Collect copper WQP samples from the distribution systems. bb) Analyze copper WQP samples from the distribution system. cc) Collect copper WQP samples from entry points. dd) Analyze copper WQP samples from entry points. ee) Report copper WQP sampling data and compliance with OWQPs to the State.
	B.8.1.4: PWS Source Water Monitoring	ff) Collect source water samples. gg) Analyze source water samples. hh) Report source water monitoring results to the State.
	CWS School and Child Care Facility Lead Sampling Costs – First Five-Year Cycle	ii) *Create a list of schools and child care facilities served by CWS and submit to State.* jj) *Develop lead outreach materials for schools and child care facilities.* kk) *Prepare and distribute initial letters explaining the sampling program and the EPA's 3Ts Toolkit.* ll) *Contact elementary school or child care facility to determine and finalize its sampling schedule (one-time) or contact secondary school to offer sampling (annual).*

Component	Subcomponents	Activities[2]
		mm) *Contact school or child care facility to coordinate sample collection logistics.* nn) *Conduct walkthrough at school or child care facility before the start of sampling.* oo) *Travel to collect samples.* pp) *Collect samples.* qq) *Analyze samples.* rr) *Provide sampling results to tested facilities.* ss) *Discuss sampling results with the school or child care facility.* tt) *Conduct detailed discussion of high sampling results with schools and child care facilities.* uu) *Report school and child care facility sampling results to the State.* vv) *Prepare and provide annual report on school and child care facility sampling program to the State.*
	CWS School and Child Care Facility Lead Sampling Costs – Second Five-Year Cycle On	ww) *Update the list of schools and child care facilities and submit to the State.* xx) *Contact schools and child care facilities to offer sampling.* yy) *Contact the school or child care facility to coordinate sample collection logistics.* zz) *Conduct walkthrough at school or child care facility before the start of sampling.* aaa) Travel to collect samples. bbb) *Collect samples.* ccc) *Analyze samples.* ddd) *Provide sampling results to tested facilities.* eee) *Discuss sampling results with the school and child care facility.* fff) *Conduct detailed discussion of high sampling results with schools and child care facilities.* ggg) *Report school and child care facility sampling results to the State.* hhh) *Prepare and provide annual report on school and child care facility sampling program to the State.*
B.8.2: PWS Corrosion Control Costs	B.8.2.1: CCT Installation	a) Conduct a CCT study. b) Install CCT (PO_4, PO_4 with post treatment, pH adjustment, or modify pH).
	B.8.2.2: Re-optimization of Existing Corrosion Control Treatment	c) Revise CCT study d) Re-optimize existing CCT.
	DSSA Costs	e) *Contact customers and collect follow-up tap sample.* f) *Analyze follow-up lead tap sample.* g) *Collect distribution system WQP sample.* h) *Analyze distribution system WQP sample.* i) *Review incidents of systemwide event and other system conditions.* j) *Consult with the State prior to making CCT changes.* k) *Report follow-up sample results and overall DSSA responses to the State.*

Component	Subcomponents	Activities[2]
	B.8.2.3: Lead CCT Routine Costs	l) *Review CCT guidance.* m) *Provide WQP data to the State and discuss during sanitary survey.* n) Notify and consult with the State on required actions in response to source water change. o) Notify and consult with the State on required actions in response to treatment change.
	B.8.2.4 CCT Activities Unique to the pre-2021 LCR	p) **Submit water quality data to determine if CCT study is needed.**
B.8.3: PWS Lead Service Line Replacement-Related Costs	Service Line Inventory	a) *Conduct records review for connector material.* b) *Compile and submit connector updated LCRR initial inventory information (baseline inventory) to the State.* c) *Identify material for unknown service lines.* d) *Report annual inventory updates to the State.* e) *Conduct field investigations for inventory invalidation.* f) *Report validation results to State.*
	Service Line Replacement Plan	g) *Develop initial SLR plan and submit to the State for review.* h) *Identify funding options for full SLRs.* i) *Include information on deferred deadline and associated replacement rate in the SLR plan.* j) *Update SLR plan annually or certify no changes.* k) *Provide a recommendation of the deferred deadline and associated replacement rate.*
	B.8.3.1: Lead Service Line Replacements	l) *System replaces lead and GRR service lines* **m) Systems replace their portion of the LSL** **n) Households replace privately-owned portion of the LSL**
	B.8.3.2: Ancillary Lead Service Line Replacement Activities	o) Contact customers and conduct site visits prior to service line replacement. p) *Deliver filters and 6 months of replacement cartridges at time of service line replacement.* q) Collect tap sample post-service line replacement. r) Analyze post-service line replacement tap sample. s) Inform customers of tap sample result. t) Submit annual report on service line replacement program to the State.
	B.8.3.3: Ancillary Service Line Replacement Activities Unique to the Pre-2021 LCR	**u) Develop information that asks if customers want their LSL replaced.** **v) Deliver information that asks if customers want their LSL replaced.** **w) Develop information that goes to customers prior to partial LSLR.** **x) Deliver prior notification for partial LSLRs.** **y) Submit documentation that partial LSLR were fulfilled** **z) Collect samples for test out provision.** **aa) Analyze lead tap samples for test out provision.**
	POU Device Installation and Maintenance	a) *Provide, monitor, and maintain POU devices.*

Component	Subcomponents	Activities[2]
PWS POU-Related Costs (Small System Compliance Option)	POU Ancillary Activities	b) *Develop POU plan and submit to the State.* c) *Develop public education materials and submit to the State.* d) *Print POU education materials.* e) *Obtain households for POU monitoring.* f) *Deliver POU monitoring materials and instructions to participating households.* g) *Collect tap samples after POU installation.* h) *Determine if sample should be rejected and not analyzed.* i) *Analyze POU tap samples.* j) *Prepare and submit sample invalidation request to the State.* k) *Inform customers of POU tap sample results.* l) *Certify to the State that POU tap results were reported to customers.* m) *Prepare and submit annual report on POU program to the State.*
B.8.4: PWS Lead Public Education, Outreach, and Notification Costs	Consumer Notice	a) *Develop lead consumer notice materials and submit to the State for review.* b) *Provide a copy of the consumer notice and certification to the State.*
	Activities Regardless of Lead 90th Percentile Level	c) *Update CCR language.* d) *Develop new customer outreach plan.* e) *Develop approach for improved public access to lead health-related information and tap sample results.* f) *Establish a process for public access to information on known or potential lead content SL locations and tap sample results.* g) *Maintain a process for public access to lead health information, known or potential lead content SL locations, and tap sample results.* h) *Respond to customer request for known or potential lead content SL information.* i) *Respond to requests from realtors, home inspectors, and potential home buyers for known or potential SL information.* j) *Develop a list of local and State health agencies.* k) *Develop lead outreach materials for local and State health agencies and submit to the State for review.* l) *Deliver lead outreach materials for local and State health agencies.* m) *Develop public education materials for known or potential SL disturbances and submit to the State.* n) *Deliver public education for SL disturbances.* o) *Deliver filters and 6 months of replacement cartridges during disturbances of SLs* p) *Develop inventory-related outreach materials and submit to the State for review* q) *Distribute inventory-related outreach materials* r) *Provide translation services for public education*

Component	Subcomponents	Activities[2]
		materials
	Public Education Activities in Response to Lead ALE	s) *Update mandatory language for lead ALE public education and submit to the State for review* t) Deliver lead ALE public education materials to all customers u) Post notice to website v) Prepare press release w) Contact public health agencies to obtain additional organizations and update recipient list x) Notify public health agencies and other organizations y) Consult with State on other public education activities z) Implement other public education activities aa) Certify to the State that lead outreach was completed[3]
	Public Education Activities in Response to Multiple Lead ALEs	bb) *Provide filters due to multiple lead ALEs* cc) *Develop outreach materials for systems with multiple lead ALEs and submit to the State for review* dd) *Conduct enhanced public education for systems with multiple lead ALEs* ee) *Consult with States on filter program for systems with multiple lead ALEs* ff) *Develop plan for making filters available and submit to the State for review* gg) *Make filters available due to multiple lead ALEs*

Acronyms: ALE = action level exceedance; CCR = consumer confidence report; CCT = corrosion control treatment; CWS = community water system; DSSA = Distribution System and Site Assessment; GRR = galvanized requiring replacement; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; LSL = lead service line; LSLR = lead service line replacement; OCCT = optimal corrosion control treatment; OWQPs = optimal water quality parameters; PO_4 = orthophosphate; POU = point-of-use; PWS = public water system; SL = service line; SLR = service line replacement; WQP = water quality parameter.

Notes:

[1] Systems will also incur burden for recordkeeping activities under the pre-2021 LCR, such as retaining records of decisions, supporting documentation, technical basis for decisions, and documentation submitted by the system. The EPA has included burden for recordkeeping with each activity when applicable and opposed to providing separate burden estimates.

[2] The EPA assigned a unique letter ID for each activity under a given rule component. Activities are generally organized with upfront, one-time activities first followed by ongoing activities. The lettering follows that used for the final LCRI, in Chapter 4, Exhibit 4-6, with the exception of activities that apply to the pre-2021 LCR but not the final LCRI.

[3] For the pre-2021 LCRI discussion in Section B.8.4, the certification is re-lettered as activity aa) and is included as part of the public education requirements when a systems exceeds the lead AL. For the final LCRI activity s) is included in Chapter 4, Section 4.3.6.2 – Activities Regardless of Lead 90th Percentile Levels because the certification includes all public education, outreach, and notification requirements.

As was done in Chapter 4, and Sections B.5 and B.6, the end of each subsection provides a summary exhibit showing the SafeWater LCR modeling approach for each water system activity (*e.g.*, Exhibit B-99). The exhibits follow the organization of the corresponding exhibits in Chapter 4 (*e.g.*, Exhibit B-99 mirrors Chapter 4, Exhibit 4-10).

- The first and second columns show how unit burden and labor rate information is combined to estimate a CWS and NTNCWS cost per activity, respectively.
- The third and fourth columns indicate the conditions under which the water system activity occurs. The columns indicate if the system activity is dependent on:
  - The system's 90th percentile range. See Section B.7 for a detailed discussion of how the SafeWater LCR model tracks a water system's 90th percentile level and accounts for changes in the 90th percentile level over the 35-year analysis period.
  - Other characteristics of the system such as presence or absence of SLs with lead content and/or CCT, and frequency of monitoring.
- The fifth column indicates the frequency of the activity (*e.g.*, one-time, annually, every 3 years).

In those instances where the costing approach for a specific activity is the same under the pre-2021 LCR and final LCRI, the exhibit directs the reader to the corresponding final LCRI exhibit in Chapter 4.

The SafeWater LCR uses the information from these exhibits to calculate total annualized water system cost for each activity. See Sections B.3 and B.7 for detail on the cost modeling methodology for the pre-2021 LCR.

B.8.1 PWS Sampling Costs

This section provides system unit burden and cost for lead tap sampling, lead WQP monitoring, copper WQP monitoring, and source water monitoring in Sections B.8.1.1 through B.8.1.4, respectively.

B.8.1.1 PWS Lead Tap Sampling

The discussion of lead tap sampling costs for water systems is presented in two subsections as follows:

- B.8.1.1.1: Lead Tap Sampling Schedules and Required Number of Samples
- B.8.1.1.2: Lead Tap Sampling Activities

Exhibit B-101 at the end of Section B.8.1.1.2 is a summary exhibit that indicates how the cost inputs are modeled by the SafeWater LCR model. Note that the SafeWater LCR model does not include the costs of copper tap sampling, because the final LCRI does not change the program that is relevant for estimating the costs using the SafeWater LCR model.

B.8.1.1.1 Lead Tap Sampling Schedules and Required Number of Samples

All CWSs and NTNCWSs are subject to lead tap sampling requirements. The frequency and required number of samples depend on the systems' lead 90th percentile level and/or compliance with OWQPs as detailed in Chapter 3, Section 3.3.7.1. Systems that qualify for reduced monitoring can collect tap samples from a reduced number of sites on an annual, triennial, or 9-year monitoring schedule. Those on standard monitoring must conduct lead tap monitoring every six months at the standard number of sample sites.

Because the number of required sampling sites and sampling schedules can vary, costs are estimated separately for systems on the different lead tap monitoring schedules. The EPA estimated the percentages of systems that would be on semi-annual monitoring,[49] and on a reduced annual *(p_tap_annual)*, triennial *(p_tap_triennial)*, or 9-year monitoring *(p_tap_nine)* schedule at the start of the LCRI implementation period (assumed to be Year 4) based on historical SDWIS/Fed data. Chapter 3, Section 4.3.7.1 provides a detailed discussion of how these percentages were derived.

The minimum required number of tap samples for CWSs and NTNCWSs on standard monitoring (*numb_samp_customer*) and reduced monitoring (*numb_reduced_tap*) under the pre-2021 LCR, 2021 LCRR, and final LCRI are the same. Refer to Exhibit 4-9 in Chapter 4 for the minimum number of tap samples for CWSs and NTNCWSs on standard monitoring and reduced monitoring schedules.

B.8.1.1.2 Lead Tap Sampling Activities

The EPA has developed costs for system activities associated with lead tap monitoring as shown in Exhibit B-99. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. Activities that are conducted by some States in lieu of the water system are identified in the exhibit and further noted below the exhibit. The last column indicates whether the activity, unit burden or cost, and SafeWater LCR data variable are identical for the pre-2021 LCR to those used for the final LCRI, as described in Chapter 4, Section 4.3.2.1.2. The assumptions that differ from the LCRI follow the exhibit. Gray shaded rows indicate new requirements that apply only to the final LCRI. They are included to more fully characterize the differences between the pre-2021 LCR and final LCRI.

Note that the conditions under which the sampling activities occur are different under the pre-2021 LCR compared to the final LCRI. Under both rules the tap sampling frequency is a function of whether the 90th percentile lead concentration is above the lead AL but under the final LCRI the AL has been lowered from 15 µg/L to 10 µg/L, as discussed in Chapter 4, Section 4.3.2.1.2. In addition, under the pre-2021 LCR, systems monitoring annually collect the reduced number of tap samples for lead and copper; whereas, under the final LCRI, systems monitoring annually collect the standard number of tap samples for lead and reduced number for copper.

Exhibit B-99: PWS Lead Tap Sampling Unit Burden and Cost Estimates under the Pre-2021 LCR[1]

Activity	Unit Burden and/or Cost[1]	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Update sampling instruction for lead tap sampling and submit to the State (one-time)	N/A	*hrs_devel_samp_op*	N/A under the pre-2021 LCR.
b) Contact homes to establish new	N/A	*hrs_add_lsl_samp_op*	N/A under the

[49] The likelihood that a system with a lead 90th percentile value at or below 15 µg/L being on an initial semi-annual monitoring schedule is 1 minus (*p_tap_annual* + *p_tap_triennial* + *p_tap_nine*).

Activity	Unit Burden and/or Cost[1]	*SafeWater LCR Data Variable*	Same As Final LCRI?
100 percent LSL tap sampling pool (one-time)			pre-2021 LCR.
c) Update and submit tap sampling plan to the State	N/A	*hrs_samp_plan_op*	N/A under the pre-2021 LCR.
d) Report any changes in sampling locations to the State	3 hrs/CWS	*hrs_chng_tap_op*	Yes.
e) Confer with the State on initial lead sampling data and status under the LCRI	N/A	*hrs_initial_tap_confer_op*	N/A under the pre-2021 LCR.
f) Obtain households for each round of lead tap sampling	Burden per sample (CWSs only) No LSLs: 0.5 hrs With LSLs: 1 hrs	*hrs_samp_volunt_op*	No. See discussion following the exhibit.
g) Offer incentives to households to encourage participation in lead tap sampling program	$10 to $100/sample per CWS	*cost_incentive*	Yes.
h) Ship lead tap sampling material and instructions to participating households	Burden per sample (CWSs only) 0.25 hrs	Burden *hrs_discuss_samp_op*	Yes.
	Cost per sample (CWSs only) $8.57 to $11.33	Cost *cost_lt_samp*[2]	No. See discussion following the exhibit.
i) Collect lead tap samples	Burden per sample 0.40 to 0.71 hrs per CWS; 0.5 hrs per NTNCWS Cost per sample $5.75 to $10.24 per CWS	Burden *hrs_pickup_samp_op* Cost *cost_pickup_samp*	Yes.
j) Determine if sample should be rejected and not analyzed	0.25 hrs/rejected sample for CWSs	*hrs_samp_reject_op*	Yes.
k) Analyze lead tap samples in-house or commercially	In-house Analysis (CWSs > 100K only) Burden: 0.44 hrs/sample Cost: $3.92/sample	In-house Analysis *hrs_analyze_samp_op*[2] *cost_lab_lt_samp*[2]	No. See discussion following the exhibit.
	Commercial Analysis (CWSs ≤100K and all NTNCWSs) $32.20/ sample	Commercial Analysis *cost_commercial_lab*[2]	No. See discussion following the exhibit.
l) Prepare and submit sample invalidation request to the State	2 hrs per sample per CWS and NTNCWS	*hrs_samp_invalid_op*	Yes.
m) Inform consumers of lead tap sample results	CWS per sample	CWS *hrs_inform_samp_op*	Yes.

Activity	Unit Burden and/or Cost[1]	*SafeWater LCR Data Variable*	Same As Final LCRI?
	Burden: 0.05 to 0.11 hrs Cost: $0.72 NTNCWS per sample Burden: 1 hr Cost: $0.079	*cost_cust_lt* NTNCWS *hrs_ntncws_inform_samp_op* *cost_ntncws_cust_lt*	
n) Certify to the State that results were reported to consumers	0.66 to 1 hr/monitoring period per CWS or NTNCWS	*hrs_cert_cust_lt_op*	Yes.
o) Submit request to renew 9-year monitoring waiver to the State	1 hr/9 years per qualifying CWS or NTNCWS	*hrs_renew_nine_op*	Yes.
p) Submit sampling results and lead 90th calculation to State	No LSLs: 2 to 3 hrs per CWS and NTNCWS With LSLs: 2.5 to 3.75 hrs per CWS and NTNCWS	*hrs_annual_lt_op*[2]	No. See discussion following the exhibit.
q) Oversee the customer-initiated lead sampling program	N/A	*hrs_cust_request_oversee_op*	N/A under the pre-2021 LCR.
r) Ship tap sampling material and instructions to participating households for customer-initiated lead sampling program	N/A	Burden *hrs_discuss_samp_op* Cost *cost_5_lt_samp*[3]	N/A under the pre-2021 LCR.
s) Collect lead tap samples for customer-initiated lead sampling program	N/A	Burden *hrs_pickup_samp_op* Cost *cost_pickup_samp*	N/A under the pre-2021 LCR.
t) Analyze lead tap samples in-house or commercially for customer-initiated lead sampling program	N/A	In-house Analysis *hrs_analyze_samp_op*[3] *cost_lab_lt_samp*[3] Commercial Analysis *cost_5_commercial_lab*[3]	N/A under the pre-2021 LCR.
u) Inform customers of lead tap sample results for customer-initiated lead sampling program	N/A	CWS *hrs_inform_samp_op* *cost_cust_lt*	N/A under the pre-2021 LCR.

Acronyms: CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; LSL = lead service line; NTNCWS = non-transient non-community water system; PWS = public water system.
Source: "Lead Analytical Burden and Costs_Final.xlsx."
Notes:

[1] Many of the activities listed above do not apply to NTNCWSs because, unlike CWSs, they collect their own samples from sampling locations under their control and thus, are unlikely to change sampling sites or reject samples for analysis. They also do not need to solicit sampling participation for customers or travel to their residences to pick up samples.
[2] In Arkansas, Louisiana, Mississippi, Missouri, and South Carolina, the State pays for the cost of bottles, shipping, analysis, and providing sample results to the system. Thus, the State will incur the burden and cost for these activities in lieu of the system (ASDWA, 2020a). In addition, the SafeWater variable *cost_lt_samp* and *cost_commercial_lab* are used for the pre-2021 LCR in lieu of the final LCRI SafeWater variables *cost_5_lt_samp* and *cost_5_commercial_lab*, respectively.

f) ***Obtain households for each round of lead tap sampling (hrs_samp_volunt_op).*** For each monitoring period under the pre-2021 LCR, CWSs will contact customers to obtain volunteers to participate in the lead tap sampling program. The EPA assumed CWSs will spend 0.5 hours per customer based on the following assumptions:

- CWSs will contact customers by phone.
- CWSs will spend 20 minutes with those that agree to participate to explain the program, or 50 percent of customers, and 5 minutes with those that do not, for an average of 15 minutes per sample.
- Because systems will need to contact 2 customers for every one sample, the 15-minute burden is doubled, resulting in an average burden of 0.5 hours per sample.

The assumptions used to estimate this burden are the same as those for the final LCRI with the exception that under that rule, systems must collect all samples from available sites served by LSLs. The EPA assumed CWSs with LSLs will require additional efforts to obtain customers to participate in the sampling pool due to a more aggressive LSLR program and require 1 hour per sample. The EPA applies the same inflation factors to account for customers that do not collect their sample (1-*pp_hh_return_samp*), sample rejection (*pp_samp_reject*), and sample invalidation (*pp_samp_invalid*) as the LCRI. See Chapter 4, Section 4.3.2.1.2, activity f) for additional detail.

h) ***Ship lead tap sampling materials and instructions to participating households (hrs_discuss_samp_op, cost_lt_samp).*** The EPA assumed CWSs will ship sampling materials to customers. Thus, CWSs will incur non-labor costs for a CWS to ship a test kit to participating customers that includes the cost of a one-liter bottle, bottle label, resealable plastic bag, directions, chain of custody form, and shipping container *(cost_lt_samp)*. The inputs and assumptions for this activity are provided in Exhibit B-100 and use the same inputs values as those used for systems without LSLs under the final LCRI but have a different variable name for the final LCRI (*cost_5_lt_samp*). Under the final LCRI the costs are higher for systems at sites with LSLs because they must have both a first- and fifth-liter sample. Thus the system will provide five sample bottles in lieu of one bottle in the sample kit. See Chapter 4, Section 4.3.2.1.2, activity h) for additional detail.

Exhibit B-100: Non-Labor Costs for CWS to Provide Test Kits (per Sample)

System Size (Population Served)	Test Kit	Shipping bottles to customers	Total Non-Labor Costs to Provide Test Kits
			cost_lt_samp
	A	B	C = A+B
≤3,300	$1.27	$7.50	$8.77
3,301 – 100,000	$1.07	$7.50	$8.57
> 100,000	$3.83	$7.50	$11.33

Notes:
A: Bottles are provided as part of the commercial laboratory fee and all CWSs serving 100,000 or fewer people are assumed to use commercial labs. Bottle costs for CWSs serving > 100,000 people are based on three vendor quotes. See file, "Lead Analytical Burden and Costs_Final.xlsx," worksheet "Sample Kit_Bottle."
B: The EPA estimated the sample kit to weigh 0.23 pounds ("Sample Kit and Shipping Costs_Final.xlsx," worksheet "Shipping to Customer Cost" for detail). The shipping cost is the 2020 United States Postal Service (USPS) retail ground shipping costs for Zones 1 or 2 for package of 1 pound or less. Postage costs are available at https://pe.usps.com/Archive/NHTML/DMMArchive20201018/Notice123.htm#_c037%20 (Accessed 6.27.2022). They are also provided in "General Cost Model Inputs_Final," worksheet, "Postage", Table 2.

k) ***Analyze lead tap samples in-house or commercially (hrs_analyze_samp_op, cost_lab_lt_samp, cost_5_commercial_lab).*** Under both the pre-2021 LCR and final LCRI, the EPA assumed that in-house analyses for lead would only be conducted by CWSs serving more than 100,000 people (*pp_lab_samp)* and that all other CWSs and all NTNCWSs would use a commercial laboratory (*pp_commercial_samp*). Under the pre-2021 LCR, systems must analyze a first-liter sample collected at any site (*i.e.*, non-lead service line or LSL site). Under the final LCRI, systems must collect a first-liter sample from non-lead service line sites and both a first- and fifth-liter sample from sites served by LSLs. Thus, the burden and cost for in-house analysis or commercial laboratory cost is for one sample per LSL site under the pre-2021 LCR as opposed to two under the final LCRI per LSL site. For the pre-2021 LCR, the EPA assumed a per sample burden and cost for an in-house lead analysis of 0.44 hours (*hrs_analyze_samp_op*) and non-labor costs for analytical materials such as preservatives, calibration standards, and QA standards of $3.92 per sample (*cost_lab_lt_samp*). Under the final LCRI the burden and cost for a first- and fifth-liter sample is double at 0.89 hours and $7.84.

The EPA assumed the per lead sample laboratory cost of $23.50 plus a cost of $8.70 to ship the sample to the laboratory for a total per sample cost of $32.20 (*cost_commercial_lab*) under the pre-2021 LCR. For the final LCRI, the EPA increased this estimate for systems with LSLs to account for the analysis and shipping of a first- and fifth-liter sample of $23.50*2 or $47.00 plus a cost to ship two bottles to the laboratory at $10.20 for a total cost of $57.20 for both samples (*cost_5_ commercial_lab*).

p) ***Submit sampling results and lead 90th percentile calculation to the State (hrs_annual_lt_op).*** The EPA estimated the burden for CWSs and NTNCWSs to submit tap monitoring results and their 90th

percentile calculation of 2 hours for systems serving 10,000 or fewer, 2.5 hours for systems serving 10,001 to 50,000, and 3 hours for systems serving more than 100,000 people. These estimates are based on the *2022 Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 48 (Tap Sample Calcs) (USEPA, 2022) and were doubled from the proposed rule to mirror changes to State burden *(hrs_annual_lt_js)* based on ASDWA's 2024 CoSTS model, section "Tap Sampling" (ASDWA, 2024). Under the final LCRI, the EPA assumed systems with LSLs will incur a 25 percent higher burden because they must provide documentation if they are unable to meet their minimum sampling requirements with sites served by LSLs. See Section 4.3.2.1.2, activity p) for additional detail.

Exhibit B-101 provides the SafeWater LCR model cost estimation approach for system lead tap sampling activities including additional cost inputs required to calculate these costs under the pre-2021 LCR. As shown in the exhibit, the SafeWater LCR model relies upon additional inputs, such the system's monitoring schedule, to compute the cost per activity. The exhibit also indicates for which activities the costing approach is the same as the final LCRI, as provided in Chapter 4, Exhibit 4-16, as well as which final LCRI activities do not apply under the pre-2021 LCR in gray shaded rows.

Exhibit B-101: PWS Lead Tap Sampling Cost Estimation in SafeWater LCR by Activity under the Pre-2021 LCR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
a) Update sampling instructions for lead tap monitoring and submit to State[3]				
N/A under the pre-2021 LCR.				
b) Contact homes to establish new 100 percent LSL tap sampling pool				
N/A under the pre-2021 LCR.				
c) Update and submit tap sampling plan to the State				
N/A under the pre-2021 LCR.				
d) Report any changes in sampling locations to the State[2]				
Total system hours per monitoring period multiplied by the system labor rate *(hrs_chng_tap_op*rate_op)*	Cost does not apply to NTNCWSs.	All	Model PWS is not on reduced tap sampling 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year
			Model PWS on annual reduced tap monitoring *p_tap_annual*	Once a year
			Model PWS on triennial reduced tap monitoring *p_tap_triennial*	Every 3 years
			Model PWS is on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years
e) Confer with the State on initial lead monitoring data and status under the LCRI				
N/A under the pre-2021 LCR.				

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
f) Obtain households for each round of lead tap sampling				
Number of required samples per system multiplied by the hours per sample and the system labor rate. The number of required samples is inflated to include those unreturned, invalidated, and rejected to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(numb_samp_customer+(numb_samp_customer*(1-pp_hh_return_samp))+(numb_samp_customer*pp_samp_invalid)+(numb_samp_customer*pp_samp_reject))*(hrs_samp_volunt_op*rate_op)*	Cost does not apply to NTNCWSs.	All	Model PWS not on reduced tap monitoring 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year
Number of required samples per system multiplied by the hours per sample and the system labor rate. The number of required samples is inflated to include those unreturned, invalidated, and rejected to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(numb_reduced_tap+(numb_reduced_tap*(1-pp_hh_return_samp))+(numb_reduced_tap*pp_samp_invalid)+(numb_reduced_tap*pp_samp_reject))*(hrs_samp_volunt_op*rate_op)*		All	Model PWS on annual reduced tap monitoring *p_tap_annual*	Once a year
			Model PWS on triennial reduced tap monitoring *p_tap_triennial*	Every 3 years
			Model PWS is on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years
g) Offer incentives to households to encourage participation in lead tap sampling program				
Number of required samples per system multiplied by the cost of the incentive. This number is not inflated by the number of samples deemed invalid or rejected because it is assumed that if a sample is invalid or rejected the system will return to the same customer to resample. The EPA also assumes that unreturned samples would not be eligible for an incentive.	Cost does not apply to NTNCWSs.	All	Model PWS not on reduced tap monitoring that offers an incentive [1 - *(p_tap_annual +*	Twice per year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
(numb_samp_customer*cost_incentive)			p_tap_triennial + p_tap_nine)] * p_incentive	
Number of required samples per system multiplied by the cost of the incentive. This number is not inflated by the number of samples deemed invalid or rejected, because it is assumed that if a sample is invalid or rejected the system will return to the same customer to resample. The EPA also assumes that unreturned samples would not be eligible for an incentive. (numb_reduced_tap*cost_incentive)	Cost does not apply to NTNCWSs.	All	Model PWS on annual reduced tap monitoring that offers an incentive p_tap_annual * p_incentive	Once a year
			Model PWS on triennial reduced tap monitoring that offers an incentive p_tap_triennial * p_incentive	Every 3 years
			Model PWS on nine-year reduced tap monitoring that offers an incentive p_tap_nine * p_incentive	Every 9 years
h) Ship lead tap sampling materials and instructions to participating households[3]				
Number of required samples multiplied by the total of the hours per sample to provide instructions times the system labor rate, plus the cost of materials per sample. The number of required samples is inflated to include those unreturned, invalidated, and rejected, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. (numb_samp_customer+(numb_samp_customer*(1-pp_hh_return_samp))+(numb_samp_customer*pp_samp_invalid)+(numb _samp_customer*pp_samp_reject))*((hrs_discuss_samp_op*rate_op)+cost_lt_samp)	Number of required samples multiplied by the cost of materials per sample. The number of required samples is inflated to include those invalidated to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. (numb_samp_customer+(numb_samp_customer*pp_samp_invalid))* cost_lt_samp)	All	Model PWS not on reduced tap sampling monitoring 1 - (p_tap_annual + p_tap_triennial + p_tap_nine)	Twice per year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS: Lead 90th - Range	Conditions for Cost to Apply to a Model PWS: Other Conditions[2]	Frequency of Activity
Number of required samples multiplied by the total of the hours per sample to provide instructions times the system labor rate, plus the cost of materials per sample. The number of required samples is inflated to include those unreturned, invalidated, and rejected, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(numb_reduced_tap+(numb_reduced_tap*(1-pp_hh_return_samp))+(numb_reduced_tap*pp_samp_invalid)+(numb_reduced_tap*pp_samp_reject))*((hrs_discuss_samp_op*rate_op)+cost_lt_samp)*	Number of required samples multiplied by the cost of materials per sample. The number of required samples is inflated to include those invalidated to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(numb_reduced_tap+(numb_reduced tap*pp_samp_invalid))* cost_lt_samp)*	All	Model PWS on annual reduced tap monitoring *p_tap_annual*	Once a year
			Model PWS is on triennial reduced tap monitoring *p_tap_triennial*	Every 3 years
			Model PWS on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years
i) Collect lead tap samples				
Number of required samples per system multiplied by the hours per sample and the system labor rate, plus the cost of materials per sample. The number of required samples is inflated to include those invalidated, unreturned, and rejected to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(numb_samp_customer+(numb_samp_customer*pp_samp_invalid)+ +(numb_customer_samp*(1-pp_hh_return_samp))+(numb_samp_customer*pp_samp_reject))*((hrs_pickup_samp_op*rate_op)+cost_pickup_samp)*	Number of required samples per system multiplied by the cost of materials per sample. The number of required samples is inflated to include those invalidated to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(numb_samp_customer+(numb_samp_customer*pp_sa*	All	Model PWS not on reduced tap monitoring 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
	*mp_invalid))*cost_pickup_samp*			
Number of required samples multiplied by the total of the hours per sample times the system labor rate, plus the cost of materials per sample. The number of required samples is inflated to include those unreturned, invalidated, and rejected, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(numb_reduced_tap+(numb_reduced_tap *(1-pp_hh_return_samp))+(numb_reduced_tap) *pp_samp_invalid)+(numb_reduced_tap*pp_samp_reject))* *((hrs_pickup_samp_op*rate_op)+cost_pickup_samp)*	Number of required samples per systems multiplied by the cost of materials per sample. The number of required samples is inflated to include those invalidated to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(numb_reduced_tap+(numb_reduced_tap) *pp_samp_invalid))* *cost_pickup_samp*	All	Model PWS on annual reduced tap monitoring *p_tap_annual*	Once a year
			Model PWS on triennial reduced tap monitoring *p_tap_triennial*	Every 3 years
			Model PWS on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years
j) Determine if sample should be rejected and not analyzed				
The number of samples expected to be rejected (calculated by multiplying the total number of required samples by the likelihood of rejection) multiplied by the hours per sample and the system labor rate. *(numb_samp_customer*pp_samp_reject)*(hrs_samp_reject_op *rate_op)*	Cost does not apply to NTNCWSs.	All	Model PWS not on reduced tap sampling monitoring 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
The number of samples expected to be rejected (calculated by multiplying the total number of required samples by the likelihood of rejection) multiplied by the hours per sample and the system labor rate. *(numb_reduced_tap*pp_samp_reject)*(hrs_samp_reject_op*rate_op)*	Cost does not apply to NTNCWSs.	All	Model PWS on annual reduced tap monitoring *p_tap_annual*	Once a year
			Model PWS on triennial reduced tap monitoring *p_tap_triennial*	Every 3 years
			Model PWS on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years
k) Analyze lead tap samples in-house or commercially[3]				
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis. The number of samples is inflated to include those invalidated, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(((numb_samp_customer+(numb_samp_customer*pp_samp_invalid))*pp_lab_samp)*((hrs_analyze_samp_op*rate_op)+cost_lab_lt_samp))+(((numb_samp_customer+(numb_samp_customer*pp_samp_invalid))*pp_commercial_samp)*((hrs_analyze_samp_op*rate_op)+cost_commercial_lab))*	Cost applies as written to NTNCWSs.	All	Model PWS not on reduced tap sampling monitoring 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year
The number of samples multiplied by the probabilities for a sample analyzed in house and a sample analyzed in a commercial lab times the different labor and material cost burdens for each type of analysis.			Model PWS on annual reduced tap monitoring *p_tap_annual*	Once a year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
The number of samples is inflated to include those invalidated, to ensure that the cost reflects the additional burden that must occur to meet the sampling requirement. *(((numb_reduced_tap+(numb_reduced_tap*pp_samp_invalid))*pp_lab_samp)*((hrs_analyze_samp_op*rate_op)+cost_lab_lt_samp))+(((numb_reduced_tap+(numb_reduced_tap*pp_samp_invalid))*pp_commercial_samp)*((hrs_analyze_samp_op*rate_op)+cost_commercial_lab))*	Cost applies as written to NTNCWSs.	All		
			Model PWS on triennial reduced tap monitoring *p_tap_triennial*	Every 3 years
			Model PWS is on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years
l) Prepare and submit sample invalidation request to the State				
The number of samples expected to be invalid (calculated by multiplying the total number of required samples by the likelihood of invalidation) multiplied by the hours per sample and the system labor rate. *(numb_samp_customer*pp_samp_invalid)*(hrs_samp_invalid_op*rate_op*	Cost applies as written to NTNCWSs.	All	Model PWS not on reduced tap monitoring 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year
The number of samples expected to be invalid (calculated by multiplying the total number of required samples by the likelihood of invalidation) multiplied by the hours per sample and the system labor rate.	Cost applies as written to NTNCWSs.	All	Model PWS on annual reduced tap monitoring *p_tap_annual*	Once a year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
(numb_reduced_tap*pp_samp_invalid)*(hrs_samp_invalid_op*rate_op)			Model PWS on triennial reduced tap monitoring p_tap_triennial	Every 3 years
			Model PWS on nine-year reduced tap monitoring p_tap_nine	Every 9 years
m) Inform consumers of lead tap sample results				
The number of required of samples per system multiplied by the total of the hours per sample times the system labor rate plus the material cost per sample. (numb_samp_customer)*((hrs_inform_samp_op*rate_op)+cost_cust_lt)	Hours per sampling event multiplied by the system labor rate, plus the material cost per sampling event. ((hrs_ntncws_inform_samp_op*rate_op)+cost_ntncws_cust_lt)	All	Model PWS not on reduced tap sampling monitoring 1 - (p_tap_annual + p_tap_triennial + p_tap_nine)	Twice per year
The number of required samples per system multiplied by the total of the hours per sample times the system labor rate plus the material cost per sample. (numb_reduced_tap)*((hrs_inform_samp_op*rate_op)+cost_cust_lt)	Hours per sampling event multiplied by the system labor rate, plus the material cost per sampling event. ((hrs_ntncws_inform_samp_op*rate_op)+cost_ntncws_cust_lt)		Model PWS on annual reduced tap monitoring p_tap_annual	Once a year
		All	Model PWS on triennial reduced tap monitoring p_tap_triennial	Every 3 years

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
			Model PWS on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years
n) Certify to the State that results were reported to consumers				
Total hours per sampling event multiplied by the system labor rate. *(hrs_cert_cust_lt_op*rate_op)*	Cost applies as written to NTNCWSs.	All	Model PWS not on reduced tap monitoring 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year
			Model PWS on annual reduced tap monitoring *p_tap_annual*	Once a year
			Model PWS on triennial reduced tap monitoring *p_tap_triennial*	Every 3 years
			Model PWS on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years
o) Submit request to renew 9-year monitoring waiver to the State[4]				
Total hours per sampling event multiplied by the system labor rate. *(hrs_renew_nine_op*rate_op)*	Cost applies as written to NTNCWSs.	All	Model PWS on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
p) Submit sampling results and lead 90th percentile calculation to the State[3]				
Total hours per sampling event multiplied by the system labor rate. *(hrs_annual_lt_op*rate_op)*	Cost applies as written to NTNCWSs.	All	Model PWS not on reduced tap monitoring 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice per year
			Model PWS on annual reduced tap monitoring *p_tap_annual*	Once a year
			Model PWS on triennial reduced tap monitoring *p_tap_triennial*	Every 3 years
			Model PWS is on nine-year reduced tap monitoring *p_tap_nine*	Every 9 years
q) Oversee the customer-initiated lead sampling program				
N/A under the pre-2021 LCR.				
r) Ship tap sample monitoring materials and instructions to participating households for customer-initiated lead sampling program				
N/A under the pre-2021 LCR.				
s) Collect lead tap samples for customer-initiated lead sampling program				
N/A under the pre-2021 LCR.				
t) Analyze lead tap samples in-house or commercially for customer-initiated lead sampling program				
N/A under the pre-2021 LCR.				
u) Inform customers of lead tap sample results for customer-initiated lead sampling program				
N/A under the pre-2021 LCR.				

