Massachusetts Assistance Program for Lead in School Drinking Water

Program Summary and Phase 2 Report

Massachusetts Department of Environmental Protection

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Table of Contents

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Executive Summary

This report describes the work undertaken and major findings of Phase 1 and Phase 2 of the Commonwealth of Massachusetts Assistance Program for Lead in School and Early Education and Care Facility Drinking Water (the Program). The Program is directed by the Drinking Water Program of the Massachusetts Department of Environmental Protection (MassDEP), with support and assistance from other Massachusetts agencies including the Departments of Public Health (DPH), Elementary and Secondary Education (ESE), and Early Education and Care (EEC), the Massachusetts Water Resources Authority (MWRA), and significant implementation via an Interdepartmental Service Agreement with the University of Massachusetts at Amherst (UMass). The Phase 1 and Phase 2 Program work was funded by the allocation of resources (~$2.75 million) from the Massachusetts Clean Water Trust by the Baker-Polito administration.

Scope of Work:

The Phase 1 and 2 Program provided funding for technical assistance, sample collection, and laboratory analysis for public schools and childcare facilities to assess the levels of lead and copper in potable water that children may drink or that is used in food preparation or medical purposes. Participation in the Program was voluntary. The sample collection and analysis work described in this report was largely undertaken between June 2016 and December 2018.

The sampling was conducted in accordance with the US Environmental Protection Agency's (US EPA) "3Ts" Guidance Manual for Lead in Schools Drinking Water, prepared as a result of the federal 1988 Lead Contamination Control Act (LCCA). First draw samples were collected after an 8 to 18-hour period of stagnation with no water use followed by a second flush sample collected after water flowed from a tap for 30 seconds after the first draw sample was collected. Both samples had 250 mL volumes and each was analyzed for lead and copper with no sample filtration.

Certified laboratories reported results electronically via the LCCA eDEP protocol. All Program water quality data are available publicly via the MA Executive Office of Energy and Environmental Affairs (EEA) Data Portal, with a targeted web page for accessing the lead and copper in schools data at:https://eeaonline.eea.state.ma.us/Portal/#!/search/leadandcopper

MassDEP issued a final report describing the Phase 1 work and results in May 2017. The report is available online at:

https://www.mass.gov/doc/final-report-massachusetts-assistance-program-for-lead-in-school-drinking-water/download

In total for Phases 1 and 2, water samples were collected from 39,358 separate locations (fixtures) in 992 different buildings in 189 communities from 178 different school systems. The most common type of tap sampled was a classroom faucet (~38%) followed by drinking water bubblers (29%) and water chillers (14%). Other fixture types included kitchen faucets, nurse's office sinks, and kitchen kettles. The number of buildings per school system ranged from 1 to 76 while the number of locations per building ranged from 1 to 234, with an overall average of 40 fixtures (or taps) per building. Most commonly, two samples were collected from each tap, first

draw (primary) and flush, but for about 14% of taps, a separate flush sample was not needed due to common adjacent plumbing supply to the taps. As such, a total of 67,908 samples were collected, ranging from 2 to 431 per building with an overall average of 68 per building. Averages for locations and samples per building were very similar for the 818 buildings in Phase 1 and the 174 buildings in Phase 2.

Approximately 97% of the 992 buildings sampled in the Program were supplied water by a local public water supplier (PWS). MWRA provided water to 14 % (137) of the 961 buildings that received PWS-supplied water, and provided free laboratory testing for samples from those facilities (6,175 samples). The remaining 3%, or 31, school buildings (17 in Phase 1, 14 in Phase 2), were independent MassDEP certified PWS. As a PWS, the school must comply with the requirements of the Lead and Copper Rule. Program findings provide additional information to MassDEP and the school-PWS to enable a supply of water with the lowest possible levels of lead and copper.

<u>Major Findings</u>:

For Phase 1 and 2, levels of lead and copper were first assessed relative to the US EPA Lead and Copper Rule (LCR) public water system Action Levels of 15 parts per billion (ppb) for lead and 1.3 parts per million (ppm) for copper. In late 2018, the US EPA issued a revised 3Ts Guidance Manual which stated that there is no safe level of lead in drinking water for children. In May 2019, MassDEP notified schools that they should strive to achieve the lowest levels of lead possible, with a goal of no greater than 1 ppb of lead, a common detection level for commercial laboratories.

