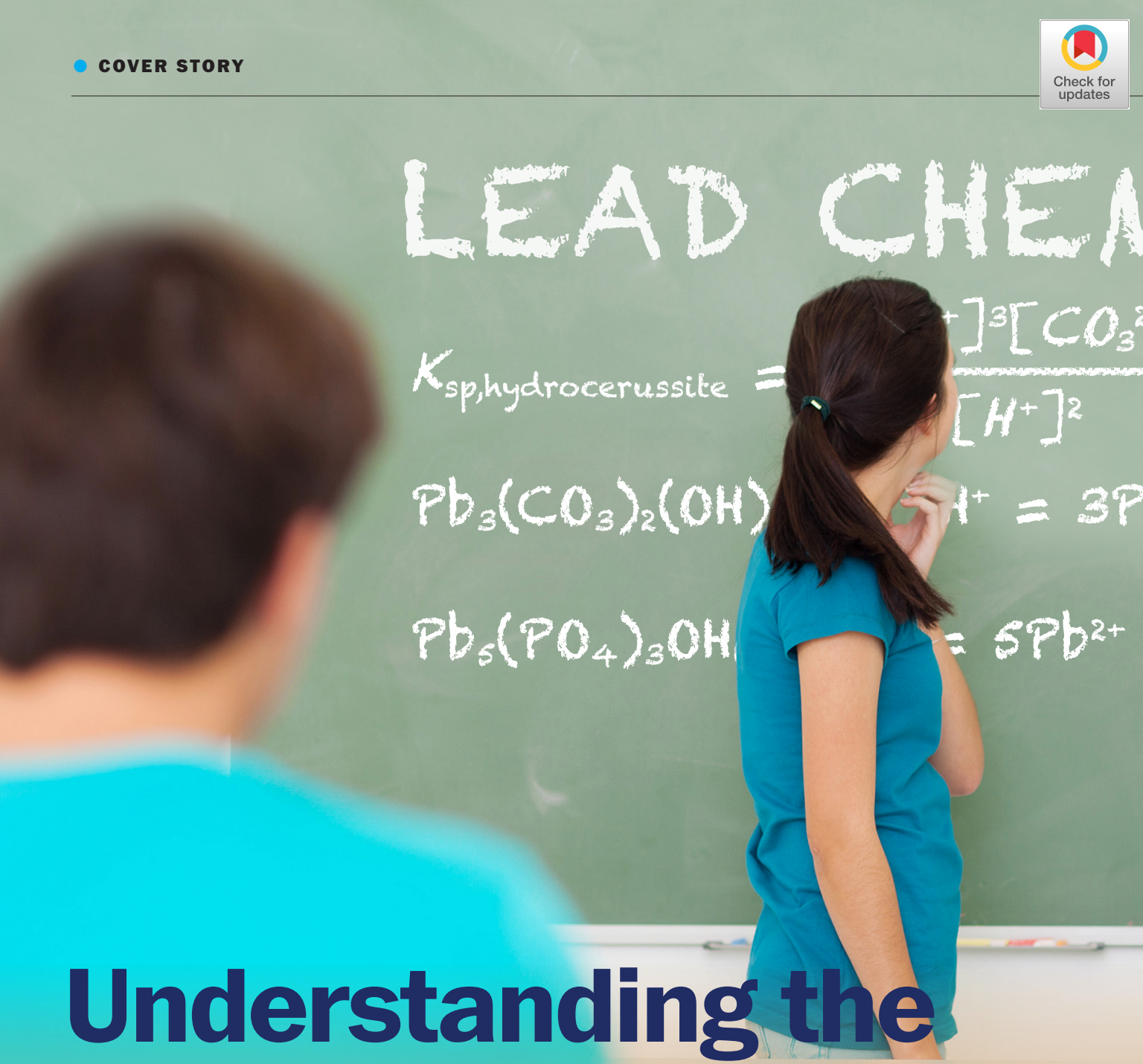