Acronyms: AL = action level; CWS = community water system; EPA = Environmental Protection Agency; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; LSL = lead service line; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *numb_reduced-tap*: the number of lead tap samples for system on reduced annual, triennial, or 9-year monitoring (Chapter 4, Section 4.3.2.1.1).
- *numb_samp_customer*: the number of lead tap samples for system on standard 6-month tap monitoring (Chapter 4, Section 4.3.2.1.1).
- *p_tap_annual, p_tap_triennial*, and *p_tap_nine*: likelihood a systems is collecting the reduced number of lead tap samples on an annual, triennial, or 9-year frequency, respectively (Chapter 4, Section 4.3.2.1.1).
- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] For modeling purposes, the EPA assumed that systems would report changes in sampling location during each monitoring period.

[3] The burden and costs to provide sample bottles (*cost_lt_samp*) under activity h), conduct analyses under activity k), and report sample results to the system under activity p) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

[4] Only a subset of systems with lead 90th percentile values ≤ 5 µg/L can quality for a 9-year monitoring waiver. See Chapter 3, Section 3.3.7.1 for additional detail.

B.8.1.2 PWS Lead Water Quality Parameter Monitoring

Under the pre-2021 LCR, lead WQP monitoring is required for all systems serving more than 50,000 people with CCT (except systems with naturally non-corrosive water that meet the criteria in 40 CFR 141.81(b)(3) or "b3" systems)[50] and those serving 50,000 or fewer people that exceed the lead AL of 15 µg/L. WQP samples are collected at representative sites throughout the distribution system (also referred to as tap WQP samples) and at each entry point to the distribution system. Systems must conduct WQP monitoring prior to the installation of CCT and after CCT installation. The State may designate OWQPs after the installation of CCT. Systems with CCT must continue to maintain WQPs at or above minimum values or within OWQP ranges designated by the State.

The remainder of this section is divided into four subsections:

- B.8.1.2.1: Baseline Corrosion Control Treatment
- B.8.1.2.2: Initial Monitoring Schedules
- B.8.1.2.3: Number of Samples
- B.8.1.2.4: Lead WQP Monitoring Activities

B.8.1.2.1 Baseline Corrosion Control Treatment

WQP monitoring requirements vary for systems with and without CCT and by type of CCT. To estimate costs associated with WQP monitoring, the EPA identified systems with and without CCT, as described in Chapter 3, Section 3.3.3. For those with CCT, the EPA estimated the percentage of systems that currently have one of the three types of CCT used in the cost model:

- Modify pH (*pbaseph*),
- Add PO_4 without pH post-treatment (*pbasepo4*), and
- Add PO_4 and modify pH (*pbasephpo4*)

See Exhibit 4-18 in Chapter 4, Section 4.3.2.2.1 for the baseline percent of systems with each of these types of CCT.

B.8.1.2.2 Initial Monitoring Schedules

As described in Chapter 3, Section 3.3.8.1, systems with CCT could qualify for reduced WQP monitoring in the distribution system under the pre-2021 LCR if they were in compliance with State-set OWQP ranges or minimums. The number of consecutive monitoring periods in which a system meets its OWQPs determines if a system qualifies for reduced semi-annual, annual, or triennial WQP tap monitoring. Note that the criteria for systems to qualify for reduced distribution system monitoring

[50] All systems serving more than 50,000 people are required to have CCT and to conduct WQP monitoring with the exception of systems that have naturally non-corrosive water, *i.e.*, "b3" systems. Refer to Chapter 3, Section 3.3.3 for the EPA's approach for deriving the number of "b3" systems (assumed to be 16 CWSs).

under the 2021 LCRR and final LCRI is more stringent than the pre-2021 LCR and includes a requirement that systems' 90th percentile levels not exceed 10 µg/L. Further, under the LCRI and 2021 LCRR systems are no longer allowed to conduct WQP tap monitoring on a triennial frequency (see Chapter 3, Section 3.3.8.2 for additional detail). For modeling purposes, the EPA applied the same approach for the pre-2021 LCR as was used for the 2021 LCRR and final LCRI, as previously described in Chapter 3, Section 3.3.8.1.

Exhibit B-102 and Exhibit B-103 provide the percentage of CWSs serving more than 50,000 people with CCT and no lead or copper ALE on each of the four possible WQP tap monitoring schedules under the LCR by source water type based on analysis of SDWIS/Fed data for 2012 through 2020. For NTNCWSs, this information is provided in Exhibit B-104 for surface water systems. Note that no ground water NTNCWS serves more than 50,000 people. Also, these exhibits exclude systems without CCT because WQP monitoring to comply with OWQPs is not required for these systems. The exhibits show that:

- The majority of CWS ground water systems (98.6 to 100%) and CWSs surface water systems (98.5 to 100%) serving more than 50,000 people met the criteria triennial reduced WQP tap monitoring.
- Of the two surface water NTNCWSs that serve more than 50,000 people, one met the criteria for annual reduced WQP tap monitoring and the other is on six-month standard monitoring.

Exhibit B-102: Percent of Ground Water CWSs Serving > 50,000 People with CCT and No Lead or Copper ALE on Various WQP Distribution System Monitoring Schedules (pre-2021 LCR)

System Size (Population Served)	6 Month (Standard)	6 Month (Reduced)	Annual (Reduced)	Triennial (Reduced)
		p_wqp_six_red	*p_wqp_annual*	*p_wqp_triennial*
	A = 1- (B+C+D)	B	C	D
50,001-100,000	0.0%	0.0%	0.0%	100.0%
100,001-1,000,000	1.4%	0.0%	0.0%	98.6%
> 1 M	0.0%	0.0%	0.0%	100.0%

Source: For additional information, see "WQP Schedules_CWS_LCR_Final.xlsx," available in the docket at EPA-HQ-OW-2022-0801 at www.regulations.gov.
Note: Percentages are based on OWQP violation and compliance data reported to SDWIS/Fed for 2012 – 2020 in the fourth quarter frozen 2020 dataset, current through December 31, 2020.

Exhibit B-103: Percent of Surface Water CWSs Serving > 50,000 People with CCT and No Lead or Copper ALE on Various WQP Distribution System Monitoring Schedules (pre-2021 LCR)

System Size (Population Served)	6 Month (Standard)	6 Month (Reduced)	Annual (Reduced)	Triennial (Reduced)
		p_wqp_six_red	*p_wqp_annual*	*p_wqp_triennial*
	A = 1- (B+C+D)	B	C	D
50,001-100,000	1.0%	1.0%	0.0%	97.9%
100,001-1,000,000	1.5%	0.0%	0.0%	98.5%
> 1 M	0.0%	0.0%	0.0%	100.0%

Source: For additional information, see "WQP Schedules_CWS_LCR_Final.xlsx," available in the docket at EPA-HQ-OW-2022-0801 at www.regulations.gov.
Note: Percentages are based on OWQP violation and compliance data reported to SDWIS/Fed for 2012 – 2020 in the fourth quarter frozen 2020 dataset, current through December 31, 2020.

Exhibit B-104: Percent of Surface Water NTNCWSs Serving > 50,000 People with CCT and No Lead or Copper ALE on Various WQP Distribution System Monitoring Schedules (pre-2021 LCR)

System Size (Population Served)	6 Month (Standard)	6 Month (Reduced)	Annual (Reduced)	Triennial (Reduced)
		p_wqp_six_red	*p_wqp_annual*	*p_wqp_triennial*
	A = 1- (B+C+D)	B	C	D
50,001-100,000	100.0%	0.0%	0.0%	0.0%
100,001-1,000,000	0.0%	0.0%	0.0%	100.0%
> 1 M				

Source: For additional information, see "WQP Schedules_NTNCWS_LCR_Final.xlsx," available in the docket at EPA-HQ-OW-2022-0801 at www.regulations.gov.
Notes:
1. Percentages are based on OWQP violation and compliance data reported to SDWIS/Fed for 2012 – 2020 in the fourth quarter frozen 2020 dataset, current through December 31, 2020.
2. The gray shaded cells denote that no surface water NTNCWS serves more than 1M people.

B.8.1.2.3 Number of Samples

The minimum number of WQP distribution system samples for CWSs and NTNCWSs on standard (*numb_enhance_wqp)* and reduced (*numb_reduced_wqp*) monitoring and minimum number of entry points (*numb_ep_wqp*) are the same under the pre-2021 LCR and final LCRI and are discussed in Chapter 4, Section 4.3.2.2.3. Under the final LCRI, the monitoring requirements are more stringent. Specifically, systems serving 10,001 to 50,000 people with CCT must conduct WQP monitoring irrespective of their lead or copper 90th percentile level. In addition systems with a lead tap sample result above the final lead AL of 10 µg/L must conduct WQP monitoring in the distribution system at or near the site with the high lead result. If an existing WQP site does not meet these criteria, the system must identify a new

WQP monitoring site and those with CCT must use it for future sampling in addition to the existing number of WQP sites. Refer to Chapter 4, Section 4.3.3.3 for a more detailed discussion.

B.8.1.2.4 Lead WQP Monitoring Activities

The EPA has developed water system costs for five lead WQP monitoring activities as shown in Exhibit B-105. The exhibit provides the unit burden and costs for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden or cost, and the SafeWater LCR model data variable for the pre-2021 LCR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.2.2.4. The assumptions that differ from the final LCRI follow the exhibit.

Exhibit B-105: PWS Lead WQP Monitoring Unit Burden and Cost Estimates under the Pre-2021 LCR

Activity	Unit Burden and/or Cost	***SafeWater LCR Data Variable***	Same As Final LCRI?
v) Collect lead WQP samples from the distribution system	Burden per sample per PWS 0.5 hrs (distribution) Cost per sample No CCT: $2.66 (CWS & NTNCWS) pH adjustment: • $1.70 to $2.66 (CWS); • $2.66 (NTNCWS) Orthophosphate: • $2.66 to $2.82 (CWS) • $2.66 (NTNCWS)	Burden *hrs_wqp_op* Cost *No CCT: cost_wqp_material* *pH: cost_wqp_material_ph* Orthophosphate: *cost_wqp_material_ortho*	Yes
w) Analyze lead WQP samples from the distribution system	In-House Burden per sample No CCT: 0.15 hrs (CWS & NTNCWS) pH adjustment: • 0.15 to 0.46 hrs (CWS) • 0.15 hrs (NTNCWS) Orthophosphate: • 0.15 to 1.34 hrs (CWS) • 0.15 hrs (NTNCWS) In-House Cost per sample No CCT: $0.63 (CWS & NTNCWS) pH adjustment: • $0.63 to $0.98 (CWS) • $0.63 (NTNCWS) Orthophosphate: • $0.63 to $1.07 (CWS) • $0.63 (NTNCWS)	In-House Burden *No CCT: hrs_wqp_analyze_dist_op* *pH: hrs_wqp_analyze_ph_op* *Orthophosphate:* *hrs_wqp_analyze_ortho_op* In-House Cost *No CCT: cost_wqp_analyze* *pH: cost_wqp_ph_analyze* *Orthophosphate:* *cost_wqp_ortho_analyze*	Yes (for in-house burden and cost).

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
	Commercial Cost per sample No CCT: $49.41 to 50.96 (CWS & NTNCWS) pH adjustment: $27.24 to $30.55 (CWS & NTNCWS) Orthophosphate: $60.34 to $61.89 (CWS & NTNCWS)	Cost for Commercial Analysis No CCT: *cost_lab_wqp*[1] pH: *cost_lab_ph_wqp* Orthophosphate: *cost_lab_ortho_wqp*	No. See discussion following this exhibit.
x) Collect lead WQP samples from entry points	Burden per sample 0.4 hrs for 80 percent of ground water PWSs[1] Cost per sample No CCT: $2.66 (CWS & NTNCWS) pH adjustment: • $1.70 to $2.66 (CWS); • $2.66 (NTNCWS) Orthophosphate: • $2.66 to $2.82 (CWS) • $2.66 (NTNCWS)	Burden *hrs_ep_wqp_op* Cost *cost_ep_wqp_material* *cost_ep_wqp_ph_material* *cost_ep_wqp_ortho_material*	Yes.
y) Analyze lead WQP samples from entry points	In-House Burden per sample No CCT: 0.15 hrs (CWS & NTNCWS) pH adjustment: • 0.15 to 0.46 hrs (CWS) • 0.15 hrs (NTNCWS) Orthophosphate: • 0.15 to 1.34 hrs (CWS) • 0.15 hrs (NTNCWS) In-House Cost per sample No CCT: $0.63 (CWS & NTNCWS) pH adjustment: • $0.63 to $0.98 (CWS) • $0.63 (NTNCWS) Orthophosphate: • $0.63 to $1.07 (CWS) • $0.63 (NTNCWS)	In-House Burden *hrs_wqp_analyze_ep_op* *hrs_wqp_analyze_ph_ep_op* *hrs_wqp_analyze_ortho_ep_op* In-House Cost *cost_wqp_analyze_ep* *cost_wqp_analyze_ph_ep* *cost_wqp_analyze_ortho_ep*	Yes.
	Commercial Cost per sample No CCT: • $50.35 to $50.78 (CWS) • No CCT: $50.96 (NTNCWS) pH adjustment: • $30.58 to $33.30 (CWS) • $33.93 (NTNCWS) Orthophosphate: • $61.90 to $63.49 (CWS)	Commercial Cost *cost_lab_wqp_ep*[1] *cost_lab_wqp_ph_ep* *cost_lab_wqp_ortho_ep*	No. See discussion following the exhibit.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
	• $63.84 (NTNCWS)		
z) Report lead WQP sampling data and compliance with OWQPs	No CCT: 4 hrs/PWS With CCT: 5 hrs/PWS	*hrs_report_wqp_op*	Yes.

Acronyms: CCT = corrosion control treatment; CWS = community water system; LCRI = Lead and Copper Improvements; NTNCWS = non-transient non-community water system; OWQP = optimal water quality parameters; PWS = public water system; WQP = water quality parameter.
Source: "WQP Analytical Burden and Costs_Final.xlsx."
Note:
[1] As explained in more detail in the text following this exhibit, the commercial WQP laboratory costs differ between the pre-2021 LCR and final LCRI for systems without CCT.

w) Analyze lead WQP samples from the distribution system (cost_lab_wqp). The commercial laboratory cost for systems without CCT differ under the pre-2021 LCR and final LCRI. In addition to monitoring for pH and alkalinity, which are required under both rule, systems without CCT under the pre-2021 LCR must also monitor calcium. The final LCRI does not include calcium as a regulated WQP because it is used to evaluate the effectiveness of calcium stabilization that is not a CCT option under the final LCRI. For modeling purposes, the EPA assumed the following for both rules:

- All systems serving more than 50,000 people would already have CCT in place or are b3 systems and would not be required to install CCT.
- All systems would conduct pH in-house but only CWSs serving more than 100,000 people would conduct all their WQP analyses in-house. All other systems would use a commercial laboratory.

Under the pre-2021 LCR, the EPA assumed that CWSs and NTNCWSs serving 50,000 or fewer people without CCT would incur a per sample commercial cost to analyze alkalinity ($26.43) and calcium ($22.36) based on the quotes provided by seven laboratories and shipping costs ranging from 0.63 to $1.28, as shown in Exhibit B-106.

Exhibit B-106: CWS and NTNCWS Lead Distribution Laboratory Costs without CCT under the Pre-2021 LCR

System Size (Population Served)	Commercial Analysis including Shipping Sample to Lab ($/Sample)			
	Alkalinity	Calcium	Shipping	Total *cost_lab_wqp*
	A	B	C	D = A:C
≤100	$26.43	$22.36	$2.18	$50.96
101-500	$26.43	$22.36	$2.18	$50.96
501-1,000	$26.43	$22.36	$1.28	$50.06
1,001-3,300	$26.43	$22.36	$1.28	$50.06
3,301-10,000	$26.43	$22.36	$1.03	$49.81
10,001-50,000	$26.43	$22.36	$0.63	$49.41
> 50,000				

Source: “WQP Analytical Burden and Costs_Final.xlsx,” worksheet “Non-Labor Cost_CWS_LCR” and Non-Labor Cost_NTNCWS_LCR.”
Notes:
General: The EPA assumed no costs for 16 CWSs serving > 50,000 people without CCT because they are b3 systems and not subject to WQP requirements
A & B: Based on quotes from seven laboratories.
C: Shipping costs are 2020 USPS postage rates. The EPA assumes systems are shipping 4 to 40 samples based on systems size to a laboratory that is in Zone 1 or 2. See WQP Analytical Burden and Costs_Final.xlsx,” Table A-2 for CWSs and Table A-4 for NTNCWSs in worksheet “ Shipping to Lab_$_LCR” for additional detail.

Under the final LCRI, the commercial laboratory cost includes only the alkalinity cost of $26.43 and shipping costs ranging from $0.81 to $4.13 based on the number of samples shipped to the laboratory. Also refer to Chapter 4, Section 4.3.2.2.4, activity v) for a discussion of WQP analytical distribution system requirements under the final LCRI.

y) ***Analyze lead WQP samples from entry points (cost_lab_wqp_ep).*** Similar to activity v), the only difference in unit burden and cost for lead WQP entry point monitoring for the pre-2021 LCR compared to the final LCRI is that systems without CCT under the pre-2021 LCR must have samples analyzed for copper (*cost_lab_wqp_ep*). Exhibit B-107 and Exhibit B-108 provide the estimated commercial laboratory costs per entry point for CWSs and NTNCWSs, respectively.

Exhibit B-107: CWS Lead Entry Point Laboratory Costs without CCT under the Pre-2021 LCR

System Size (Population Served)	Commercial Analysis including Shipping Sample to Lab ($/Sample)			
	Alkalinity	Calcium	Shipping	Total *cost_lab_wqp_ep*
	A	B	C	D = A:C
≤100	$26.43	$22.36	$1.99	$50.78
101-500	$26.43	$22.36	$1.85	$50.64
501-1,000	$26.43	$22.36	$1.56	$50.35
1,001-3,300	$26.43	$22.36	$1.62	$50.41
3,301-10,000	$26.43	$22.36	$1.63	$50.42
10,001-50,000	$26.43	$22.36	$1.67	$50.46
> 50,000				

Source: “WQP Analytical Burden and Costs_Final.xlsx,” worksheet “ Non-Labor Cost_CWS_LCR” and Non-Labor Cost_NTNCWS_LCR.”
Notes:
General: The EPA assumed no costs for 16 CWSs serving > 50,000 people without CCT because they are b3 systems and not subject to WQP requirements
A & B: Based on quotes from seven laboratories.
C: Shipping costs are 2020 USPS postage rates. The EPA assumes systems are shipping 4.4 to 6.1 samples based on systems size to a laboratory that is in Zone 1 or 2. See WQP Analytical Burden and Costs_Final.xlsx,” Table A-1 in worksheet “ Shipping to Lab_$_LCR” for additional detail.

Exhibit B-108: NTNCWS Lead Entry Point Laboratory Costs without CCT under the Pre-2021 LCR

System Size (Population Served)	Commercial Analysis including Shipping Sample to Lab ($/Sample)			
	Alkalinity	Calcium	Shipping	Total cost_lab_wqp_ep
	A	B	C	D = A:C
≤100	$26.43	$22.36	$2.18	$50.96
101-500	$26.43	$22.36	$2.18	$50.96
501-1,000	$26.43	$22.36	$2.18	$50.96
1,001-3,300	$26.43	$22.36	$2.18	$50.96
3,301-10,000	$26.43	$22.36	$2.18	$50.96
10,001-50,000	$26.43	$22.36	$2.18	$50.96
> 50,000				

Source: "WQP Analytical Burden and Costs_Final.xlsx," worksheet "Non-Labor Cost_CWS_LCR" and Non-Labor Cost_NTNCWS_LCR."

Notes:

General: The EPA assumed no costs for 16 CWSs serving > 50,000 people without CCT because they are b3 systems and not subject to WQP requirements

A & B: Based on quotes from seven laboratories.

C: Shipping costs are 2020 USPS postage rates. The EPA assumes systems are shipping 4 samples to a laboratory that is in Zone 1 or 2. See WQP Analytical Burden and Costs_Final.xlsx," Table A-3 in worksheet " Shipping to Lab_$_LCR" for additional detail.

The SafeWater LCR model cost estimation approach for estimating the cost of lead WQP monitoring including additional cost inputs required to calculate these costs are identical to those for the LCRR. For additional detail, refer to Exhibit B-19 in Section B.5.2.2.4.

B.8.1.3 PWS Copper Water Quality Parameter Monitoring

As was done for the final LCRI, the SafeWater LCR models Copper WQP Monitoring separately from the Lead WQP Monitoring for the pre-2021 LCR. The frequency of Lead WQP Monitoring depends on the lead 90th percentile, with all systems above the AL and all systems serving more than 50,000 people except b3 systems conducting Lead WQP Monitoring. Copper WQP Monitoring is required when a system exceeds the copper AL. To not double count the cost of WQP monitoring for systems experiencing both a copper ALE and a lead ALE simultaneously, the SafeWater LCR models the costs of Copper and Lead WQP Monitoring separately and restricts Copper WQP Monitoring to systems with a copper ALE only and lead 90th percentile not greater than the lead AL of 15 µg/L.

The cost inputs used to estimate WQP costs in response to a copper ALE are identical to those incurred in response to a lead ALE, as shown in Exhibit B-109, with the following exceptions:

- The likelihood of a system's exceeding the copper ALE, which corresponds to *p_copper_ale*, is used in lieu of system's lead 90th percentile level.
- Systems are not assumed to be on reduced WQP distribution system monitoring in response to a copper ALE, and all systems are assumed to be on a six-month standard monitoring schedule. Thus, the data inputs associated with reduced monitoring are not applicable. These include the

reduced number of WQP monitoring samples per distribution sample site (*numb_reduced_wqp*), and the likelihood that a system will be on a six-month (*p_wqp_six_red*), annual (*p_wqp_annual*), or triennial schedule (*p_wqp_triennial*) WQP sampling schedule.

This approach is also used for the final LCRI and is detailed in Chapter 4, Section 4.3.2.3.1.

Exhibit B-109: PWS Copper WQP Monitoring Unit Burden and Cost Estimates

Activity		Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
aa)	Collect copper WQP samples from the distribution system	*Same as Exhibit B-105, activity v).*		
bb)	Analyze copper WQP samples from the distribution system	*Same as Exhibit B-105, activity w).*		
cc)	Collect copper WQP samples from entry points	*Same as Exhibit B-105, activity x).*		
dd)	Analyze WQP samples from entry point copper	*Same as Exhibit B-105, activity y).*		
ee)	Report copper WQP sampling data and compliance with OWQPs	*Same as Exhibit B-105, activity z).*		

Acronyms: LCRI = Lead and Copper Rule Improvements; OWQP = optimal water quality parameter; WQP = water qualify parameter.
Source: "WQP Analytical Burden and Costs_Final.xlsx."

The SafeWater LCR model cost estimation approach for estimating the cost of copper WQP monitoring including additional cost inputs required to calculate these costs are identical to those for the LCRR. For additional detail, refer to Appendix B, Exhibit B-21 in Section B.5.2.3.2.

B.8.1.4 PWS Source Water Monitoring

Under the pre-2021 LCR, water systems were required to conduct source water monitoring when they exceeded the lead or copper AL. Under the final LCRI, systems can forego source water monitoring if they previously sampled source water in response to an ALE, the State has not required source water treatment, and they have not added any new water sources that changes their primacy source type. For modeling purposes, no system is assumed to have source water treatment.

The EPA has developed system costs for three source water monitoring activities as shown in Exhibit B-110. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. Activities that are conducted by some States in lieu of the water system are identified in a footnote below the exhibit. The last column indicates that the unit burden or cost, and the SafeWater LCR model data variable for the pre-2021 LCR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.2.4.2.

Exhibit B-110: PWS Source Monitoring Burden and Cost Estimates under the Pre-2021 LCR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
ff) Collect source water samples	Burden 0.5 hrs/sample Cost $1.12/sample for CWSs serving > 100K	Burden *hrs_source_op* Cost *cost_source_material*[1]	Yes.
gg) Analyze source water samples	In-House Burden 0.44 hrs/sample for CWSs serving > 100K In-House Cost $3.92/sample for CWSs serving > 100K Commercial Cost $31.00/sample for CWSs serving ≤ 100K and NTNCWSs	In-House Burden *hrs_analyze_samp_op*[1] In-House Cost *cost_source_analyze*[1] Commercial Cost *cost_source*	Yes.
hh) Report source water monitoring results to the State	1 hour/report	*hrs_report_source_op*[1]	Yes.

Acronyms: CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system.

Sources:

ff), hh): 2022 *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 15 (USEPA, 2022); "Lead Analytical Burden and Costs_Final.xlsx," worksheets "Source_Collect_Analyze_CWS" and "Source_Collect_Analyze_NTNCWS."

gg): See file "Lead Analytical Burden and Costs_Final.xlsx," worksheets "Source_Collect_Analyze_CWS" and "Source_Collect_Analyze_NTNCWS."

Note:

[1] The burden and costs for these activities are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

Exhibit B-111 shows the SafeWater LCR model cost estimation approach for system source water monitoring activities including additional cost inputs required to calculate these costs under the pre-201 LCR.

Exhibit B-111: PWS Source Water Monitoring Cost Estimation in SafeWater LCR by Activity under the Pre-2021 LCR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
ff) Collect source water samples				
The number of EPs per system multiplied by the number of samples, then multiplied by the total of the labor hours per sample times the system labor rate, plus the cost per sample. *((numb_ep*numb_st_sample)*((hrs_source_op*rate_op)+cost_source_material))*	Cost applies as written to NTNCWSs.	At or below AL	Model PWSs with surface water sources and a copper ALE *p_copper_ale*	Once per event
			Model PWSs with ground water sources and a copper ALE *p_copper_ale*	Every three years per event
		Above AL	Model PWSs with surface water sources	Once a year
			Model PWSs with ground water sources	Every three years
gg) Analyze source water samples[2]				
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per EP multiplied by the number of EPs per system times the percentage of samples analyzed in house and the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per EP multiplied by the number of EPs per system times the percentage of samples analyzed commercially times the material cost of the commercial lab analysis per sample. *((pp_lab_samp*(numb_ep*numb_st_sample))*((hrs_analyze_samp_op*rate_op)+cost_source_analyze))+((pp_commercial_samp*(numb_ep*numb_st_sample))*cost_source)*	Cost applies as written to NTNCWSs.	At or below AL	Model PWS with surface water sources and a copper ALE *p_copper_ale*	Once per event

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
			Model-PWS with ground water sources and a copper ALE *p_copper_ale*	Every three years per event
		Above AL	Model PWS with surface water sources	Once a year
			Model PWS with ground water sources	Every three years
hh) Report source water monitoring results				
The total reporting hours per system multiplied by the labor rate. *(hrs_report_source_op*rate_op)*	Cost applies as written to NTNCWSs.	At or below AL	Model PWS with surface water sources and a copper ALE *p_copper_ale*	Once per event
			Model PWS with ground water sources and a copper ALE *p_copper_ale*	Every three years per event
		Above AL	Model PWS with surface water sources	Once a year
			Model PWS with ground water sources	Every three years

Acronyms: AL = action level; ALE = action level exceedance; CWS = community water system; EP = entry points; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *numb_ep*: number of entry points per systems (Chapter 4, Section 4.3.2.2.3).
- *numb_st_sample*: number of samples per entry point for source water monitoring (Chapter 4, Section 4.3.2.4.1).

- *p_copper_ale*: likelihood a system with exceed the copper AL (Chapter 4, Section 4.3.2.3.1).
- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] The burden and costs to provide sample bottles (*cost_source_material*) under activity ff), conduct analyses under activity gg), and report results to the system under activity hh) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

B.8.2 PWS Corrosion Control Costs

This section discusses water system activities related to CCT installation (Section B.8.2.1), re-optimization (Section B.8.2.2), and lead CCT routine activities (Section B.8.2.3) under the pre-2021 LCR and associated burden and costs. CCT activities that are unique to the pre-2021 LCR are presented in Section B.8.2.4.

Systems serving 50,000 or fewer people without CCT were not required to conduct CCT steps under the pre-2021 LCR unless they exceeded the lead and/or copper AL. Systems serving 50,000 or fewer people that exceeded the lead/copper AL were required to install CCT after making OCCT recommendation to the State and, if required, to conduct a CCT study.

Systems with CCT under the pre-2021 LCR were required to continue to operate and maintain OCCT, including maintaining WQPs at or above minimum values or within OWQP ranges designated by the State. States could modify their determination of OCCT and OWQPs on their own initiative or in response to a request by a water system or other interested party. Although the pre-2021 LCR did not explicitly require systems adjust their CCT (*i.e.,* re-optimize CCT), the EPA assumed that systems would revise their study and re-optimize in response to a subsequent lead ALE. Also, the pre-2021 LCR does not require responses to individual samples over the action level as under the 2021 LCRR and final LCRI.

Unique to the pre-2021 LCR, a State can allow systems to forgo a study prior to installing or re-optimizing CCT. The EPA assumes that in these cases, States would require water systems to submit water quality data.

The derivation and values for baseline pH (*baselineph_wocct*, *baselineph_woph*, *baselineph_wpo4ph*, *baselineph_wph)* and baseline PO_4 dose (*baselinepo4dose*) are the same as those used to calculate the CCT costs for the 2021 LCRR and can be found in Chapter 4, Section 4.3.3.

B.8.2.1 CCT Installation

Under the pre-2021 LCR, PWSs without CCT may be required to install CCT if they exceed the lead AL of 15 µg/L. The approach for estimating capital and O&M costs for CCT installation is the same under the pre-2021 LCR as under the final LCRI, as described in Chapter 4, Section 4.3.3.1.1. The frequency at which systems exceeded the lead AL is different, however, under the pre-2021 LCR compared to the final LCRI due to revised sampling requirements for LSL systems and lower lead AL.

The EPA has developed system costs for ancillary activities associated with CCT installation as shown in Exhibit B-112. The exhibit provides the unit burden and/or cost for the activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activities, unit burden or cost, and SafeWater LCR data variables are different for the pre-2021 LCR from those used for the final LCRI. An explanation of the unit burden and cost estimates for the activities follow the exhibit.

Exhibit B-112: PWS CCT Installation-Related Unit Burden and Cost Estimates for the Pre-2021 LCR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Conduct a CCT study	\$7,985 to \$12,256/desktop study; \$58,393/demonstration study	*cost_cct_study_desk; cost_cct_study_dem*	No. See discussion following the exhibit.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements.
Source: a): "CCT Study and Review Costs_Final.xlsx."
Note: Activity b), "Install CCT Treatment (PO_4, PO_4 with post treatment, pH adjustment, or modify pH)" is the same as the final LCRI as discussed in Chapter 4, Section 4.3.3.1.

a) ***Conduct a CCT study (cost_cct_study_desk, cost_cct_study_dem).*** The EPA assumed States will require a subset of systems to conduct a CCT study prior to CCT installation using the data variable *p_cct_study,* as shown in Exhibit B-113. The EPA's assumptions are provided in the notes below the exhibit.

Exhibit B-113: Likelihood of CCT Study (*p_cct_study*)

System Size (Population Served)	Systems with LSLs	Systems without LSLs
	A	B
≤ 1,000	0%	0%
1,001 - 50,000	90%	33%
> 50,000	N/A	N/A

Acronyms: LSL = lead service line.
Source: "CCT Study and Review Costs_Final.xlsx." Based on recommendations in the OCCT Recommendations Document (USEPA, 2019).
Notes:
A: For systems with LSLs, the EPA's *Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems* (*i.e.*, OCCT Recommendations Document) (USEPA, 2019) recommends that all systems serving 50,000 people or fewer do a study. The EPA recognizes, however, that very small systems serving 1,000 people or fewer may lack the resources to do a study, even if they have LSLs. In these cases, the State can designate OCCT without a study. For systems serving 1,001 - 50,000 with LSLs, the EPA assumed that for a small portion (10 percent), treatment is straightforward and does not require a CCT study. The EPA assumed that large systems serving > 50,000 people conducted CCT studies already except for CWSs with naturally non-corrosive water that meet the criteria in § 141.81(b)(3), *i.e.*, b3 systems, and are assumed to never have a lead or copper ALE and thus, will not be required to conduct a study or install CCT.
B: For systems without LSLs, the EPA assumed that very small systems serving 1,000 people or fewer may lack the resources to do a study. In these cases, the State can designate OCCT without a study. The OCCT Recommendations Document recommends that the State use the checklist in Exhibit 4.2 of that document to determine whether to require a study. The EPA assumed that based on this checklist, State will require 33 percent of systems serving 1,001 - 50,000 without LSLs to conduct a CCT study.

Systems can perform a “desktop study” based on documented analogous treatments with other systems of similar size, water chemistry, and distribution system configuration. Alternatively, they can perform a “demonstration study” using at least one of the following study tools: pipe rig/loop tests, metal coupon tests, or partial system tests. The EPA assumed that systems required to conduct a CCT study will use a contractor. Exhibit B-114 provides the data variable, inputs values, and general approach use to estimate the costs per system to conduct a desktop or demonstration study.

Exhibit B-114: CCT Study Costs ($2020)

System Size (Population Served)	Cost per system for contractor to conduct desktop study	Cost per system for contractor to conduct demonstration study
	cost_cct_study_desk	*cost_cct_study_dem*
	A	**B**
≤ 3,300	$7,985	N/A
3,301-50,000	$12,256	$58,393
> 50,000	N/A	N/A

Source: “CCT Study and Review Costs_Final.xlsx.”

Notes:

A,B: The EPA used American Society of Civil Engineers (ASCE) and Bureau of Labor Statistics (BLS) as sources for contractor labor rates, identification of major tasks for each study type, and estimated burden (hours) and costs for each task to develop cost estimate for systems serving ≤3,300 people and those serving 3,301 to 50,000 people. The EPA assumed that large systems serving > 50,000 people conducted CCT studies already except for CWSs with naturally non-corrosive water that meet the criteria in § 141.81(b)(3), *i.e.*, b3 systems, and are assumed to never have a lead or copper ALE and thus, will not be required to conduct a study or install CCT.

B: The EPA did not develop unit cost estimates for demonstration studies for systems serving ≤ 3,300 people because demonstration studies are likely cost prohibitive for these systems.

Exhibit B-115 shows the EPA’s estimated likelihood of a system doing a demonstration study vs. a desktop study (*p_demo_study*) by LSL status and size category with detailed assumptions in the notes. Note that systems may have conducted a study previously if they exceeded the TL in the past. The EPA assumed the same probabilities of a demonstration study vs. a desktop study for systems without CCT that exceed the TL and are required to conduct a CCT study.

Exhibit B-115: Likelihood of Demonstration Study vs. a Desktop Study (*p_demo_study*)

System Size (Population Served)	Systems with LSLs	Systems without LSLs
	A	**B**
≤ 3,300	0%	0%
3,301 - 10,000	50%	10%
10,001 - 50,000	90%	90%
> 50,000	N/A	N/A

Acronyms: LSL = lead service line.

Source: "CCT Study and Review_Final.xlsx." Based on recommendations in the EPA's *Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems* (*i.e.*, OCCT Recommendations Document) (USEPA, 2019).
A, B. The EPA assumed that no systems serving 3,300 people or fewer will conduct a demonstration study, regardless of LSL status, due to resource constraints. For systems serving 3,301 to 50,000 people, the EPA used the checklist in Exhibit 4.4 of the OCCT Recommendations Document to estimate the likelihood that systems would conduct a demonstration. Based on the checklist, the EPA assumed that 50 percent of systems with LSLs serving 3,301 to 10,000 people would conduct a demonstration study while only 10 percent of these systems without LSLs would perform the demonstration study. For systems serving 10,001 to 50,000 people, the EPA assumed that most would do a demonstration study except for a small number (10 percent) that could meet the criteria with a desktop study. The EPA assumed that large systems serving > 50,000 people conducted CCT studies already except for CWSs with naturally non-corrosive water that meet the criteria in § 141.81(b)(3), *i.e.*, b3 systems, and are assumed to never have a lead or copper ALE and thus, will not be required to conduct a study or install CCT.

Exhibit B-116 shows the SafeWater LCR model cost estimation approach for the cost of ancillary system activities association with CCT installation under the pre-2021 LCR including additional cost inputs required to calculate these costs.

