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Standard Guide for Using Publicly Available Data to Identify Schools and Vulnerable Communities at High Risk for Elevated Lead in Drinking Water[1,2]

This standard is issued under the fixed designation E3366; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

Sections 50105 and 50110 of the *Infrastructure Investment and Jobs Act* (**1**)[3] direct the US EPA to identify schools and housing in vulnerable communities at high risk to lead exposure from water supply infrastructure. The Agency has responded with its *Guidance for Developing and Maintaining a Service Line Inventory* EPA 816-B-22-001 (August 2022) and the January 2021 Lead and Copper Rule Revision. The Lead and Copper Rule Revision establishes new limits for lead and copper in drinking water. This guide describes a series of steps to effectively identify schools and vulnerable communities at risk of high lead levels in drinking water using only publicly-available information and robust geographic information systems software and is consistent with the Predictive Modeling approach described in Section 5.5 of *Guidance for Developing and Maintaining a Service Line Inventory*. This guide complements the records review activities described in EPA's lead service line replacement guidance. Stakeholders can use the procedures described in this guide to rapidly assess the likelihood of lead in water exceeding the limits in federal regulations (*40 CFR 141 et seq.*) without the costs associated with inspecting water service lines and water service line connections at schools and in *vulnerable communities*.

According to EPA:

Service line inventories are the foundation from which water systems take action to address a significant source of lead in drinking water - lead service lines (LSLs). Establishing an inventory of service line materials and identifying the location of LSLs is a key step in getting them replaced and protecting public health. Lead service line replacement (LSLR) is not dependent on knowing the location of all LSLs; in fact, simultaneously developing an inventory while conducting LSLR can have many benefits. For example, systems can save costs by replacing LSLs when crews find them onsite during service line investigations. Systems can also leverage the opportunity for LSLR by seeking customer consent and private property access during service line investigation. Replacing LSLs in a safe and prompt manner while crews are in the field for inventory development provides an opportunity for public health benefits for consumers by more quickly eliminating this potential source of lead exposure from drinking water. (EPA August 2022)

1. Scope

1.1 As the General Accountability Office (GAO) reported in 2018 (**2**), the discovery of toxic levels of lead in drinking water in Flint, Michigan in 2015 renewed awareness about the risks that lead poses to public health. Exposure to lead can result in elevated blood lead levels and negative health effects. Children are at particular risk, because their growing bodies absorb more lead than adults, so protecting them from lead is important to lifelong good health. According to the Centers for Disease Control and Prevention (CDC), elevated blood lead levels have been linked to anemia, kidney and brain damage, learning disabilities, and decreased growth. As a result of widespread human use, lead is prevalent in the environment; for example, it can be found in paint (lead in paint was banned in the United States in 1978)[4] and soil, and can leach into drinking water from lead-containing plumbing materials, such as faucets and drinking fountains.

1.2 Lead in school drinking water is a concern because it is a daily source of water for over 50 million children enrolled in public schools. The pattern of school schedules—including time off over weekends, holidays, and extended breaks—can contribute to standing water in the school's plumbing system. If there is lead in the plumbing system, the potential for it to leach into water can increase the longer the water remains in contact with the plumbing. Estimating the risk of lead contamination of schools' drinking water at the State level is a complex and important challenge. Variable water quality among water systems and changes in water chemistry during distribution affect lead dissolution rates from pipes and fittings. In addition, the locations of lead-bearing plumbing materials are uncertain. EPA, 2002 (**3**), Triantafyllidou and Edwards, 2012 (**4**).

1.3 The US EPA is responsible for enforcement of the *Safe Drinking Water Act* (SDWA) on Tribal land; there is no delegation of this authority to the States.

1.4 Sections 50105 and 50110 of the *Infrastructure Investment and Jobs Act* (Public Law 117–58) (**1**) provides funding and directs the US EPA and the Department of Interior to address lead in drinking water systems that provide potable water to schools and on Tribal land. EPA has announced that in accordance with this statute, the Agency discourages partial lead service line replacements and encourages full replacement of deficient service lines. The legislation provided the US EPA with approximately $15 billion over a 5-year period to achieve this goal.

1.5 This guide describes steps to rapidly identify community and public water systems, as defined in the SDWA, at risk of lead concentrations exceeding the maximum contaminant level (MCL), using publicly available data. These steps augment and complement the records review activities that the US EPA encourages as part of the LSLR program.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[5]

E3032 Guide for Climate Resiliency Planning and Strategy

2.2 *EPA References:*[6]

EPA 810-R-19-003 EPA. Strategies to Achieve Full Lead Service Line Replacement. October 2019

EPA 816-B-22-001 EPA Guidance for Developing and Maintaining a Service Line Inventory. August 2022

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *community water system, CWS, n*—as defined in the Safe Drinking Water Act, a water system that supplies water to the same population year-round.

3.1.1.1 *Discussion*—A community water system serves at least 25 people at their primary residences or at least 15 residences that are primary residences (for example, municipalities, mobile home park, subdivisions).

3.1.2 *maximum contaminant level (MCL), n*—The highest level of a contaminant that is allowed in drinking water.

3.1.2.1 *Discussion*—MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.

3.1.3 *maximum contaminant level goal (MCLG), n*—The level of a contaminant in drinking water below which there is no known or expected risk to health.

3.1.3.1 *Discussion*—MCLGs allow for a margin of safety and are non-enforceable public health goals.

3.1.4 *national primary drinking water regulations (NPDWRs), n*—the National Primary Drinking Water Regulations (NPDWR) are legally enforceable primary standards and treatment techniques that apply to public water systems.