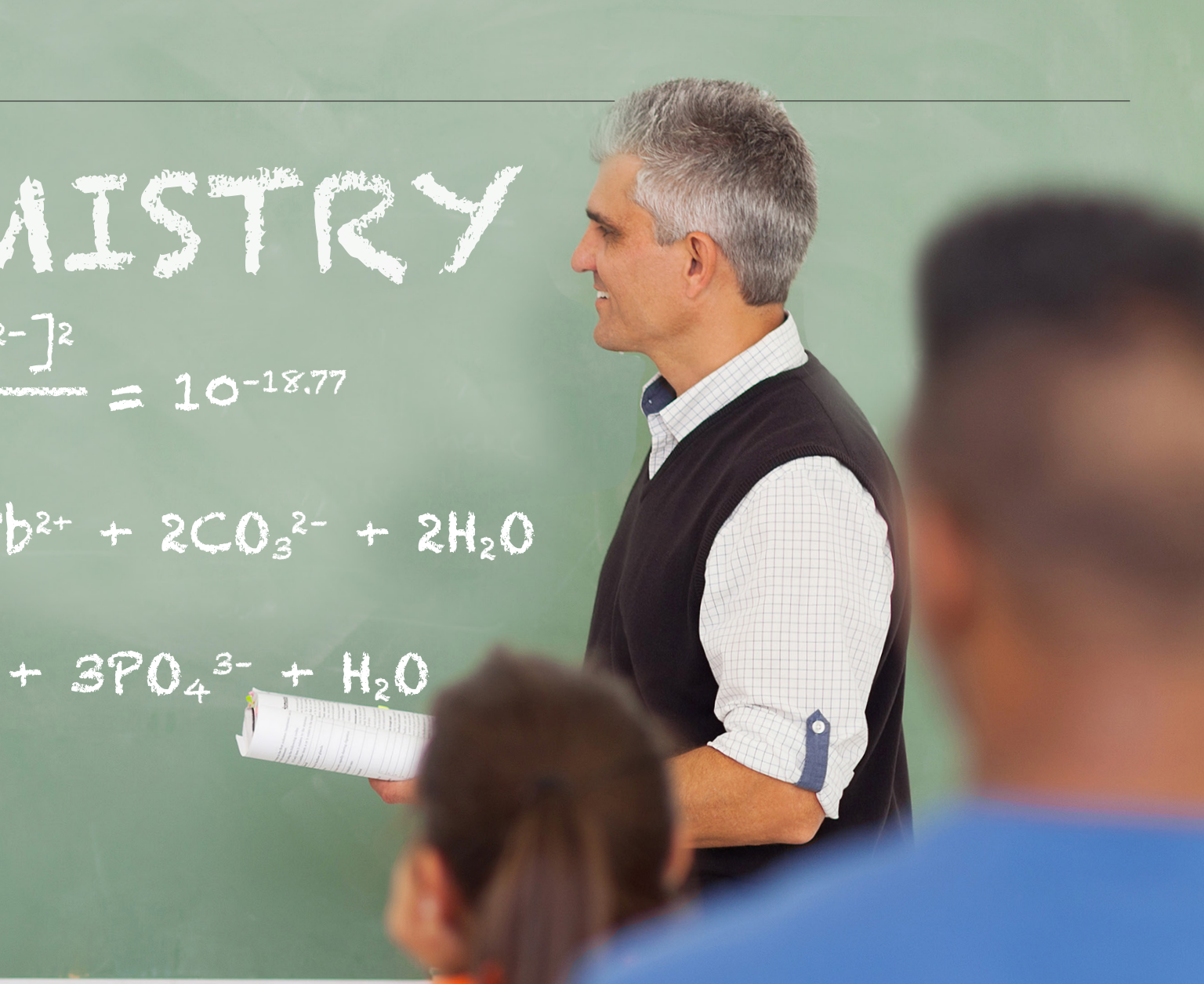