Exhibit B-116: PWS Ancillary CCT Cost Estimation in SafeWater LCR by Activity under the Pre-2021 LCR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
a) Conduct a CCT study				
Systems will use a contractor for the CCT study, and the study will either be a demonstration study or a desk top study. The cost per study is determined by multiplying the cost for a demonstration study by the likelihood that a system will opt for a demonstration study, plus the cost of a desk top study multiplied by the likelihood that a system will not opt instead for a demonstration study. *((p_demo_study*cost_cct_study_dem)+((1-p_demo_study)*cost_cct_study_desk))*	Cost applies as written to NTNCWSs.	Above AL	Model PWSs without CCT that conducts a study on CCT installation *p_cct_study*	One time

Acronyms: AL = action level; CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; PWS = public water system.
Notes:
[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

B.8.2.2 Re-optimization of Existing Corrosion Control Treatment

PWSs may re-optimize CCT in response to an ALE. The re-optimization of CCT at a system requires both technology-related capital and annual O&M costs as well as a number of ancillary associated costs. The EPA uses the same approach to estimate the costs for re-optimizing existing CCT under the pre-2021 LCR

as under the final LCRI, as described in Chapter 4, Section 4.3.3.2.1. The frequency at which systems exceeded the lead AL is different, however, under the pre-2021 LCR compared to the final LCRI due to revised sampling requirements for LSL systems.

The EPA has developed system ancillary costs for activities associated with CCT re-optimization as shown in Exhibit B-117. The exhibit provides the unit burden and costs for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden or cost, and the SafeWater LCR model data variable are identical for the pre-2021 LCR to those used for the final LCRI. The assumptions that differ from the 2021 LCRR follow the exhibit.

Exhibit B-117: PWS CCT Ancillary Re-optimization Unit Burden and Cost Estimates under the Pre-2021 LCR

Activity	Unit Burden and/or Costs	*SafeWater LCR Data Variable*	Same As Final LCRI?
c) Revise CCT study	$6,148 to $11,831/system	*cost_revise_cct*	No. See discussion following exhibit.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements.
Sources: "CCT Study and Review Costs_Final.xlsx."
Note: Activity d), "Re-optimize existing CCT" was previously discussed in this Section.

c) Revise CCT study (cost_revise_cct). The EPA estimated the following costs for a revised study:

- Systems serving 3,300 or fewer people: $6,148.
- Systems serving 3,301 to 50,000 people: $8,756.
- Systems serving more than 50,000 people: $11,831.

See the derivation file, "CCT Study and Review Costs_Final.xlsx" for additional detail. For some systems serving 50,000 or fewer people with CCT, the EPA assumes that the State will designate re-optimized CCT without requiring them to revise their study. The EPA used recommendations in the OCCT Recommendations Document (USEPA, 2019) to estimate the likelihood of a CCT study (*p_cct_study*) from Section B.8.2.1.

Exhibit B-118 provides the SafeWater LCR model costing approach for estimating the cost for re-optimization of CCT including additional cost inputs that are required to calculate these costs under the pre-2021 LCR.

Exhibit B-118: PWS CCT Ancillary Re-optimization Cost Estimation in SafeWater LCR by Activity under the Pre-2021 LCR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
c) Revise CCT study				
Material cost per system for the marginal contractor cost, with the difference between desk-top and demonstration study reflected in the stratification of the data by system size. *cost_revise_cct*	Cost applies as written to NTNCWSs.	Above AL	Model PWS re-optimizing CCT *p_cct_study*	One time

Acronyms: AL = action level; CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; PWS = public water system.

Note:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *p_cct_study:* Likelihood a State will require a CCT study (Section B.8.2.1).
- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

B.8.2.3 Lead CCT Routine Costs

The EPA has developed system costs for routine activities associated with CCT under the pre-2021 LCR, as shown in Exhibit B-119. The exhibit provides the unit burden and costs for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden or cost, and the SafeWater LCR model data variable for the pre-2021 LCR are identical to those used for the LCRI, as described in Chapter 4, Section 4.3.3.4. Gray shaded rows indicate new requirements that apply only to the final LCRI.

Exhibit B-119: PWS Lead CCT Routine Unit Burden and Cost Estimates under the Pre-2021 LCR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
l) Review CCT guidance	N/A	*hrs_rev_cct_op*	N/A under the pre-2021 LCR.
m) Provide WQP data to State and discuss during sanitary survey	N/A	*hrs_sanit_surv_op*	N/A under the pre-2021 LCR.
n) Notify and consult with State on required actions in response to source water change	N/A for systems on standard tap monitoring	*hrs_coop_source_chng_rout_op*	N/A under the pre-2021 LCR.
	6 to 12 hrs/system on reduced tap monitoring	*hrs_coop_source_chng_red_op*	Yes.
o) Notify and consult with State on required actions in response to treatment change	46 to 84 hrs/system on reduced tap monitoring	*hrs_coop_treat_chng_op*	Yes.

Acronyms: CCT = corrosion control treatment; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; WQP = water quality parameter.
Sources:
l), m): "CCT Study and Review Costs_Final.xlsx."
n): **"**Likelihood_SourceChange_Final.xlsx."
o): "Likelihood_TreatmentChange_Final.xlsx."
Notes:
l), m): Under the pre-2021 LCR, consultation with the State prior to making a source or treatment change applied only to those systems on a reduced monitoring schedule, *i.e.,* monitoring less frequently than semi-annually. The final LCRI adds a requirement for this consultation to also apply to system monitoring semi-annually (see Chapter 4, Section 4.3.3.4, activities n) and o) for additional detail.

Exhibit B-120 shows the SafeWater LCR model cost estimation approach for the cost of ancillary system activities association with CCT installation including additional cost inputs required to calculate these costs. The exhibit also indicates in gray shaded rows which final LCRI activities from Chapter 4, Exhibit 4-71 do not apply under the pre-2021 LCR.

Exhibit B-120: PWS Lead CCT Routine Cost Estimation in SafeWater LCR by Activity[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
l) Review CCT guidance				
N/A under the pre-2021 LCR.				
m) Provide WQP data to the State and discuss during sanitary survey				
N/A under the pre-2021 LCR.				
n) Notify and consult with State in response to a change in source water[2]				
The total hours per system multiplied by the system labor rate. *(hrs_coop_source_chng_red_op*rate_op)*	Cost applies as written to NTNCWSs.	All	Model PWS that is on reduced tap sampling with a change in source water *(p_tap_annual + p_tap_triennial + p_tap_nine) * p_source_chng*	Once a year
o) Notify and consult with State in response to a change in water treatment				
The total hours per system multiplied by the system labor rate. *(hrs_coop_treat_chng_op*rate_op)*	Cost applies as written to NTNCWSs.	All	Model PWS that is on reduced tap sampling with a change in source water *(p_tap_annual + p_tap_triennial + p_tap_nine) * p_source_chng*	Once per event

Acronyms: CCT = corrosion control treatment; CWS = community water system; LCR = Lead and Copper Rule; LCRR = Lead and Copper Rule revisions; NTNCWS = non-transient non-community water system; PWS = public water system; WQP = water quality parameter.
Notes:
[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *p_tap_annual, p_tap_triennial,* and *p_tap_nine*: Likelihood a system will qualify to collect lead tap samples at an annual, triennial, and nine-year frequency, respectively (Chapter 3, Section 3.3.7.1).
- *p_source_chng*: Likelihood that a system will change sources in a given year (Chapter 3, Section 3.3.9.1).
- *p_treat_chng:* Likelihood that a system will change treatment in a given year (Chapter 3, Section 3.3.9.3).
- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

B.8.2.4 CCT Activities Unique to the Pre-2021 LCR

Unique to the pre-2021 LCR, a State can allow systems to forgo a study prior to installing or re-optimizing CCT. The EPA assumes that in these cases, States would require water systems to submit water quality data. Exhibit B-121 shows this activity and the unit burden. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity and unit burden are unique to the pre-2021 LCR. The assumptions for estimating the burden follow the exhibit.

Exhibit B-121: PWS CCT Costs Unique to the Pre-2021 LCR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
p) Submit water quality data to determine if CCT study is needed	4 to 8 hrs/system	*hrs_submit_wq_data_op*	No. See discussion following the exhibit.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements.
Source: "CCT Study and Review Costs_Final.xlsx."

p) Submit water quality data to determine if CCT study is needed (hrs_submit_wq_data_op). States can allow systems serving 50,000 or fewer people without CCT to forego a study prior to installing or re-optimizing CCT. The EPA assumed for those systems that are not required to conduct a study, the State would require systems to submit water quality data to allow the State to determine the type of CCT to be installed. The EPA assumed systems would use the electronic templates provided with the *Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems* (hereafter referred to as the "OCCT Recommendations Document") (USEPA, 2019) and require 4 hours for systems serving 3,300 or fewer people and 8 hours for those serving 3,301 to 50,000 people to provide these data. Note that under the final LCRI, the EPA assumed this activity would not apply because all systems would conduct a study prior to installing CCT as opposed to submitting water quality data. The EPA multiplied *hrs_submit_wq_data_op* by 1 minus *p_cct_study* to determine the burden for systems to submit water quality data in lieu of a CCT study.

For systems with CCT, States can also allow systems serving 50,000 or fewer people to forego conducting a revised CCT study prior to re-optimizing CCT. The EPA assumed for those systems that are not required to conduct a study, the State would require systems to submit water quality data to allow the State to determine needed CCT modifications that constitute re-optimized CCT. The same assumptions are used as for those systems without CCT.

Exhibit B-122 shows the SafeWater LCR model cost estimation approach for the cost of CCT activities unique to the pre-2021 LCR including additional cost inputs required to calculate these costs.

Exhibit B-122: PWS CCT Cost Estimation for Activities Unique to the Pre-2021 LCR in SafeWater LCR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
p) Submit water quality data to determine if CCT study revision is needed				
The hours per system multiplied by the system labor rate. *(hrs_submit_wq_data_op*rate_op)*	Cost applies as written to NTNCWSs.	Above AL	Model PWS installing CCT Model PWS re-optimizing CCT serving ≤ 50,000 people	One time

Acronyms: AL = action level; CCT = corrosion control treatment; CWS = community water system; LCRR = Lead and Copper Rule revisions; NTNCWS = non-transient non-community water system; PWS = public water system.
Notes:
[1] The data variables in the exhibit are defined previously in this section with the exception of: *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

B.8.3 PWS Lead Service Line Replacement-Related Costs

Under the pre-2021 LCR, water systems with LSLs that continued to exceed the lead AL were required to annually replace at least seven percent of the initial number of LSLs in their distribution system. Systems could stop LSLR when the system no longer exceeded the lead AL for two consecutive six-month monitoring periods.

This section is divided into three subsections:

- B.8.3.1: Lead Service Line Replacements
- B.8.3.2: Ancillary Lead Service Line Replacements
- B.8.3.3: Ancillary Service Line Replacement Activities Unique to the Pre-2021 LCR

Note that the final LCRI greatly expands the requirements associated with SLR, including developing an SL inventory and plan, additional customer outreach, and customer-initiated SL replacements that correspond to activities a) through l). These activities do not apply to the pre-2021 LCR and, thus, are not discussed in the section. For additional detail, see Chapter 4, Section 4.3.4.

B.8.3.1 Lead Service Line Replacements

This section summarizes the EPA's cost estimates for replacement of LSLs under the pre-2021 LCR. Under that rule, systems were required to replace LSLs when they continue to exceed the lead AL after installing CCT or source water treatment, whichever occurred later. Systems can discontinue LSLR after they no longer exceed the lead AL for two consecutive, six-month monitoring periods. Under the final

LCRI, water systems would be required to fully replace all lead and GRR service lines within 10 years unless the State has set a shorter schedule or approved a deferred rate.

The estimated percent of systems that exceed the lead AL of 15 µg/L is presented in Exhibit B-123. The exhibit presents separate estimates for systems with and without LSLs and a low and high estimate to represent uncertainty in the estimate.

Exhibit B-123: Number and Percent of CWSs by Lead 90th Percentile Classification under the Pre-2021 LCR

Category	No LSLs	Has LSLs
Low Estimate		
P90 ≤ 5 µg/L	88.5%	74.6%
5 µg/L < P90 ≤ 10 µg/L	7.1%	18.0%
10 µg/L < P90 ≤ 12 µg/L	1.0%	2.8%
12 µg/L < P90 ≤ 15 µg/L	1.0%	2.2%
P90 >15 µg/L	2.3%	2.4%
High Estimate		
P90 ≤ 5 µg/L	79.6%	60.0%
5 µg/L < P90 ≤ 10 µg/L	11.7%	23.2%
10 µg/L < P90 ≤ 12 µg/L	2.0%	4.9%
12 µg/L < P90 ≤ 15 µg/L	1.9%	4.0%
P90 >15 µg/L	4.8%	7.9%

Acronyms: LSL = lead service line; P90 = lead 90th percentile level.
Source: Initial P90 Categorization_LCR_Final.xlsx.
Note: The percentages have changed slightly from those presented in the proposed LCRI EA because in this final LCRI EA, they are based on additional systems with known LSL status from the DWINSA supplement.

Under the pre-2021 LCR, the following types of replacements can count toward the annual 7 percent replacement rate:

- **Utility-side LSLR (*i.e.,* Partial LSLR):** The pre-2021 LCR only required systems to replace the portion of the LSL that they owned. Often, the system's ownership stops at the homeowner's property line, and the homeowner's portion is not required to be replaced.
- **Full LSLR:** Full LSLR is when the entire LSL is replaced (*i.e.*, the utility-side portion and the customer-owned portion, if applicable).
- **"Test out" LSLs:** An LSL can "test out" (*i.e*., be considered replaced) if all samples from the LSL are at or below the lead AL. "Test out" LSLs do not have to be physically replaced.

Exhibit B-124 provides the estimated likelihood of these three types of replacements.

Exhibit B-124: Likelihood of Type of Replacement

System Size (Population Served)	Estimated Percent of Systems that Select Test Out Option	Estimated Percent of LSLs that Meets Criteria for Test Out	Estimated Percent of LSLs Replaced through the Testing	Estimated Percent of LSLR that are Utility-Side Only	Estimated Percent of LSLR that are Full
	(pp_lcr_test)	*(pp_lcr_test_yes)*		*(pp_lslr_partial)*	*(pp_lcr_full)*
	A	**B**	**C=A*B**	**D = 72% - (72%*C)**	**E = 28%-(28%*C)**
≤10,000	0%	0%	0%	72%	28%
>10,000	25%	80%	20%	58%	22%

Acronyms: LSL = lead service line; LSLR = lead service line replacement.

Notes:

A: The EPA assumes that 25 percent of CWSs serving more than 10,000 people with CCT that are triggered into LSLR would test their LSLs before replacing them to determine if any meet the test out criteria. The EPA only has documentation indicating that larger systems conduct a mix of test outs and replacements when required to replace LSLs. Thus, the EPA assumed that zero percent of CWSs serving ≤ 10,000 will elect to use the test out criteria.

B: The EPA assumed that the percent of LSLs that meet the test out criteria under the pre-2021 LCR is 80 percent for systems serving > 10,000 people based on success rate from DC Water (76 percent) and Fort Wayne (89.2 percent). The *Economic and Supporting Analysis: Short-Term Regulatory Changes to the Lead and Copper Rule* indicated a test out success rate for DC Water of 76 percent but did not indicate the number of LSL test-out samples collected (USEPA, 2007). Fort Wayne took 1,975 sample and 213 or 10.8 percent were above 15 µg/L, with the remaining 89.2 percent ≤15 µg/L.

D & E: A survey by Black & Veatch, which targeted 300 water systems and had a response rate of 41 systems, indicated 72 percent of replacements involved removal of the utility side only. The remaining 28 percent involved removal of both the public and private side. Results were presented at EPA's LSLR workshop in 2004. For more information on the survey, see *Strategies to Obtain Customer Acceptance of Complete Lead Service Line Replacement* (AWWA, 2005).

Under the pre-2021 LCR, the EPA assumed for modeling purposes that CWSs will incur costs to replace only their portion of the line (*i.e.*, partial replacements). The cost for the customer side is assigned as a household cost. The SafeWater LCR model tracks the percent of LSLR that are full and adjusts the inventory for each year in the 35-year analysis period. NTNCWSs are assumed to own the entire service line and to conduct full replacements.

Exhibit B-125 shows the unit costs for partial and full replacements. Additional detail is also provided in Appendix A. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden or cost, and the SafeWater LCR model data variable are identical to those used for the pre-2021 LCR as for the final LCRI, as described in Chapter 4, Section 4.3.4.3. The assumptions that differ from the 2021 LCRR follow the exhibit. The gray shaded row indicates an activity that does not apply under the pre-2021 LCR.

Exhibit B-125: PWS LSLR Cost Estimates under the Pre-2021 LCR

Activity	Cost Estimate Range	*SafeWater LCR Data Variable*	Same As Final LCRI?
l) System replaces lead or GRR service lines	N/A	*cost_lslr_lsl_reg_mand_pws; cost_lslr_partial_reg_pws; cost_lslr_gal_prev_lsl_reg_pws*	N/A under the pre-2021 LCR.
m) Systems replace their portion of the LSL	CWS Partial: $1,920 - $5,400 NTNCWS Full: $6,507 - $8,519	CWS *cost_lslr_partial_reg_pws* NTNCWS *cost_lslr_lsl_reg_mand_pws*	No. See explanation following this exhibit.
n) Households replace privately-owned portion of the LSL	CWS Partial: $1,920 - $5,400	*cost_lslr_partial_reg_pws*	No. See explanation following this exhibit.

Source: "LSLR Unit Cost_Final.xlsx."

Acronyms: CWS = community water system; GRR = galvanized requiring replacement; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; LSL = lead service lines; NTNCWS = non-transient non-community water system.

Notes:

m): Reflects the cost of physical replacement only. As previously discussed in this section, under the pre-2021 LCR, systems can also replace their LSL through a non-physical means using the "test out" provision. Under the pre-2021 LCR and final LCRI, NTNCWSs were assumed to own and replace the entire LSLs. The same data variable and cost input are used for NTNCWSs under both rules.

n): Under the pre-2021 LCR, households were assumed to incur the cost for the customer-owned portion to achieve full LSLR.

m) Systems replace their portion of the LSL (cost_lslr_partial_reg_pws). The EPA has developed low and high unit cost estimates based on reported project data in the 7th DWINSA for full replacements, partial replacements, and replacements of GRR service lines. Low and high unit cost estimates are based on the 25th and 75th percentile data from 33 DWINSA reported projects. The detailed methodology for estimating the SLR unit costs is provided in Appendix A, Section A.2. For the pre-2021 LCR, water systems are not required to replace GRR.

The EPA applied the low and high cost estimates for partial replacement of $1,920 - $5,400 to CWSs (*cost_lslr_partial_reg_pws*) and the low and high cost estimates for full replacements of $6,507 - $8,519 for NTNCWSs (*cost_lslr_lsl_reg_mand_pws)* because in general NTNCWSs own their entire service line. In addition to the unit cost and likelihood of the type of LSLR under each program, the EPA needs the total number of LSLs replaced each year (*num_lsl_replace*) to estimate LSLR costs under the pre-2021 LCR. The number of LSLs replaced is calculated as the number of LSLs for a system multiplied by the replacement rate per year. The EPA assumed a 7 percent replacement rate as required by the pre-2021 LCR. The EPA assumed that LSLR under the pre-2021 LCR will last an average of three years based on an analysis of SDWIS/Fed data for 103 CWSs (see LSLR_Time_Span_Analysis_CWS_Final.xlsx").

n) ***Households replaces their portion of the LSL (cost_lslr_partial_reg_pws).*** Under the pre-2021 LCR, the EPA assumed households would pay for the replacement of their portion of the LSL and would incur a low or high-end cost of $1,920 - $5,400.

Exhibit B-126 provides the SafeWater LCR model cost estimation approach for systems and households to replace LSLs including additional cost inputs required to calculate these costs.

Exhibit B-126: Lead Service Line Replacement Cost Estimation in SafeWater LCR by Activity[1,2]

System Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
l) System replaces lead or GRR service lines				
N/A under the pre-2021 LCR.				
m) Systems replace their portion of the LSL				
The sum of the number of lines replaced via the different replacement options multiplied by the costs per type of replacement. Replacement options include full LSLR and partial replacements on the system owned side of the LSL. *(num_lslr_lsl_replace+num_lslr_partial_replace)*cost_lslr_partial_reg_pws)*	The sum of the number of lines replaced via the different replacement options multiplied by the costs per type of replacement. *num_lslr_lsl_replace*cost_lslr_lsl_reg_mand_pws*	Above AL	Model PWS subject to the LSLR program	Once a year
n) Households replace privately-owned portion of the LSL				
The number of full lead line replacements multiplied by the per line cost to households. The conditional likelihoods in this equation account for the removal of tested out lines from the inventory. The EPA assumes that customers always pay for the part of the LSL belonging to them when an LSL is fully or partially replaced. Customers do not pay for pigtail/gooseneck replacements in the model. *(num_lslr_lsl_replace* cost_lslr_partial_reg_pws)*	Cost does not apply to NTNCWSs.	Above AL	Households within Model PWSs subject to the LSLR Program	Once a year

Acronyms: AL = action level; CWS = community water system; GRR = galvanized requiring replacement; LCR = Lead and Copper Rule; LSL = lead service line; LSLR = lead service line replacement; NTNCWS = non-transient non-community water system; PWS = public water system;.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *num_lslr_lsl_replace*: Number of LSLs replaced per year that is calculated in the SafeWater LCR model.

[2] Systems can discontinue these activities if they no longer exceed the lead AL for two consecutive, six-month monitoring periods.

B.8.3.2 Ancillary Lead Service Line Replacement Activities

The EPA developed system costs for ancillary activities associated with LSLR under the pre-2021 LCR, as shown in Exhibit B-127. The exhibit provides the unit burden and cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. Activities that are conducted by some States in lieu of the water system are identified in the exhibit and further noted below the exhibit. The last column indicates if the activity, unit burden or cost, and the SafeWater LCR model data variable for the pre-2021 LCR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.3.4.4. The assumptions that differ from the LCRI follow the exhibit. Gray shaded rows indicate requirements that apply to the final LCRI. Those activities that are unique to the pre-2021 LCR are discussed in Section B.8.3.3.

Exhibit B-127: PWS LSL Replacement Ancillary Unit Burden and Cost Estimates under the Pre-2021 LCR

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same as Final LCRI?
o) Contact customers and conduct site visits prior to service line replacement	Burden per replaced service line 1.70 to 2.07 hrs Cost per replaced service line $11.64 to $16.13	Burden *hrs_replaced_lsl_contact_op* Cost *cost_replaced_lsl_contact*	Yes.[1]
p) Deliver filters and 6 months of replacement cartridges at time of SLR	N/A	*cost_filter_hh*	N/A under the pre-2021 LCR.
q) Collect tap sample post-service line replacement	Burden per sample CWSs: 0.9 to 1.2 hrs Cost per sample per CWS Travel: $5.75 to $10.24 Bottle: $0 to $2.85	Burden *hrs_collect_lsl_plslr_op* Cost *cost_pickup_samp* *cost_lsl_samp*[2]	No. See explanation following the exhibit.
r) Analyze post-service line replacement tap sample	In-house Analysis (CWSs > 100K only) Burden: 0.44 hrs/sample Cost: $3.92 Commercial Analyses $32.20/sample	In-house Analysis *hrs_analyze_lsl_plslr_op*[2] *cost_lab_lsl_plslr*[2] Commercial Analysis *cost_commercial_lsl_plslr*[2]	No. See explanation following the exhibit.
s) Inform customers of tap sample result	Burden CWSs: 0.05 -0.11 hrs/sample Cost CWSs: $0.72/sample	Burden *hrs_inform_samp_op* Cost *cost_cust_plslr*	No. See explanation following the exhibit.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same as Final LCRI?
t) Submit annual report on service line replacement program to State	1 to 8 hrs/CWS 1 hr/NTNCWS	*hrs_report_lcr_op*	Yes[4]

Acronyms: CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; SLR = service line replacement.
Sources:
p), q) & u): "LSLR Ancillary Costs_Final.xlsx."
r)-t): " Lead Analytical Burden and Costs_Final.xlsx."
Notes:
[1] This input corresponds to activity m) in Chapter 4, Section 4.3.4.4 for the final LCRI.
[2] NTNCWSs are assumed to own and control their entire LSL and will fully replace the LSL. In addition, they are not expected to contact customers prior to replacement to coordinate any efforts. In addition, under the pre-2021 LCR, monitoring after a service line replacement only is required after partial LSLR. Therefore, the only activity that applies to NTNCWSs in this exhibit under the pre-2021 LCR is submitting an annual report (*hrs_report_lcr_op*).
[3] The burden and costs for these activities are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).
[4] Although the report content under the annual LSLR reports differs between the pre-2021 LCR and final LCRI, the EPA assumed systems would incur a similar burden to prepare this report and thus, used the same data variable name and input for both rules. For the final LCRI, this input corresponds to activity r) in Chapter 4, Section 4.3.4.4.

q) ***Collect tap samples after post-service line replacement (hrs_collect_lsl_plslr_op, cost_pickup_samp, cost_lsl_samp).*** Under the pre-2021 LCR, systems must offer to collect a lead tap sample at each home for which a partial replacement (*i.e.,* utility-side only) was conducted. The EPA assumed all residents would agree to this testing. The EPA also assumed no NTNCWS would conduct a partial LSLR because all NTNCWSs would own and replace the entire service line. Thus, this sampling requirement would not apply to NTNCWSs. The burden and costs for this activity are different from the tap sampling requirements discussed in Section B.8.1.1.2 because the system collects the sample after replacement as opposed to the tap sampling program in which the customer collects the sample. Exhibit B-128 and Exhibit B-129 provide the estimated CWS burden and cost to collect these samples.

Exhibit B-128: CWS Unit Burden for LSLR-Related Sample Collection

System Size (Population Served)	Burden (hrs/Sample)		
	Round-trip travel to customer's home	Sample Collection Burden	Total Sample Collection Burden *hrs_collect_lsl_plslr_op*
	A	B	C = A + B
≤100,000	0.40	0.5	0.9
100,001-1,000,000	0.51	0.5	1.0

System Size (Population Served)	Burden (hrs/Sample)		
	Round-trip travel to customer's home	Sample Collection Burden	Total Sample Collection Burden
			hrs_collect_lsl_plslr_op
	A	B	C = A + B
>1,000,000	0.71	0.5	1.2

Source: "Lead Analytical Burden and Costs_Final.xlsx," worksheet, "LSLR_CollectAnaly_CWS_LCRR_LCRI."
Notes:
A: Based on census data and zip codes from the 2006 Community Water System Survey, the EPA assumed the following one-way driving distances for CWSs: 5.0 miles serving ≤ 100,000 people, 6.4 miles serving 100,001 - 1M, and 8.9 miles for > 1M. These distances were doubled to estimate roundtrip mileage. See file, "Estimated Driving Distance_Final.xlsx for additional detail on how these estimates were derived. The EPA assumed an average speed of 25 miles per hour.
B: The EPA assumed the same collection burden following LSLR as for source water sample collection, which is based on the 2022 *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 15, Average Labor Hrs. for Collection (Per Sample) (USEPA, 2022).
C: Under the final LCRI, the variable name *hrs_collect_lsl_lslr_op* is used.

Exhibit B-129: CWS Non-labor Unit Cost to Collect Post-SLR Tap Sample

System Size (Population Served)	Cost (hrs/Sample)	
	Round-trip travel to customer's home	Bottle Cost
	cost_pickup_samp	cost_other_lt_samp
	A	B
≤100,000	$5.75	$0.00
100,001-1,000,000	$7.36	$2.85
>1,000,000	$10.24	$2.85

Source: "Lead Analytical Burden and Costs_Final.xlsx," worksheet, "LSLR_CollectAnaly_CWS_LCRR_LCRI."
Notes:
A: Based on census data and zip codes from the 2006 Community Water System Survey, assumed the following one-way driving distances for CWSs: 5.0 miles serving ≤ 100,000 people, 6.4 miles serving 100,001 - 1M, and 8.9 miles for > 1M. These distances were doubled to estimate roundtrip mileage. See file, "Estimated Driving Distance_Final.xlsx for additional detail on how these estimates were derived. The EPA assumed an average speed of 25 miles per hour and used the Federal reimbursement rate of $0.575 (2020 mileage rate).
B: Bottles are included as part of the commercial laboratory fee. Only CWSs serving more than 100,000 people are assumed to conduct analyses in-house for lead. For a detailed discussion of the assumptions used to estimate bottle costs, see file "Lead Analytical Burden and Costs_Final.xlsx," worksheet, "Sample Kit_Bottle_$."

Under the pre-2021 LCR, systems will incur the same burden and cost to collect one sample following replacement of each partial or full LSL. In addition, the requirement applies to both CWSs and NTNCWSs.

r) ***Analyze post-service line replacement tap samples (hrs_analyze_lsl_plslr_op, cost_lab_lsl_plslr, cost_commercial_lsl_plslr).*** The EPA assumed CWSs serving more than 100,000 people will conduct

lead analyses in-house and require 0.44 hours per sample based on estimates provided by three laboratories (*hrs_analyze_lsl_plslr_op*). These systems will also incur consumable costs of $3.92 per sample based on information from three vendors (*cost_lab_lsl_plslr*). The remaining CWSs and all NTNCWSs are assumed to use commercial laboratories and incur a cost of $23.50 per lead sample based on quotes from seven laboratories plus a per sample shipping cost of $8.70 for a total per sample cost of $32.20 (*cost_commercial_lsl_plslr*). Note that these cost are the same as those incurred by CWSs under the final LCRI for systems analyzing samples following service line replacement but the variable names are different, as shown in Exhibit B-119. In addition, under the final LCRI, systems must collect a lead tap sample following all service line replacements. Thus, these costs also apply to NTNCWSs. See Chapter 4, Section 4.3.4.4, activity p) for additional detail.

s) Inform customers of tap sample results (hrs_inform_samp_op, cost_cust_plslr). CWSs must notify their customers of their lead analytical results in samples collected in response to a partial LSLR. The EPA assumed CWSs would incur the same burden and cost to provide this notification as estimated under the final LCRI replacement program. Note that under the final LCRI, the variable names are different and the notifications also apply to NTNCWSs. See Chapter 4, Section 4.3.4.4, activity q) for additional detail.

Exhibit B-130 provides the SafeWater LCR model cost estimation approach for PWS ancillary LSLR activities including additional cost inputs that are required to calculate these costs. The gray shaded row indicates an activity that does not apply to the pre-2021 LCR.

Exhibit B-130: Lead Service Line Replacement Ancillary Cost Estimation in SafeWater LCR by Activity under the Pre-2021 LCR[1,2]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
o) Contact customers and conduct site visits prior to service line replacement				
The number of full lines replaced multiplied by the total of the hours per line times the system labor rate, plus the material cost. The pre-2021 LCR allowed systems to "test out" an LSL instead of physically replacing it. The test out lines count towards the replacement target but because they do not result in the same benefits as the removal of an LSL they are not included in the calculation of lead lines replaced (num_lsl_replace). The equation is adjusted to reflect this using pp_lcr_test and pp_lcr_test_yes. *(num_lsl_replace*((hrs_replaced_lsl_contact_op*rate_op)+cost_replaced_LSL_contact))*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year
p) Deliver filters and 6 months of replacement cartridges at time of SLR				
N/A under the pre-2021 LCR.				
q) Collect lead tap samples post-service line replacement[2,3]				
The samples for a system's partial LSL replacements multiplied by the total of the material cost per sample, plus the hours per sample times the system labor rate. *(num_lslr_partial_replace*numb_samp_plslr)*(cost_lsl_samp+cost_pickup_samp+(hrs_collect_lsl_plslr_op*rate_op))*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year
r) Analyze post-service line replacement[2]				
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per replaced lead line multiplied by the number of replaced lead lines and the percentage of samples analyzed in house times the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in a commercial lab times the material cost of the commercial lab analysis per sample.	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
*(((num_lslr_partial_replace*numb_samp_plslr)*pp_lab_samp)*((hrs_analyze_lsl_plslr_op*rate_op)+cost_lab_lsl_plslr))+(((num_lslr_partial_replace*numb_samp_plslr)*pp_commercial_samp)*cost_commercial_lsl_plslr)*				
s) Inform customers of results tap sample results[2]				
The samples for a system's partial LSLRs multiplied by the material cost, the hours per sample, and the system labor rate. *(num_lslr_partial_replace*numb_samp_plslr)*((hrs_inform_samp_op*rate_op)+cost_cust_plslr)*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year
t) Submit annual report on service line replacement program to State				
The estimated total reporting hours per system multiplied by the system labor rate. *(hrs_report_lcr_op*rate_op)*	Cost applies as written to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year

Acronyms: AL = action level; CWS = community water system; LCR = Lead and Copper Rule; LSL = lead service line; LSLR = lead service line replacement; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] The data variables in this exhibit are defined previously in Section B.5.4.4 with the exception of:

- *num_lslr_partial_replace*: Number of partial LSLs replaced per year that is calculated in the SafeWater LCR model.
- *numb_samp_plslr*: Number of samples collected following partial LSLR. Assumed to be one per replacement.
- *rate_op*: PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] These activities apply after systems (assumed to be CWSs only) conduct a partial LSLR. The system can discontinue these activities after it no longer exceeds the lead AL of 15 µg/L for two consecutive, six-month monitoring periods.

[3] The burden and costs to provide sample bottles (*cost_lsl_samp*) under activity q) and conduct analyses under activity r) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

B.8.3.3 Ancillary Service Line Replacement Activities Unique to the Pre-2021 LCR

Under the pre-2021 LCR systems will incur ancillary activities associated with LSLR that do not apply to the final LCRI, as shown in Exhibit B-131. The activities in this exhibit apply only to CWSs because, NTNCWSs are assumed to fully replace their LSLs and are not expected to contact customers prior to replacement to coordinate any efforts.

Exhibit B-131: PWS LSL Replacement Ancillary Unit Burden and Cost Estimates under the Pre-2021 LCR[1]

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same as Final LCRI?
u) Develop information that asks if customers want their LSL replaced (one-time)	7 hrs/CWS subject to mandatory LSLR	*hrs_lcr_lslr_out_op*	No. Unique to the pre-2021 LCR.
v) Deliver information that asks if customers want their LSL replaced (one-time)	Burden 0.0025 hrs per delivery Cost $0.703 per delivery	Burden *hrs_lcr_lslr_out_deliv_op* Cost *cost_lcr_lslr_out*	No. Unique to the pre-2021 LCR.
w) Develop information that goes to customers prior to partial LSLR (one-time)	7 hrs/CWS subject to mandatory LSLR	*hrs_lcr_lslr_prior_op*	No. Unique to the pre-2021 LCR.
x) Deliver prior notification for partial LSLRs	Burden 0.5 hrs per delivery Cost $0.703 per delivery	Burden *hrs_prior_notif_op* Cost *cost_prior_notif*	No. Unique to the pre-2021 LCR.
y) Submit documentation that partial LSLR requirements were fulfilled	0.5 hrs	*hrs_report_plslr_op*	No. Unique to the pre-2021 LCR.
z) Collect samples for test out provision	Burden per sample for CWSs 0.9 to 1.2 hrs Cost per sample for CWSs Travel: $5.75 to $10.24 Bottle: $0 to $2.85	Burden *hrs_collect_lsl_plslr_op* Cost *cost_pickup_samp* *cost_lsl_samp*[2]	No. Unique to the pre-2021 LCR.
aa) Analyze lead tap samples for test out provision	In-house Analysis (CWSs > 100K only) Burden: 0.44 hrs/sample Cost: $3.92/sample Commercial Analysis $32.30/ sample	In-house Analysis *hrs_analyze_lsl_plslr_op*[2] *cost_lab_lsl_plslr*[2] Commercial Analysis *cost_commercial_lsl_plslr*[2]	No. Unique to the pre-2021 LCR.

Acronyms: CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; LSL = lead service lines; LSLR = lead service line replacement; NTNCWS = non-transient non-community water system.
Sources:

u) -y): "LSL Ancillary Costs_Final.xlsx."
z) & aa): " Lead Analytical Burden and Costs_Final.xlsx."

Notes:

[1] The activities in this exhibit apply only to CWSs because, NTNCWSs are assumed to fully replace their LSLs and are not expected to contact customers prior to replacement to coordinate any efforts.

[2] The burden and costs for these activities are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

u) ***Develop information that asks if customers want their LSL replaced (hrs_lcr_lslr_out_op).*** CWSs subject to mandatory LSLR will incur burden to ask their customers if they want their portion of the LSL replaced prior to initiating replacement of the system-side. The EPA estimated systems will incur a burden of 7 hours based on the *2022 Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 33a (USEPA, 2022).

v) ***Deliver information that asks if customer wants their LSL replaced (hrs_lcr_lslr_out_deliv_op, cost_lcr_lslr_out).*** The EPA assumed systems will incur a burden of 0.0025 hours per letter or 15 minutes per 100 copies to prepare the materials described in activity v) for delivery based on the *Economic and Supporting Analysis: Short-Term Regulatory Changes to the Lead and Copper Rule*, p. 54 (USEPA, 2007). The EPA estimates systems will incur a cost of $0.703 to send the materials ($0.017 for pamphlet, $0.06 for ink, $0.076 for envelope, and $0.55 for postage). See file "General Cost Model Inputs_Final.xlsx" for assumptions for paper, envelope, and postage. Bulk rate does not apply because notice is being sent to fewer than 200 households. The EPA assumed this information is sent to 7 percent of households with LSLs to meet the minimum requirement of the rule. Note that the number of households with LSLs changes during the 35-year rule analysis period, decreasing over time as the system fully replaces LSLs (households with LSLs each year is expressed in the SafeWater LCR model as *hh_remain_lsl*).

w) ***Develop information that goes to customers prior to partial LSLR (hrs_lcr_lslr_prior_op).*** Under the pre-2021 LCR, systems must notify customers prior to partial replacement of an LSL explaining that they may experience a temporary increase in lead levels and measures they can take to minimize their exposure. The materials must also include an offer to replace the customer-side at the owner's expense. The EPA assumes systems will incur a burden of 7 hours based on the 2022 *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 33a (USEPA, 2022). See Exhibit B-124 for the percent of LSLs that are partial replacements (*p_lslr_partial*)) of the 7 percent of LSLs replaced per year under mandatory replacement. See activity s) for explanation of how the EPA tracks the number of households with LSLs remaining for each system over the 35-year analysis period.

x) ***Deliver information prior to partial LSLR (hrs_prior_notif_op, cost_prior_notif).*** The EPA assumed systems will incur a burden of 0.5 hours for all system sizes to provide a letter with the materials described in activity t) based on the 2022 *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)* in Exhibit 35 (Partial LSL Letter) (USEPA, 2022). The EPA assumed systems will incur the same mailing cost of $0.703 described in activity s). This information goes to the same percent of households with LSLs as activity s).

y) ***Submit documentation that partial LSLR was fulfilled (hrs_report_plslr_op).*** The EPA assumed systems will incur a burden of 0.5 hours to provide documentation to the State that they fulfilled

their partial LSLRs requirements that include activities q) – s) in Section B.8.3.2, and activities u) through y) that are described above. The estimate of 0.5 hours is based on the 2022 Disinfectants and Disinfection Byproducts, Chemical, and Radionuclides Rules ICR, Exhibit 35 (Partial LSL Letter).

z) ***Collect samples for test out provision (hrs_collect_lsl_plslr_op, cost_pickup_samp, cost_lsl_samp).*** Systems electing to use the test out provision are assumed to collect one sample per tested LSLs (*numb_samp_test*). As shown in Exhibit B-124, the EPA assumed 25 percent of CWSs serving more than 10,000 people would test all LSLs before replacing them to determine if any meet the test out criteria (*pp_lcr_test*). The EPA assumed systems test 7 percent of LSLs per year, with the number of LSLs per system based on the estimated percentage of LSLs (*perc_lsl*) adjusted each year to account for full LSLR (*i.e.,* households with LSLs each year is expressed in the SafeWater LCR model as *hh_remain_lsl*). Systems will incur the same burden and cost with this sample collection as described in activity q) in Section B.8.3.2.

aa) ***Analyze lead tap samples for test out provision (hrs_analyze_lsl_plslr_op, cost_lab_lsl_plslr, cost_commercial_lsl_plslr).*** The EPA assumed systems would incur the same costs and burden to analyze a lead tap sample in-house or commercially as described in activity r) in Section B.8.3.2.