Analysis of the Phase 1 and 2 results on a school building basis shows that:

- 98% of buildings had at least one sample with lead greater than 1 ppb
- 29% of buildings had exceedances for both lead (i.e., > 15 ppb) and copper (i.e., > 1.3 ppm copper)
- 39% of buildings had at least one sample with lead greater than 15 ppb but no copper level exceedances
- 4% of buildings had at least one sample with copper level greater than 1.3 ppm but no lead exceedances
- 28% of buildings had no samples with lead or copper exceedances.
- 20 buildings (2%), usually with relatively few sample locations, had all lead levels at or below 1 ppb

Within a school building, the levels of lead and copper can vary greatly between fixtures, especially for lead. This variability is due to differences in the age, type, material, water volume, and connected supply plumbing between fixtures. As such, it is not possible to predict the lead level in fixtures for which samples were not collected. Copper variability is less noticeable, probably due to the very common use of copper plumbing materials.

Analysis of results based on year of school construction suggest a possible beneficial impact on decreasing lead levels from the federal actions to decrease lead in plumbing material (1986) and improve corrosion control treatment via the Lead and Copper Rule (1991). However, additional information regarding upgrades to the buildings' plumbing is needed to better understand the correlation between year of plumbing installation and exceedances. This trend is not observed for copper levels.

Lead results for the first draw and flush samples within a building can also be very different. Stagnation of water in contact with lead-containing materials generally results in increased lead levels over time. Flushing prior to use or following longer than normal periods of stagnation (e.g., weekends, holidays) can bring water with lower or non-detectable lead levels to the fixture. Analysis of combined fixture sample results for all buildings show that:

- 10% of first draw samples had lead greater than 15 ppb, while only 2% of flush samples exceeded 15 ppb
- 47% of first draw samples had lead in the 1 to 15 ppb range, while 29% of flush samples were in this range
- Only 42% of first draw samples had lead levels at or less than 1 ppb, while many more (69%) of flush samples had lead below the level of concern (1 ppb)

Overall, the paired results highlight the significant short-term benefits of fixture flushing on decreasing lead levels.

The overall copper concentration results for all buildings show that for both first draw and flush samples, the most common copper concentration range is 0.1 to 0.5 ppm (51% first draw and 43% flush). Relatively few samples had copper concentrations that exceeded the copper Action Level of 1.3 ppm, 3.4% for first draw samples and 2.0% for flush samples. In general, flushing has a minor impact on copper levels.

Analysis of results on a type of fixture basis showed that classroom faucets and kitchen fixtures had the highest lead levels in first draw samples. Therefore, targeted fixture remediation and the implementation of flushing routines is recommended for these fixture types.

Recommendations:

MassDEP recommends that schools and childcare facilities follow the extensive guidance available on the MassDEP website. Key components include:

- Conduct sampling and water quality analysis for all drinking water fixtures at least once every three years.
- Discontinue use of fixtures that yield lead levels of 15 ppb or greater.
- For all fixtures that yield lead levels greater than 1 ppb and less than 15 ppb - take remedial action to decrease lead levels to no greater than 1 ppb. Such actions may include:
    - Replacement of plumbing material (fixtures, piping)
    - Installation of fixtures with point-of-use lead removal filters
    - Short-term and temporary improvement of water quality by always flushing a fixture prior to using the water
- Follow MassDEP guidance for flushing of building water systems following periods of building closure prior to reopening.

1. Introduction and Background: Lead and Copper in DW

1.1 Regulatory and Guidance History: measurements and materials

The quality of drinking (or potable) water supplied to people is regulated nationally by the US Environmental Protection Agency (US EPA) via the Safe Drinking Water Act (as amended), the National Primary Drinking Water Regulations and, in Massachusetts, by the Department of Environmental Protection (MassDEP) via state laws and regulations which are at least as stringent as the US EPA regulations. Compliance with regulations is met by regular monitoring and reporting of measurements of water quality by public water suppliers (PWS). Measurements of many water quality parameters are made with samples primarily collected at points where water enters a water distribution system (most often following one or more treatment processes) and at locations within a water distribution system. However, people typically withdraw water for drinking, cooking, bathing and other uses from a faucet or other outlet (a tap) connected to the plumbing within or adjacent to a building, also known as premise plumbing, that is supplied by a service connection (a pipe) from a nearby water main. Unfortunately, some materials that have been used in premise plumbing and service connections may cause a deterioration in drinking water quality. Of particular concern from a health perspective is the leaching of the element lead (chemical symbol Pb) into water from plumbing materials. Copper (chemical symbol Cu) leaching into water is also of concern, but is a less prevalent problem from a health perspective (but may be an aesthetic and plumbing integrity problem).