Understanding the Proposed Revisions to the Lead and Copper Rule

Stephen Estes-Smargiassi, David Cornwell, Rebecca Slabaugh, and Steve Via



Key Takeaways

In November 2019, the USEPA published the revisions to the Lead and Copper Rule with seemingly small changes that could have significant implications.

The proposed revisions will require water systems to immediately prepare a lead service line (LSL) inventory and an LSL replacement plan.

The proposal would expand the current public education requirements to include sampling for lead at schools and childcare facilities.

The proposal would require Tier 1 notification of lead action level exceedances; it also would require active outreach to customers when lead service lines are replaced.

Layout imagery by michaeljung/Shutterstock.com

The US Environmental Protection Agency (USEPA) released its proposed Lead and Copper Rule (LCR) Revisions in 2019, and USEPA administrator Andrew Wheeler has stated that he intends to finalize the rulemaking in 2020. Since its publication, the current proposal has already influenced state primacy agency practices. The proposed rule will require changes in current practice at all community water systems and nontransient, noncommunity water systems (NTNCWS); as practitioners prepare to comply, they need to consider how these changes will affect compliance metrics and associated performance as well as the implications of the rule construction on planning and implementation of water system treatment, distribution systems, and public outreach activities.

Introduction

In November 2019, the US Federal Register contained the USEPA's proposal for revising the Lead and Copper Rule. This revision, first conceived in 2005, had been in development since shortly after the 2007 LCR Revisions. The current LCR is generally recognized as one of the most complicated federal primary drinking water standards. The rule contains several interdependent components where even seemingly small changes in one part of the rule have significant implications on other areas. The entire rule is further complicated by the nature of the risk that the rule is intended to mitigate—namely, the health risks posed by lead and copper in drinking water, where their primary source is corrosion of piping on customer property.

LCR development has continued in part because the public health community remains concerned about the lifelong effects of lead exposure even at very low blood lead levels. Since USEPA first began contemplating this revision, the Centers for Disease Control and Prevention (CDC) has redefined the benchmark blood lead level (BLL) intended to drive intervention into households to reduce lead exposure. The current BLL of concern is 5 µg/dL, but CDC is expected to reduce that level to 3.5 µg/dL or lower on the basis of more recent national BLL surveillance data. Importantly in the United States, children in poverty—and in particular black, non-Hispanic children—tend to disproportionately have elevated blood levels.

Lead exposure remains a multimedia risk management challenge, but federal regulations for other media are also changing. In June 2019, lead in dust standards changed to reflect concerns about lower-level lead exposure. While lead, paint, and dust are most often identified as risk factors, current modeling illustrates that exposure from drinking water can be most significant for bottle-fed infants and young children.

Since its promulgation, the LCR has led to significant reductions in lead levels in drinking water. Revising the LCR to provide additional risk reduction has proved sufficiently challenging that USEPA went beyond its usual rule development processes to organize a working group under the National Drinking Water Advisory Council (NDWAC). Over 17 months, the working group developed recommendations for improving the current rule.

Importantly, the NDWAC recommendations build on the current rule's success, targeting additional actions that both improve corrosion control practices and remove lead pipes from service over time. The working group also emphasized the importance of improving communication with the public about risks posed by lead exposure and steps that households can take to further reduce their exposure to lead. The LCR Revisions incorporate several concepts from the NDWAC report, but the translation of those concepts to the proposed regulatory construct does not follow the NDWAC recommendations.

Context

Before exploring the specific requirements of the proposed rule, it is essential to understand the public water systems that must follow the LCR. There are about 151,000 public water systems in the United States, and the LCR applies to all community water systems and all NTNCWS. In total, the LCR requirements apply to almost 68,000 water systems, and 94% of those systems serve 10,000 people or fewer (see Table 1 for more details). USEPA has estimated that a significant portion of these small systems do not have corrosion control as defined by the LCR, while only about 35% of midsized systems (10,000–50,000 people served) have corrosion control in place.

The number of systems that must pass through the regulatory checkpoints in the revised rule was a significant consideration in structuring the LCR revisions because each change, new deadline, and additional reporting submission brings with it workload challenges for water systems and states. When a new regulatory step involves technical evaluation, the impacts on state enforcement capacity are even more severe.

The proposed LCR revisions include several new components that are applicable to all these systems but affect systems of different sizes, types, and corrosion control treatment status differently. Rule elements include LSL replacement, sampling, corrosion control treatment, public education, public notice, and source water treatment. The following is a summary of selected major elements of the proposed rule provisions.

Lead Service Line Plan and Replacement

Under the proposed rule, all systems subject to the LCR are to reduce the number and impact of partial LSL and lead gooseneck replacements through planning, required procedures, and improved customer education and coordination. Water systems are to pursue full LSL replacement (from main to building inlet). The proposed rule does not require a water system to pay for replacement of the customer-owned portion of an LSL, but there are triggers in the proposal for achieving minimum replacement rates; in those instances, failing to achieve an adequate number of complete LSL replacements is a violation.

All systems must develop and maintain a publicly accessible inventory of LSLs and service lines of unknown materials. Systems that serve more than 100,000 persons must post the inventory on their websites. Water systems must complete and submit an initial inventory to their primacy agency within three years from the final rule publication date. Importantly, the inventory must reflect whether a service line is made of lead or not, and that determination must reflect the materials present in the entire service line from the main to the building inlet regardless of ownership. Following initial development, the inventory must be updated annually.

The LSL inventory will indicate if service lines are lead, not lead, or that the material is unknown. In preparing the inventory, water systems must include galvanized pipes that are or have previously been downstream of lead pipe in the inventory as an LSL. At a minimum, materials included in the inventory are to be on the basis of available records including plumbing codes, permits, building department records, and water system records. Historical practices like those reflected in standard operating procedures can be taken into account. After the LSL inventory is initially developed, it will improve as information accrues from ongoing water system activities or active investigations.