Exhibit B-132 provides the SafeWater LCR model cost estimation approach for PWS ancillary LSLR that are unique to the pre-2021 LCR including additional cost inputs that are required to calculate these costs.

Exhibit B-132: Lead Service Line Replacement Ancillary Cost Estimation in SafeWater LCR by Activity under the Pre-2021 LCR[1,2]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
u) Develop information that asks if customers want their LSL replaced				
The total hours per system multiplied by the system labor rate. *(hrs_lcr_lslr_out_op*rate_op)*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	One time
v) Deliver information that asks customer if their want their LSL replaced				
Seven percent of the number of remaining LSL households multiplied by the total of the hours per household times the system labor rate, plus the material cost. *(.07*hh_remain_lsl)*((hrs_lcr_lslr_out_deliv_op*rate_op)+cost_lcr_lslr_out)*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year
w) Develop information that goes to customers prior to partial LSLR				
The total hours per system multiplied by the system labor rate. *(hrs_lcr_lslr_prior_op*rate_op)*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	One time
x) Deliver prior notification for partial LSLRs				
The number of lines partially replaced multiplied by the total of the hours per line times the system labor rate, plus the material cost. *num_lslr_partial_replace*((hrs_prior_notif_op*rate_op)+cost_prior_notif)*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year
y) Submit documentation that partial LSLR requirements were fulfilled				
The estimated total hours per system multiplied by the system labor rate. *(hrs_report_plslr_op*rate_op)*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
z) Collect lead tap samples for test out provision[3]				
The number of samples required for each service line that is "test out" multiplied by the hours per sample times the system labor rate, plus the total of the material cost per sample. *((num_lsl_testout)*(numb_samp_test))*(cost_lsl_samp+cost_pickup_samp+(hrs_collect_lsl_plslr_op*rate_op))*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year
aa) Analyze lead tap samples for test out provision[3]				
There are different labor (burden) and material costs for a sample analyzed in house and a sample analyzed using a commercial lab. The in-house analysis costs are calculated using the number of required samples per tested lead line multiplied by the number of test lead lines and the percentage of samples analyzed in house times the system labor rate, plus the material cost of the in-house analysis per sample. The commercial lab analysis costs are calculated using the number of required samples per system multiplied by the percentage of samples analyzed in a commercial lab times the commercial lab analysis per sample. *((((num_lsl_testout)*(numb_samp_test))*pp_lab_samp)*((hrs_analyze_lsl_plslr_op*rate_op)+cost_lab_lsl_plslr))+((((num_lsl_testout)*(numb_samp_test))*pp_commercial_samp)*cost_commercial_lsl_plslr)*	Cost does not apply to NTNCWS.	Above AL	Model PWSs complying with the mandatory LSLR program	Once a year

Acronyms: AL = action level; CWS = community water system; LSL = lead service line; LSLR = lead service line replacement; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] The data variables in this exhibit are defined previously in Section B.8.3.1 through B.8.3.3 with the exception of:

- *rate_op*: PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] The system can discontinue the activities in this exhibit after it no longer exceeds the lead AL for two consecutive, six-month monitoring periods.

[3] The burden and costs to provide sample bottles (*cost_lsl_samp*) under activity z) and conduct analyses under activity aa) are incurred by the State in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina (ASDWA, 2020a).

B.8.4 PWS Lead Public Education, Outreach, and Notification Costs under the Pre-2021 LCR

Under the pre-2021 LCR, systems will incur labor and non-labor costs to lead PE in response to lead ALE of 15 µg/L. The EPA has developed system costs for these activities, as provided in Exhibit B-133. The exhibit provides the unit burden and/or cost for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit burden or cost, and SafeWater LCR data variable are identical for the pre-2021 LCR to those used for the final LCRI, as described in Chapter 4, Section 4.3.6.3. The gray shaded row indicates an activity that is not required under the pre-2021 LCR.

Note that the final LCRI, includes additional PE, outreach, and notification activities that require expedited consumer notice of individual tap results, are independent of a systems lead 90th percentile level, those that are triggered when a system has at least three lead ALEs in a five-year period (*i.e.*, has multiple lead ALEs). Those requirements are not included in B.8.4 but are detailed in Chapter 4, Sections 4.4.6.1, 4.3.6.2, and 4.3.6.4, respectively, as activities a) through s) and bb) through gg) .

Exhibit B-133: PWS Public Education Burden in Response to Lead ALE under the Pre-2021 LCR

Activity	Unit Burden and/or Cost	***SafeWater LCR Data Variable***	Same As Final LCRI?
s) Update mandatory language for lead ALE public education and submit to the State for review (one-time)	N/A	*hrs_pe_al_devel_op*	N/A under the pre-2021 LCR.
t) Deliver lead ALE public education materials to all customers	CWSs 0.0025 hours/household; $0.27 to $0.40/CWS NTNCWSs 1 hr/NTNCWS $0.079/NTNCWS	CWSs *hrs_distr_edu_op;* *cost_pe_lcr_delivery* NTNCWSs *hrs_ntncws_distr_edu_op;* *cost_ntncws_pe_lcr_delivery*	Yes.
u) Post notice to website	0.5 hrs/CWSs serving > 50,000 people	*hrs_web_op*	Yes.
v) Prepare press release	10 hrs/press release per CWS serving > 3,300 people; $0/press release	*hrs_pr_op;* *cost_pr*	Yes.
w) Contact public health agencies to obtain additional organizations and update recipient list	0.5 hrs/CWSs serving ≤3,300 people; 1.5 hrs/CWSs serving 3,301 to 100,000 people; 2.5 hrs/CWS serving > 100,000 people	*hrs_ha_op*	Yes.
x) Notify public health agencies and other organizations	0.0025 hours/organization/CWS; $5.97/organization/CWS	*hrs_distr_agencies_pe_op;* *cost_pe_lead_ale*	Yes.

Activity	Unit Burden and/or Cost	*SafeWater LCR Data Variable*	Same As Final LCRI?
y) Consult with the State on other public education activities	2 hrs/CWS	*hrs_ale_consult_op*	Yes.
z) Implement other public education activities	2.7 to 1,039.2 hrs/CWS; $38.82 to $297,956/CWS	*hrs_ale_other_op; cost_ale_other*	Yes.
aa) Certify to the State that lead outreach was completed[1]	CWSs 2 hrs/CWS serving ≤50,000 people; 3 hrs/CWS serving > 50,000 people NTNCWSs 0.66 hrs/NTNCWS serving ≤50,000 people; 1 hr/NTNCWS serving > 50,000 people	CWSs *hrs_pe_certify_quarterly_op* NTNCWSs *hrs_cert_outreach_annual_op*	Yes

Acronyms: ALE = action level exceedance; CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system.
Sources:
v) - aa): “Public Education Inputs_CWS_Final.xlsx”; “Public Education Inputs_NTNCWS_Final.xlsx.”
u), bb): “Public Education Inputs_CWS_Final.xlsx.”
Notes
[1] For the final LCRI, this corresponds to activity s), which is included in Chapter 4, Section 4.3.6.2 – Activities Regardless of lead 90th Percentile Levels. For the final LCRI, the certification includes all public education, outreach, and notification requirements.

Exhibit B-134 shows the SafeWater LCR model cost estimation approach for system lead PE activities and indicates if the approach is the same as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-126, as well as a final LCRI activity that does not apply under the pre-2021 LCR in a gray shaded row.

Exhibit B-134: PWS Lead ALE Public Education Unit Cost Estimation in SafeWater LCR by Activity under the Pre-2021 LCR[1]

CWS Cost Per Activity	NTNCWS Cost Per Activity	Conditions for Cost to Apply to a Model PWS		Frequency of Activity
		Lead 90th - Range	Other Conditions	
s) Update mandatory language for lead ALE PE and submit to the State for review				
N/A under the pre-2021 LCR. Assumed to have already occurred for all model PWSs with a lead ALE.				
t) Deliver lead ALE public education materials to all customers				
Same as final LCRI (see activity u) in Exhibit 4-126 in Chapter 4).				
u) Post lead notice on website				
Same as final LCRI (see activity v) in Exhibit 4-126 in Chapter 4).				
v) Prepare a press release				
Same as final LCRI (see activity w) in Exhibit 4-126 in Chapter 4).				
w) Contact public health agencies to obtain additional organizations and update recipient list				
Same as final LCRI (see activity x) in Exhibit 4-126 in Chapter 4).				
x) Notify public health agencies and other organizations				
Same as final LCRI (see activity y) in Exhibit 4-126 in Chapter 4).				
y) Consult with the State on other public education activities				
Same as final LCRI (see activity z) in Exhibit 4-126 in Chapter 4).				
z) Implement other PE activities				
Same as final LCRI (see activity aa) in Exhibit 4-126 in Chapter 4).				
aa) Certify to State that lead outreach was completed[3]				
The total hours per system multiplied by the system labor rate. *(hrs_pe_certify_quarterly_op*rate_op)*	The total hours per system multiplied by the system labor rate. *(hrs_cert_outreach_annual_op*rate_op)*	Above AL	All model PWSs	Once a year[2]

Acronyms: AL = action level; ALE = action level exceedance; CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; PE = public education; PWS = public water system.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] System can discontinue PE activities after they no longer exceeds the lead AL.

[3] CWSs submit their certifications quarterly but for modeling purposes, the burden is estimated on an annual basis. Under the final LCRI this cost is aggregated under the public education activities regardless of lead 90th percentile level and is provided in Chapter 4, Exhibit 4-119 as activity s) .

B.9 Detailed State Costing Approach for the Pre-2021 LCR

For many of the water system activities described in Section 0, the 56 primacy agencies (States)[51] will incur costs in the form of burden (*i.e.*, hours) to provide oversight and review. The State burden is multiplied by the labor rate ($/hr), as presented in Chapter 3, Section 3.3.11.2 to estimate labor unit costs. The remainder of this section is organized as follows:

- B.9.1: State Administrative Costs under the Pre-2021 LCR
- B.9.2: State Sampling Related Costs under the Pre-2021 LCR
- B.9.3: State CCT-Related Costs under the Pre-2021 LCR
- B.9.4: State Lead Service Line Testing and Replacement under the Pre-2021 LCR
- B.9.5: State Lead Public Education and Outreach under the Pre-2021 LCR

The final LCRI requirements associated with one-time activities to implement and administer the rule changes, lead in drinking water testing at schools and child cares, DSSA requirements, public outreach requirements other than those required when a system exceeds the lead AL, and the POU program are not applicable to the pre-2021 LCR and thus are not included B.9. However, Exhibit B-135 shows all the components, subcomponents, and activities from Exhibit 4-141 in Chapter 4 for the final LCRI to facilitate comparison between the two rules. For each major rule component, each activity has a unique letter ID. The differences in activities costed for the final LCRI and the pre-2021 LCR are identified as follows: 1) gray shading italicized text indicates activities under the final LCRI that were not part of the pre-2021 LCR requirements; and 2) yellow shaded activities in bold are specific to the LCR and are not included in the final LCRI requirements.

At the end of each subsection, the EPA provides a summary exhibit showing the SafeWater LCR modeling approach for each State activity, as was done in Section B.5 for PWSs. The SafeWater LCR model uses the information from these exhibits to calculate total annualized State cost for each activity. See Section B.6 for detail on the cost modeling methodology.

Exhibit B-135: State Cost Components, Subcomponents, and Activities Organized by Section[1]

Component	Subcomponents	Activities[2]
B.9.1: State Administrative Costs under the Pre-2021 LCR		*a) Adopt rule and develop program.* *b) Modify data management systems.* *c) Provide system training and technical assistance.* *d) Provide staff training.* *e) Review and approve small system flexibility option.*
B.9.1: State Administrative Costs under the Pre-2021	None	f) Coordinate with the EPA. g) Provide ongoing technical assistance.

[51] The 56 primacy agencies include 49 states (excluding Wyoming), District of Columbia, Puerto Rico, Guam, United States Virgin Islands, American Samoa, North Mariana Islands, and Navajo Nation. Note that some burden and costs pertaining D.C. are incurred by the EPA but for modeling purposes are assigned to the D.C.

Component	Subcomponents	Activities[2]
LCR (continued)		h) Report to SDWIS/Fed. i) Train staff for annual administration.
B.9.2: State Sampling Related Costs under the Pre-2021 LCR	B.9.2.1: State Lead Tap Sampling Costs	a) Provide templates for revised sampling instructions and conduct review. b) Review updated sampling plan. c) Review initial lead monitoring data and prepare systems for status under the rule. d) Review change in tap sample locations. e) Review 9-year monitoring waiver renewal. f) Review sample invalidation requests. g) Review consumer notification certifications. h) Review monitoring results and 90th percentile calculations.
	B.9.2.2: State Lead WQP Sampling Costs	i) Review lead WQP sampling data and compliance with OWQPs.
	B.9.2.3: State Copper WQP Monitoring Costs	j) Review copper WQP sampling data and compliance with OWQPs.
	B.9.2.4: State Source Water Monitoring Costs	k) Review source water monitoring results.
	State School Sampling Costs	l) *Review list of schools and child care facilities.* m) *Provide templates on school and child care facility testing program.* n) *Review school and child care facility testing program materials.* o) *Review school and child care facility sampling results after individual sampling events.* p) *Review annual reports on school and child care facility lead in drinking water testing program.*
B.9.3: State CCT-Related Costs under the Pre-2021 LCR	B.9.3.1: State CCT Installation Costs	a) Review CCT study and determine type of CCT to be installed b) Set OWQPs after CCT installation
	B.9.3.2: State CCT Re-optimization Costs	c) Review CCT study and determine needed OCCT adjustment d) Reset OWQPs after CCT re-optimization
	State DSSA Costs	e) *Consult with system prior to any DSSA CCT adjustments* f) *Review report on DSSA responses*
	B.9.3.3: State Lead CCT Routine Costs	g) *Review CCT guidance and applicability to individual PWSs* h) *Review water quality data with PWSs during sanitary survey* i) Consult on required actions in response to source water change j) Consult on required actions in response to treatment change
	B.9.3.4 State CCT Costs Unique to the Pre-2021 LCR	k) **Determine need for a CCT study** l) **Determine type of CCT or systems without a study** m) **Determine the need for a revised CCT study** n) **Determine the CCT adjustment for systems without**

Component	Subcomponents	Activities[2]
		a revised study
B.9.4: State Lead Service Line Testing and Replacement under the Pre-2021 LCR	*SL Inventory Costs*	a) *Review connector updated LCRR initial inventory (baseline inventory)* b) *Review annual service line inventory updates* c) *Review inventory validation report*
	SLR Plan Review Costs	d) *Review initial SLR plan* e) *Review information on deferred deadline and associated replacement rate in the SLR plan and determine fastest feasible rate.* f) *Review annually updated SLR plan or certification of no change.* g) *Conduct triennial review of water system updated recommended deferred deadline and associated replacement rate and determine fastest feasible rate.*
	SLR Report Review Costs	h) Review annual SLR program report[3]
	None	i) **Review report on lead tap samples following partial LSLR**
State Lead Public Education and Outreach under the Pre-2021 LCR *Related Costs*	*One-Time POU Program Costs*	a) *Review POU plan.* b) *Provide templates for POU outreach materials.* c) *Review POU public education materials.*
	Ongoing POU Program Costs	d) *Review sample invalidation request for POU monitoring.* e) *Review customer notification certifications.* f) *Review annual POU program report.*
	Consumer Notice	a) *Provide templates for consumer notice materials.* b) *Review lead consumer notice materials.* c) *Review copy of the consumer notice and certification.*
	Activities Regardless of the Lead 90th Percentile Level	d) *Provide templates for updated CCR language.* e) *Provide templates for local and State health department lead outreach.* f) *Review lead outreach materials for local and State health departments.* g) *Participate in joint communication efforts with local and State health departments.* h) *Provide templates for service line disturbance outreach materials.* i) *Review public education materials for service line disturbances.* j) *Provide templates for inventory-related outreach materials.* k) *Review inventory-related outreach materials.* l) *Provide technical assistance to PWSs for public education materials.* m) *Review public education certifications.*
B.9.5: State Lead Public Education and Outreach under the Pre-2021 LCR		n) *Provide templates for updated public education materials for systems with a lead ALE* o) *Review revised lead language for systems with a*

Component	Subcomponents	Activities[2]
		lead ALE p) Consult with CWS on other public education activities in response to lead ALE q) Review public education certifications[4]
	Public Education Activities in Response to Multiple Lead ALEs	p) *Review plan for making filters available.* q) *Provide templates for systems with multiple lead ALEs.* r) *Review outreach materials provided by systems with multiple lead ALEs.* s) *Consult on filter program for systems with multiple lead ALEs.*

Acronyms: ALE = action level exceedance; CCR = Consumer Confidence Report; CCT = corrosion control treatment; CWS = community water system; DSSA = Distribution System and Site Assessment; EPA = Environmental Protection Agency; LCR = Lead and Copper Rule; LSLR = lead service line replacement; OCCT = optimal corrosion control treatment; OWQPs = optimal water quality parameters; POU = point-of-use; PWS = public water system; SDWIS/Fed = Safe Drinking Water Act Information System/Federal version; SL = service line; SLR = service line replacement; WQP = water quality parameter.

Notes:

[1] States will also incur burden for recordkeeping activities under the pre-2021 LCR, such as retaining records of decisions, supporting documentation, technical basis for decisions, and documentation submitted by the system. The EPA has included burden for recordkeeping with each activity when applicable as opposed to providing separate burden estimates.

[2] The EPA assigned a unique letter of identification (ID) for each activity under a given rule component. Activities are generally organized with upfront, one-time activities first followed by ongoing activities. Note that these activities are different than the activities identified for PWSs in Exhibit B-13. Activities shaded in gray indicate new requirements that apply only to the LCRR. They are included to more fully characterize the differences between the pre-2021 LCR and final LCRI.

[3] The review of the annual SLR report applies to the pre-2021 LCR and final LCRI. This report is discussed in Section B.9.4.

[4] For the final LCRI, the review of certifications corresponds to activity s) that is included in Chapter 4, Section 4.4.6.2 – Activities Regardless of Lead 90th Percentile Levels.

B.9.1 State Administrative Costs under the Pre-2021 LCR

Because the pre-2021 LCR is already in effect, States will not incur one-time rule implementation burden that are included for the final LCRI as activities a) through e) in Chapter 4, Section 4.4.1.1. However, States will incur burden for four annual administration activities, as shown in Exhibit B-136. This exhibit provides the unit burden estimate for each activity. The third column provides the corresponding SafeWater LCR model data variable. The last column indicates whether the activity, unit burden, and the SafeWater LCR model data variable are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.1.2. The assumptions that differ from the final LCRI follow the exhibit.

Note that State burden estimates for responding to specific requirements of the pre-2021 LCR (*e.g.*, review changes in a system's treatment, consult with systems) are presented in the sections for those particular rule requirements.

Exhibit B-136: State Annual Administration Activities and Unit Burden Estimates under the Pre-2021 LCR

Activity	Unit Burden (hours/State)	*SafeWater LCR Data Variable*	Same As Final LCRI?
f) Coordinate with the EPA	1,040	*hrs_coord_epa_js*	Yes.
g) Provide ongoing technical assistance	774	*hrs_ta_js*	No. See discussion following the exhibit.
h) Report to SDWIS/Fed	1,040	*hrs_sdwis_js*	No. See discussion following the exhibit.
i) Train staff for annual administration	104	*hrs_train_ann_js*	Yes.
Per State Total	2,958		

Acronyms: EPA = Environmental Protection Agency; LCRI = Lead and Copper Rule Improvements; SDWIS/Fed = Safe Drinking Water Information System/Federal version.

Sources:

f), g), and i): "Administrative Burden and Costs_Final.xlsx." All unit burdens are based on the administrative burden estimated for the EPA's 2012, *Economic Analysis for the Final Revised Total Coliform Rule*, Exhibit 7.4 (USEPA, 2012).

g): ASDWA 2020 and 2024 CoSTS models (ASDWA, 2020b; ASDWA, 2024). Also see " Administrative Burden and Costs_Final.xlsx."

Notes:

f): States must coordinate with their EPA Regional office to be certain that their program is consistent with Federal requirements.

g): Includes ongoing tracking and follow-up activities for review of monitoring data and public notice and education for systems with lead ALEs. See "Administrative Burden and Costs_Final.xlsx worksheet," "Deriv_Ongoing TA_LCR" for additional detail on how this burden estimate was derived.

h): Includes the burden for States to report 90th percentile data, milestone, and violation and compliance information to SDWIS/Fed. Under the LCRR, the EPA assumed additional administrative burden (+560 hours or 0.25 full time equivalents) for States to report the following to SDWIS/Fed: OCCT status of all water systems, including the parameters that define the optimization; all lead 90th percentile values for systems serving 3,300 or fewer in lieu of only those levels above 15 µg/L; and the current number of LSLs and service lines of unknown material for all water systems.

i): Assumed States will have annual burden to continue to train staff.

g) ***Provide ongoing technical assistance (hrs_ta_js).*** The EPA determined the on-going tracking and follow-up per system estimates provided in ASDWA 2020 and 2024 CoSTS models (ASDWA, 2020b; ASDWA, 2024) for the review of monitoring data and public notice and education as follows:

1. Determined the per system burden estimates separately for 12 categories that included small, medium, and large CWSs with and without LSLs and NTNCWSs with and without LSLs because the estimates and rule applicability vary by system size, system type, and LSL status.

2. Multiplied the per system estimate by the number of systems in each of the 12 categories based on the system inventory information provided in Chapter 3, Section 3.3.1.

3. Summed the burden for the four system type and LSL status categories to derive a total burden by size category.

4. Divided each burden by the 49 States used in the ASDWA CoSTs model to derive a total burden by size category.

5. Determined the weighted average across the size categories.

6. Divided the burden is step 5 by five because the estimates are provided for a five-year period.

   In determining the per system burden estimates, the EPA reviewed both ASDWA 2020 and 2024 CoSTS models. In the instances where the burdens differed between the ASDWA 2020 CoSTS and ASDWA 2024 CoSTS models, the EPA used the higher of the two to provide a more conservative estimate. There were no changes in burden estimates applicable to the LCR, so the burden remained the same in the proposed and final rules. Note that the EPA did not include ASDWA's estimates for reporting or re-evaluation activities in the ongoing technical assistance burden because they are included in other data variables nor violations or compliance estimates because the EPA assumed full compliance for cost modeling purposes. Also, the ongoing technical assistance burden does not include estimates from "CCT" worksheets because they are one-time activities and the EPA has accounted for their burden in other activities.

h) ***Report to SDWIS/Fed (hrs_sdwis_js).*** The EPA estimated the Includes the annual burden for States to report 90th percentile data, milestone, and violation and compliance information to SDWIS/Fed of 1,040 hours. Under the final LCRI, the EPA assumed additional administrative burden (+560 hours or 0.25 full time equivalents) for States to report to additional SDWIS/Fed reporting requirements that include OCCT status of all water systems, including the parameters that define the optimization; all lead 90th percentile values for systems serving 3,300 or fewer in lieu of only those levels above the lead AL; and the existing number of lead, GRR, and service lines of unknown material for all water systems.

Exhibit B-137 shows the SafeWater LCR model cost estimation approach for State administrative activities and indicates that the costing approach is the same as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-145.

Exhibit B-137: State Administration and Rule Implementation Costing Approach in SafeWater LCR by Activity under the pre-2021 LCR[1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
f) Coordinate with the EPA				
Same as final LCRI (see Exhibit 4-145 in Chapter 4).				
g) Provide ongoing technical assistance				
Same as final LCRI (see Exhibit 4-145 in Chapter 4).				

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
h) Report to SDWIS/Fed				
Same as final LCRI (see Exhibit 4-145 in Chapter 4).				
i) Train staff for annual administration				
Same as final LCRI (see Exhibit 4-145 in Chapter 4).				

Acronyms: CWS = community water system; EPA = Environmental Protection Agency; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; SDWIS/Fed = Safe Drinking Water Information System/Federal version.

B.9.2 State Sampling Related Costs under the Pre-2021 LCR

This section provides State unit burden related to lead tap sampling, lead WQP monitoring, copper WQP monitoring, and source water monitoring in Sections B.9.2.1 through B.9.2.4, respectively. As noted in Subsections B.9.2.1 and B.9.2.4, as well as Section B.9.4 that pertains to LSLR, Arkansas, Louisiana, Mississippi, Missouri, and South Carolina pay for the cost of bottles, analysis, and providing sample results to the system as part of their State's oversight and implementation responsibilities. Thus, these States will incur the cost of bottles, analysis, and providing lead sample results to the system (ASDWA, 2020a). Note that there may be additional State laboratories that incur some analytical and reporting burden and costs in lieu of the system that would result in an underestimation of State costs.

School testing under the final LCRI does not apply to the pre-2021 LCR and thus is not covered in this section. For additional detail, refer to Chapter 4, Section 4.4.2.5.

B.9.2.1 State Lead Tap Sampling Costs

The EPA has identified and developed costs for State oversight and review activities associated with lead tap sampling conducted by water systems under the pre-2021 LCR, as shown in Exhibit B-138. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. Activities that are conducted by some States in lieu of the water system are identified in a footnote below the exhibit. The last column indicates whether the activity, unit burden, and the SafeWater LCR model data variable for the pre-2021 LCR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.2.1. The assumptions that differ from the final LCRI follow the exhibit. Gray shaded rows indicate new requirements that do not apply to the pre-2021 LCR.

Exhibit B-138: State Lead Tap Sampling Burden Estimates under the Pre-2021 LCR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Provide templates for revised sampling instructions and conduct review (one-time)	N/A	*hrs_rev_samp_js*	N/A under the pre-2021 LCR.

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
b) Review updated sampling plan (one-time)	N/A	*hrs_rev_samp_plan_js*	N/A under the pre-2021 LCR.
c) Review initial lead tap sampling data and prepare systems for status under the rule	N/A	*hrs_initial_tap_rev_js*	N/A under the pre-2021 LCR.
d) Review change in tap sample locations[1]	2 hrs/CWS	*hrs_chng_tap_js*	Yes.
e) Review 9-year monitoring waiver renewal	0.5 hrs/PWS for those with 9-year monitoring waiver	*hrs_renew_nine_js*	Yes.
f) Review sample invalidation requests	2 hrs/invalidation request	*hrs_samp_invalid_js*	Yes.
g) Review consumer notification certifications	0.33 to 0.5 hrs/certification	*hrs_cert_cust_lt_js*	Yes.
h) Review monitoring results and 90th percentile calculations	0.5 to 2 hrs/PWS	*hrs_annual_lt_js*[2]	No. See discussion following the exhibit.

Acronyms: CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; PWS = public water system.
Source: "Lead Analytical Burden and Costs_Final.xlsx."
Notes:
[1] Applies to CWSs only. The EPA assumed 0 hours for NTNCWSs because they collect their own samples from sampling locations under their control and thus, are unlikely to change sampling sites and submit documentation to the State for review.
[2] As previously discussed in Section B.8.1.1.2 in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles, shipping, analysis, and providing sample results to the system (ASDWA, 2020a). Thus, the State will incur the burden and cost for these activities in lieu of the system. In this instance, the system burden to provide monitoring results and 90th percentile calculations is applied to these States and *hrs_annual_lt_js* would be 0. Instead, they will incur the system burden of *hrs_annual_lt_op* (see B.8.1.1.2, activity p)).

h) Review monitoring results and 90th percentile calculations (hrs_annual_lt_js). The EPA estimated the burden for States to review monitoring results and lead 90th percentile calculations is 0.5 hours for systems serving 3,300 or fewer, 1 hour for systems serving 3,301 to 10,000, 1.5 hours for systems serving 10,001 to 100,000, and 2 hours for systems serving greater than 100,000. These estimates are based on the 2022 *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 48 (Tap Sample Calcs) (USEPA, 2022) and were doubled from the proposed rule based on ASDWA's 2024 CoSTS model, section "Tap Sampling" (ASDWA, 2024). For the final LCRI, the burden for LSL systems is 1.25 times higher because LSL systems must provide a justification if they are unable to collect their required number of samples from only sites served by LSLs.

Exhibit B-139 shows the SafeWater LCR model cost estimation approach for State lead tap monitoring activities including additional cost inputs required to calculate these costs, as well as final LCRI activities from Chapter 4, Exhibit 4-148 that do not apply under the pre-2021 LCR in gray shaded rows.

Exhibit B-139: State Lead Tap Sampling Unit Cost Estimation in SafeWater LCR by Activity under the Pre-2021 LCR[1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
a) Provide templates for revised sampling instructions and conduct review				
N/A under the pre-2021 LCR.				
b) Review updated sampling plan for LSL systems				
N/A under the pre-2021 LCR.				
c) Review initial lead monitoring data and prepare systems for status under the rule				
N/A under the pre-2021 LCR.				
d) Review change in tap sample locations				
The hours per system multiplied by the State labor rate *(hrs_chng_tap_js*rate_js)*	Cost does not apply to States for NTNCWSs.	All	States with systems not on reduced tap monitoring 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice a year
			States with systems on reduced annual tap sampling *p_tap_annual*	Once a year
			States with systems on reduced triennial tap sampling *p_tap_triennial*	Every 3 years
			States with systems on reduced nine year sampling *p_tap_nine*	Every 9 years
e) Review 9-year monitoring waiver renewal				
The hours per system multiplied by the State labor rate *(hrs_renew_nine_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	States with systems on reduced nine-year sampling *p_tap_nine*	Every 9 years
f) Review sample invalidation requests				
The number of samples determined to be invalid multiplied by the hours per sample per system and the State labor rate *(numb_samp_customer*pp_samp_invalid)*(hrs_samp_invalid_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	States with systems not on reduced tap sampling 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice a year
The number of samples determined to be invalid multiplied by the hours per sample per system and the State labor rate. *(numb_reduced_tap*pp_samp_invalid)*(hrs_samp_invalid_js*rate_js)*			States with systems on reduced annual tap sampling *p_tap_annual*	Once a year

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions[2]	
			States with systems on reduced triennial tap sampling *p_tap_triennial*	Every 3 years
			States with systems on reduced nine year sampling *p_tap_nine*	Every 9 years
g) Review consumer notification certifications				
The hours per system multiplied by the State labor rate. *(hrs_cert_cust_lt_js*rate_js)*	Cost applies as written to States for NTNCWSs.	All	States with systems not on reduced tap sampling 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice a year
			States with systems on reduced annual tap sampling *p_tap_annual*	Once a year
			States with systems on reduced triennial tap sampling *p_tap_triennial*	Every 3 years
			States with systems on reduced nine year sampling *p_tap_nine*	Every 9 years
h) Review monitoring results and 90th percentile calculations[2]				
The hours per system multiplied by the State labor rate. (hrs_annual_lt_js*rate_js)	Cost applies as written to States for NTNCWSs.	All	States with systems not on reduced tap sampling 1 - *(p_tap_annual + p_tap_triennial + p_tap_nine)*	Twice a year
			States with systems on reduced annual tap sampling *p_tap_annual*	Once a year
			States with systems on reduced triennial tap sampling *p_tap_triennial*	Every 3 years
			States with systems on reduced nine year sampling *p_tap_nine*	Every 9 years

Acronyms: CWS = community water system; LCR = Lead and Copper Rule; LCRR = Lead and Copper Rule Revisions; LSL = lead service line; NTNCWS = non-transient non-community water system.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of the following:

- *numb_reduced_tap*: the number of lead tap samples for system on reduced annual, triennial, or 9-year monitoring (Chapter 4, Section 4.3.2.1.1).
- *numb_samp_customer*: the number of lead tap samples for system on standard 6-month tap monitoring (Chapter 4, Section 4.3.2.1.1).
- *pp_samp_invalid*: Likelihood that a lead sample will be deemed invalid (Chapter 4, Section 4.3.2.1.2, activity f)).
- *p_tap_annual, p_tap_triennial,* and *p_tap_nine*: Likelihood a system will qualify to collect lead tap samples at an annual, triennial, and nine-year frequency, respectively (Chapter 3, Section 3.3.7.1).
- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

[2] In Arkansas, Louisiana, Mississippi, Missouri, and South Carolina, the State conducts this activity in lieu of the system (ASDWA, 2020a). In these States, the burden for *hrs_annual_lt_js* is 0. Instead, they will incur the system burden of *hrs_annual_lt_op* (see B.8.1.1.2, activity p)).

B.9.2.2 State Lead WQP Sampling Costs

The EPA has developed State costs for the review of lead WQP monitoring data submitted by systems serving 50,000 or fewer people that exceed the lead AL of 15 µg/L and all systems serving more than 50,000 people with CCT[52] under the pre-2021 LCR, as shown in Exhibit B-140. The exhibit provides the unit burden for this review. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden, and the SafeWater LCR model data variable are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.2.2.

The conditions under which the inputs apply differ under the pre-2021 LCR and final LCRI. Under the final LCRI, systems are not allowed to conduct distribution WQP monitoring on a triennial frequency as was allowed under the pre-2021 LCR. Further, more systems will be required to conduct WQP monitoring under the final LCRI because: 1) more systems are expected to exceed the lead AL due to more stringent tap sampling and 90th percentile protocol requirements for systems with LSLs; and 2) systems serving 10,001 to 50,000 people with CCT will be required to continue WQP monitoring irrespective of their lead 90th percentile level.

Exhibit B-140: State Lead WQP Monitoring Burden Estimates under the Pre-2021 LCR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
i) Review lead WQP sampling data and compliance with OWQPs	No CCT: 5 hrs/system/6-month monitoring period; With CCT: 8.5 hrs/system/6-month monitoring period	*hrs_wqp_js*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; OWQP = optimal water quality parameter; WQP = water quality parameter.

[52] All systems serving more than 50,000 people except those with naturally non-corrosive water (*i.e.*, "b3" systems") are required to have CCT.

Source: " WQP Analytical Burden and Costs_Final.xlsx."

The SafeWater LCR model costing approach for estimating the cost of lead WQP monitoring including additional cost inputs that are required to calculate these costs under the pre-2021 LCR are identical to those for the LCRR. For additional detail, refer to Exhibit B-68 in Section B.6.2.2.

B.9.2.3 State Copper WQP Monitoring Costs

The EPA has developed State costs for the review of copper WQP monitoring data per six-month monitoring period under the pre-2021 LCR, as shown in Exhibit B-141. The exhibit provides the unit burden for this review. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden, and the SafeWater LCR model data variable are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.2.3.

Exhibit B-141: State Copper WQP Monitoring Burden Estimates under the Pre-2021 LCR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
j) Review copper WQP sampling data and compliance with OWQPs	No CCT: 5 hrs/system/6 month monitoring period; With CCT: 8.5 hrs/system/6 month monitoring period	*hrs_wqp_js*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; OWQP = optimal water quality parameter; WQP = water quality parameter.
Source: " WQP Analytical Burden and Costs_Final.xlsx."

The SafeWater LCR model costing approach for estimating the cost of lead WQP monitoring including additional cost inputs that are required to calculate these costs are identical to those for the final LCRI. For additional detail, refer to Exhibit B-70 in Section B.6.2.3.

B.9.2.4 State Source Water Monitoring Costs

Under the pre-2021 LCR, source water monitoring was required if a water system had a significant source water change. PWSs also were required to conduct source water monitoring when they exceeded the lead or copper AL. The likelihood of a significant source change or ALE, as well as the required number of source water samples, are described in Chapter 4, Section 4.3.2.4.1. Under the final LCRI, systems can forego source water monitoring if they previously sampled source water in response to an ALE, the State has not required source water treatment, and they have not added any new water sources that changes their primacy source type. For modeling purposes, no system is assumed to have source water treatment.

The EPA has developed State costs to review source water monitoring data as shown in Exhibit B-142. The exhibit provides the unit burden for this review. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates that the activity, unit burden, and the SafeWater LCR model data variable are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.2.4.

Exhibit B-142: State Source Monitoring Burden Estimates

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As LCRR?
k) Review source water monitoring results	0.5 hrs/system/monitoring period in which source water samples are collected	*hrs_source_js*[1]	Yes.