Engineers, scientists and regulators have long recognized concerns about elevated levels of lead and copper in drinking water due to service connections and premise plumbing. Several federal laws and regulations have been promulgated with the purpose of minimizing human exposure to lead and copper in drinking water through control of allowable plumbing materials, measurement and reporting of tap water quality, and water treatment optimization.

Regrettably, the past widespread use of lead pipe service connections and lead containing materials in premise plumbing, the longevity of such materials, and the expense of replacing them means that material replacement has not occurred at a level sufficient to eliminate concerns. The 1986 Safe Drinking Water Act amendments prohibited the use of pipes, solder or flux that were not “lead-free”, but at that time “lead-free” was defined as < 0.2% by weight for solder and flux but < 8% by weight for pipes and fixtures such as valves and pipe fittings. Allowable levels of lead in plumbing materials were significantly decreased by the 2011 federal Reduction of Lead in Drinking Water Act that redefined “lead-free” to mean less than 0.25% lead by weighted average for all wetted surfaces. The NSF/ANSI 372 standard reflecting these requirements appeared in 2014 such that obtaining very nearly lead-free plumbing materials is now feasible. In addition, in no small measure due to the national attention to widespread elevated levels of lead in Flint, Michigan drinking water in 2014-2015, many states, municipalities, and public water supply agencies have invested significantly in the removal of lead service lines. In Massachusetts, MassDEP and the MWRA have been extensively engaged in such efforts.

Identifying that a building has service connection and/or plumbing materials that may leach lead or copper into water at levels of concern often requires targeted measurements of tap water quality. The 1991 US EPA Lead and Copper Rule (LCR) mandated that public water suppliers periodically assess tap water quality from a specified number of homes with the highest risk of having elevated lead levels. Typically, home occupants would collect a 1-liter volume first draw or stagnation sample after an overnight period of no water use in the building.

The LCR established “Action Levels” for lead and copper such that corrosion control treatment optimization is required if more than 10% of the tap water samples analyzed have levels exceeding the lead Action Level (AL) of 0.015 mg/L (15 ppb) or the copper AL of 1.3 mg/L (1.3 ppm). Public water suppliers are also required to distribute public education materials when lead AL or lead and copper ALs are exceeded in more than 10% of samples. Public education is not required solely for a copper AL exceedance. It is important to note that the copper AL is the same as the health based maximum contaminant level goal (MCLG) for copper while the lead AL is not; the MCLG for lead is zero based on being a probable human carcinogen. In 2021, the USEPA promulgated LCR Revisions (LCRR) with required compliance beginning in October 2024.

The neurotoxin effects of lead are most significant for the developing brains of young children. Past lead exposure is assessed by measuring blood lead levels (BLL). Recognizing the prevalence of elevated BLL in the US, important lead sources, such as leaded gasoline for combustion engines and lead containing paint, were prohibited during the 1970’s, leading to subsequent decreased average population BLLs. The possible contribution of drinking water to BLL in children was also recognized, leading to the federal Lead Contamination Control Act (LCCA) of 1988. This law established a voluntary program aimed at decreasing the levels of lead and copper in drinking water at schools and early education and care facilities (EECFs). The law provided a list of banned water coolers to be removed (and not purchased) due to lead containing materials. The law also directed the US EPA to develop guidance for how and where to collect water samples for analysis of lead and copper.

The 1994 US EPA guidance document *Lead in Drinking Water in Schools and Non-residential Buildings* was replaced about 10 years later by the 2006 document *3Ts of Reducing Lead in Drinking Water in Schools: Revised Technical Guidance*, often simply referred to as “the 3Ts.” At that time, the 3Ts were Training, Testing, and Telling, all directed at education about the concerns of lead in drinking water, how to properly collect samples for analysis, and describing the meaning of the analysis results and what actions to take. The original 3Ts document recommended that school taps be taken out of service if a 250 mL volume sample had lead levels greater than 20 ppb. The 3Ts recommendation was often misinterpreted as another “action level” as used in the US EPA LCR, which is incorrect as the school sample level of concern is for a single tap sample result while the LCR ALs apply to the distribution of results for samples from many homes. The MassDEP approach to the original LCCA guidance is described in the following section.

In October 2018, the US EPA released a revised guidance document entitled *3Ts for Reducing Lead in Drinking Water in School and Child Care Facilities, A Training, Testing and Taking Action Approach*. The “Revised 3Ts” indicates that there is “no safe level of lead for children” and that facilities are advised to “reduce their lead levels to the lowest possible concentrations.” The Revised 3Ts document indicates that there may also be a state or local “remediation trigger level.” MassDEP guidance to schools and EECFs subsequent to the release of the US EPA Revised 3Ts is also described in the following report section.