In the same time frame that the system LSL inventory is prepared, water systems must also prepare an LSL replacement plan that includes

- a strategy for funding full LSL replacement,
- proposing an annual LSL replacement rate in the event the rule requirements trigger a mandatory replacement program, and
- implementing procedures for replacing LSLs, including customer notifications and provision of pitcher filters for affected households.

When water systems develop LSL replacement plans, they should consider how to meet the minimum annual replacement rate of 3% should they experience a lead action level exceedance as well as replacement rates that systems can

Number of US Water Systems Subject to the Lead and Copper Rule

	Community Water System		Nontransient Noncommunity Water System	
System Size (Population Served)	Number of Systems	Percent Without CCT	Number of Systems	Percent Without CCT
Small Systems				
≤100	12,046	75	8,429	87
101–500	15,307		6,514	
501–1,000	5,396		1,608	
1,001–3,300	8,035		867	
3,301–10,000	4,974		148	
Medium Systems				
10,001–50,000	3,331	36	20	35
Large Systems				
50,001–100,000	550	1	2	0
100,001–1,000,000	407		1	
>1,000,000	21		0	
Total	50,067		17,589	

Source: Data from Exhibits 4-7 and 4-8 in the US Environmental Protection Agency's Economic Analysis for the Proposed Lead and Copper Rule Revisions (October 2019).

CCT—corrosion control treatment

Table 1

implement should they exceed the proposed lead trigger level of 10 μg/L. The primacy agency will need to approve individual replacement rates, and these state decisions are subject to USEPA regional administrator oversight.

Within 30 days of completing an LSL inventory and annually thereafter, water systems with LSLs must provide notice to households with service lines made of lead or unknown materials; a physical letter mailed to the owner is acceptable. The LCR specifies the content of the notice including the health effects of lead, steps customers can take to reduce lead exposure, and—depending on whether the home has a service line of lead or an unknown material—how to remove the service line or how to identify an LSL. Beginning three years after rule promulgation, and with their LSL inventories in hand, water systems are required to provide public education to customers in advance of infrastructure work that will affect LSLs and those for which the material is unknown. Table 2 describes these areas in more detail.

Corrosion Control Treatment

A system's LSL inventory also provides a point of departure for changes to the rule's corrosion control requirements, and the proposed rule places more emphasis on corrosion control treatment for systems with LSLs and with higher 90th percentile lead concentrations. Building from the LSL inventory, USEPA expects systems with LSLs to focus sampling on homes with LSLs. To accomplish this, USEPA revised the LCR compliance monitoring requirements so that samples will be drawn from four tiers (Figure 1).

When locating homes to sample, systems are to not use faucets that have point-of-use or sites with point-of-entry treatment devices designed to remove inorganic contaminants. Systems with LSLs are to limit calculation of their 90th percentile lead level to samples from Tiers 1 and 2. If there are not enough Tier 1 and 2 sample results, then the system may use the highest observations from Tier 3 and 4 sites. If the system does not collect enough samples from its own compliance monitoring efforts, it must use observations from other data sets such as customer-requested samples that are compliant with the rule. The 90th percentile is calculated only on the basis of the number of samples required by the rule. The calculation protocol requires observations to be arranged from highest to lowest concentration—first with samples from Tiers 1 and 2, and then with the highest additional observations collected from Tier 3 and 4 samples sites—so as to not "dilute" higher observations in the calculation.

The proposed rule will also expand current requirements on how to sample for lead and copper at the

Definition of a Lead Service Line and Implications for Rule Provisions

Components Between Water Main and Interior Plumbing	Include in LSL Inventory	Counts as a Replacement	Include in Tier 1 Sample Pool	Requires Public Education When Disturbed
Lead pipe anywhere between gooseneck and interior plumbing	Yes	When all lead is removed	Yes	Yes
Unknown pipe material anywhere between gooseneck and interior plumbing	Yes	Where lead pipe is found, and all lead is removed	No	Yes
Galvanized pipe if preceded by lead (pipe, gooseneck, etc.) at any time	Yes	When replaced along with any remaining preceding lead pipe	No	Yes
Lead gooseneck with nonlead or nongalvanized pipe between gooseneck and interior plumbing	No	No[a]	No	Yes

LSL—lead service line

[a]Must replace if utility-owned when encountered during planned or emergency work. Must offer to replace, but not pay, if customer-owned.