Acronyms: LCRR = Lead and Copper Rule Revisions.
Source: "Lead Analytical Burden and Costs_Final.xlsx."
Notes:
[1]As previously discussed in Section B.8.1.4 in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles, shipping, analysis, and providing sample results to the system (ASDWA, 2020a). Thus, the State will incur the burden and cost for these activities. In these States, because the State is reporting the results, the burden to review the results (*hrs_source_js*) is 0. Instead, the system burden to report the results (*hrs_report_source_op*) is applied to these States (see Section B.8.1.4, activity hh)).
[2]The unit burden and data variable names are the same between the pre-2021 LCR and final LCRI. However, their applicability differs. Under the pre-2021 LCR, systems were required to continue to conduct source water monitoring whenever they had a lead or copper ALE. Under the final LCRI, systems forego source water monitoring if they previously sampled source water in response to an ALE, the State has not required source water treatment, and they have not added any new water sources that changes their primacy source type. For modeling purposes, no system is assumed to have source water treatment.

Exhibit B-143 shows the SafeWater LCR model cost estimation approach for State source water monitoring activities including additional cost inputs required to calculate these costs under the pre-2021 LCR.

Exhibit B-143: State Source Water Monitoring Cost Estimation in SafeWater LCR by Activity under the pre-2021 LCR[1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Event
		Lead 90th - Range	Other Conditions	
k) Review source water monitoring results[2]				
The hours per system multiplied by the State labor rate. *(hrs_source_js*rate_js)*	Cost applies as written to States for NTNCWSs.	At or below AL	States with systems with surface water sources and a copper ALE *p_copper_ale*	Once per event
		Above AL	States with systems with surface water sources	Once per year
		At or below AL	States with systems with groundwater sources and a copper ALE *p_copper_ale*	Every three years per event

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Event
		Lead 90th - Range	Other Conditions	
		Above AL	States with systems with groundwater sources	Every three years

Acronyms: AL = action level; ALE = action level exceedance; CWS = community water system; NTNCWS = non-transient non-community water system**.**

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *p_tap_annual, p_tap_triennial,* and *p_tap_nine*: Likelihood a system will qualify to collect lead tap samples at an annual, triennial, and nine-year frequency, respectively (Chapter 3, Section 3.3.7.1).
- *numb_st_sample*: number of samples per entry point for source water monitoring (Chapter 4, Section 4.3.2.4.1).
- *p_copper_ale*: likelihood a system with exceed the copper AL (Chapter 4, Section 4.3.2.3.1).
- *rate_op:* PWS hourly labor rate (Chapter 3, Section 3.3.11.1).

[2] As previously discussed in Section B.8.1.4 in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles, shipping, analysis, and providing sample results to the system (ASDWA, 2020a). Thus, the State will incur the burden and cost for these activities in lieu of the system. In these States, because the State is reporting the results, the burden to review the results (*hrs_source_js*) is 0. Instead, the system burden to report the results (*hrs_report_source_op*) is applied to these States (see Section B.8.1.4, activity hh)).

B.9.3 State CCT-Related Costs under the Pre-2021 LCR

State oversight and review activities related to CCT are grouped into four major subcomponents:

- B.9.3.1: State CCT Installation Costs
- B.9.3.2: State CCT Re-optimization Costs
- B.9.3.3: State Lead CCT Routine Costs
- B.9.3.4: State CCT Activities Unique to the Pre-2021 LCR

State oversight activities related to find-and-fix when a single sample exceeds 15 µg/L is a new requirement under the final LCRI and does not apply to the pre-2021 LCR and thus are not discussed in Appendix B.

B.9.3.1 State CCT Installation Costs

The EPA developed State cost for one-time activities associated with CCT installation under the pre-2021 LCR, as shown in Exhibit B-144. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variables in red/italic font. The last column indicates whether the activity, unit burden or cost, the SafeWater LCR model data variable, and/or applicability are identical for the pre-2021 LCR to those used for the final LCRI, as described in Chapter 4, Section 4.4.3.1.

Exhibit B-144: State CCT Installation-Related Burden Estimates

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
a) Review CCT study and determine type of CCT to be installed	27 to 52 hrs/system	*hrs_review_cct_lead_js*	Yes.
b) Set OWQPs after CCT installation	2 to 12 hrs/system serving ≤ 50,000 people	*hrs_set_owqp_js*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; LSL = lead service line; OWQP = optimal water quality parameter.

Exhibit B-145 provides the SafeWater LCR model cost estimation approach for State activities related to CCT Installation and indicates that the costing approach is the same as the final LCRI, as provided in Chapter 4, Exhibit 4-160.

Exhibit B-145: State CCT Installation Cost Estimation in SafeWater LCR by Activity[1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
a) Review CCT study and determine type of CCT to be installed				
Same as final LCRI (see Exhibit 4-160 in Chapter 4).				
b) Set OWQPs after CCT installation				
Same as final LCRI (see Exhibit 4-160 in Chapter 4).				

Acronyms: CCT = corrosion control treatment; CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; OWQP = optimal water quality parameter.

B.9.3.2 State CCT Re-optimization Costs

The EPA identified and developed State cost for oversight and review activities associated with a system's re-optimization of existing CCT under the pre-2021 LCR, as shown in Exhibit B-146. This exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variables in red/italic font. The last column indicates whether the activity, unit burden, and the SafeWater LCR model data variable for the pre-2021 LCR are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.3.2.

Exhibit B-146: State CCT Re-Optimization-Related Burden Estimates under the Pre-2021 LCR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
c) Review study and determine needed OCCT adjustment	28 to 50 hrs/system	*hrs_review_cct_lead_js*	Yes.
d) Reset OWQPs after CCT re-optimization	2 to 20 hrs/system	*hrs_reset_owqp_js*	Yes.

Acronyms: CCT = corrosion control treatment; LCRI = Lead and Copper Rule Improvements; LSL = lead service line; OCCT = optimal corrosion control treatment; OWQP = optimal water quality parameter.

Exhibit B-147 shows the SafeWater LCR model cost estimation approach for State activities related to CCT re-optimization and indicates that the approach for the final pre-2021 LCR is the same as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-163.

Exhibit B-147: State CCT Re-optimization Cost Estimation in SafeWater LCR by Activity under the Pre-2021 LCR[1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
c) Review CCT study and determine needed OCCT adjustment				
Same as final LCRI (see Exhibit 4-163 in Chapter 4).				
d) Reset OWQPs after CCT re-optimization				
Same as final LCRI (see Exhibit 4-163 in Chapter 4).				

Acronyms: CCT = corrosion control treatment; CWS = community water system; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system; OCCT = optimal water quality parameters; OWQP = optimal water quality parameters.
Notes:
[1] The data variables in the exhibit are defined previously in this section with the exception of:
- *p_cct_study:* Likelihood a State will require a CCT study (Section B.8.2.1).
- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

B.9.3.3 State Lead CCT Routine Costs

The EPA developed State cost associated with routine CCT activities under the pre-2021 LCR, as shown in Exhibit B-148. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variables in red/italic font. The last column indicates whether the activity, unit burden or cost, the SafeWater LCR model data variable, and/or applicability for the pre-2021 LCR are identical to those used for the LCRR, as described in Chapter 4, Section 4.4.3.4. Gray shaded rows indicate requirements that do not apply to the pre-2021 LCR.

Exhibit B-148: State Lead CCT Routine Burden Estimates under the Pre-2021 LCR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
g) Review CCT guidance and applicability to individual PWSs	N/A	*hrs_cct_review_js*	N/A. Does not apply to the pre-2021 LCR.
h) Review water quality data with	N/A	*hrs_sanit_surv_js*	N/A. Does not apply to the pre-2021 LCR.

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
PWSs during sanitary survey			
i) Consult on required actions in response to source water change	6 to 12 hrs/system on reduced tap monitoring	*hrs_coop_source_chng_red_js*	Yes.
	N/A for systems on standard monitoring.	*hrs_coop_source_chng_rout_js*	N/A. Does not apply to the pre-2021 LCR.
j) Consult on required actions in response to treatment change	46 to 84 hrs/system on reduced tap monitoring	*hrs_coop_treat_chng_ js*	Yes.

Acronyms: CCT = corrosion control treatment; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; PWS = public water system.

Sources:

i): "Likelihood_SourceChange_Final.xlsx."

j): "Likelihood_TreatmentChange_Final.xlsx."

Notes:

i) & j): Under the pre-2021 LCR, consultation with the State prior to making a source or treatment change applied only to those systems on a reduced monitoring schedule, *i.e.*, monitoring less frequently than semi-annually. Under the final LCRI this consultation to also apply to system monitoring semi-annually (see Chapter 4, Section 4.4.3.4 activities i) and j) for additional detail.

Exhibit B-149 provides the SafeWater LCR model cost estimation approach for State activities related to consultation on a change in source or treatment including additional cost inputs that are required to calculate total costs under the pre-2021 LCR.

Exhibit B-149: State Lead CCT Routine Cost Estimation in SafeWater LCR by Activity under the pre-2021 LCR[1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
g) Review CCT guidance and applicability to individual PWSs				
N/A under the pre-2021 LCR.				
h) Review water quality data with PWSs during sanitary survey				
N/A under the pre-2021 LCR.				
i) Consult on required actions in response to source water change[2]				
The hours per system multiplied by the State labor rate. *(hrs_coop_source_chng_ red_js*rate_js)*	Cost applies as written for primacy agencies to NTNCWSs.	Below AL	States with any model PWSs on reduced tap sampling that have a change in source water 1- *[p_tap_annual + p_tap_triennial +*	Once per event

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
			p_tap_nine] and p_source_chng	
j) Consult on required actions in response to treatment change				
The hours per system multiplied by the State labor rate. *(hrs_coop_treat_chng_ js*rate_js)*	Cost applies as written for primacy agencies to NTNCWSs.	Below AL	States with any model PWSs on reduced tap sampling that have a change in treatment 1- *[p_tap_annual + p_tap_triennial + p_tap_nine] and p_treat_change*	Once per event

Acronyms: AL = action level; CCT = corrosion control treatment; CWS = community water system; LCR = Lead and Copper Rule; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *p_tap_annual, p_tap_triennial,* and *p_tap_nine*: Likelihood a system will qualify to collect lead tap samples at. an annual, triennial, and nine-year frequency, respectively (Chapter 3, Section 3.3.7.1).
- *p_treat_chng:* Likelihood that a system will change treatment in a given year (Chapter 3, Section 3.3.9.3).
- *p_source_chng:* Likelihood a system will have a source change (Chapter 3, Section 3.3.9.1).
- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

B.9.3.4 State CCT Activities Unique to the Pre-2021 LCR

The EPA developed State cost for CCT activities unique to the pre-2021 LCR as shown in Exhibit B-150. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variables in red/italic font. The last column indicates that the activity is unique to the pre-2021 LCR. A description of these activities follows the exhibit.

Exhibit B-150: State CCT Activities Unique to the Pre-2021 LCR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
k) Determine need for a CCT study	4 to 16 hrs/system serving ≤50K	*hrs_lcr_study_js*	No. Unique to the pre-2021 LCR.
l) Determine type of CCT for systems without a study	20 to 80 hrs/system serving ≤50K	*hrs_lcr_cct_js*	No. Unique to the pre-2021 LCR.
m) Determine need for a revised CCT study	4 to 16 hrs/system serving ≤50K	*hrs_lcr_study_js*	No. Unique to the pre-2021 LCR.
n) Determine type of CCT adjustment for systems without a study	20 to 80 hrs/system serving ≤50K	*hrs_lcr_cct_js*	No. Unique to the pre-2021 LCR.

Acronyms: CCT = corrosion control treatment; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements.
Source: "CCT Study and Review Costs_Final.xlsx."

k) ***Determine need for a CCT study (hrs_lcr_study_js).*** The EPA estimated that States would require 4 hours, 8 hours, and 16 hours to determine if systems serving 3,300 or fewer people, 3,301 to 10,000 people, and 10,001 to 50,000 people, respectively, would need to conduct a study prior to installing CCT. The EPA based the burden for this decision on responses provided by North Carolina to an ASDWA 2016 questionnaire (available in the docket at EPA-HQ-OW-HQ-2017-0300 at www.regulations.gov) for systems serving 3,300 or fewer people and systems serving 10,001 to 50,000 people. North Carolina did not provide an estimate for systems serving 3,301 to 10,000 people and the EPA assumed 50 percent of the burden needed for those serving 10,001 to 50,000 people. All assumed 0 burden for those serving more than 50,000 people because these systems should already have CCT in place.

l) ***Determine type of CCT for systems without a study (hrs_lcr_cct_js).*** Exhibit B-151 provides the data variable and inputs values associated with the States determination of the type of required CCT for systems that do not conduct a CCT study. The estimates are based on North Carolina and Indiana's responses to a 2016 ASDWA questionnaire. North Carolina reported that determining CCT without a study would take 24 hours for systems serving ≤ 100 people to 80 hours for those serving 10,001 to 50,000 people. Indiana responded that this would take 16 hours for systems serving ≤ 100 people to 80 hours for those serving 10,001 to 50,000 people. The EPA assumed 20 hours (averaging 16 and 24 hours from North Carolina and Indiana) for systems serving ≤ 100 people and 80 hours for systems serving 10,001 to 50,000 people, which was the estimate reported by both States. For the size categories in between, the EPA assumed 40 hours for those systems serving 101 to 1,000 people and 60 hours for those serving 3,301 - 10,000 people.

Exhibit B-151: Estimated Burden to Determine CCT for Systems with No Study

System Size (Population Served)	Determine CCT when study is NOT required (hrs/system) *(hrs_lcr_cct_js)*
≤100	20
101-1,000	40
1,001-10,000	60
10,001-50,000	80
> 50,000	N/A

Acronyms: CCT = corrosion control treatment.
Source: "CCT Study and Review Costs_Final.xlsx."
Note: The shaded row indicates size categories that are not subject to these requirements because with very few exceptions, systems serving > 50,000 were already required to conduct a CCT study and install CCT under the pre-2021 LCR.

An important input in estimating total State costs for this activity is the likelihood that the State will require a study. The EPA estimated the likelihood of a CCT study (*p_cct_study*) for LSL and non-lead service line systems based on the recommendations in the OCCT Recommendations Document (USEPA, 2019). For detailed approach and values, see Section B.8.2.1.

m) ***Determine need for a revised CCT study (hrs_lcr_study_js).*** States have discretion to determine if a system serving 50,000 or fewer people must revise their CCT study. The EPA assumed this activity will require the same burden as determining the need for a CCT study and used the same data variable of *hrs_lcr_study_js*. See activity k) for data inputs and assumptions.

n) ***Determine CCT adjustment for systems without a revised study (hrs_lcr_cct_js).*** For systems serving 50,000 or fewer people that do not revise their CCT study, States will determine the needed CCT adjustment. The EPA assumed this activity will require the same burden as determining CCT when no study is done and used the same data variable for *hrs_lcr_cct_js*. See activity l) for data inputs and assumptions.

To estimate the likelihood that the State will determine the needed CCT adjustment without a revised study, the EPA used the likelihood that State will require a new CCT study (*p_cct_study*) as described in Section B.8.2.1. The EPA assumed that all systems serving more than 50,000 people will revise their study.

Exhibit B-152 provides the SafeWater LCR model cost estimation approach for State activities that are unique to the pre-2021 LCR including additional cost inputs that are required to calculate total costs.

Exhibit B-152: State Activities Unique to the Pre-2021 LCR Cost Estimation in SafeWater LCR by Activity[1]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
k) Determine need for a CCT study				
The hours per system multiplied by the State labor rate. *(hrs_lcr_study_js*rate_js)*	Cost applies as written to States for NTNCWSs.	Above AL	States with any model PWSs installing CCT	One time
l) Determine type of CCT for systems without a study				
The hours per system multiplied by the State labor rate. *(hrs_lcr_cct_js *rate_js)*	Cost applies as written to States for NTNCWSs.	Above AL	States with any model PWSs installing CCT without conducting a study on the installation of CCT 1 - *p_cct_study*	One time
m) Determine need for a revised CCT study				
The hours per system multiplied by the State labor rate. *(hrs_lcr_study_js*rate_js)*	Cost applies as written to States for NTNCWSs.	Above AL	States with model PWSs re-optimizing CCT	One time
n) Determine CCT adjustment for systems without a revised study				

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
The hours per system multiplied by the State labor rate. *(hrs_lcr_cct_js*rate_js)*	Cost applies as written to States for NTNCWSs.	Above AL	States with-model PWSs re-optimizing CCT that are not required to first conduct a CCT study 1 - *p_cct_study*	One time

Acronyms: AL = action level; CCT = corrosion control treatment; CWS = community water system; NTNCWS = non-transient non-community water system; PWS = public water system.

Notes:

[1] The data variables in the exhibit are defined previously in this section with the exception of:

- *p_cct_study:* Likelihood a State will require a CCT study (Section B.8.2.1).
- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

B.9.4 State Lead Service Line Testing and Replacement under the Pre-2021 LCR

Under the pre-2021 LCRI, States did not incur the one-time burden associated with the new SLR program oversight responsibilities described in Chapter 4, Sections 4.4.4.1 through 4.4.4.3, activities a) through g) that pertain to inventory, plan development and revision, and reassessment of deferred SLR rates. Thus, these activities are not discussed in this section.

For the pre-2021 LCR, the EPA developed State costs for two ongoing activities associated with the review of water systems' LSL testing and LSLR program activities as shown in Exhibit B-153. The third column provides the corresponding SafeWater LCR model data variables in red/italic font. The last column indicates whether the activity, unit burden, the SafeWater LCR model data variable, and/or applicability are identical to those used for the final LCRI, as described in Chapter 4, Section 4.4.4.2. The assumptions that differ from the 2021 LCRR follow the exhibit.

Exhibit B-153: State Ongoing LSL Testing and Replacement-Related Costs Burden Estimates[1]

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
h) Review annual SLR program report	1 to 4 hrs/CWS; 1 hr/NTNCWS	*hrs_report_lcr_js*	Yes.[2]
i) Review report on lead tap samples following partial LSLR	0.5 hrs/CWS	*hrs_report_plslr_js*	No. Unique to the pre-2021 LCR.

Acronyms: CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; LSLR = lead service line replacement; NTNCWS = non-transient non-community water system; SLR = service line replacement.

Source: "LSLR Ancillary Costs_Final.xlsx."

Notes:

[1] As previously discussed in Sections B.8.3.2 and B.8.3.3, Arkansas, Louisiana, Mississippi, Missouri, and South Carolina pay for the cost of bottles, analysis, and providing sample results to the system as part of their State's LCR oversight and implementation responsibilities (ASDWA, 2020a). Thus, these States will incur the burden and cost to provide sample bottles and conduct lead sample analyses.

[2] Although the report content under the annual LSLR reports differ between the pre-2021 LCR and final LCRI, the EPA assumed the State would incur a similar burden to review this report and thus, used the same data variable name and input for both rules. Refer to Chapter 4, Section 4.4.4.3, activity h) for additional detail.

i) Review report on lead tap samples following partial LSLR (hrs_report_plslr_js). States will incur annual burden to review CWS's submittal of LSL sample results following partial LSLR. As previously stated, NTNCWSs are assumed to conduct full replacements and such would not be providing these sample results. The EPA assumed States will require 0.5 hours to review these results based on the 2022 *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*, Exhibit 35 (Partial LSL Letter) (USEPA, 2022).

Exhibit B-154 provides the SafeWater LCR model cost estimation approach for State LSLR activities and indicates if the approach is the same for the pre-2021 LCR as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-177. It also includes additional cost inputs that are required to calculate these costs.

Exhibit B-154: State Lead Service Line Replacement Cost Estimation in SafeWater LCR by Activity[1,2]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity[3]
		Lead 90th - Range	Other Conditions	
h) Review annual SLR program report				
Same as final LCRI (see Exhibit 4-177 in Chapter 4).				
i) Review report on lead tap sampling following partial LSLR				
The hours per system multiplied by the State labor rate. *(hrs_report_plslr_js*rate_js)*	Cost does not apply to State for NTNCWSs.	Above AL	States with systems complying with the mandatory LSLR program	Once a year

Acronyms: AL = action level; CWS = community water system; LCRI = Lead and Copper Rule Improvements; LSLR = lead service line replacement; NTNCWS = non-transient non-community water system; SLR = service line replacement.

Notes:

[1] Under the pre-2021 LCR, these activities could stop after the system no longer has a lead ALE for two consecutive, six-month monitoring periods.

[2] The data variables in the exhibit are defined previously in this section with the exception of:

- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

[3] As previously discussed in Sections B.8.3.2 and B.8.3.3, in Arkansas, Louisiana, Mississippi, Missouri, and South Carolina the State pays for the cost of bottles and shipping and conducting the analysis for samples following LSLR (ASDWA, 2020a). Thus, the State will incur the burden and cost for these activities.

B.9.5 State Lead Public Education and Outreach under the Pre-2021 LCR

Under the pre-2021 LCR, States incurred oversight burden associated with PE that is required for water systems that exceed the lead AL of 15 µg/L. These oversight activities are provided in Exhibit B-155. The exhibit provides the unit burden for each activity. The third column provides the corresponding SafeWater LCR model data variable in red/italic font. The last column indicates whether the activity, unit

burden, and the SafeWater LCR model data variable are identical for the pre-2021 LCR to those used for the final LCRI, as described in Chapter 4, Section 4.4.6.3. The gray shaded row indicates an activity that is not required under the pre-2021 LCR.

Note that the final LCRI, includes additional PE, outreach, and notification State oversight activities associated with expedited consumer notice of individual sample tap sample results, requirements that are independent of a systems lead 90th percentile level, and those that are triggered when a system has more than one lead ALE in a five-year period. Those requirements are not included in this section but are detailed in Chapter 4, Sections 4.4.6.1, 4.4.6.2, and 4.4.6.4, respectively, as activities a) through m) and q) through t).

Exhibit B-155: State PE Burden in Response to Lead ALE under the Pre-2021 LCR

Activity	Unit Burden	*SafeWater LCR Data Variable*	Same As Final LCRI?
n) Provide templates for updated public education materials for systems with a lead ALE (one-time)	N/A	*hrs_ale_lang_temp_js*	N/A under the pre-2021 LCR.
o) Review revised lead language (one-time)	N/A	*hrs_ale_lang_js*	N/A under the pre-2021 LCR.
p) Consult with CWS on other public education activities in response to lead ALE	2 hrs/CWS	*hrs_ale_consult_js*	Yes.
q) Review public education certifications	CWSs 1 to 1.5 hrs/CWS NTNCWSs 0.33 to 0.5 hr/NTNCWS	CWSs *hrs_pe_certify_quarterly_js* NTNCWSs *hrs_cert_outreach_annual_js*	Yes.

Acronyms: ALE = action level exceedance; CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system.
Sources:
p): "Public Education Inputs_CWS_Final xlsx.
q): "Public Education Inputs_CWS_Final.xlsx; "Public Education Inputs_NTNCWS_Final.xlsx."

Exhibit B-156 shows the SafeWater LCR model cost estimation approach for State PE activities including additional cost inputs that are required to calculate these costs under the pre-2021 LCR. The exhibit also indicates if the approach is the same as that used for the final LCRI, as provided in Chapter 4, Exhibit 4-189, as well an activity that does not apply under the pre-2021 LCR in a gray shaded row.

Exhibit B-156: State Lead ALE Public Education Costing Approach in SafeWater LCR by Activity under the Pre-2021 LCR[1,2]

State Cost Per Activity for CWSs	State Cost Per Activity for NTNCWSs	Conditions for Cost to Apply to a State		Frequency of Activity
		Lead 90th - Range	Other Conditions	
n) Provide templates for updating public education materials for systems with a lead ALE				
N/A under the pre-2021 LCR. Assumed to have already occurred for all model PWSs with a lead ALE.				
o) Review revised lead language for systems with a lead ALE				
N/A under the pre-2021 LCR. Assumed to have already occurred for all model PWSs with a lead ALE.				
p) Consult with CWS on other PE activities in response to lead ALE				
Same as final LCRI (see activity p) in Exhibit 4-189 in Chapter 4).				
q) Review public education certifications				
The hours per system multiplied by the State labor rate. *(hrs_pe_certify_quarterly_js*rate_js)*	The hours per system multiplied by the State labor rate. *(hrs_cert_outreach_annual_js*rate_js)*	Above AL	All States	Once a year[3]

Acronyms: AL = action level; ALE = action level exceedance; CWS = community water system; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements; NTNCWS = non-transient non-community water system**;** PE = public education.

Notes:

[1] States can discontinue these activities when the system no longer has a lead ALE for one monitoring period.

[2] The data variables in the exhibit are defined previously in this section with the exception of:

- *rate_js:* State hourly labor rate (Chapter 3, Section 3.3.11.2).

[3] The State will review certifications quarterly for CWSs. For modeling purposes, the State burden is estimated on an annual basis. Under the final LCRI this cost is aggregated under the public education activities regardless of lead 90th percentile level and corresponds to activity m) that is included in Chapter 4, Section 4.4.6.2.

B.10 References

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USEPA. 2022. *Disinfectants/Disinfection Byproducts, Chemical, and Radionuclides Rules ICR (Renewal)*. Submitted to OMB for review and approval on March 24, 2023. (EPA ICR Number 1896.12, OMB Control Number 2040-0204).

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Appendix C: Costs and Benefits of the Final LCRI as Compared to the pre-2021 LCR

C.1 Introduction

In the primary economic analysis (EA), the EPA used the final Lead and Copper Rule Revisions (2021 LCRR) regulatory framework as the baseline for the estimated incremental costs and benefits of the final Lead and Copper Rule Improvements (LCRI) (see Chapters 4, 5, and 6). This choice of baseline in the primary EA is consistent with Office of Management and Budget (OMB) guidance in Circular A4 (OMB, 2023). Circular A4 states that the proposed regulations “are generally measured against a no-action baseline: an analytically reasonable forecast of the way the world would look absent the regulatory action being assessed.” Absent in the final regulatory changes in this final LCRI rulemaking, the 2021 LCRR would remain in effect and best represents the future regulatory framework and costs faced by public water systems (PWSs) and the resultant social benefits that would accrue to the public free of additional regulatory action.

Because most of the regulatory requirements of the 2021 LCRR have not been implemented as of the date of this final rule the EPA for informational purposes, in this appendix, estimated the incremental costs and benefits of the final LCRI using the pre-2021 Lead and Copper Rule (LCR) as the baseline regulatory framework. The results shown are the incremental costs and benefits of the final LCRI if the requirements of the 2021 LCRR to be implemented after October 24, 2024, had not been promulgated. These results will assist stakeholders that are more familiar with the current, or pre-2021 LCR, state of the world with understanding the potential estimated impacts of the final LCRI.

C.2 National Costs and Benefits with pre-2021 LCR Baseline

At a discount rate of 2 percent, the annual monetized incremental costs of the final LCRI, when compared to the pre-2021 LCR baseline, ranges from \$1.8 billion to \$2.4 billion (Exhibit C-1).

As seen in Exhibit C-2, the annual monetized incremental benefits of the final LCRI, when compared to the pre-2021 LCR baseline, ranges from \$16.2 billion to \$34.6 billion at a 2 percent discount rate.

Exhibit C-1: Estimated National Annualized Monetized Incremental Costs of the Final LCRI at 2 Percent Discount Rate (pre-2021 LCR Baseline, millions of 2022 dollars)

	Low Estimate			High Estimate		
	Baseline	LCRI	Incremental	Baseline	LCRI	Incremental
PWS Annual Costs						
Sampling	$75.8	$166.0	$90.2	$76.7	$176.2	$99.5
PWS SLR*	$1.3	$1,259.0	$1,257.7	$12.2	$1,763.9	$1,751.7
Corrosion Control Technology	$429.1	$591.1	$162.0	$476.7	$692.9	$216.2
Point-of Use Installation and Maintenance	$0.0	$5.1	$5.1	$0.0	$9.6	$9.6
Public Education and Outreach	$0.3	$267.3	$267.0	$0.8	$302.2	$301.4
Rule Implementation and Administration	$0.0	$3.4	$3.4	$0.0	$3.4	$3.4
Total Annual PWS Costs	***$506.5***	***$2,291.9***	***$1,785.4***	***$566.4***	***$2,948.2***	***$2,381.8***
Household SLR Costs**	$0.9	$0.0	-$0.9	$9.5	$0.0	-$9.5
State Rule Implementation and Administration	$10.6	$66.1	$55.5	$11.0	$67.6	$56.6
Wastewater Treatment Plant Costs***	$0.5	$3.0	$2.5	$1.3	$5.1	$3.8
Total Annual Rule Costs	**$518.5**	**$2,361.0**	**$1,842.5**	**$588.2**	**$3,020.9**	**$2,432.7**

Acronyms: LCRI = Lead and Copper Rule Improvements; SLR = lead service line replacement; PWS = public water system.

Notes: Previous Baseline costs are projected over the 35-year period of analysis and are affected by the EPA's assumptions on three uncertain variables which vary between the low and high cost scenarios.

*Service line replacement includes full and partial lead service lines and galvanized requiring replacement service lines.

** The EPA in the *Economic Analysis for the Final Lead and Copper Rule Revisions* (hereafter referred to as the "Final 2021 LCRR EA") (USEPA, 2020b) assumed that the cost of customer-side service line replacements made under the pre-2021 LCR service line replacement requirements (baseline for the 2021 LCRR EA) would be paid for by households. The agency also assumed that system-side service line replacements under the pre-2021 LCR requirements would be paid by the PWS. The EPA made these modeling assumptions based on information the agency had about previous pre-2021 LCR replacement projects. Also, as part of the 2021 LCRR EA, the EPA assumed that service line replacement conducted under the 2021 LCRR final rule 3 percent mandatory replacement requirement would be paid for by PWSs. This assumption followed from the fact that failure to meet the 2021 LCRR mandatory LSLR requirement would be a violation and could motivate more systems to meet the replacement target even if they had to adopt customer incentive programs that would shift the cost of replacing customer-side service lines from customers to the system. To be consistent with these 2021 LCRR modeling assumptions, for purposes of the EA of the final LCRI, the EPA assumed that mandatory replacement costs would fall only on systems. Therefore, the negative incremental values reported for the "Household

SLR Costs" category do not represent a net cost savings to households. They represent an assumed shift of the estimated service line replacement costs from households to systems. The EPA made this assumption for the final LCRI because it has insufficient information to estimate the actual service line replacement cost sharing relationship between customers and systems at the national level of analysis and therefore defaults to the most conservative assumption by placing all replacement costs on the system. Moreover, as explained in section V.B.5, subsection *Assessment of Service Line Replacement Cost-Sharing Prohibition* in the Federal Register Notice for this rulemaking, the EPA has not used its section 1412 authority under the Safe Drinking Water Act (SDWA) to direct how a water system covers the costs of compliance with a national primary drinking water rule, which is, at its core, a matter of State and local law.
***Due to many water systems operating both the wastewater and drinking water systems, the EPA is evaluating the costs of additional phosphate usage for informational purposes. These costs are not “likely to occur solely as a result of compliance” with the final LCRI, and therefore are not costs considered as part of the Health Risk Reduction and Cost Analysis (HRRCA) under SDWA, Section 1412(b)(3)(C)(i)(III).

Exhibit C-2: Estimated National Annualized Monetized Incremental Benefits of the Final LCRI at 2 Percent Discount Rate (pre-2021 LCR Baseline, millions of 2022 dollars[a])

	Low Estimate			High Estimate		
	Baseline	**LCRI**	**Incremental**	**Baseline**	**LCRI**	**Incremental**
Annual IQ Benefits	$124.5	$6,831.3	$6,706.8	$611.4	$10,963.0	$10,351.6
Annual Low-Birth Weight Benefits	$0.1	$5.4	$5.3	$0.4	$5.7	$5.3
Annual ADHD Benefits	$3.4	$196.3	$192.9	$33.1	$599.5	$566.4
Annual Adult CVD Premature Mortality Benefits	$179.9	$9,454.3	$9,274.4	$1,531.3	$25,210.0	$23,678.7
Total Annual Benefits	**$307.9**	**$16,487.3**	**$16,179.4**	**$2,176.2**	**$36,778.2**	**$34,602.0**

Acronyms: ADHD = attention-deficit/hyperactivity disorder; CVD = cardiovascular disease; IQ = intelligence quotient; LCR = Lead and Copper Rule; LCRI = Lead and Copper Rule Improvements.
Notes: [a] The economic value of each avoided health effect is described in Chapter 5, Section 5.5.

C.3 References

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Appendix D: Adverse Health Effects Associated with Lead Exposures

This appendix provides a qualitative discussion of the adult and child health effects associated with lead exposure, which are anticipated to be reduced by the rule. The health effects discussed in this chapter were identified using two comprehensive U.S. Government documents summarizing the literature on lead exposure and its health impacts: *EPA's Integrated Science Assessment for Lead* (USEPA, 2024) (hereafter referred to as the EPA ISA) and the U.S. Department of Health and Human Services' *National Toxicology Program Monograph on Health Effects of Low-Level Lead (National Toxicology Program, 2012)* (hereafter referred to as the NTP Monograph). Both sources present comprehensive reviews of the literature on adverse human health effects associated with lead exposures. Specifically, the EPA ISA reviewed the literature published since its 2006 review of health outcomes associated with all levels of lead exposure. The NTP Monograph reviewed available literature on lead exposures resulting in blood lead levels <10 micrograms per deciliter (µg/dL), as these are representative of current U.S. lead exposure levels, and at the time the review was conducted, health effects above 10 µg/dL were well documented (NTP, 2012 p. XV).[53]

The EPA ISA and the NTP Monograph both provide conclusions on the association between lead exposure and adverse human health outcomes. The EPA (2024) ISA uses a five-level hierarchy to classify the weight of evidence for causation based on epidemiological and toxicological studies. This section primarily discusses health endpoints assigned causal determinations in the top two levels of the hierarchy. These top two categories are:

- **Causal relationship:** Pollutant (Contaminant) has been shown to result in health effects in studies in which chance, bias, and confounding could be ruled out with reasonable confidence.
- **Likely to be a causal relationship**: Pollutant (Contaminant) has been shown to result in health effects in studies in which chance and bias can be ruled out with reasonable confidence, but potential issues remain.

Similarly, the NTP Monograph conducted a review of the epidemiological literature for the association between low-level lead exposure (defined by blood lead levels <10 µg/dL) and select health endpoints, and categorized their conclusions using a four-level hierarchy. This section primarily discusses health endpoints assigned conclusions in the top two levels of the NTP Monograph hierarchy. These top two categories are:

- **Sufficient evidence of association:** Chance, bias, and confounding could be ruled out with reasonable confidence.
- **Limited evidence of association:** Chance, bias, and confounding could not be ruled out with reasonable confidence.

Among the *causal* and *likely to be causal* health endpoints in the EPA (2024) ISA, and the *sufficient* and *limited evidence of association* health endpoints in the NTP Monograph, eight categories of health

[53] At the time the NTP monograph was being written, blood lead levels in both children and adults were considered elevated if they were above 10 µg/dL (ABLES, 2009; CDC, 2007).

effects were identified and are therefore discussed in this appendix: cardiovascular effects (Section D.1), renal effects (Section D.2), reproductive and developmental effects (Section D.3), immune effects (Section D.4), hypersensitivity and allergy response (Section D.5), resistance to bacterial infection (Section D.6), neurological effects (Section D.7), and cancer (Section D.8). It is anticipated that a reduction in lead exposures to adults and children due to the rule will subsequently result in a reduction in the health effects associated with lead exposures described in this appendix. If expected changes in exposure as a result of the rule are quantified, it would be possible to develop quantitative estimates of changes in several of these health endpoints (see Chapter 5). Additionally, other health effects of lead exposure not discussed in this appendix may also be reduced because of the final LCRI requirements.

D.1 Cardiovascular Effects

Recent evidence suggests that exposure to lead may result in cardiovascular disease (CVD); specifically, increases in hypertension, coronary heart disease (CHD), and CVD-related premature mortality (NTP, 2012; USEPA, 2024). Lead is thought to impact the cardiovascular system in several ways. According to the EPA (2024) ISA, the mechanistic evidence from toxicological studies is strongest for the role of lead-induced oxidative stress in hypertension. Evidence in the 2024 ISA further expands and supports the multiple studies cited in the EPA (2013) ISA that show lead changes enzymatic activity, leading to an increase in formation of reactive oxygen species, which results in increased risk of oxidative damage to the cardiovascular system. Additionally, these reactive oxygen species interfere with nitrogen dioxide (a vasodilator), resulting in the constriction of blood vessels and therefore an increase in blood pressure. High blood pressure is a well-recognized risk factor for CVD and CVD-related premature mortality (Ezzati et al., 2006).

Another potential mechanism through which lead may adversely affect the cardiovascular system is by altering the normal function of vascular cells, including endothelial and vascular smooth muscle cells (USEPA, 2024). For example, lead induces inflammatory damage to endothelial cells, which line the interior of blood vessels and help to regulate blood pressure (Cines et al., 1998; USEPA, 2024). There is also evidence that lead exposure stimulates migration and proliferation of vascular smooth muscle cells, which are both significant events in the pathogenesis of atherosclerosis (USEPA, 2024). Atherosclerosis is a key component of the pathological process of peripheral arterial disease, stroke, and coronary heart disease, all of which can cause CVD premature mortality (CDC, 2004).

Lead may also exert cardiovascular toxicity through disruption of calcium homeostasis. Evidence suggests that dysregulated calcium levels alter heart rate, which is associated with cardiovascular morbidity and CVD premature mortality in older adults (USEPA, 2013). Calcium-induced pro-coagulant activity may contribute to thrombosis, a risk factor for stroke and heart attack (USEPA, 2013). While the EPA (2024) ISA did not assign causality determinations for specific cardiovascular endpoints, the available evidence supported a causal relationship between lead exposure, cardiovascular effects, and cardiovascular-related mortality as a category.

The remainder of Section D.1 discusses specific evidence regarding potential effects of lead exposure on cardiovascular health. Apart from blood pressure and hypertension (Section D.1.1) and electrocardiogram (EKG) abnormalities (Section D.1.2), cardiovascular health outcomes are discussed for adults only. This is because several of the longer-term cardiovascular morbidity and CVD premature mortality endpoints typically do not manifest until later in life.