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[2] Adapted from "Identifying Schools at High Risk for Elevated Lead in Drinking Water Using Only Publicly Available Data. Science of the Total Environment

[3] The boldface numbers in parentheses refer to a list of references at the end of this standard.

[4] Lead in Paint. Centers for Disease Control and Prevention. https://www.cdc.gov/nceh/lead/prevention/sources/paint.htm

[5] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[6] Available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, http://www.epa.gov.

3.1.4.1 *Discussion*—Primary standards and treatment techniques protect public health by limiting the levels of contaminants in drinking water.

3.1.5 *public water system, n*—As defined in the Safe Drinking Water Act, a public water system provides water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serves an average of at least 25 people for at least 60 days a year.

3.1.5.1 *Discussion*—A public water system may be publicly or privately owned.

3.1.6 *vulnerable communities, n*—are groups and communities at a higher risk for poor health as a result of the barriers they experience to social, economic, political and environmental resources, as well as limitations due to illness or disability.

3.2 *Abbreviations and Acronyms:*

3.2.1 *CCR*—Consumer Confidence Report

3.2.2 *CWS*—Community Water System

3.2.3 *EPA*—U.S. Environmental Protection Agency

3.2.4 *GAO*—General Accountability Office

3.2.5 *GIS*—Geographic Information System

3.2.6 *LSL*—Lead Service Line

3.2.7 *LSLR*—Lead Service Line Replacement

3.2.8 *MCL*—Maximum Contaminant Level

3.2.9 *MCLG*—Maximum Contaminant Level Goal

3.2.10 *NPDWR*—National Primary Drinking Water Regulations

3.2.11 *SDWA*—Safe Drinking Water Act (42 USC 300f *et seq.* 1974; §612 as implemented by Public Law No: 114-322. 2016)

3.2.12 *SDWIS* —Safe Drinking Water Information System

4. Significance and Use

4.1 Lead can enter drinking water when service lines or plumbing fixtures that contain lead corrode, especially where the water has high acidity or low mineral content. According to the EPA, lead typically enters school drinking water as a result of interaction with lead-containing plumbing materials and fixtures within the building (EPA 2019 EPA 2018, (**5**)). Although lead pipes and lead solder were not commonly used after 1986, water fountains and other fixtures were allowed to have up to 8 percent lead until 2014 (GAO, 2018 (**2**)). Consequently, both older and newer school buildings can have lead in drinking water at concentrations that exceed the NPDWR.

4.2 Following the reports in 2015 of elevated lead levels in the water in Flint, Michigan, Congress passed the Water Infrastructure Improvements for the Nation Act in 2016 (Public Law 114-322), which, among other things, amended the SDWA, to establish a grant program for states to assist school districts in voluntary testing for lead contamination in drinking water at schools. As a condition of receiving funds, school districts are required to test for lead using standards that are at least as stringent as those in federal guidance for schools.

4.3 California's State Water Resources Control Board's Division of Drinking Water initiated an aggressive program of sampling and public water systems supplying water to schools in 2018. California Assembly Bill 746 published on October 12, 2017, effective January 1, 2018, requires community water systems to test lead levels, by July 1, 2019, in drinking water at all California public, K-12 school sites that were constructed before January 1, 2010.

4.4 Lobo (2021) (**6**) reports that two factors predominantly control lead leaching into the drinking water: *(1)* the presence or absence of lead-bearing plumbing materials, and *(2)* water quality that promotes the formation of soluble or insoluble lead corrosion products. This guide provides a method of using publicly-available information to determine if the water supplied to schools presents an unacceptable lead exposure hazard.

4.5 The procedures described in the guide are consistent with Sections 4, 5, and 6 of Guide E3032.

5. Procedure

5.1 *Data Collection:*

5.1.1 The data requirements for this guide include demographics, water quality, age of the water supply pipes and associated infrastructure, and school capture area (boundaries)[7]. The data requirements are based upon the research conducted at the University of California, Berkeley (Lobo, 2021 (**7**).

5.2 *Demographic Data:*

5.2.1 Use the US Census Bureau's data portal ()to obtain the socioeconomic information for the students attending each school by assigning data from individual census tracts to schools drawing students from those census tracts. Social data from American Community Survey (**8**) should be used to estimate social conditions within census tracts. Select socioeconomic features that correspond to race, poverty levels and unemployment. State annual school census reports, that include information on race/ethnicity, by grade level, are another source of demographic data that is publicly available.

5.2.1.1 Low-income minority groups have been reported to be at a disproportionately larger risk of lead exposure from old and poorly maintained water infrastructure in Flint, MI and the state of New Jersey (Hanna-Attisha et al., 2016 (**9**); Gleason et al., 2019 (**10**)). Lobo (2021 (**7**)) suggests including measures of race and poverty into a machine learning model to account for the fact that race and poverty may be good proxies for the absence or presence of lead-bearing plumbing materials.

5.3 *Collect Water Quality Data:*

5.3.1 The main water quality parameters that control lead solubility in drinking water are Triantafyllidou, et al., 2021 (**11**)[8]:

5.3.1.1 *pH*—elevated pH levels tend to decrease lead concentrations due to both the relatively low solubility of lead corrosion products and slower dissolution rates at high pH values in drinking water.

[7] Adapted from "Identifying Schools at High Risk for Elevated Lead in Drinking Water Using Only Publicly Available Data. Science of the Total Environment

[8] National Center for Environmental Health, Division of Environmental Health Science and Practice https://www.cdc.gov/nceh/ehsp/default.html