Table 2

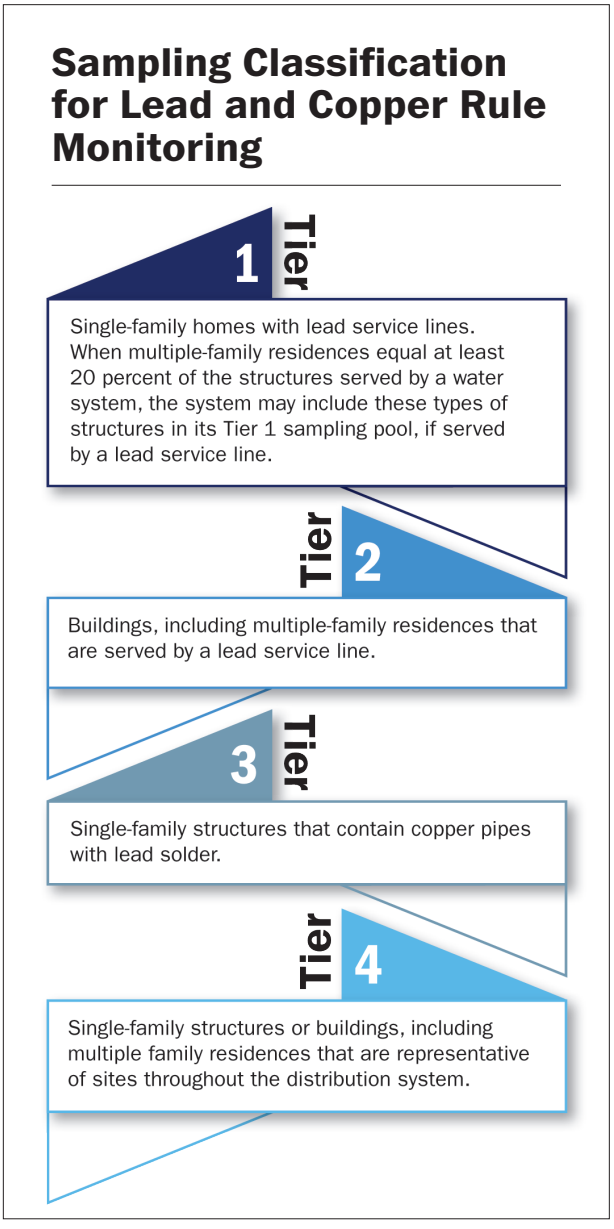


Figure 1

tap, requiring the sampling protocol to (1) not specify pre-stagnation period flushing, (2) not include removal of aerator, and (3) include use of wide-mouth sample bottles at a flow typical of normal use.

Taken together, the changes in the sample pool and explicit details for sampling instructions mean that some water systems will need to revise their sample plans and will be required to return to routine monitoring to demonstrate their lead levels are below the lead action level and trigger level before returning to reduced monitoring. The proposed LCR allows for systems to sort out their tap sample data set before the rule deadline of three years after final rule publication. At that time, systems will need to adjust their monitoring frequency to the rule requirements (Figure 2).

It is not clear how the combination of changes in the sample site pool, sampling protocol, and 90th percentile calculation will change observed 90th percentile values. USEPA's analysis of data collected for the third Six-Year Review found that 6.3%–11.0% of systems with LSLs had 90th percentiles greater than 15 µg/L. Using this same data set, 7.6%–15.5% of similar systems had 90th percentiles between 10 and 15 µg/L. Looking at this entire data set—including samples that were unlikely to be taken for sites consistent with the new Tier 1 definition—at least 10% of observed 90th percentile values were greater than 10 µg/L. Previous work indicates that the shift in sample site pool alone will lead to 12.5% of systems with LSLs to exceed the lead action level.

While states have the authority to require a system to evaluate corrosion control at any time, the proposed rule explicitly requires evaluations when a system exceeds either the lead trigger level or action level. The lead action