D.1.1 Blood Pressure and Hypertension

The association between lead and blood pressure or hypertension is the most widely studied of the cardiovascular endpoints. Blood pressure is the force exerted by the heart against the walls of the arteries and is measured in units of millimeters of mercury (mmHg). Systolic blood pressure is the maximum pressure exerted during the pumping phase of the heartbeat. Diastolic blood pressure is the minimum pressure in the arteries when the heart muscle relaxes between beats (National Toxicology Program, 2012). Hypertension is the medical term for high blood pressure (currently, systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg) compared to an optimal blood pressure of <120/80 mmHg. Blood pressures of 120-139/80-89 mmHg are considered prehypertension (National Toxicology Program, 2012).

D.1.1.1 Adults

The NTP Monograph assigned the highest categorization to the relationship between lead exposure and hypertension. While the EPA (2024) ISA did not assign causality determinations for specific cardiovascular endpoints, the available evidence supported a causal relationship between lead exposure, cardiovascular effects, and cardiovascular-related mortality. Similar to findings from the 2013 ISA, the strong evidence for this conclusion comes from studies that consistently demonstrate the effects of lead exposure on increased blood pressure and hypertension, including evidence from several prospective epidemiologic studies that identified an association between higher blood and bone lead levels and higher incidence of hypertension plus increased blood pressure in adults. The link between lead levels and higher blood pressure is further supported by findings from studies using other study designs including cross-sectional studies, meta-analyses, and animal studies. However, uncertainties remain regarding the timing, frequency, duration, and level of lead exposure contributing to the blood pressure effects observed in epidemiology studies (USEPA, 2024). The NTP Monograph states that there is *sufficient evidence of association* between blood lead levels <10 µg/dL and increased blood pressure and risk of hypertension (National Toxicology Program, 2012, p. 63). The NTP Monograph notes that two meta-analyses (Navas-Acien et al., 2008; Nawrot, Thijs, Den Hond, Roels, & Staessen, 2002) concluded that there is an association between lead exposure and hypertension.

Sensitive subpopulations may have unique lead related risks for increased blood pressure and hypertension. In particular, pregnant women and post-menopausal women may experience the mobilization of bone lead due to the body's effort to increase the amount of calcium in the blood stream from bone stores (Gulson et al., 1997; S. J. Rothenberg, Khan, et al., 2000). The NTP Monograph states that there is *sufficient evidence of association* between blood lead levels <10 µg/dL and increased blood pressure and risk of hypertension during pregnancy (National Toxicology Program, 2012, p. 64). However, it reports that the evidence is mixed for post-menopausal women.

D.1.1.2 Children

Compared to adults, children have a much lower prevalence of CVD, which makes it difficult to determine the relationship between lead exposure and cardiovascular endpoints. The 2024 ISA reiterates the small amount of evidence suggesting a relationship between Pb exposure and BP and hypertensive effects in children and notes that recent evidence supports the previous findings. Only a handful of studies have been published examining cardiovascular endpoints in children. The NTP Monograph found *inadequate evidence of association* to evaluate the potential association between

blood lead and effects on blood pressure and hypertension in children (National Toxicology Program, 2012, p. 64). Since neither document reports strong evidence regarding lead exposure effects on blood pressure and hypertension in children, this endpoint is not further discussed in this section.

D.1.2 Electrocardiogram Abnormalities

D.1.2.1 Adults

The NTP Monograph concluded that there is *limited evidence of association* between blood lead <10 µg/dL and EKG abnormalities (National Toxicology Program, 2012, p. 70). EKG abnormalities are changes in the typical pattern of electrical activity of the heart, including the P wave (atrial activity), QRS wave (ventricle activity), and T wave (return to resting state). The NTP Monograph concluded that polymorphisms in iron metabolism genes may modify the relationship between lead and EKG abnormalities. The NTP Monograph also concluded that there is *inadequate evidence of an association* between lead exposure and heart rate variability due to inconsistent results among four publications on lead and heart rate variability with mean blood lead levels <10 µg/dL (Gump et al., 2011; Jhun et al., 2005; National Toxicology Program, 2012; S. K. Park et al., 2008; S. K. Park et al., 2006). Heart rate variability is defined as changes in the interval between heartbeats (American Heart Association, 2011). Heart rate variability "reflects sympathetic (low frequency) and parasympathetic (high and low frequency) autonomic nervous system function, with decreases in variability indicating abnormal autonomic function" (National Toxicology Program, 2012, p. 87). Several studies have examined the relationship between lead exposures, as determined by blood or bone lead levels, and EKG abnormalities using the Normative Aging Study[54] population. In a study of 775 cohort men, bone lead (in both the tibia and patella) was significantly associated with EKG abnormalities, but blood lead was not (Cheng et al., 1998). A prospective study using 496 men from the Normative Aging Study also found tibia lead to be significantly associated with changes in the heart's electrical activity over an 8-year follow-up (Eum, 2011). Findings from a 2009 study reported bone lead to be significantly associated with specific changes in the electrical activity of the heart (S. K. Park et al., 2009). These, however, were the only lead exposure studies focusing on EKG abnormalities in the NTP Monograph. The EPA (2024) ISA mentions that there was additional "epidemiologic and toxicological evidence for effects such as changes in cardiac electrophysiology (e.g., electrocardiography measures of cardiac depolarization, repolarization, and HRV), arrythmia, and markers of atherosclerosis"; however, the ISA did not assign a determination for this endpoint (USEPA, 2024, pp. IS-43).

D.1.2.2 Children

The NTP Monograph concluded that there is *limited evidence of association* between blood lead <5 µg/dL and EKG abnormalities (National Toxicology Program, 2012, p. 75). The NTP Monograph conclusion is based on findings from the Oswego Children's Study that revealed an association between decreased stroke volume and increased total peripheral resistance in response to acute stress tasks and

[54] The Normative Aging Study is a longitudinal study of U.S. men consisting mostly of veterans from World War II and the Korean War.

concurrent blood lead among 9.5-year-olds (Gump et al., 2011; Gump et al., 2007; Gump et al., 2005). EKG abnormalities among children are not discussed in the EPA (2024) ISA.

D.1.3 Clinical Cardiovascular Conditions

Evidence from the EPA (2024) ISA supports a causal relationship between lead exposure, cardiovascular effects, and cardiovascular-related mortality. This newer evidence further supports the evidence from the 2013 ISA. The EPA (2024) ISA acknowledges that there is some uncertainty in the effects of timing, frequency, duration, and level of lead exposures on cardiovascular outcomes. The NTP Monograph found *limited evidence of association* between blood lead <5 µg/dL and general clinical CVD (National Toxicology Program, 2012, p. 70). A recent meta-analysis supports these findings. Chowdhury et al., (2018) looked at 37 studies examining the relationship between metals and CVD in a systematic review. In order to standardize the analysis, they compared top versus bottom thirds of baseline levels, pooled relative risks and found a relative risk (confidence interval) for lead was 1.43 (1.16 to 1.76) for CVD, 1.85 (1.27 to 2.69) for coronary heart disease, and 1.63 (1.14 to 2.34) for stroke.

Atherosclerosis is the process where lipids, cholesterol, cellular waste products, calcium, and fibrin (a clotting material in the blood) deposit or accumulate in the inner lining of an artery (American Heart Association, 2014). The buildup that results is called plaque. Atherosclerosis is measured using various indicators such as intima-media thickness, arterial stiffness, stenosis, and aortic media thickness. Several studies have found associations between lead exposure and these indicators (Lee et al., 2009; Poręba et al., 2011a; Zeller et al., 2010).

Peripheral arterial disease is caused by atherosclerosis, which narrows the arteries and reduces the amount of blood reaching tissues in a person's arms or legs. The NTP Monograph noted that for conditions that are exacerbated by increases in blood pressure, such as peripheral arterial disease, there has been a demonstrated increased risk from lead exposure. Studies have indicated that increased blood lead levels are associated with a higher risk of peripheral arterial disease (Guallar et al., 2006; Muntner et al., 2005; Navas-Acien et al., 2004).

As with peripheral arterial disease, coronary heart disease is also exacerbated by increases in blood pressure. Evidence using a variety of lead measures (blood lead, bone lead and environmental levels, e.g. airborne dust, has shown that higher lead levels are associated with increased risk of coronary heart disease (Jain et al., 2007; Kim et al., 2008) and myocardial infarction (Afridi et al., 2010; Gustavsson et al., 2001). Elevated blood lead is associated with left ventricular hypertrophy in the heart, an outcome associated with coronary heart disease (Schwartz, 1991).

D.1.4 Cardiovascular Mortality

Lead-induced cardiovascular morbidity has implications for CVD premature mortality. CVD premature mortality is defined as death attributed to heart or circulatory causes (National Toxicology Program, 2012, p. 62). The EPA (2024) ISA concluded that there is sufficient evidence that there is a *causal relationship* between lead exposure, cardiovascular effects, and cardiovascular-related mortality. Specifically, the EPA stated, "a large number of prospective cohort studies reported consistent associations between body Pb concentrations and cardiovascular outcomes such as increased BP, hypertension, and cardiovascular mortality." (USEPA, 2024, p.IS-42). The NTP concluded that there is *limited evidence of association* between blood lead levels <10 µg/dL and increased mortality from

cardiovascular causes and that the "association between increased CVD mortality and increased blood Pb was supported by three prospective studies but not supported by two prospective studies, one of which reported a significant association with bone Pb" (National Toxicology Program, 2012, p. 90). However, several studies published after the NTP Monograph have found significant associations between CVD premature mortality and lead exposure (Aoki et al., 2016; Lanphear et al., 2018; Ruiz-Hernandez et al., 2017). However, differences in exposure metrics, timing of exposure, and extent of exposure yield differences in estimates of risk. For further information on these studies, the reader is referred to Chapter 5. An additional study, Duan et al., (2020) was published after the literature search in the Abt Associates report which described the concentration-response functions used to support this economic analysis (EA), was described in the 2024 Lead ISA. Duan et al., (2020) examined more recent NHANES data (1999-2014), finding a relative risk ratio of 1.39 (95% CI: 1.28, 1.51) and is reported in the 2024 Lead ISA as finding "associations of similar magnitude" of the other studies used in the benefits analysis described in Chapter 5.

Investigations of the association between lead exposure and CVD premature mortality have been conducted using nationally representative cross-sectional data from the National Center for Health Statistics' National Health and Nutrition Examination Survey (NHANES). Menke et al. (2006) evaluated participants in NHANES with blood lead data collected between 1988 to 1994 and found a significant relationship between blood lead levels and increased mortality after 12 years of follow-up. After controlling for a large number of confounding factors including hypertension and kidney function, the authors observed an association between lead exposure and cardiovascular mortality at a low mean blood lead concentration (2.58 µg/dL). Analyses of smaller studies also find a positive relationship between lead exposure and CVD-related premature mortality. A study of American 65- to 87-year-old females, found a higher risk of combined CVD premature mortality and coronary heart disease mortality among women with blood lead levels >8 µg/dL (Khalil et al., 2009).

The two studies cited in the NTP Monograph as the reason for the *limited*, rather than *sufficient evidence*, of an association between lead exposure and CVD premature mortality are Moller & Kristensen (1992) and Weisskopf et al. (2009). Moller & Kristensen (1992) examined the risk of developing coronary heart disease and CVD using both fatal and non-fatal cases. The authors found a significant univariate association between blood lead and total mortality, coronary heart disease, and CVD. The statistically significant association was attenuated when the models included potential confounders, although the association remained positive (*i.e.,* an increase in blood lead was related to an increase in mortality). The authors did not examine the risk of CVD premature mortality after eliminating the non-fatal cases included in the analysis. Weisskopf et al. (2009) evaluated the relationship between bone and blood lead and several health endpoints including all-cause, CVD-related, and cancer-related deaths. The authors found bone lead, specifically patella lead, to be associated with a slight increase in CVD premature mortality; however, this association was not statistically significant.[55] Weisskopf et al. (2009) did not find an association between blood lead and any

[55] In a 2015 reanalysis, Weisskopf et al. found that, after further adjustment and application of methods to decrease potential bias, the association between patella lead and CVD premature mortality reached statistical significance. No associations between tibia or blood lead were found in the reanalysis.

other mortality category.

Since the NTP Monograph was published, three new analyses of the NHANES data have found significant associations between lead exposures and CVD premature mortality. Aoki et al. (2016) examined over 18,600 adults in NHANES 1999-2010 and found that hematocrit-corrected[56] blood lead levels were significantly associated with CVD premature mortality. Ruiz-Hernandez et al. (2017) examined changes in uncorrected blood lead levels and CVD premature mortality between participants in NHANES 1988-1994 and NHANES 1999-2004. The study found that declines in lead exposure were associated with reductions in CVD premature mortalities. Lanphear et al. (2018) examined the same cohort as the (Menke et al., 2006) study described above, but used a longer period of follow-up for CVD premature mortality, allowing for additional deaths to be included in the analysis. The Lanphear et al. (2018) analyses found significant associations between blood lead levels and CVD premature mortality, with greater increases in CVD premature mortality for a given increase in blood lead observed in individuals with blood lead levels below 5 µg/dL.

D.2 Renal Effects

The primary functions of the kidney include regulating water levels and balancing the levels of water and essential chemicals in the body (USEPA, 2024). The key measurement that reflects kidney function is the glomerular filtration rate (GFR), which estimates how much blood passes through the tiny filters in the kidneys, called glomeruli, each minute (National Library of Medicine, 2015). The best method for measuring GFR is very invasive and time consuming because it involves the measurement of exogenously delivered radionuclide or radiocontrast markers in timed, sequential blood samples or kidney imaging (USEPA, 2013). Therefore, alternative methods to measure kidney function have been developed and used in health effect studies such as measuring serum creatinine, blood urea nitrogen, cystatin C, and creatinine clearance.

D.2.1 Adults

The NTP Monograph concluded that there is *sufficient evidence of an association* between lead exposure and decreased kidney function. Specifically, the NTP Monograph found *sufficient evidence of an association* between blood lead levels <5 µg/dL and decreased GFR (National Toxicology Program, 2012, p. 80). The 2013 EPA ISA stated that the evidence of renal effects from lead exposure is *suggestive of a causal relationship* based on multiple high-quality epidemiologic studies; however, the 2024 ISA has updated the conclusion to be a *causal* relationship between Pb exposure and renal effects. "Notably, prospective studies with baseline measures of renal function reduce uncertainty regarding potential reverse causality, providing additional evidence of Pb-associated decrements in renal function in adult populations with mean BLLs <5 ug/dL" (USEPA, 2024).

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[56] Aoki et al. (2016) corrected blood lead for hematocrit (*i.e.*, the proportion of whole blood composed of red blood cells) in order to take into account red blood cell counts. This is because the majority of lead in blood is found in red blood cells but lead itself may cause red blood cell numbers to decrease. If lead decreases red blood cell counts, then measuring uncorrected blood lead may result in an underestimation of the association between blood lead and CVD premature mortality.

Lead exposure was found to contribute to kidney effects in the general population. Several high-quality epidemiology studies found an association between increased blood lead and increased serum creatinine (C de Burbure et al., 2003; Kim et al., 1996; Lai et al., 2008; Muntner et al., 2003; Navas-Acien et al., 2009; Staessen et al., 1990; Tsaih et al., 2004). Serum creatinine levels ≥30 mg/g indicate albuminuria, or the presence of excess protein in urine; if persistent, albuminuria can indicate kidney damage. The relationship between blood lead and serum creatinine was also identified as it pertains to specific subpopulations. Specifically, Muntner et al. (2003) found an increased risk for elevated serum creatinine in hypertensives but not normotensives. Additionally, Tsaih et al. (2004) found a relationship between changes in serum creatinine and baseline blood and bone lead in diabetics but not nondiabetics. Further, Staessen (1990) found a correlation between blood lead and serum creatinine only in males, but not in females. Thus, the large outcomes from large population studies may be impacted by comingling individuals with specific sensitivities with the general population.

Epidemiology studies using other markers of kidney dysfunction found similar associations between lead levels and kidney dysfunction. Studies have observed an association between blood lead and decreased creatinine clearance, which is another marker of kidney dysfunction (Akesson et al., 2005; Muntner et al., 2005; Payton et al., 1994; Staessen et al., 1992). Similarly, studies measuring adverse renal effects by measuring cystatin C as an indicator of kidney dysfunction have found a relationship between decreased kidney function and blood lead (C. de Burbure et al., 2006; Fadrowski et al., 2010). Studies measuring GFR[57] as an indicator of kidney function have found an increased risk of decreased GFR with increasing lead levels (Akesson et al., 2005; Muntner et al., 2005). Muntner et al. (2005) specifically found an increased risk for chronic kidney disease in individuals with higher blood lead (1.63–2.47 µg/dL) when compared to people with blood lead less than 1.06 µg/dL. In addition, the patterns between lead exposure and decreased kidney function have been identified in adolescents (C. de Burbure et al., 2006; Fadrowski et al., 2010). However, some research has found no association between blood lead and adverse renal effects in the general population (Coria et al., 2009; Mortada, 2004) and in adolescents (C. de Burbure et al., 2006; Fadrowski et al., 2010).

D.2.2 Children

The NTP Monograph concluded that there is *limited evidence of association* between blood lead levels <5 µg/dL and decreased kidney function among 12- to 20-year-olds (National Toxicology Program, 2012, p. 84). The *limited evidence of association* conclusion is based primarily on a study by Fadrowski et al. (2010) using 1988-1994 NHANES III data that observed a relationship between blood lead levels and decreased estimated GFR (eGFR, based on cystatin C) among 12- to 20-year-olds. The NTP Monograph notes that the weight of this evidence is bolstered by the findings at similar lead levels in adults ((Needleman et al., 1990), p. 84). The EPA ISA does not assign a conclusion category for renal effects in children but does note that recent studies of elevated lead exposure in children did not consistently indicate reduced kidney function (Coria et al., 2009; Khan et al., 2010).

[57] GFR is the ideal measurement for kidney function.

D.3 Reproductive and Developmental Effects

Lead exposure has been linked to adverse reproductive and developmental effects including delayed puberty, decreased postnatal growth, changes to sperm, decreased fertility, increased time to conception, fetal development effects, and reduced gestational age.

D.3.1 Delayed Puberty

Measures of sexual maturation and puberty include age at menarche and Tanner developmental staging[58] of breasts, testicular volume, and pubic hair. The EPA (2024) ISA found a *causal relationship* between lead exposure and developmental effects, which includes delayed puberty, based on the epidemiology and toxicology literature. The NTP Monograph stated that there is *sufficient evidence of association* between concurrent blood lead <10 µg/dL and delays in sexual maturation or puberty onset in 8- to 17-year-olds, and *limited evidence* that blood lead <5 µg/dL is associated with delayed puberty (Needleman et al., 1990, p. 94).The NTP Monograph's *sufficient evidence* conclusion is based on the agreement of reported inverse associations between blood lead level and measures of sexual maturation in eight cross-sectional studies and one prospective study (Denham et al., 2005; Gollenberg et al., 2010; Hauser et al., 2008; Naicker et al., 2010; Selevan et al., 2003; Staessen et al., 2001; Tomoum et al., 2010; Williams et al., 2010; Wu et al., 2003). The *limited evidence* conclusion was made based on the availability of only four cross-sectional studies reporting associations between blood lead levels <5 µg/dL and delayed markers of puberty (Denham et al., 2005; Selevan et al., 2003; Staessen et al., 2001; Wu et al., 2003), coupled with a study reporting a lack of association in a cross-sectional study of girls (Wolff et al., 2008). Several large, cross-sectional analyses using 1988-1994 NHANES III data have reported delayed development in girls as determined by Tanner pubic hair and breast stages and age at menarche with low levels of blood lead (Gollenberg et al., 2010; Selevan et al., 2003; Wu et al., 2003).

While fewer studies of delayed puberty have been conducted in boys, the limited evidence suggests lead-related associations with decreased testicular volume, lower Tanner genital stages, and lower Tanner stages of pubic hair development (Hauser et al., 2008; J. A. Staessen et al., 2001; Tomoum et al., 2010; Williams et al., 2010). Similar associations have been found in studies conducted internationally (Naicker et al., 2010; Tomoum et al., 2010). Associations between lead exposure and significant delays in sexual maturation reported in these studies remained when adjusting for factors such as race, body mass index, and socioeconomic status.

D.3.2 Postnatal Growth

The NTP Monograph found *sufficient evidence of association* between concurrent blood lead <10 µg/dL in children and decreased postnatal growth (National Toxicology Program, 2012, p. 94), p. 94. Findings from several cross-sectional studies and three prospective studies support the significant association between concurrent blood lead levels and indicators of decreased postnatal growth in 1- to 16-year-olds. For example, this association between blood lead and height has been observed through the analysis of the 1988-1994 NHANES III data in 1- to 7-year-olds (Ballew et al., 1999), as well as in 8- to 16-

[58] Tanner staging is a system frequently used for evaluating pubertal maturation. Tanner staging is based on five stages of development and can be used to evaluate pubertal disorders.

year-old girls (Selevan et al.,1984). Other effects of blood lead on postnatal growth reported in cross-sectional studies include height, leg and arm length, head and chest circumference, and body weight (Hauser et al., 2008; Ignasiak et al., 2006; Kafourou et al., 1997; Kordas et al., 2004; Little et al., 2009).

The NTP Monograph found *limited evidence* of an association between maternal blood lead levels and postnatal growth. Specifically, the NTP Monograph noted *limited evidence* that maternal blood lead <10 µg/dL is associated with decreased head circumference in children up to 4 years old based on three prospective studies (National Toxicology Program, 2012, p. 98 ; Rothenberg et al., 1993; Rothenberg et al., 1999; Schell et al., 2009). Lead exposure has also been shown to affect child height and body weight later in life. A study of Mexican children found that increases in maternal bone lead during pregnancy were associated with decreased body weight in 5-year-old girls (Afeiche et al., 2011).

Although the EPA ISA found a *causal relationship* between lead exposure and developmental effects, the report notes that this causal determination is based on the findings of delayed pubertal onset among males and females rather than postnatal growth. The EPA (2024) ISA stated that recent studies examining the association between lead exposure and postnatal growth are inconsistent, “though epidemiologic studies that examined BLLs, as opposed to other biomarkers, provide more consistent patterns of inverse associations between Pb exposure and height and weight in children (8 mo to 11 yr)” (USEPA, 2024, pp. IS-54).

D.3.3 Sperm Parameters

Sperm parameters include characteristics such as sperm count or concentration, sperm motility, and sperm morphology. The EPA (2024) ISA concluded that there is sufficient evidence that there is a *causal relationship* between lead exposure and male reproductive function, which includes sperm quality based on animal toxicological studies showing detrimental effects on semen quality, sperm, and fecundity/fertility with supporting evidence in epidemiology studies of associations between lead exposure and detrimental effects on sperm. The NTP Monograph states that there is *sufficient evidence of association* between blood lead levels ≥15 µg/dL and adverse changes in sperm parameters predominantly based on occupational studies of men reporting effects at blood lead levels ranging from 15 to 50 µg/dL (National Toxicology Program, 2012, p. 98). Several studies found that higher blood or semen lead was associated with lower sperm count or concentration (Alexander et al., 1998; Alexander et al., 1996; Assennato et al., 1986; Bonde et al., 2002; Chowdhury et al., 1986; Fisher-Fischbein et al., 1987; Lancranjan et al., 1975; Lerda, 1992; Mahmoud et al., 2005; Naha et al., 2005; Naha & Chowdhury, 2006; Naha & Manna, 2007; Robins et al., 1997; Telisman et al., 2000).

Higher blood or semen lead levels have also been found to be associated with decreased sperm motility (Chowdhury et al., 1986; Kasperczyk et al., 2008; Lancranjan et al., 1975; Lerda, 1992; Naha & Chowdhury, 2006; Naha & Manna, 2007). One study found that sperm motility improved in male battery workers undergoing treatment to lower blood lead (Viskum et al., 1999). Abnormal sperm morphology is also associated with lead exposure in the epidemiology literature (Chowdhury et al., 1986; Fisher-Fischbein et al., 1987; Hsu et al., 2009; Lancranjan et al., 1975; Lerda, 1992; Naha et al., 2005; Naha & Chowdhury, 2006; Naha & Manna, 2007; Robins et al., 1997; Telisman et al., 2000). The effect of lead on sperm parameters at lower lead exposure levels is unclear based on the available literature. A threshold below which blood lead levels will not exert an effect has not been clearly established. Recent

toxicological data in the 2024 ISA support the findings in the 2013 ISA, specifically potential impact on sperm or semen quality (e.g., sperm density, motility, morphology, etc.) (USEPA, 2024, p. IS-36).

D.3.4 Fertility and Time to Conception

Evidence indicates that lead exposure increases the risk of reduced fertility and increased time to conception (reduced fecundity) in men. The EPA (2024) ISA determined that there is sufficient evidence to conclude there is a *causal relationship* between male reproductive function and lead exposure based primarily on toxicological studies. The NTP Monograph concluded that “there is *sufficient* evidence that paternal blood levels ≥ 20 µg/dL are associated with delayed conception time and *limited* evidence that blood Pb levels ≥ 10 µg/dL in men are associated with other measures of reduced fertility” (National Toxicology Program, 2012, p. 104). The NTP Monograph states that their *sufficient evidence* of delayed conception time conclusion is based on four studies reporting increased time to pregnancy with blood lead levels of 20-40 µg/dL in men, and that the *limited evidence* of reduced fertility conclusion is also based on these four studies plus a single large retrospective occupational study that reported increased odds of infertility among men with blood lead levels ≥10 µg/dL. The inverse association between male fertility and lead exposure appears to be present for males with above-average blood lead levels. Several studies reported an increased time to pregnancy or decreased fecundability in men with blood lead levels between 20 and 40 µg/dL (Apostoli et al., 2000; De Rosa, 2003; Sallmen et al., 2000; Shiau et al., 2004). In addition, a study of male workers at a lead battery plant found decreased odds for a live birth in the wives of lead workers with mean blood lead of 46 µg/dL compared to workers with mean blood lead of 10 µg/dL or relative to pre-exposure (Gennart et al., 1992). Large occupational cohorts have also demonstrated that blood lead ≥ 10 µg/dL can lead to higher odds of male infertility (Sallmen et al., 2000).

D.3.5 Spontaneous Abortions

The association between lead exposure and likelihood of spontaneous abortion has been investigated in both men and women. The NTP Monograph states that there is *limited* evidence that maternal blood lead <10 µg/dL is associated with spontaneous abortion (National Toxicology Program, 2012, p. 107). This conclusion is based on a prospective nested case-control study by Borja-Aburto et al. (1999). NTP also states that there is *limited* evidence that paternal blood lead >31 µg/dL is associated with spontaneous abortions based on a retrospective nested case-control study by Lindbohm et al. (1991) (National Toxicology Program, 2012, p. 107). Borja-Aburto et al. (1999) suggests increased odds of spontaneous abortion for maternal blood lead <10 µg/dL. Borja-Aburto et al. (1999) found evidence for a concentration-response relationship and significant odds ratios for spontaneous abortions (odds ratios of 2.3, 5.4, and 12) with maternal blood lead during the first trimester of pregnancy of 5-9, 10-14, and ≥15 µg/dL as compared to pregnant women with maternal blood lead of <5 µg/dL. Results from a Chinese study of anembryonic pregnancy, as well as several occupational exposure studies, support these findings (Faikoglu et al., 2006; Gundacker et al., 2010; Lamadrid-Figueroa et al., 2007; Yin et al., 2008). Among women with a history of previous spontaneous abortions, evidence exists that the rate of spontaneous abortion may be higher in women with higher plasma/blood lead ratios compared to women with lower plasma/blood lead ratios (Lamadrid-Figueroa et al., 2007). Evidence also suggests that women with higher placental lead levels were more likely to have had a previous miscarriage compared to women with lower placental lead levels (Gundacker et al., 2010).

As for paternal lead levels being associated with spontaneous abortions, several occupational studies indicate that elevated blood lead is associated with increased odds of spontaneous abortion. A Finnish study of men with occupational exposure to lead and with wives aged 18-40 found that paternal blood lead >31 µg/dL was associated with higher odds of spontaneous abortion (odds ratio = 3.8 (95 percent confidence interval: 1.2, 12)) compared to men with blood lead <21 µg/dL (Lindbohm et al., 1991). Similar findings have been reported in other occupational epidemiology studies (Al-Hakkak et al., 1986; Beckman & Nordström, 1982).

D.3.6 Reduced Fetal Growth/Low Birth Weight

When examining the reduced fetal growth/low birth weight outcome, there are several measures of reduced growth or intrauterine growth restrictions: small for gestational age (babies with birth weight below the 10^{th} percentile for a given gestational age), lower birth weight (evaluated as a continuous variable), and low birth weight (<2,500 grams after at least 37 weeks of gestation). Several indicators of lead exposure can be used to examine the relationship between lead exposure and reduced fetal growth including blood lead, bone (patella and tibia) lead, umbilical cord lead, placental lead, air lead, and breast milk lead (2 months postpartum). The NTP Monograph states that there is *sufficient evidence of association* between maternal blood lead <5 µg/dL and reduced fetal growth or lower birth weight based on several prospective studies, a large retrospective cohort study of over 43,000 mother-infant pairs by Zhu et al. (2010), and a number of cross-sectional studies with maternal or umbilical cord blood lead at delivery (National Toxicology Program, 2012, p. 109). The EPA (2013) ISA combined all adverse birth outcomes (*i.e.,* neural tube defects, which are birth defects of the brain or spinal cord, preterm birth, low birth weight) into one category, whereas the NTP Monograph reviewed measures of an infant's birth weight (e.g., small for gestation age or lower birth weight) as a stand-alone category. The EPA (2024) ISA concluded the evidence was *likely to be a causal relationship* between lead exposure and adverse birth outcomes (*i.e.,* neural tube defects, preterm birth, and low birth weight/fetal growth) based on a "recent quasi-experimental study that reported Pb-related changes in birth weight and probability of low birth weight, preterm birth, and small for gestational age, in addition to other studies demonstrating effects between Pb exposure and preterm birth (Table 8.1)" (Appendix 8, UESPA, 2024).

The relationship between lead exposure and low birth weight (<2,500 grams after at least 37 weeks of gestation) was investigated heavily using both maternal blood lead and cord blood lead levels. Many of the studies looking at the effect of maternal blood lead on birth weight have found an inverse relationship between this exposure metric and response (Bornschein et al., 1989; Cantonwine et al., 2010; Dietrich et al., 1987; Ernhart et al., 1986; Gundacker et al., 2010; Kordas et al., 2009; Osman et al., 2000; Srivastavaet al., 2001; Zhu et al., 2010). In the largest cohort study of the association to date, Zhu et al. (2010) found that the slope of the association between birth weight and lead exposure was steeper at lower blood lead levels. For example, a 2 µg/dL increase in blood lead would be expected to decrease birth weight by approximately 40 grams given an initial blood lead level of 0 µg/dL and by 10 grams given an initial blood lead of 8 µg/dL. However, the magnitude of observed decreases in birth weight varies by study. Several analyses found the relationship between blood lead and birth weight to be linear. A handful of studies referenced in the EPA (2013) ISA and NTP Monograph did not find any relationship between maternal blood lead and birth weight (Gonzalez-Cossio et al., 1997; Iranpour et al., 2007; Loiacono et al., 1992; Rahman & Hakeem, 2003; Sowers et al., 2002). Since the documents were published, several additional cohort studies have also found significant associations between lead

exposure and decreased birth weight (Rabito et al., 2014; Taylor et al., 2014; Taylor et al., 2016). A few have found evidence of an association only in certain segments of the population (*e.g.,* women with low calcium intake as in Hong et al., 2014) or only in male infants (Nishioka et al., 2014; Perkins et al., 2014).

Elevated cord blood lead was also shown to adversely affect infant birth weight (Atabeket al., 2007; Bellinger et al., 1991; Cantonwine et al., 2010; Ernhart et al., 1986; Gundacker et al., 2010; Neuspiel et al., 1994; Osman et al., 2000; Srivastava et al., 2001; Zentner et al., 2006). However, some studies have not found the same association (Gonzalez-Cossio et al., 1997; Iranpour et al., 2007; Janjua et al., 2009; Loiacono et al., 1992; Wells et al., 2011).

Placental lead has also been used to study the effects of lead exposure on low birth weight. Although some studies have found that higher placental lead levels are associated with lower birth weight (Llanos & Ronco, 2009; Ward et al., 1990), several have either not found an association or found a positive association between placental lead level and birth weight (Gundacker et al., 2010; Odland, 2004; Wibberly, 1977). Elevated bone lead levels were associated with lower birth weight in several studies (Cantonwine et al., 2010; Gonzalez-Cossio et al., 1997; Kordas et al., 2009).

D.3.7 Preterm Birth and Gestational Age

The NTP Monograph states that there is *limited evidence of an association* between maternal blood lead or umbilical blood lead <10 µg/dL and preterm birth or reduced gestational age (National Toxicology Program, 2012, p. 112). Increases in maternal blood lead levels during pregnancy have been associated with increased incidence of preterm birth in several prospective and cross-sectional studies (Cantonwineet al., 2010; Dietrich et al., 1987; Fagheret al., 1993; Fahim et al., 1976; Jelliffe-Pawlowski et al., 2006; McMichael et al., 1986; Vigeh et al., 2011). However, there is inconsistency among the results using each of these metrics (National Toxicology Program, 2012, p. 114). In addition, a large retrospective cohort (43,288 mother–infant pairs) from the New York State Heavy Metals Registry did not find an association between maternal blood lead (mean, 2.1 µg/dL) and preterm birth (Zhu et al., 2010). Associations between lead exposure and risk of preterm birth have also been observed when examining umbilical cord blood lead (Cantonwine et al., 2010; Fagher et al., 1993; Fahim et al., 1976; McMichael et al., 1986; Patel & Prabhu, 2009; Torres-Sanchez et al., 1999) and placental lead levels (Falcon et al., 2003; Ward et al., 1990; Ward et al., 1987). Therefore, NTP assigned this endpoint a conclusion of *limited*, rather than *sufficient*, evidence.

D.4 Immune Effects

The immune system is responsible for protecting organisms from foreign agents, such as microbes or chemicals (Schultz & Grieder, 1987). The immune system is dependent on its ability to distinguish between “self” and “non-self” initiators of response. White blood cells, antibodies, and other proteins and chemical substances along with a complex signaling system are components of an immune response. Immune function can be measured in several ways including by the level and function of different immune cells (*e.g.,* T-cells, B-cells, monocytes, macrophages, neutrophils, lymphocytes, or cells involved in delayed-type hypersensitivity (DTH)); and immune cell secretions (*e.g.,* cytokines). Immune function can also be measured through the presence of antibodies (*e.g.,* immunoglobulins such as IgE, IgG, IgA); clinical indicators of allergy (*e.g.,* positive skin prick tests); and the presence of immune-based disease (*e.g.,* asthma, autoimmunity).

Health outcomes related to the immune system associated with lead exposure include increased hypersensitivity and allergy response in children exposed prenatally (see Section D.5), and decreased resistance to bacterial infections (see Section D.6).

D.5 Increased Hypersensitivity and Allergy Response

D.5.1 Adults

The EPA (2024) ISA found that the evidence is *suggestive of, but not sufficient to infer, a causal relationship* between Pb exposure and sensitization and allergic responses. “In contrast to evidence presented in the 2013 Pb ISA (U.S. EPA, 2013), the recent studies provide little evidence of an association between exposure to Pb and atopic disease, and inconsistent evidence for immunological biomarkers involved in sensitization and allergic response” (USEPA, 2024). The NTP Monograph found *inadequate evidence* in adults to address the potential association between blood lead <10 µg/dL and IgE, allergy, eczema, or asthma in adults due to a general lack of studies at lower doses and inconsistency in the available data ((National Toxicology Program, 2012, p. 45), p. 45). In adults, lead exposure has been linked to changes in a spectrum of cellular and humoral immune responses including changes in T lymphocyte and macrophage function, suppression of the DTH response, increased IgE production, changes in cytokine production, and inflammation.

D.5.2 Children

The EPA (2024 ISA found that the evidence is *suggestive of, but not sufficient to infer, a causal relationship* between Pb exposure and sensitization and allergic responses.. “A considerable uncertainty in the evidence base is the limited number of children with asthma in the cohort studies evaluated, both in recent studies and in the 2013 Pb ISA. This decreases the statistical power to detect an association” (USEPA, 2024). The NTP Monograph states that there is *limited* evidence of an association between lead exposure and increased IgE in children. This conclusion is based on evidence for lead-related increases in IgE from several cross-sectional studies (K.L. Hon, 2011; Hon et al., 2009; K.L. Hon et al., 2010; Karmaus et al., 2005; Lutz et al., 1999; Sun et al., 2009). The NTP Monograph additionally concluded that there is *limited* evidence of a link between lead exposures and increased allergic sensitization, based on the aforementioned studies of lead and IgE together with a prospective study on allergic sensitization by Jedrychowski et al. (2011) (National Toxicology Program, 2012, p. 49). Jedrychowski et al. (2011) collected data on both concurrent and prenatal exposure in 5-year-olds and examined the allergic sensitization or atopy (determined by a skin prick test) to common allergens administered when the children were 5-year-olds. Maternal blood lead and umbilical cord blood lead were significantly associated with frequency of sensitization in the children, but current blood lead levels were not. Data from the Jedrychowski et al. (2011) study also showed a lead-associated increase in serum IgE. There is also evidence that low levels of prenatal lead exposure (<10 µg/dL in blood) in adults is associated with increased hypersensitivity and allergy in their offspring.

D.6 Resistance to Bacterial Infection

D.6.1 Adults

The EPA (2024) ISA states that there is *likely to be a causal relationship* between lead exposure and decreased host resistance in adults based on epidemiological studies examining the relationship between Pb exposure and immunosuppression , expanding on the evidence in the 2013 ISA, . This endpoint was not considered in the NTP Monograph. Evidence from human studies indicates an association between lead exposure and weakened resistance to bacterial infection. In fact, as described in the EPA (2013) ISA, the ability of lead to cause reduced bacterial resistance in animals has been known for several decades. Animal studies suggest that a potential mode of action for this outcome is the suppression of Th1 cytokine production and reduction of macrophage function. “The strongest evidence supporting a ‘likely to be causal’ relationship between Pb exposure and immunosuppression comes from toxicological studies consistently demonstrating that Pb exposures suppress the DTH response and increase susceptibility to bacterial infection in animals with BLLs < 30 ug/dL” (USEPA, 2024).The epidemiology studies demonstrated that increased susceptibility to bacterial infections and suppressed DTH reactions are associated with blood lead levels (7-25 µg/dL) in adults as a consequence of dietary lead exposure (USEPA, 2013, p. 1-34).