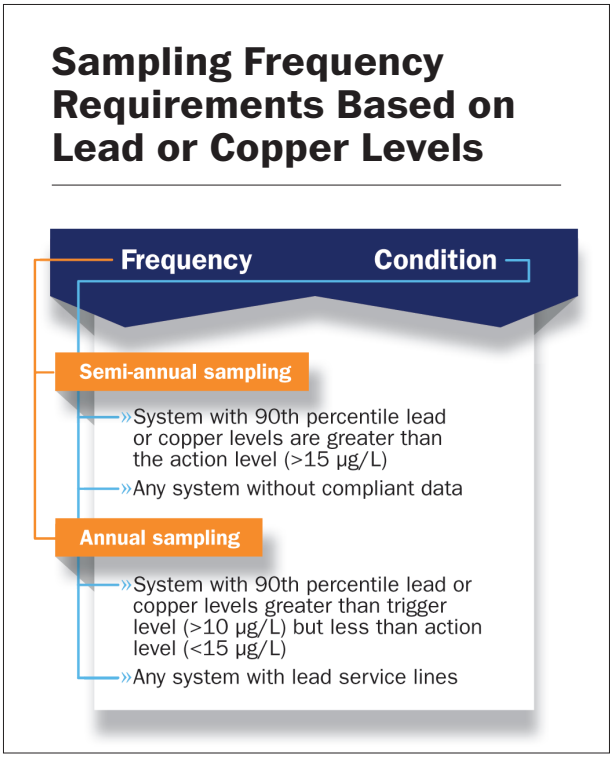


Figure 2

level remains unchanged; it is the 90th percentile lead concentration in the required in-home tap sample data set. The newly added lead trigger level is 10 µg/L, and it is evaluated using the same calculation as the action level. Like the action level the lead trigger level applies to all systems subject to the rule. If a system already has corrosion control in place, then the evaluation is described as "re-optimization" but there is little substantive difference in the regulatory requirement.

Systems that are triggered into evaluating corrosion control have a limited number of options to choose from (e.g., pipe loop study, partial system test, or analogous system comparison). The definitive test included in the proposal is a pipe loop study; once triggered, a system has 18 months to complete the study and inform the state of the corrosion control treatment it intends to pursue. The study must at a minimum test use of (1) pH-alkalinity and orthophosphate (PO_4^{3-}) and (2) orthophosphate as a corrosion inhibitor with doses of 1 and 3 mg/L. While systems can continue to consider silicate addition for corrosion control, calcium hardness is no longer an allowed corrosion control treatment. The proposed rule does not include a specific mechanism or time frame for re-evaluating corrosion control for those systems that currently base their corrosion control treatment on calcium hardness to establish new water quality parameter monitoring.

All systems must develop and maintain a publicly accessible inventory of LSLs and service lines of unknown materials.

Not all systems that are triggered into corrosion control studies are immediately required to install treatment. Systems required by the state to install treatment and systems that exceed the lead action level must install corrosion control treatment. Systems that serve more than 50,000 people and systems that serve between 10,000 and 50,000 people that exceed the trigger level must re-optimize. Small and medium systems that exceed the lead action level again after initially exceeding the trigger level must install treatment. Any system triggered into installing corrosion control is considered optimized if the system keeps its 90th percentile lead value below 5 µg/L for two six-month monitoring periods. Small or medium systems that achieve 90th percentile lead values below the trigger level for two six-month monitoring periods are also deemed optimized.

Any system subject to the LCR that switches to a new source or long-term change in treatment is required to seek state approval. Long-term changes noted in the rule include switching secondary disinfectants, coagulants, and/or corrosion inhibitor products, as well as changes in finished water pH or disinfectant residual. Such changes can lead the state to change tap sample monitoring frequency, modify water quality parameter monitoring requirements, or direct the system to evaluate impacts on corrosion control treatment and adjust that treatment.

The proposed rule corrosion control requirements also involve responding to individual elevated lead concentrations. When individual lead observations from in-home tap samples are greater than 15 µg/L, the water system must initiate a "find-and-fix" process where the system collects a sample from close to the site with the elevated lead value within five days for analysis of water quality parameters and a follow-up tap sample for lead at the home that had the high value. The follow-up tap sample must be taken within 30 days. The system is required to identify and address the elevated lead at the tap sample site. The additional site where the find-and-fix water quality parameter data was collected will be added to the water system's ongoing water quality parameter monitoring program.

Public Education

The proposal expands the current LCR public education requirements in several ways, including outreach to consumers on LSLs, engaging consumers during construction affecting LSLs, sampling for lead at schools, and outreach to consumers regarding individual high lead observations.

The proposal includes specific changes to required language in annual consumer confidence reports (CCRs) and revised health effects language for both the CCRs and public notices. See the sidebar on page 13.

In drafting the proposed rule, the USEPA emphasized the potential for lead exposure to affect children's IQ with lifelong consequences. The agency did solicit comments on whether the linkage between lead and cardiovascular health warranted greater consideration in the proposal. The current state of research on this linkage has led most recent USEPA rulemakings to focus on IQ effects, but efforts are underway to elucidate any correlations with cardiovascular health. While there are an estimated 500,000 young children in the United States with BLL greater than 5 µg/dl (2.1% of children less than five years old), almost half

of adults in the United States suffer from some form of cardiovascular disease, and heart disease causes 1 in 4 deaths in the United States. Even incremental reductions in the risk of heart disease can contribute to significant benefits in terms of lives saved or quality adjusted life years in a benefit-cost analysis.