D.6.2 Children

Epidemiology studies found a higher prevalence of respiratory infections among children with higher concurrent blood lead levels. A study of children in Boston found a relationship between an increase in infections and cord blood lead ≥ 10 µg/dL at the time of birth (Rabinowitz et al., 1990). Higher blood lead levels were also associated with an increase in infections in a study of German children with a mean blood lead level of 3.34 µg/dL (Karmaus et al., 2005). While the EPA (2013) ISA states that there is *likely to be a causal relationship* between lead exposure and decreased host resistance to infection, inadequate statistical analysis and consideration of confounders in the identified studies are not sufficient to support a causal conclusion for children (USEPA, 2013, p. 4-552).

D.7 Neurological Effects

The nervous system is responsible for controlling the body’s sensory, integrative, and motor functions by transmitting signals that initiate a response throughout the body (National Institute of Child Health and Human Development, 2013). The nervous system is divided into two parts: the central nervous system (brain and spinal cord) and the peripheral nervous system, which consists of the somatic nerves and ganglia. Neurological function can be measured in several ways depending on the outcome of interest. In this section, the following health outcomes will be discussed: cognitive function, behavior, conduct disorders, internalizing behaviors, psychological effects, neurodegeneration, and sensory function.

D.7.1 Cognitive Function

Cognitive function is typically measured through Intelligence Quotient (IQ) tests (Srivastava et al., 2001). Other measures of cognitive function include pattern comparison speed, vocabulary, and word list memory (National Toxicology Program, 2012). Strong associations have been found between decreased

IQ and early childhood lead exposures, including *in utero* exposures. The effects of childhood lead exposure on cognitive function can persist through adulthood.

D.7.1.1 Adults

Based on prospective studies indicating associations of higher bone lead levels with declines in cognitive function in adults, the EPA (2024) ISA determined a *causal relationship* between lead exposure and cognitive function decrements. Recent prospective cohort studies with longer follow-up periods, multiple and repeatedly measured cognitive outcomes, and adjustment for multiple risk factors and confounders reduce uncertainties and strengthen the overall evidence related to the association of Pb exposure with cognitive function in adulthood. Specifically, recent cohort studies indicate that higher adult bone Pb levels (tibia mean range: 10.5 to 21.6 µg/g, patella mean range: 12.6 to 30.6 µg/g) were associated with poor cognitive function/performance during young-, mid- or older-adulthood periods. The NTP Monograph found *limited evidence of association* between decreased cognitive function in adults at exposure levels <10 µg/dL due to mixed results for an association with blood lead and a more consistent association with bone lead (National Toxicology Program, 2012, p. 27).

A study of 141 older men from the Normative Aging Study reported that concurrent blood lead levels (mean, 5.5 µg/dL) were associated with decreases in specific measures of cognitive function, including pattern comparison speed, vocabulary, word list memory, the Boston Naming Test (Payton, Riggs, Spiro, Weiss, & Hu, 1998). The study authors found that tibia lead (but not patella lead) level was associated with decreased performance in a test of spatial ability. Wright et al. (2003) studied 736 older men from the Normative Aging Study and reported and associations between blood lead (mean, 4.5 µg/dL), patella lead, and tibia lead and decreased performance on the Mini-Mental State Examination (MMSE). Muldoon et al. (1996) also examined cognitive performance, with the MMSE and Wechsler Adult Intelligence Scale-Revised, for 530 older women and found that blood lead level (mean, 4.8 µg/dL) was associated with decreased performance on the Trail Making Test and the Digit Symbol Substitution Test. However, this result was found among rural participants but not urban subjects.

Other studies reported an association between bone lead and decreased performance but did not find an association with blood lead levels. Shih et al. (2006) reported a lack of an association between current blood lead level (mean, 3.5 µg/dL) and cognitive function, however, they found tibia lead levels to be significantly associated with lower scores in all seven domains of the cognitive test battery. Weuve et al. (2009) reported that tibia lead levels were associated with reduced cognitive function measured by the Telephone Interview for Cognitive Status in a study of 587 older women from the Nurses' Health Study. However, blood lead and patella lead levels were not significantly related to the test score.

Two additional studies did not find associations with blood lead levels. Nordberg et al. (2000) did not find an association between blood lead level (mean, 3.7 µg/dL) and performance on the MMSE in a study of 762 older adults in Sweden. Gao et al. (2008) reported that concurrent blood lead (mean, 3.9 µg/dL) was not significantly related to cognitive function in a study of 188 people from rural China.

D.7.1.2 Children: IQ

The EPA (2024) ISA and NTP Monograph found that the strongest evidence for an association between lead and neurological effects is captured in studies that examine intellectual function among children. Intellectual function is typically assessed using IQ scores, which are evaluated by administering a test

such as the Wechsler Intelligence Scale for Children (WISC) or the Stanford-Binet Intelligence Scale (National Toxicology Program, 2012, p. 20). Since IQ is a measure of general intelligence, these scales include tests of vocabulary, comprehension, reasoning, memory, speed, and arithmetic. Raw IQ scores are standardized at the population level to obtain a mean of 100 and standard deviation of 15 for each age group (Beres et al., 2000). Cognitive function in children can also be assessed using alternative tests that do not measure IQ, including the Mental Development Index (MDI) and the General Cognitive Index (GCI).

The EPA (2024) ISA stated that recent studies support the 2013 ISA conclusion that "Pb-associated cognitive effects in children occur in populations with mean BLLs between 2 and 8 ug/dL (Appendix 3.5.1.6.1) (USEPA, 2024, p. IS-27). The NTP Monograph concluded that there is *sufficient evidence of association* between blood lead levels <5 µg/dL and decreases in various general and specific measures of cognitive function in children from 3 months to 16 years of age. This conclusion is based on prospective and cross-sectional studies using a wide range of tests to assess cognitive function (National Toxicology Program, 2012, p. 27).

Recent longitudinal epidemiologic studies with group or population means <5 µg/dL add to the evidence, generally supporting conclusions from the 2013 Pb ISA (USEPA, 2024, p. IS-28). Canfield et al. (2003) studied 6- to 60-month-olds and 3- to 5-year-olds in Rochester, NY and found that each 10 µg/dL increase in average lifetime blood lead level was associated with a 4.6-point decrease in IQ. In a study of the same cohort, Jusko et al. (2008) found that children with blood lead levels <5 µg/dL scored 4.9 points higher on IQ tests than children with blood lead levels between 5 and 9.9 µg/dL. A pooled analysis of seven international cohort studies by Lanphear et al. (2005) estimated IQ decreases of 3.9, 1.9, and 1.1 points when blood lead increases from 2.4 to 10 µg/dL, 10 to 20 µg/dL, and 20 to 30 µg/dL, respectively. Thus, the effects of incremental changes in lead on IQ appear to be larger in magnitude at lower levels of lead exposure than at higher levels (*e.g.,* nonlinear).

In 2013, Crump et al. published a statistical reevaluation of the data used in the Lanphear et al. (2005) pooled analysis that related low levels of blood lead to intellectual deficits in children. In this work Crump et al. had two main goals: (1) to reproduce the results of Lanphear et al. (2005) and correct any errors, and (2) perform an independent analysis of the Lanphear et al. (2005) database. In 2019, Lanphear published a correction to the original 2005 paper. Budtz-Jørgensen et al. (2013) reanalyzed the Lanphear et al. (2005) data using additional statistical methods and a benchmark dose approach. All three papers are summarized in more detail in Appendix J of the Final 2021 LCRR EA and Budtz-Jørgensen et al. (2013), Crump et al., (2013) and Lanphear et al (2019) reinforce the findings in the original Lanphear et al. (2005) paper. Jusko et al (2008) and Min et al (2009), which use more recent blood lead levels than those used in the Crump and Lanphear analyses, both identified deficits in IQ at a lower blood lead level than Crump et al. (2013), who used the data published by Lanphear et al. in 2005. Min et al. (2009) only examines concurrent exposure, and the authors identify that at age 4 there is a decrease of 0.77 IQ points for every 1 µg/dL increase in blood lead level. In Min et al. (2009), the dose-response relationship between concurrent blood lead level and Performance IQ at 4 years showed a steep slope at lower levels (up to 7 µg/dL) but did not reach significance. Jusko et al. (2008) demonstrated that the slope of the blood-lead IQ relationship was steeper at lower levels of lead exposure where IQ decreased by 1.2, 0.32, and 0.15 points per 1-µg/dL increase in peak blood lead over the range of 2.1–10 µg/dL, 10–20 µg/dL, and 20–30 µg/dL, respectively. In both the Min and Jusko studies, the steeper slopes at lower blood lead levels without log transformation showed increased

deficits; this reinforces the fact that reducing lead levels in lower ranges of average blood lead level has a significant impact on preventing IQ loss.

The NTP Monograph also found *limited evidence* of decreased cognitive function in children with prenatal exposure levels <5 µg/dL. This conclusion is based on strong, consistent support for an association between increased umbilical cord blood lead and decreased MDI scores, plus the mixed evidence for maternal blood lead and MDI or other measures of cognitive function in children (National Toxicology Program, 2012, p. 31). Several prospective studies indicated a negative association between prenatal lead exposures <5 µg/dL and both general and specific cognitive function. General cognitive function is measured using general non-IQ assessment tools (*e.g.,* the MDI and GCI tests). Specific cognitive functions may be measured using individual subsets of the WISC (*e.g.,* Block Design or Digit Span) tool. There is strong epidemiological evidence of the effects of lead exposure on cognitive function from MDI scores in children aged 6 months to 3 years, and scores on specific cognitive function tests in children aged 6 months to 16 years (National Toxicology Program, 2012, p. 27). A study of a Mexican cohort found an association between increased maternal patella lead and decreased MDI scores among 2-year-olds, suggesting that maternal cumulative lead exposure also plays a role in decreased cognitive function in children (Gomaa et al., 2002).

D.7.1.3 Children: Academic Achievement

The relationship between lead exposure and decrements in Full Scale Intelligence Quotient (FSIQ) has been reviewed by several researchers and government agencies. There also is agreement that lower FSIQ and learning are linked with poorer academic performance and achievement. FSIQ is a combination of 10 subtest scores most commonly evaluated using the WISC and is considered the most representative measure of full cognitive function. The EPA (2024) ISA determined a *causal relationship* between lead exposure and decrements in children's cognitive functioning, which includes academic performance and achievement. This conclusion is based on several lines of evidence including findings from prospective studies in diverse populations, coherence with evidence in animals, and evidence describing modes of action. The NTP Monograph found *sufficient evidence* of decreases in measures of academic achievement in 6- to 18-year-olds with blood lead <5 µg/dL based on the consistency of effects on several measures of academic achievement in multiple studies (National Toxicology Program, 2012, p. 23). Both prospective and cross-sectional studies conducted on children with blood lead <10 µg/dL in North America, Europe, and Africa have documented an inverse relationship between blood lead and class rank, end-of-grade testing, and scores on academic performance tests. Associations between decreased academic achievement and lead exposure have been noted in prospective studies for early-childhood lead exposure in blood (9-36 months of age) and tooth dentin (6- to 8-year-olds) and later in life achievement (Chandramouli et al.,2009; Miranda et al., 2009; Needleman et al., 1990). However, these findings are complicated by the fact that blood lead measurements change over time. Cross-sectional study results support the negative association between concurrent blood lead and academic achievement for children (Al-Salea et al., 2001; Lanphear et al., 2000; Rabinowitz et al., 1992; Wang et al., 2002).

The studies reviewed in the EPA (2024) ISA revealed lower performance on tests of math, reading, and spelling skills, as well as lower probability of completing high school, lower class rank, and lower teacher ratings of academic function. The confidence in the association between blood lead in children and decreased academic performance is bolstered by the fact that it is consistent regardless of the academic

achievement measure used. Miranda et al. (2009) found that an increase in blood lead from 1 to 10 µg/dL was associated with a 2.3-point decrease in end-of-grade score in children in the 5^{th} percentile of end-of-grade compared to a 0.8-point decrease in children in the 95^{th} percentile of end-of-grade score. This impact was shown to be independently associated with end-of-grade score even after accounting for socioeconomic factors.

Several studies found the association between blood lead and math or reading test scores to remain significant after the consideration of confounders such as socioeconomic status, maternal education, material intelligence, and parental caregiving. For example, a study of 488 children in the United Kingdom found that Standard Assessment Test grades decreased 0.3 points (95 percent confidence interval: -0.5, -0.1) when blood lead at 30 months old was doubled. The study adjusted for maternal education, maternal smoking, home ownership, parental socioeconomic status, and parental caregiving quality (Chandramouli et al., 2009). The same study revealed that Standard Assessment Test scores did not differ between children with blood lead 0-2 µg/dL compared to those with 2-5 µg/dL (Chandramouli et al., 2009). Similarly, Needleman et al. (1990) found an increased probability of dropping out of high school in 18-year-olds with tooth lead levels >20 ppm compared to those with tooth lead levels <10 ppm. Although Needleman et al. (1990) adjusted for several confounders including maternal education, IQ, and age, socioeconomic status, and subject alcohol use, controlling for these variables could have contributed to the imprecision of the effect estimate. The small sample size (132 subjects) could also have impacted the results.

Cross-sectional studies referenced in the EPA (2013 and 2024) ISA also reported relationships between lower scores in math and reading test results and higher concurrent blood lead. The association between lead exposure and lower math and reading scores was identified in more than one analysis of NHANES data. For example, Lanphear et al. (2000) found a supra-linear relationship between blood lead and math scores among nearly 5,000 6- to- 16-year-olds. This was similar to the relationship between FSIQ and lead levels. The analysis of the 1988-1994 NHANES III data revealed that a 1 µg/dL increase in concurrent blood lead was associated with a 0.70-point decrease in math score among all subjects and a 1.1-point decrease among 6- to 16-year-olds with blood lead <5 µg/dL (Lanphear et al., 2000). In addition to its large sample size, the examination of multiple chemical exposures included in this analysis of NHANES III data provides increased confidence in the results.

Of the studies reviewed in the NTP Monograph and conducted in the 15 years prior to the NTP Monograph, many revealed decrements in academic achievement in relation to blood lead <10 µg/dL and as low as 2 µg/dL. This relationship remains stable after controlling for several confounders such as socioeconomic factors, sex, race/ethnicity, and age of subject during blood lead measurement, parental education, and tobacco exposure. An analysis of 4,853 6- to 16-year-olds in the 1988-1994 NHANES III dataset revealed an association between decreased achievement measured via the Wide Range Achievement Test-Revised and concurrent blood lead <5 µg/dL (Lanphear et al., 2000). Some studies have reported differential effects of blood lead on test scores: in a study of fourth graders in North Carolina, children with lower test scores experienced greater decreases in scores given the same increase in blood lead than children with higher test scores (Miranda et al., 2009). Lower parental education and lower socioeconomic status were also shown to affect children with lower test scores in the studies reviewed, implying that lead with other confounders can increase the impact from lead alone among children with low baseline achievement levels.

The EPA also reviewed the Kordas et al. (2005) and Evens et al. (2015) cross-sectional studies. Kordas et al. used a battery of 14 cognitive tests that examined different aspects of executive functions, which showed steeper slopes for tests on math, memory, and a picture vocabulary test. The second study, Evens et al. (2015), utilized a standardized test that focused on examining critical and quantitative reasoning abilities, which were shown to be influenced by lead levels even below 5 µg/dL.

D.7.2 Attention-Related Behavior

The NTP Monograph noted *limited evidence of association* between maternal blood lead levels <10 µg/dL and incidence of attention-related behaviors via *in utero* lead exposures based on the mixed results of studies with prenatal exposure data (National Toxicology Program, 2012, p. 37). A study of 1,923 15- and 17-year-olds in the Boston area found cord blood lead and tooth dentin lead to be associated with inflexible behavior but not hyperactivity in 8-year-olds (Leviton et al., 1993). Another study of 195 children in the Cincinnati area reported that scores on the Continuous Performance Test was inversely associated with average childhood blood lead at <5 years of age, blood lead at 6.5 years of age, and maternal blood lead level during the first and second trimester of pregnancy (Ris et al., 2004). This indicates that children with higher blood lead levels had poorer test performance. Some participants in the Ris et al. (2004) study also had early childhood blood lead levels above 10 µg/dL, indicating that in addition to prenatal exposures to lead, they were exposed to high levels of lead in early childhood.

The NTP Monograph found *sufficient evidence* of attention-related behavioral problems in 3- to 18-year-olds with blood lead <5 µg/dL based on the consistency of effects in the studies reviewed and the support for effects down to and below 2 µg/dL blood lead (National Toxicology Program, 2012, p. 34). Rather than basing this determination solely on the outcome of attention-deficit/hyperactivity disorder (ADHD), the broader category of attention-related behaviors is used in the NTP Monograph for two reasons. First, NTP states in the Monograph that using "attention-related behaviors" more accurately reflects the diversity of the behavioral effects data presented in the literature. The diagnostic criteria for attention-related behaviors can include several types of behavioral deficits in addition to hyperactivity, inattention, and the overall diagnosis of ADHD. Secondly, the diagnosis of ADHD in the studies reviewed lacks the strength of a diagnosis given by trained clinicians using Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria.[59] For example, several of the studies examined diagnosed ADHD based on untrained teacher evaluations, parental reporting of a physician's diagnosis, or whether a child was taking ADHD medication.

Most of the studies reviewed in the NTP Monograph identified significant associations between blood lead <5 µg/dL in children and attention-related behaviors, with several reporting the association at blood lead <2 µg/dL. As described in the NTP Monograph, over 10 studies suggest an association between current average blood lead of 1-11 µg/dL and attention-related behavioral issues, ADHD, or other indicators of decreased attention or increased hypersensitivity in 3- to 18-year-olds. For example, Wang et al. (2008) reported a significant association between ADHD determined from a structured

[59] The DSM is the standard classification of mental disorders used by mental health professionals in the United States. The DSM contains a list of diagnostic criteria for each disorder and indicates which symptoms and for how long these symptoms must be present in order to report a diagnosis.

diagnostic interview and concurrent blood lead >5 µg/dL in a case-control study of 1,260 Chinese 4- to 12-year-olds. A study of Romanian children also found an increase in attention-related behavioral problems based on parent and teacher ratings using German diagnostic surveys in a study of 83 8- to 12-year-olds with concurrent mean blood lead of 3-5 µg/dL (Nicolescu et al., 2010). Two studies conducted in the United States with 7- to 9-year-old inner-city black children found that blood lead was positively related to several attention-related behaviors including higher ADHD and inattention scores (Chiodo et al., 2007; Chiodo et al., 2004).

NHANES data were used to support the relationship between blood lead and attention-related behaviors. Braun et al. (2006) found the odds of ADHD to be more than four times greater among 4- to 15-year-olds in the 1999-2002 NHANES with blood lead >2 µg/dL compared to children with blood lead <0.8 µg/dL. Similarly, Froehlich et al. (2009) found that children in the 2001-2004 NHANES with concurrent blood lead >1.3 µg/dL and concurrent blood lead of ≥0.9 to 1.3 µg/dL had 2.3-greater and 1.7-greater odds, respectively, of ADHD compared to children with blood lead <0.8 µg/dL. While Froehlich et al. (2009) used the Diagnostic Interview Schedule for Children to determine ADHD in subjects, Braun et al. (2006) relied on parental report of stimulant medication or previous diagnosis of ADHD.

The NTP Monograph found *limited evidence* of attention-related behavioral problems in children with prenatal lead exposure at blood lead <10 µg/dL based on the review of several studies (National Toxicology Program, 2012, p. 34). The limited conclusion was chosen because the children in the studies were also exposed to lead in early childhood, therefore the timing of exposure that is most important in causing the adverse effect could not be determined. A prospective study of prenatal and early childhood lead exposure up to 6 years old found that performance on the Continuous Performance Test – Conners' Version at ages 15-17 years old was inversely related to maternal blood lead during the first or second trimester of pregnancy (mean=8.9 µg/dL), mean blood lead under 5 years old, and concurrent blood lead at age 6.5 years old (Ris et al., 2004). This indicates that children with higher lead exposures did not score as well as children with lower lead exposures on these tests. However, blood lead levels of participants during early childhood were above 10 µg/dL. Studies of cord lead levels (mean=6.8 µg/dL) and tooth dentin lead levels in 1,923 8-year-olds in Boston were associated with inflexible behavior but not with hyperactivity (Leviton et al., 1993). The NTP Monograph conclusion is also based on bone lead studies that found an association between lead exposure and attention-related behaviors such as hyperactivity and inattention. Lead levels in primary teeth and tibiae have been reported to be significantly associated with measures of inattention in 19- to 20-year-olds (Bellinger 1994).

The EPA (2024) ISA strengthened the conclusions of the 2013 ISA which concluded that there was a *causal relationship* between lead exposure and inattention, impulsivity, and hyperactivity in children based on recent studies of children with group mean BLLs $\leq 5\ \mu g/dL$ supporting the 2013 ISA conclusions and "prospective studies of ADHD, including a study of clinical ADHD that controlled for parental education and SES, although not quality of parental caregiving reported positive associations" (USEPA, 2024). The 2024 ISA addresses the uncertainties presented in the 2013 ISA by stating that "The largest uncertainty addressed by the recent evidence base is the previous lack of prospective studies examining ADHD (Appendix 3.5.2.4–3.5.2.5). The bulk of the recent evidence comprises prospective studies that establish the temporality of the association between Pb exposure and parent or teacher ratings of ADHD symptoms and clinical ADHD. Across studies, associations were observed with tooth Pb concentrations, childhood BLLs (<6 µg/dL), and with maternal or cord BLLs (2–5 µg/dL)."

The causal relationship for inattention, impulsivity and hyperactivity cited in the EPA (2024, Appendix 3, Table 3-3) ISA relies on data from both cross-sectional studies and prospective cohort studies. The studies characterized as strongest were the prospective studies that investigated attention and found associations with blood or tooth lead level. Several of the studies cited in the EPA (2013) ISA were also cited in the NTP Monograph including Ris et al. (2004) and Bellinger et al. (1994). The prospective studies demonstrated the temporality of the association between lead exposure and onset of attention-related effects. The research collectively looked at lead exposures at various points in time including prenatal blood lead, blood lead measured 9-11 years before attention was measured, lifetime average blood lead, and tooth lead. Several confounders were controlled for in most prospective studies including parental education; IQ; caregiving quality; socioeconomic status; birth outcomes; and exposure to alcohol, drugs, or smoking. The newer studies reviewed in the EPA (2013) ISA found evidence of an association between measures of decreased attention and concurrent blood lead level between 2 and 5 µg/dL. However, there are several limitations that should be considered when interpreting these results. For example, the studies did not consider the effects of potential confounders such as parental caregiving quality and examined adolescents who may have been influenced by higher lead exposures during early childhood. Further supporting the relationship between BLLs and ADHD, the EPA's 2024 ISA identified a cross-sectional study by Geier et al. (2018) that also found a relationship after adjusting for covariates "such as" gender, race and socioeconomic status odds ratio (95% CI) 1.29 (1.03-1.55). This study examined 2,109 people aged 10-19 using 2003-2004 NHANES data (Geier et al., 2018).

D.7.3 Conduct Disorders

The EPA (2024) ISA determined a *likely causal relationship* between lead exposure and conduct disorders in children primarily based on consistent results from recent prospective cohort studies (see Appendix 3.5.3.1 of the 2024 Pb ISA). The determination was influenced by the uncertainty introduced by inconsistent animal evidence with relevant exposures and the small number of epidemiological studies identified. Several prospective studies indicate a positive association between conduct issues and prenatal maternal blood lead measurements, concurrent (age 6 years), and lifetime average (4-5 years or 11-13 years) blood lead (mean=6.8-14.3 µg/dL) (Burns et al., 1999; Dietrich et al., 2001). Dietrich et al. (2001) reported an association between lead exposure and self and parent-reported delinquent and antisocial acts. The study used prenatal maternal first trimester blood lead measurements, average childhood lead exposure, and a late body burden of lead levels for 15- to 17-year-olds. Several cross-sectional studies reported associations between conduct problems and lead exposure at blood lead lower than those reported in the prospective studies (1-5 µg/dL). Although the cross-sectional studies reported relationships between lead exposure and outcome, the EPA (2013) ISA notes that confidence in these results is limited due to inadequate adjustment for confounding variables.

The NTP Monograph found *sufficient evidence* of increased incidence of problem behaviors in children with blood lead <5 µg/dL based on the consistency of effects in multiple prospective and cross-sectional studies (National Toxicology Program, 2012, p. 46). The NTP Monograph included delinquent, criminal, or antisocial behavior in its review of problem behaviors. The conclusion was based on data from several prospective and cross-sectional studies illustrating increased criminal behavior in 6- to 15-year-olds with concurrent blood lead <1-15 µg/dL. Adjustments for confounders were made in several of the studies

for socioeconomic variables including sex, race/ethnicity, age of blood lead measurement, parental education, and tobacco exposure. One of the key studies reviewed in the NTP Monograph is a cross-sectional study of the 2001-2004 NHANES data that found a relationship between conduct disorders and blood lead ≥0.8 µg/dL in 8- to 15-year-olds compared to 8- to 15-year-olds with blood lead <0.7 µg/dL conducted by Braun et al. (2008).

Several studies found associations between elevated blood lead levels in young adults and criminal behavior. Wright et al. (2008) analyzed 250 young adults aged 19-24 enrolled in the Cincinnati Lead Study. The study reported a relationship between higher rates of total criminal arrests and blood lead at 6 years old. The association between crime and increased lead exposure is supported by studies measuring tooth dentin lead. In a New Zealand study of 1,265 21-year-olds, Fergusson et al. (2008) found an association between reported crimes and tooth dentin lead from primary teeth shed at 6 to 8 years old. Bellinger et al. (1994) also reported a significant relationship between tooth dentin lead levels and problem behaviors in 8-year-olds in Boston. The NTP Monograph found *limited evidence* of increased incidence of problem behaviors in children with prenatal exposure to lead levels <10 µg/dL. The analysis by Wright et al. (2008) suggested a relationship between higher maternal blood lead during the first or early second trimester of pregnancy and higher rates of total criminal arrests among 19- to 24-year-olds enrolled in the Cincinnati Lead Study. Several studies supported the association between lead exposure and delinquent behavior or criminal arrests. However, the blood lead levels in some of the participants were above 10 µg/dL, thus making the generalizability of these studies' findings to blood lead <10 µg/dL limited.

D.7.4 Internalizing Behaviors

In contrast to studies that investigated externalizing behaviors in children such as inattention, impulsivity, and conduct disorders, there are also studies that investigated internalized behaviors. Internalizing behaviors include withdrawn behaviors, symptoms of depression, fearfulness, and anxiety. Internalized behaviors are most often assessed through parent or teacher reports using the Child Behavior Checklist.[60]

The EPA (2024) ISA determined a *likely causal relationship* between lead exposure and internalized behaviors in children (USEPA, 2024, p. IS-33). Multiple prospective studies of various populations provide key evidence for an association between increased lead exposure and higher ratings of internalized behaviors. These studies reported cord blood, concurrent blood (age 3), lifetime average blood, and tooth lead levels to be associated with higher ratings of internalized behaviors in children 3- to 13-year-old children. Results from cross-sectional studies also support the EPA ISA's causal determination of a relationship between lead exposure and internalized behaviors in children for concurrent blood (Liu et al., 2011; Roy et al., 2009) and hair lead levels (Bao et al., 2009).

[60] The Child Behavior Checklist is a widely used questionnaire to assess behavioral and emotional problems in children.

D.7.5 Psychological Effects

The EPA (2024) ISA states that there is a *likely causal relationship* between lead exposure and psychopathological effects based on "recent prospective analyses provide additional support for a positive association between bone and BLLs and psychopathological effects in older adults, although results from cross-sectional studies are inconsistent. Recent toxicological studies in rodents with developmental exposure continue to provide evidence of anxiety-like behaviors. Multiple studies demonstrate the persistence of these effects into adulthood. Additionally, a few recent studies in rodents demonstrated effects of adult-only Pb exposures on anxiety-like behavior after 42–126 d of exposure (BLLs: 7.1 to 28.4 ug/dL), but not following a 30-d exposure (BLLs: 6.8 to 8.8 ug/dL)" (USEPA, 2024, p. IS-40). In some cases, the epidemiology results are supported by evidence from studies of toxicology. The NTP Monograph concluded that there is *limited evidence* for an association between lead levels and psychiatric symptoms based on the small number of studies supporting such effects. Two of these studies were from a single cohort[61] (National Toxicology Program, 2012, p. 38). The NTP Monograph points out that in adults, the studies "do not include cohorts where that blood Pb levels were consistently below 10 µg/dL from birth to the time of the behavioral assessment". Thus, the evidence for effects below 10 µg/dL is not strong.

Self-reported symptoms of depression and anxiety in adults are linked to higher concurrent blood lead or tibia lead levels in cross-sectional studies. Three studies on the association between lead levels and psychological effects were referenced by both reports (Bouchard et al., 2009; Rajan et al., 2007; Rhodes, et al., 2003). The studies indicated an association between lead levels and panic disorder, somatization, and the global severity index[62]. One study, Bouchard et al. (2009), determined that what they described as a generalized anxiety disorder was not associated with lead levels, but Rhodes et al. (2003) found that elevated anxiety and phobic anxiety were significantly associated with blood, tibia and patella lead levels.

D.7.6 Neurodegeneration

Some studies described in the NTP Monograph, and the EPA (2024) ISA looked at measures of the progressive loss of neurological functions as manifest in amyotrophic lateral sclerosis (ALS) and essential tremor disorders.

The EPA 2024 ISA found that there is a *suggestive, but not sufficient to infer, a causal relationship* between lead and neurodegenerative diseases The NTP Monograph concluded that there is *limited evidence* of an association between increased occurrence of ALS and blood lead levels <10 µg/dL (National Toxicology Program, 2012, p. 38). Both the NTP Monograph and the EPA ISA discuss the potential of reverse causation. That is, the observed associations between blood lead and ALS may not necessarily mean that lead exposure contributes to the development of ALS. Instead, it could be that the decreases in activity associated with ALS increase bone turnover, which releases lead from bone and thereby increases blood lead levels. Five studies on the association between lead and ALS were

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[61] *i.e.,* the Normative Aging Study

[62] An indicator quantifying a respondent's psychological distress status.

reviewed in both reports; while three studies observed effects, only two of these studies had significant results (Fang et al., 2010; Kamel et al., 2005). Fang et al. (2010) conducted a case-control study of U.S. military veterans and found that associations between blood lead and ALS remained significant after adjustment for indicators of bone turnover. Although this study suggests that reverse causation is not likely, the EPA (2013) ISA points out that the study lacked actual measurements of bone lead, and that directionality still cannot be established. In addition, studies in ALS patients have generally produced inconsistent results. The EPA ISA specifically points to the mixed findings of the Kamel studies (Kamel et al., 2002; Kamel et al., 2003; Kamel et al., 2005) of a New England cohort of ALS cases recruited from the Neuromuscular Research Unit at the New England Medical Center and the Neurophysiology Laboratory at Brigham and Women's Hospital (p. 4-223).

The NTP Monograph determined that there is evidence of a *sufficient association* between essential tremor incidence in adults and blood lead levels <10 µg/dL, but evidence of a *limited association* in adults with blood lead levels <5 µg/dL (National Toxicology Program, 2012, p. 39). The four studies on this endpoint identified in the NTP Monograph examined more than 300 cases of essential tremor, and all indicated consistent associations between diagnosis and blood lead levels. However, the NTP Monograph found *limited* evidence at <5 µg/dL because the two identified studies examining participants with blood lead <5 µg/dL are representative of only a small group of patients. NTP concluded that there is *sufficient* evidence of a relationship at blood lead levels of <10 µg/dL because the same pattern of effects was observed in two "widely separated" groups in terms of geography (National Toxicology Program, 2012, p. 51).

D.7.7 Auditory Function

Auditory function can be evaluated through measurements of hearing thresholds, auditory processing, and changes to brainstem auditory evoked potential.

D.7.7.1 Adults

The EPA ISA states that the evidence on lead exposure and auditory function is *suggestive of a causal relationship* based on limited epidemiological evidence with relevant bone or blood lead levels, and a lack of animal evidence at relevant exposures (USEPA,2024). The NTP Monograph found *limited evidence* for associations between decreased auditory function and both prenatal and adult blood lead levels of <10 µg/dL based on a supportive but small body of studies on the subject (National Toxicology Program, 2012, p. 40).

Four studies in adults are highlighted in the NTP Monograph. These address individuals with lower blood lead levels. Forst et al. (1997) reported that blood lead level (mean, 5 µg/dL; range, 1-18 µg/dL) was associated with an elevated hearing threshold at 4,000 Hz, but not at other frequencies. Hwang et al. (2009) found at blood lead levels ≥7 µg/dL that hearing thresholds were significantly increased in a study of 259 steel plant workers in Taiwan. In a case-control study of 121 adult cases (mean lead level, 10.7 µg/dL) referred for hearing testing, elevated blood lead was significantly associated with higher hearing thresholds compared to controls (Chuang et al., 2007). In a cross-sectional analysis of 448 men in the Normative Aging Study, tibia lead (mean, 23 µg/g) and patella lead (mean, 33 µg/g) were significantly associated with hearing loss indicated by higher hearing thresholds (Park et al., 2010).

D.7.7.2 Children

The NTP Monograph found *sufficient evidence* of decreased hearing in children with blood lead <10 µg/dL (National Toxicology Program, 2012, p. 40). The conclusion set in the NTP Monograph is based on several cross-sectional studies that reported increased hearing thresholds and an increase in brainstem auditory evoked potential in 4-to 19-year-olds. The NTP Monograph references two studies conducted by Schwartz and Otto on blood lead and hearing loss, which are also reviewed in the EPA ISA. In their analysis of NHANES II (1976-1980) data, Schwartz and Otto (Schwartz & Otto, 1987) found a significant relationship between blood lead and increased hearing thresholds for pure-tone frequencies in 4,519 4- to 19-year-olds. The researchers also found an association between hearing loss and blood lead ≥8 µg/dL, as well as a 2-decibel decrease in hearing at all frequencies with an increase in blood lead from 6 to 18 µg/dL in an analysis of the Hispanic Health and Nutrition Examination Survey data for 3,545 six- to 19-year-olds (Schwartz & Otto, 1991).

The NTP Monograph found *limited evidence* of decreased hearing in children with prenatal lead exposure at blood lead <10 µg/dL (National Toxicology Program, 2012, p. 40). A limited conclusion was assigned rather than a *sufficient* conclusion because few of the studies identified addressed low-level lead exposures. The *limited* conclusion is based on three studies that demonstrated an association between prenatal exposure to blood lead <10 µg/dL and auditory effects. Two studies reported changes in the latency and interpeak interval of brainstem auditory evoked potential in infants born to mothers with blood lead <10 µg/dL and 5- to 6-year-olds born to mothers with mean blood lead of 8 µg/dL (Rothenberget al., 1994; Rothenberg et al., 2000). In an analysis of 259 children enrolled in the Cincinnati Lead Study, Dietrich et al. (1992) found associations between auditory processing disorders at age 5 and both prenatal lead exposure (mean prenatal blood lead=8 µg/dL) and early childhood lead exposure (mean infant blood lead=5 µg/dL). However, the applicability of Dietrich et al.'s, (1992) findings to blood lead <10 µg/dL is limited given that mean blood lead of subjects aged 1-5 was 10-17 µg/dL.

The EPA (2024) ISA determined a *suggestive of, but not sufficient to infer, a causal relationship* between lead exposure and decreased auditory function in children based on cross-sectional and case-control studies generally supporting an association between Pb exposure and hearing loss "but are not entirely consistent." The uncertainty in this determination is due to a lack of animal evidence in juveniles and at relevant exposures. Both prospective and cross-sectional studies demonstrated a relationship between higher blood lead and decreased auditory function in children. Most studies reviewed adjusted for socioeconomic factors, and several studies controlled for child health and nutrition. The association between higher lead exposure and decreased auditory function was found for several time periods of exposure including prenatal maternal, neonatal, lifetime average (to age 5), and concurrent (age 4-19) blood lead (Dietrich et al., 1992; Rothenberg et al., 2000; Schwartz & Otto, 1987, 1991). This association is also supported by animal studies, but at levels higher than relevant to the scope of the EPA ISA.

D.7.8 Motor Function

Motor function includes both fine and gross motor function. Fine motor function includes skills such as response speed and dexterity, while gross motor function includes postural balance, action tremor, and agility. Since there is little evidence on this endpoint available in adults, the EPA (2024) ISA did not provide a conclusion on the association between lead exposure and motor function during adulthood. In

children aged 4.5 to 17 years old, the EPA (2024) ISA determined a *likely causal relationship* between lead exposure and decreased motor function (USEPA, 2024).[63] This relationship was demonstrated for both fine and gross motor function. A few studies provided the EPA with key evidence to determine a *likely causal* relationship between lead exposure and motor function decrements. Ris et al. (2004) found that higher early childhood blood lead (mean age=78 months; mean blood lead=11.7 µg/dL) was associated with poorer fine motor function in adolescents aged 12-17 from the Cincinnati Lead Study. Bhattacharya et al. (2006) found a significant relationship between decrements in gross motor skills and higher early childhood blood lead among participants in the Cincinnati Lead Study. Additional analyses of this cohort suggest that decreased upper limb dexterity, fine motor composite score, and poorer postural balance are associated with higher concurrent, lifetime average, and neonatal (but not prenatal maternal blood lead measurements) blood lead (Bhattacharya et al., 1995; Dietrich et al., 1993). The EPA ISA reports that the studies reviewed adjusted for confounders such as child health, parental caregiving quality, and socioeconomic factors. On the other hand, cross-sectional studies and toxicological data reviewed in the EPA ISA provided mixed evidence of an association between motor function decrements and higher blood lead.

D.8 Cancer

Animal studies provided the EPA with evidence to determine a *likely causal relationship* between lead exposure and cancer (USEPA,2024). Additionally, the International Agency for Research on Cancer (IARC) lists inorganic lead compounds as probable human carcinogens, and organic lead compounds as not classifiable (International Agency for Research on Cancer, 2006). The NTP Monograph did not review cancer because it reviewed the carcinogenic effects of lead in its Report on Carcinogens. In the 2004 Report on Carcinogens, NTP found that lead and lead compounds are *reasonably anticipated to be human carcinogens* based on *sufficient* evidence from toxicological studies and *limited* evidence from human studies. Lead exposure is associated most strongly with lung and stomach cancer, but has also been associated with increased risk for urinary-bladder cancer (National Toxicology Program, 2004).

Inconsistent results have been reported in the epidemiological literature on the relationship between lead exposure and cancer mortality. One epidemiological study using NHANES III (1988-1994) data demonstrated an association between increased blood lead and increased cancer mortality (Schober et al., 2006). However, other studies have reported weak or no associations (Khalil et al., 2009; Menke et al., 2006; Weisskopf et al., 2009).

Despite the inconclusiveness of epidemiology evidence, toxicological studies demonstrate associations between lead exposure and cancer. Although no new relevant animal studies were identified, the ISA states, “animal studies available in previous reviews continue to provide strong support for the carcinogenic potential of high Pb exposures (chronic 10,000 ppm Pb acetate diet or 2,600 ppm drinking water Pb acetate)” (USEPA, 2024, Appendix 10, p. 10-23). There is strong evidence of lead-induced tumor development in animal studies with long-term exposures (18-24 months) to high lead concentrations (> 2,600 ppm) (Azar et al., 1973; Kasprzaket al., 1985; Koller, et al., 1985; Van Esch &

[63] Effects on motor function in children were not reviewed as an endpoint in the NTP Monograph.

Kroes, 1969). Additionally, the Lead ISA identified the potential that early life exposures could induce cancer in adulthood (Waalkes et al., (1995); Tokar et al. (2010)).

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Appendix E: Adverse Health Effects Associated with Copper Exposures

Although copper is an essential trace element required for several metabolic processes, excess copper intake is toxic and linked to various adverse health effects. Copper is common in human diets: the average adult ingests approximately 1 mg/day, and absorbs approximately half of that amount (National Research Council, 2000). Copper is necessary for many physiological functions including aerobic metabolism, immune and cardiac function, glucose metabolism regulation, and essential for adequate human growth. Additionally, copper deficiency has been linked to altered cholesterol metabolism, and anemia and bone-marrow abnormalities among children (Bost et al., 2016; National Research Council, 2000). The National Academy of Science has set a Recommended Daily Allowance for copper in healthy adults of 0.9 mg/day, and Recommended Daily Allowances ranging from 0.34 mg/day to 0.7 mg/day for children 1 years up to 13 years old (Institute of Medicine, 2001). Recommended Daily Allowances represent the necessary daily amount of copper needed for normal metabolic functions. The National Academy of Science also developed Tolerable Upper Intake Levels for copper, which range from 1 mg/day for children 1-3 years of age to 10 mg/day for adults, including pregnant mothers. These Tolerable Upper Intake Levels values are contentious, as varying concentrations of excess copper intake have been found to cause excess retention in the body, leading to adverse health effects (Turnlund et al., 2005).

Studies show that adverse gastrointestinal and hepatic effects are associated with high copper ingestion. Acute gastrointestinal symptoms are the most common adverse effect observed among adults and children. Chronic hepatic effects are also a concern, particularly for those with Wilson's disease and children pre-disposed to genetic cirrhosis syndromes. These diseases disrupt copper homeostasis, leading to excess accumulation that can be worsened by excess copper ingestion (National Research Council, 2000).

This appendix provides a qualitative discussion of the adult and child health effects associated with ingested copper exposure, which are anticipated to be reduced by the rule. The monetary value associated with the benefits of the final LCRI are not quantified in this appendix because quantitative changes in exposure were not estimated.

The health effects discussed in this Appendix were identified using various sources. The United States Department of Health and Human Services' Toxicological Profile for Copper (ATSDR, 2004) provides a comprehensive review of all effects associated with copper exposure in literature before 2004. The National Research Council's *Copper in Drinking Water* provides a comprehensive review of effects associated with ingesting copper via drinking water in literature before 2000. An additional search was conducted to identify studies published after 2004. However, these health effects are not expected to occur at the concentrations currently found in public drinking water systems that are in compliance with the Lead and Copper Rule. A recent study as part of the American Healthy Homes Survey II tested 678 US homes where children may be living and found 1.5% exceeded the action level for copper of 1.3 mg/L. The mean copper concentration was found to be 125 µg/L (Bradham et al., 2023).

E.1 Acute Gastrointestinal Distress

Copper exposure via drinking water has been linked to gastrointestinal distress, most often nausea and vomiting, and less often, diarrhea and abdominal pain (ATSDR, 2004), however, as described below

these levels were higher than are found in most U.S. water in compliance with the Lead and Copper Rule. The gastrointestinal system absorbs 12-60% of ingested copper and is suggested as an explanation for gastrointestinal effects (de Romanaet al., 2011; Wapnir, 1998). Copper absorption primarily occurs in the duodenum, but also the stomach and distal part of the small intestine. Copper is then transported to the liver via the portal vein (Bost et al., 2016; Kodama and Bhadhprasit, 2012). Since the literature on this endpoint primarily examines adults, gastrointestinal effects discussed in this appendix pertain to healthy adults unless otherwise specified.

Many studies have found nausea to be the primary acute health effect of a single exposure to copper in drinking water among healthy adults. The maximum contaminant level goal (MCLG) the EPA established in the Lead and Copper Rule for copper is 1.3 mg/L. The MCLG is the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, allowing an adequate margin of safety. The World Health Organization's Guidelines for Drinking Water Quality summarized various case studies of copper contamination in beverages and public water supplies. It found nausea, vomiting and diarrhea to be acute onset symptoms of copper exposure at concentrations as low as 4 mg/L, typically occurring within 15 to 60 minutes of initial exposure (World Health Organization, 2004).

Nausea and vomiting resulting from acute exposures are thought to be caused by a reflex response from the stimulation of the vagal nerve, which originates in the stomach (de Romana et al., 2011). Larger ingested copper doses directly stimulate the hypothalamic vomit center in addition to the vagal nerve causing vomiting. The physiological changes that result in diarrhea are not well understood (de Romana et al., 2011). Copper ingestion reduces the mucosal barrier capacity and gastric permeability to sucrose and delays the first phase of gastric emptying by decreasing antral area. However, these effects have been found to be independent of gastrointestinal symptoms (Araya et al., 2003; Gottelandet al., 2001). Generally, the ionic form of copper is considered an irritant of the gastrointestinal tract and has been suggested as an explanation for gastrointestinal symptoms caused by copper in drinking water (National Research Council, 2000).

E.2 Chronic Liver Toxicity

Copper exposure has been linked to hepatic effects in susceptible individuals, such as those with Wilson's disease or infants and children who have genetic susceptibilities. For these populations, chronic liver disease is a primary concern. Liver effects are not considered a major concern for healthy adults, as long-term daily exposure to copper in a regular diet of up to 12 mg/day has shown no adverse liver effects (Institute of Medicine, 2001). This level is higher than the expected copper levels in water systems in compliance with the previous LCR. A recent study assessed the association between copper and non-alcoholic fatty liver disease.

E.2.1 Wilson's Disease

Wilson's disease is an autosomal recessive genetic disorder of copper metabolism, characterized by defective ATP7B function leading to impaired biliary excretion of copper, affecting 1 in 30,000 individuals (Ala et al., 2007). High copper deposition in the liver, brain, cornea and low levels of ceruloplasmin are markers of the disease that typically do not present before age 7, and often manifest into chronic liver cirrhosis (de Romana et al., 2011). Other clinical manifestations of the disease include

neurological, psychiatric, and ophthalmic symptoms. It is generally agreed that the disease does not manifest as a result of excess copper exposure, but excess dietary copper intake can worsen the disease once present (Ala et al., 2007; ATSDR, 2004).

Currently, individuals with Wilson's disease are advised to avoid foods high in copper and to test drinking water levels, in addition to undergoing medicinal treatment. High hepatic copper levels have been observed in individuals with Wilson's disease who consume average copper intakes, therefore excess copper from foods and water are of concern in this population (ATSDR, 2004). Due to the rarity of Wilson's disease, there are currently no controlled trials examining effects of ingested copper. Despite this, current literature still suggests that individuals with Wilson's disease should avoid high copper intake, even if they are stable and adhering to medical therapy (Russell et al., 2018).

E.2.2 Infants and Children with Genetic Susceptibilities

Effects on the liver are primarily a concern among infants and children who have genetic susceptibilities affecting copper homeostasis. Infants have a higher absorption and reduced capacity to excrete copper at high doses compared to other age groups, and the same is assumed for children (National Research Council, 2000). However, the literature does not support an association between elevated copper exposure and hepatic effects in non-susceptible infants and children.

There are several disorders associated with liver toxicosis and copper exposures in children. Indian Childhood Cirrhosis (ICC) is characterized by swelling and degeneration of liver cells and the presence of excess copper deposits (Prasad et al., 1996). It was thought to be found exclusively among Indian children, and incidence has rapidly declined in the last three decades (Yadav et al., 2015). Idiopathic Copper Toxicosis (ICT) refers to cases that have similar presentation to ICC but occur outside of India (Nayak and Chitale, 2013).

The exact etiology of these diseases is unknown but has been hypothesized to involve both genetic susceptibilities and high copper exposure. Childhood cirrhosis in India has been attributed to the use of copper containers and consumption of high-copper animal milk during infancy, as incidence of ICC significantly decreased with promotion of preventative activities (de Romana et al., 2011). However, a review of 103 case studies of childhood cirrhosis in Germany found that less than 10 percent were attributable to copper exposures (World Health Organization, 2004). In a recent review of the literature on ICC and ICC-like diseases, Nayak and Chitale (2013) concluded that excessive copper ingestion through water and food are not a primary cause of the development of the disease nor further liver injury. Furthermore, genealogic studies of families suggest that genetic inheritance is necessary for the manifestation of ICC and ICT (Nayak and Chitale, 2013). Therefore, while these disorders involve genetic predisposition and accumulation of copper, the significance of copper ingestion to the development of ICC and ICT remains unclear.

In the general population of infants and children, epidemiological and human controlled exposure studies have failed to find any associations between copper exposure and adverse effects on the liver. In a study by Scheinberg and Sternlieb (1996), death from cirrhosis or any liver disease among children under 6 years of age in towns exposed to drinking water containing approximately 9 mg/L of copper were compared to children in towns with lower copper concentrations. No difference in incidence of hepatic mortality was observed (Scheinberg and Sternlieb, 1996). A 2011 review of studies on liver diseases in infants concluded that genetic susceptibility is important because infant populations with

similarly high levels of exposure in the same geographical areas did not develop liver abnormalities (de Romana et al., 2011). In a study by Olivares et al. (1998), no alterations in liver function were found in healthy infants exposed to 0.315 mg/kg/day of copper in drinking water for 9 months. In addition, no differences in serum concentrations of copper were observed, which suggests that infants and children can adapt to different levels of copper intake by varying absorption of copper.

E.3 References

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Appendix F: Sensitivity Analysis for IQ Valuation in Children and Costs and Benefits of the Final Rule at a 3 Percent and 7 Percent Discount Rate

This appendix contains a sensitivity analysis based on an alternate value of an IQ point, described in Section F.1. This appendix also contains the costs and the benefits at the 3 and 7 percent discount rates. The values for an IQ point and case of ADHD at the 3 and 7 percent discount rates, which are used in the estimation of benefits when using the 3 and 7 percent discount rates (shown in Section F.4) are shown in Section 0[64]. The rule costs at a 3 percent and 7 percent discount rate are presented in Section F.3. The rule benefits at a 3% and 7% discount rate are presented in Section F.4. A comparison of the costs and benefits at a 3% and 7% discount rate are presented in Section F.5.

F.1 Sensitivity Analysis for the Value of an IQ point

As a sensitivity analysis for scenario IQ benefits of the final LCRI, the EPA used an alternative estimate for the value of an IQ point based on Lin et al.'s (2018). This section first briefly describes the Lin et al. (2018) analysis, then presents the alternate estimate for the value of an IQ point from Lin et al. (2018).

Lin et al. (2018) uses the Bureau of Labor Statistics' National Longitudinal Survey for the year 1979 (NLSY79) to examine how the effect of IQ on earnings varies over the lifecycle to age 50. Lin et al. (2018) generated estimates that are comparable to Salkever (1995) because they included participants with zero earnings in the analysis to capture effects related to labor participation. But in contrast to Salkever (1995), Lin et al. (2018) modeled a reduced form relationship by including IQ in the earnings equation without controlling for education due its endogeneity. Therefore, the coefficient on IQ captures both the direct effect on earnings and the indirect effect resulting from increased educational attainment. Lin et al. (2018) included a similar but not identical set of socioeconomic background variables as Salkever (1995). In addition, Lin et al. (2018) included three non-cognitive personality traits—sociability, self-esteem, and perceived level of control over one's life. Lin et al. (2018) also compared the results to estimates using a more recent survey—the NLSY 1997 cohort (NLSY97), a survey of roughly 9,000 Americans born from 1980 to 1984 (BLS, 2015). They found that the effect of IQ on earnings at age 30 was not significantly different across the two cohorts. Lin et al. (2018) noted that, after adjusting for years worked, reference age, and IQ scale, their central estimate of the effect of IQ on lifetime earnings is within two percent of the USEPA (2008) range of estimates. Because Lin et al. (2018) estimates of the IQ-earnings effect increase with age, their estimate of the IQ-earnings effect at age 30 is smaller than Salkever (1995) found. According to Lin et al. (2018), their estimates are generally applicable to policies aimed at improving cognitive performance including reduced exposure to neurotoxins. Further discussion can be found in Appendix K of the 2021 Final LCRR EA and in USEPA (2019).

The results presented in Exhibit F-1 use Lin et al.'s preferred estimates, after performing the conversion to a per IQ point estimate (see Lin et al. (2018, footnote 42)). Unlike the estimates based on the EPA

[64] For low birth weight and cardiovascular mortality, the discounting is done in SafeWater, as described in Chapter 5.

reanalysis of Salkever (1995), lost earnings while in school are implicitly accounted for in the Lin et al. (2018) IQ effect percentage.

The overall estimate for males and females combined is computed assuming a population that is 52 percent male based on the male: female ratio of births (CDC, 2017). For the reasons described above, the estimated values of an IQ point for males and females based on the Lin et al. estimates are lower than the EPA Salkever reanalysis estimates, and therefore inform our low scenario benefits estimates.

As was the case with the main IQ analysis presented in Chapter 5, the IQ point values need to be discounted to age 7 for use in the benefits analysis. The Lin et al. value of an IQ point discounted to age 7 is $22,908 using a 2 percent discount rate, in 2022 dollars. Like the main estimate, a declining interest rate was used after the year 2079 for the 2 percent discount rate.

Exhibit F-1. Estimated National Annual Children's IQ Benefits, All PWSs – 2 Percent Discount Rate (millions of 2022 USD)

	Main Analysis			Lin et al. (2018)		
	Baseline	LCRI	Incremental	Baseline	LCRI	Incremental
Annual IQ Point Decrement Avoided due to CCT	59,586	45,371	-14,215	59,586	45,371	-14,215
Annual Value of IQ Impacts Avoided due to CCT (millions of 2022 USD)	$2,306.1	$1,707.5	-$598.6	$1,251.1	$926.3	-$324.8
Annual IQ Point Decrement Avoided due to SLR	24,476	233,404	208,929	24,476	233,404	208,929
Annual Value of IQ Impacts Avoided due to SLR (millions of 2022 USD)	$963.6	$8,988.7	$8,025.1	$522.7	$4,876.5	$4,353.8
Annual IQ Point Decrement Avoided due to POU	226	52	-173	226	52	-173
Annual Value of IQ Impacts Avoided due to POU (millions of 2022 USD)	$9.3	$2.0	-$7.3	$5.0	$1.1	-$3.9

	Main Analysis			Lin et al. (2018)		
	Baseline	**LCRI**	**Incremental**	**Baseline**	**LCRI**	**Incremental**
Annual IQ Point Decrement Avoided due to Filters	0	5,234	5,234	0	5,234	5,234
Annual Value of IQ Impacts Avoided due to Filters (millions of 2022 USD)	$0.0	$264.8	$264.8	$0.0	$143.6	$143.6
Total Annual Child Cognitive Development Benefits (millions of 2022 USD)	**$3,279.0**	**$10,963.0**	**$7,684.0**	**$1,778.8**	**$5,947.5**	**$4,168.7**

Acronyms: CCT = corrosion control treatment; IQ = Intelligence quotient; LCRI = Lead and Copper Rule Improvements; SLR = lead service line replacement; POU = point-of-use; PWSs = public water systems; USD = United States dollar.

F.2 Valuation of Avoided IQ Loss and Avoided Case of ADHD at 3 Percent and 7 Percent Discount Rates

The main IQ estimate (used for both the high and low scenarios) based on Salkever at a 3% discount rate is $28,520 and $7,180 at the 7% discount rate in 2022 dollars. The high and low estimates for ADHD at a 3 percent and 7 percent are summarized in Exhibit F-2. These IQ and ADHD values are using when estimating benefits under the 3 and 7 percent discount rate scenarios presented in Section F.4 below.

Exhibit F-2: ADHD Valuation at a 3 Percent and 7 Percent Discount Rate

Assumed Persistence of ADHD Into Adulthood	Age at ADHD Diagnosis	3% Discount Rate (2022 USD)	7% Discount Rate (2022 USD)
90%	11 (High- Froelich)	$159,928	$104,756
29.3%	7 (Low- Ji)	$111,927	$70,775

Acronyms: ADHD = attention deficit hyperactivity disorder; USD = United States Dollar.

F.3 Final Rule Costs at a 3 Percent and 7 Percent Discount Rate

Exhibit F-3 and Exhibit F-4 present the costs of the final LCRI at a 3 and 7 percent discount rate.

Exhibit F-3: Estimated National Annualized Rule Costs - 3 Percent Discount Rate (millions of 2022 USD)

	Low Estimate			High Estimate		
	Baseline	**LCRI**	**Incremental**	**Baseline**	**LCRI**	**Incremental**
PWS Annual Costs						
Sampling	$137.7	$166.7	$29.0	$148.5	$177.4	$28.9
PWS SLR*	$92.8	$1,366.4	$1,273.6	$136.1	$1,913.7	$1,777.6
Corrosion Control Technology	$558.1	$595.1	$37.0	$656.2	$697.2	$41.0
Point-of Use Installation and Maintenance	$2.4	$5.0	$2.6	$5.9	$9.4	$3.5
Public Education and Outreach	$71.2	$281.1	$209.9	$74.2	$320.0	$245.8
Rule Implementation and Administration	$0.1	$3.9	$3.8	$0.2	$4.0	$3.8
Total Annual PWS Costs	***$862.3***	***$2,418.2***	***$1,555.9***	***$1,021.1***	***$3,121.7***	***$2,100.6***
Household SLR Costs**	$8.7	$0.0	-$8.7	$28.4	$0.0	-$28.4
State Rule Implementation and Administration	$39.5	$66.5	$27.0	$43.1	$68.1	$25.0
Wastewater Treatment Plant Costs***	$2.9	$2.9	$0.0	$4.7	$4.9	$0.2
Total Annual Rule Costs	**$913.4**	**$2,487.6**	**$1,574.2**	**$1,097.3**	**$3,194.7**	**$2,097.4**

Acronyms: LCRI = Lead and Copper Rule Improvements; SLR = service line replacement; PWS = public water system; USD = United States Dollar.

Notes: Previous Baseline costs are projected over the 35-year period of analysis and are affected by the EPA's assumptions on three uncertain variables which vary between the low and high cost scenarios.

*Service line replacement includes full and partial lead service lines and galvanized requiring replacement service lines.

**The EPA in the Final 2021 LCRR EA (USEPA, 2020) assumed that the cost of customer-side service line replacements made under the goal-based replacement requirement would be paid for by households. The agency also assumed that system-side service line replacements under the goal-based replacement requirement and all service line replacements (both customer-side and systems-side) would be paid by the PWS under the 3 percent mandatory replacement requirement. The EPA made these modeling assumptions based on the different levels of regulatory responsibility systems faced operating under a goal-based replacement requirement versus a mandatory replacement requirement. While systems would not be subject to a potential violation for not meeting the replacement target under the goal-based replacement requirement, under the 3 percent mandatory replacement requirement the possibility of a violation could motivate more systems to meet the replacement target even if they had to adopt customer incentive programs that would shift the cost of replacing customer-side service lines from customers to the system. To be consistent with these 2021 LCRR modeling assumptions, under

the final LCRI, the EPA assumed that mandatory replacement costs would fall only on systems. Therefore, the negative incremental values reported for the "Household SLR Costs" category do not represent a net cost savings to households. They represent an assumed shift of the estimated service line replacement costs from households to systems. The EPA has insufficient information to estimate the actual service line replacement cost sharing relationship between customers and systems at the national level of analysis.
***Due to many water systems operating both the wastewater and drinking water systems, the EPA is evaluating the costs of additional phosphate usage for informational purposes. These costs are not "likely to occur solely as a result of compliance" with the final LCRI, and therefore are not costs considered as part of the HRRCA under SDWA, Section 1412(b)(3)(C)(i)(III).

Exhibit F-4: Estimated National Annualized Rule Costs - 7 Percent Discount Rate (millions of 2022 USD)

	Low Estimate			High Estimate		
	Baseline	**LCRI**	**Incremental**	**Baseline**	**LCRI**	**Incremental**
PWS Annual Costs						
Sampling	$153.7	$167.8	$14.1	$169.0	$180.6	$11.6
PWS SLR*	$126.0	$1,743.6	$1,617.6	$183.2	$2,436.5	$2,253.3
Corrosion Control Technology	$583.2	$610.1	$26.9	$689.3	$711.6	$22.3
Point-of Use Installation and Maintenance	$2.4	$4.4	$2.0	$5.7	$8.2	$2.5
Public Education and Outreach	$77.7	$330.7	$253.0	$82.9	$385.2	$302.3
Rule Implementation and Administration	$0.2	$6.5	$6.3	$0.3	$6.6	$6.3
Total Annual PWS Costs	***$943.2***	***$2,863.1***	***$1,919.9***	***$1,130.4***	***$3,728.7***	***$2,598.3***
Household SLR Costs**	$11.3	$0.0	-$11.3	$37.0	$0.0	-$37.0
State Rule Implementation and Administration	$44.1	$67.3	$23.2	$48.7	$69.5	$20.8
Wastewater Treatment Plant Costs***	$2.7	$2.4	-$0.3	$4.2	$4.1	-$0.1
Total Annual Rule Costs	**$1,001.3**	**$2,932.8**	**$1,931.5**	**$1,220.3**	**$3,802.3**	**$2,582.0**

Acronyms: LCRI = Lead and Copper Rule Improvements; SLR = service line replacement; PWS = public water system; USD = United States dollar.
Notes: Previous Baseline costs are projected over the 35-year period of analysis and are affected by the EPA's assumptions on three uncertain variables which vary between the low and high cost scenarios.
*Service line replacement includes full and partial lead service lines and galvanized requiring replacement service lines.

**The EPA in the Final 2021 LCRR EA (USEPA, 2020) assumed that the cost of customer-side service line replacements made under the goal-based replacement requirement would be paid for by households. The agency also assumed that system-side service line replacements under the goal-based replacement requirement and all service line replacements (both customer-side and systems-side) would be paid by the PWS under the 3 percent mandatory replacement requirement. The EPA made these modeling assumptions based on the different levels of regulatory responsibility systems faced operating under a goal-based replacement requirement versus a mandatory replacement requirement. While systems would not be subject to a potential violation for not meeting the replacement target under the goal-based replacement requirement, under the 3 percent mandatory replacement requirement the possibility of a violation could motivate more systems to meet the replacement target even if they had to adopt customer incentive programs that would shift the cost of replacing customer-side service lines from customers to the system. To be consistent with these 2021 LCRR modeling assumptions, under the final LCRI, the EPA assumed that mandatory replacement costs would fall only on systems. Therefore, the negative incremental values reported for the "Household SLR Costs" category do not represent a net cost savings to households. They represent an assumed shift of the estimated service line replacement costs from households to systems. The EPA has insufficient information to estimate the actual service line replacement cost sharing relationship between customers and systems at the national level of analysis.
***Due to many water systems operating both the wastewater and drinking water systems, the EPA is evaluating the costs of additional phosphate usage for informational purposes. These costs are not “likely to occur solely as a result of compliance” with the final LCRI, and therefore are not costs considered as part of the HRRCA under SDWA, Section 1412(b)(3)(C)(i)(III).

F.4 Final Rule Benefits at a 3 Percent and 7 Percent Discount Rate

Exhibit F-5 and Exhibit F-6 present the benefits of the final LCRI at the 3 and 7 percent discount rates under both the high and low scenarios. These benefits follow the methodology described in Chapter 5, using the inputs at 3 and 7 percent for IQ and ADHD described in Section. Discounting at 3 and 7 percent for LBW and CVD Mortality is done in Safewater.

Exhibit F-5: Estimated National Annual Benefits - 3 Percent Discount Rate (millions of 2022 USD)

	Low Estimate			High Estimate		
	Baseline	**LCRI**	**Incremental**	**Baseline**	**LCRI**	**Incremental**
Annual Child Cognitive Development Benefits	$778.3	$4,381.0	$3,602.7	$2,114.2	$7,034.7	$4,920.5
Annual Low-Birth Weight Benefits	$1.0	$5.2	$4.2	$1.8	$5.4	$3.6
Annual ADHD Benefits	$27.8	$161.7	$133.9	$147.1	$487.5	$340.4
Annual Adult CVD Premature Mortality Benefits	$1,657.5	$8,905.6	$7,248.1	$7,750.2	$23,784.8	$16,034.6
Total Annual Benefits	**$2,464.6**	**$13,453.5**	**$10,988.9**	**$10,013.3**	**$31,312.4**	**$21,299.1**

Acronyms: ADHD = Attention-Deficit/Hyperactivity Disorder; CVD = cardiovascular disease; LCRI = Lead and Copper Rule Improvements; USD = United States dollar.

Exhibit F-6: Estimated National Annual Benefits - 7 Percent Discount Rate (millions of 2022 USD)

	Low Estimate			High Estimate		
	Baseline	**LCRI**	**Incremental**	**Baseline**	**LCRI**	**Incremental**
Annual Child Cognitive Development Benefits	$158.9	$873.7	$714.8	$433.0	$1,406.8	$973.8
Annual Low-Birth Weight Benefits	$0.9	$4.4	$3.5	$1.5	$4.6	$3.1
Annual ADHD Benefits	$14.0	$79.6	$65.6	$73.5	$237.1	$163.6
Annual Adult CVD Premature Mortality Benefits	$1,298.8	$6,801.6	$5,502.8	$6,101.8	$18,297.8	$12,196.0
Total Annual Benefits	**$1,472.6**	**$7,759.3**	**$6,286.7**	**$6,609.8**	**$19,946.3**	**$13,336.5**

Acronyms: ADHD = Attention-Deficit/Hyperactivity Disorder; CVD = cardiovascular disease; LCRI = Lead and Copper Rule Improvements; USD = United States dollar.

F.5 Comparison of Costs to Benefits and a 3 Percent and 7 Percent Discount Rate

Exhibit F-7 and Exhibit F-8 display a comparison of the costs and benefits of the final LCRI at the 3 and 7 percent discount rates.

Exhibit F-7: Comparison of Estimated Monetized National Annualized Incremental Costs to Benefits of the LCRI - 3 Percent Discount Rate (millions 2022 USD)

	Low Scenario	**High Scenario**
Annualized Incremental Costs	$1,574.2	$2,097.4
Annualized Incremental Benefits	$10,988.9	$21,299.1
Annual Net Benefits	**$9,414.7**	**$19,201.7**

Exhibit F-8: Comparison of Estimated Monetized National Annualized Incremental Costs to Benefits of the LCRI - 7 Percent Discount Rate (millions 2022 USD)

	Low Scenario	High Scenario
Annualized Incremental Costs	$1,931.5	$2,582.0
Annualized Incremental Benefits	$6,286.7	$13,336.5
Annual Net Benefits	**$4,355.2**	**$10,754.5**

F.6 Sensitivity Analysis of Costs and Benefits Assuming Some CWS Customers Refuse Service Line Replacement

For the final LCRI's economic analysis, the EPA assumed that 100% of property owners would provide access to the water system to conduct a full service line replacement. This is a reasonable assumption for purposes of the economic analysis in order to develop a conservative estimate of costs. Moreover, there are many water systems that have already completed at or near 100% LSLR (e.g., Madison, WI; Lansing, MI; Green Bay, WI; Newark, NJ; Flint, MI; Framingham, MA), demonstrating that achieving this level of customer participation in service line replacement programs is possible. In addition, the final LCRI contains many requirements and incentives to facilitate water systems gaining access for full replacement (see section IV.B.3.b of the final LCRI *Federal Register* notice). Further, the availability of significant funding from the Bipartisan Infrastructure Law and other sources can reduce or eliminate direct costs to property owners for service line replacement (where water systems do not pay for the full service line replacement) (see section III.G of the final LCRI Federal Register notice).

Some systems' have reported lower property owner participation rates in their service line replacement programs in the past. The EPA does not believe these rates are comparable to those projected under the LCRI, given the rule's requirements and incentives for systems to gain access to complete the full replacement of lead and GRR service lines, as well as the significant external funding to support full replacement of lead and GRR service lines. Given the rule provisions allowing the water system to avoid replacing the service line where the property owner refuses access (when customer consent is required), the EPA does anticipate that some property owners may refuse access for the system to complete full replacement; however, the agency does not expect these refusals to be widespread.

Because the EPA received comments that some customers may refuse to allow CWS assess to replace lead or GRR service line on their property and that the analysis of the cost and benefits of the proposed rule did not account for this eventuality, the EPA has conducted a sensitivity analysis of the costs and benefits of the final LCRI under the assumption that customer agreement is needed to obtain access to replace customer side lead and GRR service lines (this may not be the case in some systems (e.g., Newark, NJ) and that only 85 percent of CWS customers with lead and GRR service lines would provide access to replace their lines. This 85 percent participation rate for the sensitivity analysis was derived by approximating the average the replacement rates of two cities' recent service line replacement program: Denver Water (95%) (Denver Water, 2024 and DC Water (65-75%) (D.C. Lead Line Task Force, 2024). Note that all other final LCRI rule requirements are held constant.

As shown in Exhibit F-9, which compares the costs of the final LCRI rule to the costs associated with the sensitivity analysis, under the high scenario, the annualized incremental costs of the sensitivity scenario, which assumes 85 percent of lead and GRR service lines are replaced, are lower than those of the final LCRI, $1.919 million versus $1.954 million. This reduction in annualized cost is driven by a reduction in SLR costs. However, this cost savings is somewhat offset by higher annualized incremental sampling, CCT, POU, and public education costs in the model. This is because, the EPA made a simplifying assumption, under the sensitivity scenario, that all systems with lead and GRR service lines could not replace 15 percent of these lines due to the inability to obtain customer consent, therefore all CWSs with lead and GRR service lines would never remove all LSLs and would continue to conduct outreach to lead and GRR service line customers and have higher probabilities of ALEs, which trigger additional LCRI requirements associated with sampling, CCT, POU, and public education activities. This assumption likely results in an overestimate of costs associated with the sensitivity scenario, but the EPA has insufficient information to allow the agency to develop a compliance scenario that reliably estimates the number of systems that replace all lead and GRR service lines versus those systems that do not.

Exhibit F-9: Estimated National Annualized Rule Cost Comparison Between the Final LCRI and the LCRI Assuming 85 Percent of Lead and GRR Service Lines are Replaced (High Scenario) - 2 Percent Discount Rate (millions of 2022 USD)

	Final Rule			LCRI Assuming 85 Percent of Lead and GRR Service Lines are Replaced		
	Baseline	**LCRI**	**Incremental**	**Baseline**	**LCRI**	**Incremental**
PWS Annual Costs						
Sampling	$143.6	$176.2	$32.6	$143.6	$198.0	$54.4
PWS SLR*	$124.5	$1,763.9	$1,639.4	$124.5	$1,533.1	$1,408.6
Corrosion Control Technology	$647.8	$692.9	$45.1	$647.8	$704.4	$56.6
Point-of Use Installation and Maintenance	$5.9	$9.6	$3.7	$5.9	$10.3	$4.4
Public Education and Outreach	$72.1	$302.2	$230.1	$72.1	$457.9	$385.8
Rule Implementation and Administration	$0.2	$3.4	$3.2	$0.2	$3.4	$3.2
Total Annual PWS Costs	***$994.1***	***$2,948.2***	***$1,954.1***	***$994.1***	***$2,907.1***	***$1,913.0***
Household SLR Costs**	$26.4	$0.0	-$26.4	$26.4	$0.0	-$26.4
State Rule Implementation and Administration	$41.8	$67.6	$25.8	$41.8	$73.6	$31.8
Wastewater Treatment Plant Costs***	$4.8	$5.1	$0.3	$4.8	$5.2	$0.4
Total Annual Rule Costs	**$1,067.1**	**$3,020.9**	**$1,953.8**	**$1,067.1**	**$2,985.9**	**$1,918.8**

Acronyms: LCRI = Lead and Copper Rule Improvements; SLR = service line replacement; PWS = public water system; USD = United States dollar.

Notes: Previous Baseline costs are projected over the 35-year period of analysis and are affected by EPA's assumptions on three uncertain variables which vary between the low and high cost scenarios.
*Service line replacement includes full and partial lead service lines and galvanized requiring replacement service lines.
**The EPA in the LCRR economic analysis (USEPA, 2020) assumed that the cost of customer-side service line replacements made under the goal-based replacement requirement would be paid for by households. The agency also assumed that system-side service line replacements under the goal-based replacement requirement and all service line replacements (both customer-side and systems-side) would be paid by the PWS under the 3 percent mandatory replacement requirement. The EPA made these modeling assumptions based on the different levels of regulatory responsibility systems faced operating under a goal-based replacement requirement versus a mandatory replacement requirement. While systems would not be subject to a potential violation for not meeting the replacement target under the goal-based replacement requirement, under the 3 percent mandatory replacement requirement the possibility of a violation could motivate more systems to meet the replacement target even if they had to adopt customer incentive programs that would shift the cost of replacing customer-side service lines from customers to the system. To be consistent with these LCRR modeling assumptions, under the final LCRI, the EPA assumed that mandatory replacement costs would fall only on systems. Therefore, the negative incremental values reported for the "Household SLR Costs" category do not represent a net cost savings to households. They represent an assumed shift of the estimated service line replacement costs from households to systems. EPA has insufficient information to estimate the actual service line replacement cost sharing relationship between customers and systems at the national level of analysis.
***Due to many water systems operating both the wastewater and drinking water systems, the EPA is evaluating the costs of additional phosphate usage for informational purposes. These costs are not "likely to occur solely as a result of compliance" with the final LCRI, and therefore are not costs considered as part of the HRRCA under SDWA, Section 1412(b)(3)(C)(i)(III).

As shown in Exhibit F-10, the estimated annualized incremental benefits under the sensitivity analysis scenario are lower than under the final LCRI rule ($22.1 billion versus $25.1 billion). This is driven by the decrease in the number of lead and GRR service line replacements and the associated reduction in lead exposure related illness. Note some of the reduction in benefits is offset by increased use of CCT and POU devices given higher rates of ALEs.

Exhibit F-100: Estimated National Annual Benefit Comparison Between the Final LCRI and the LCRI Assuming 85 Percent of Lead and GRR Service Lines are Replaced (High Scenario) - 2 Percent Discount Rate (millions of 2022 USD)

	Final Rule			LCRI Assuming 85 Percent of Lead and GRR Service Lines are Replaced		
	Baseline	**LCRI**	**Incremental**	**Baseline**	**LCRI**	**Incremental**
Annual IQ Benefits	$3,279.0	$10,963.0	$7,684.0	$3,279.0	$10,022.7	$6,743.7

Annual Low-Birth Weight Benefits	$1.8	$5.7	$3.9	$1.8	$5.2	$3.4
Annual ADHD Benefits	$179.9	$599.5	$419.6	$179.9	$550.2	$370.3
Annual Adult CVD Premature Mortality Benefits	$8,174.9	$25,210.0	$17,035.1	$8,174.9	$23,146.3	$14,971.4
Total Annual Benefits	**$11,635.6**	**$36,778.2**	**$25,142.6**	**$11,635.6**	**$33,724.4**	**$22,088.8**

Acronyms: ADHD = attention-deficit/hyperactivity disorder; CVD = cardiovascular disease; IQ = intelligence quotient; LCRI = Lead and Copper Rule Improvements; USD = United States dollar.

Exhibit F-11 compares the annualized incremental net benefits of the final LCRI and the sensitivity scenario. The incremental annualized net benefits of the sensitivity scenario (85 percent of lead and GRR service lines being replaced because of customers refusing water systems access to replace lines) would be roughly $3 billion lower ($20.2 billion versus $23.2 billion) than the final LCRI.

Exhibit F-11: Comparison of Estimated Monetized National Annualized Incremental Costs, Benefits, and Net Benefits Between the Final LCRI and the LCRI Assuming 85 Percent of Lead and GRR Service Lines are Replaced - (High Scenario) - 2 Percent Discount Rate (millions 2022 USD)

	Final Rule	LCRI Assuming 85 Percent of Lead and GRR Service Lines are Replaced
Annualized Incremental Costs	$1,953.8	$1,918.8
Annualized Incremental Benefits	$25,142.6	$22,088.8
Annual Net Benefits	**$23,188.8**	**$20,170.0**

F.7 References

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