The more dramatic changes to the LCR public education requirements come in the form of entirely new provisions. As mentioned, once the initial LSL inventory is completed, an initial notice and then subsequent annual notices to homes with LSLs or service lines of unknown material are required. The inventory also sets the stage for water systems to engage building occupants and property owners in the course of infrastructure work to take the opportunity to remove an LSL and communicate about the risks associated with lead. Because service lines of unknown material may be lead pipe, communication is required for those buildings as well. The rule lists the following requirements for water systems:

- Contact the owners of service lines, their agents, and nonowner residents of a structure 45 days before a partial LSL replacement, offering to replace the portion of the service line not owned by the water system. Provide information explaining that consumers may experience a temporary increase of lead levels in their drinking water due to the replacement; supply information about the health effects of lead; and list actions consumers can take to minimize their exposure to lead in drinking water, including flushing.
- The water system must provide the residents of a building where there is a full or partial LSL replacement with a pitcher filter certified to remove lead, three months of replacement cartridges, and instructions for use.
- The water system must take a follow-up tap sample between three and six months after completion of any partial or full LSL replacement, and provide those results to the residents of the building.
- If a lead gooseneck is encountered in infrastructure work, the system must offer to replace any customer-owned lead connection, as well as provide the risk mitigation information, pitcher filter with replacement cartridges, and post-replacement tap sample observations to residents as provided with an LSL replacement.
- When the gooseneck is encountered or LSL replacement occurs on an emergency basis, the system has 24 hours to deliver the required pitcher filter and educational information.
- If water system construction requires shutting off the service, this disturbance requires notification of homes with LSLs or service lines of unknown material.

The USEPA's proposal requires water systems to sample for lead at five taps in each school and two taps in each licensed childcare facility in its service area at least once every five years. The USEPA cites accepted national estimates of the number of these facilities. There are roughly 101,000 elementary schools, almost 26,000 secondary schools, and more than 767,000 childcare facilities in the United States. At schools, samples must be drawn from two drinking water fountains, one kitchen faucet used for food or drink preparation, one classroom faucet, and one nurse's office faucet, as available. In childcare facilities, samples are taken from

REQUIRED CONSUMER CONFIDENCE REPORT INFORMATION STATEMENT ON LEAD EXPANDED

If present, lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. [NAME OF UTILITY] is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. You share the responsibility for protecting yourself and your family from the lead in your home plumbing. You can take responsibility by identifying and removing lead materials within your home plumbing and taking steps to reduce your family's risk. Before drinking, flush your pipes for several minutes by running your tap, taking a shower, doing laundry or a load of dishes. You can also use a filter certified to remove lead from drinking water. If you are concerned about lead in your water you may wish to have your water tested, contact [NAME OF UTILITY and CONTACT INFORMATION]. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available at http://www.epa.gov/safewater/lead.

REQUIRED HEALTH EFFECTS LANGUAGE IN CONSUMER CONFIDENCE REPORT AND PUBLIC NOTICE

Exposure to lead can cause serious health effects in all age groups. Infants and children who drink water containing lead could have decreases in IQ and attention span and increases in learning and behavior problems. Lead exposure among women who are pregnant increases prenatal risks. Lead exposure among women who later become pregnant has similar risks if lead stored in the mother's bones is released during pregnancy. Recent science suggests that adults who drink water containing lead have increased risks of heart disease, high blood pressure, kidney or nervous system problems.

one drinking water fountain and one of either a kitchen faucet used for preparation of food or drink or one classroom faucet.

Samples are 250-mL, first-draw stagnant water samples; samples may be drawn by the system, school staff, or childcare facility staff. Engaging all of these systems requires developing a list of schools and childcare facilities in the water system's service area, keeping in mind that many water system service areas encompass multiple jurisdictions and do not necessarily include all of a given community (see Table 3 for information on facilities and water systems).

A final component of public education in the proposed rule that is of particular note is the requirement to notify the occupants of the residence where the tap was sampled of results within 24 hours when an individual observation is above the lead action level. This notification includes information about the health risks associated with lead and measures the household can take to reduce lead exposure. However, it was found through experience in Ohio that implementing a requirement to notify customers of individual high lead results in two business days can be challenging, and even a well-organized water system can experience monitoring and reporting violations.

Also important is that systems must provide the required communication materials and pitcher filters in the required times. It will also be necessary to document adherence to those procedures and, if the rule is finalized as proposed, meet numerous new reporting requirements so that the state can ensure the system is meeting the LCR requirements.

Public Notification

In 2016, section 2106 of the Water Infrastructure Improvements for the Nation Act amended the Safe Drinking Water Act (SDWA) to require water systems to provide "Notice that the public water system exceeded the lead action level under section 141.80(c) of title 40, Code of Federal Regulations (or a prescribed level of lead that the Administrator establishes for public education or notification in a successor regulation promulgated pursuant to section 1412)."

The USEPA has proposed that Tier 1 public notice occur following every lead action level exceedance. The 24-hour time frame begins "after the public water system learns of the violation or exceedance." This provision sets the stage for very abrupt communication with the public about lead; if water systems do not have an effective ongoing public communication program, such notices could be disruptive to the community. Equally important, once the alarm bell has been rung with a Tier 1 public notice, unlike an acute microbial risk, there is no immediate strategy to quickly end the elevated alert status.

Compliance Deadlines

As proposed in the LCR, water systems will have two tasks to accomplish immediately after the rule is finalized: prepare an LSL inventory and an LSL replacement plan. At a minimum, those two items will need to be prepared within three years of rule promulgation. Unfortunately, state efforts

School and Child Care Facilities per Community Water System (CWS)

System Size (Population Served)	Number of CWS	Number of Facilities per System		
		K–8 Schools	Secondary Schools	Childcare
≤100	12,046	0.02	0.005	0.2
101–500	15,307	0.10	0.020	0.6
501–1,000	5,396	0.20	0.100	1.9
1,001–3,300	8,035	0.60	0.200	4.8
3,301–10,000	4,974	1.90	0.500	14.7
10,001–50,000	3,331	7.20	1.800	55.1
50,001–100,000	550	23.00	5.800	174.7
100,001–1,00,000	407	80.20	20.400	610.0
>1,000,000	21	663.10	168.700	5,044.5
Total	50,067			

Source: Data from Exhibits 5-53, 5-54, and 5-55 in the US Environmental Protection Agency's Economic Analysis for the Proposed Lead and Copper Rule Revisions (October 2019).

K–8—kindergarten through 8th grade

Table 3

to acquire primacy for the rule will be occurring in parallel with the work of the systems. States have two years to prepare a primacy application, and they can request a two-year extension.

Unless your state adopts SDWA regulations by reference to the federal code, your system may not have a state partner to provide guidance as to their expectations, data systems for submissions, or other details of implementation. Monitoring plans for many systems will likely require revision once LSL inventories are complete, and changes in monitoring schedules will take effect the January after the initial three-year interval is completed.

Small-System Flexibility

Ninety-four percent of the systems affected by the revised LCR serve fewer than 10,000 people, and 23% of those approximately 63,300 small systems are community water systems. The USEPA's proposal provided three alternative compliance strategies: (1) install corrosion control treatment and optimize it to remove lead, (2) remove all LSLs within 15 years, or (3) install and maintain point-of-use devices at all homes in the system's service area.

NTNCWS also have the opportunity to remove all lead-bearing materials from their plumbing. The USEPA estimates that between 8% and 13% of NTNCWS will comply with the LCR Revisions using an alternative compliance path, with the overwhelming majority of these systems relying on point-of-use devices. Interestingly, the economic analysis reflects 22%–27% of small community water systems complying using an alternative compliance path. The USEPA's estimate is that 6%–11% of small systems will comply by removing LSLs rather than implementing corrosion control treatment and that few small community water systems will rely on point-of-use devices to comply.

Conclusions

During the comment period, AWWA, the Association of State Drinking Water Administrators, individual utilities, and many others submitted suggestions to the USEPA on ways to advance sound elements of the proposed rule revisions and to facilitate implementation. It is not clear how many of those recommendations the USEPA will incorporate. Regardless, water systems now have a clearer picture of what elements the USEPA expects to pursue in the final LCR, and they can prepare by addressing the following:

- Service line material inventory development can begin immediately, and procedures to improve on existing inventories can be adopted.
- Evaluate current business systems for delivering timely public notices, reaching individual customers with sample results, distributing pitcher filters to specific households, and contacting residents within buildings.
- Review current corrosion control treatment practice, distribution system conditions, and observed lead levels to better understand what additional corrosion control measures may be warranted.
- Identify funding strategies for accelerating full LSL replacement.
- Engage state officials to advance childcare licensure requirements that address lead in childcare environments, including lead-in-water testing and remediation.
- Engage state officials to support addressing lead in school environments, including lead-in-water testing and remediation.

Authors' note: *This article was prepared on behalf of the AWWA Lead and Copper Rule Technical Advisory Workgroup.*

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AWWA Resources

- Coupon Procedures for Evaluating Lead and Copper Solubility. Cornwell DA, Wagner JR. 2019. *Journal AWWA.* 111:10:12. https://doi.org/10.1002/awwa.1377.
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