1.2 Massachusetts DEP Approach to Lead and Copper in Drinking Water

MassDEP has the responsibility of enforcing compliance with federal and state regulations for the supply of drinking water to Massachusetts residents. In doing so, MassDEP interacts routinely with US EPA Region 1 which encompasses the New England states. MassDEP also routinely works with PWSs and utility organizations to provide the guidance and education required for compliance with regulations, including those that address levels of lead and copper in drinking water.

To comply with the LCR, utilities periodically collect samples from household taps for analysis of lead and copper. If the sampling results indicate compliance with the copper and lead ALs (90% of samples less than the AL), monitoring frequency may be reduced to once per year and then further reduced to once every three years; an Action Level Exceedence results in a return to semi-annual monitoring. Since 1992, MassDEP has required PWSs to collect additional tap water samples from two schools (two taps at each school) whenever required LCR sampling and analysis is conducted. These samples are collected using the LCCA 3Ts procedures, and the results are not used for determining LCR compliance. MassDEP initiated this effort to raise awareness of the LCCA guidance for schools and PWS operators, to assist in the evaluation of corrosion control measures, and to encourage full engagement of the 3Ts guidance.

It is important to note that sampling and analysis of lead in drinking water at schools and EECFs (outside of the Massachusetts LCR requirement described) has not been, and is not currently, required by federal or state regulations. However, MassDEP has promoted and supported the voluntary LCCA program for assessing lead and copper in school drinking water since its initial passage in 1988. MassDEP has a long history of devoting resources to promoting use of, and providing technical assistance for, the 3Ts approach to decreasing lead levels in school and EECF drinking water. In addition, many PWSs have a long history of providing assistance to schools, including in some cases, free analysis of lead and copper in drinking water; a prominent example is the extensive work by the MWRA for facilities in its service area. Despite the 20 ppb guidance in the original 3Ts document, MassDEP opted to set the lead goal for school drinking water at 15 ppb, the same as the LCR AL. The new LCRR will require PWSs to offer free lead and copper analysis of water samples from each elementary school (five samples) and EECF (two samples) in their service area as well as secondary schools (five samples) they serve upon request.

1.2.1 The Massachusetts Assistance Program for Lead in School Drinking Water

In late April 2016, in the midst of heightened national attention to lead in drinking water due to events in Flint, Michigan, the Baker-Polito administration announced the “Massachusetts Assistance Program for Lead in School Drinking Water” to fund implementation of LCCA based sampling and analysis of lead and copper levels in tap water at K-12 public schools and EECFs in Massachusetts. Approximately $2.75 million of funding was made available from the Massachusetts Clean Water Trust. MassDEP worked closely with the MWRA, DPH, DESE, and DEEC to develop and implement the Program. In addition, MassDEP contracted with drinking water experts from the Department of Civil and Environmental Engineering at UMass to assist in implementing the new state-wide voluntary program for analysis of lead and copper in school and EECF drinking water.

What is now referred to as Phase 1 of the Program was initiated in June 2016 with extensive activity in the Fall of 2016 and early winter of 2016. A final report on the Phase 1 Program was made available in May 2017. Based on remaining available resources and continued need, Phase 2 of the Program began in September 2017 and remained in place through June 2020. Most Phase 2 sampling and analysis was conducted between September 2017 and December 2018, with only limited subsequent technical assistance provided through June 2020. The main purpose of this report is to summarize the results of the Phase 2 work and the overall results from the combined Phase 1 and Phase 2 efforts.

Nearly all sampling, analysis, and results reporting for Phase 1 and Phase 2 were completed prior to the release of the Revised 3Ts guidance by US EPA in October 2018. As a result, 15 ppb was the highlighted level of concern (action level) for lead for the Phase 1 and Phase 2 sampling work.

In response to the October 2018 US EPA Revised 3Ts guidance document, MassDEP provided revised guidance to schools in May 2019. In a letter to schools, MassDEP stated support for the 3Ts goal of reducing lead in school and childcare drinking water to the lowest possible levels. Thus, the new level of concern is greater than 1 ppb for lead in school and EECF drinking water. The Phase 2 Program began providing technical assistance with respect to this revised level of concern following MassDEP's guidance to schools in May 2019, and the 1 ppb lead level remains the level of concern for ongoing Massachusetts programs.

To view MassDEP's guidance to schools, see: https://www.mass.gov/doc/letter-to-schools-and-child-care-facility-officials-revised-3ts-guidance-and-wiin-act-grant/download

1.2.2 Ongoing Massachusetts Initiatives:

EAP

In 2016, the US Congress passed the Water Infrastructure Improvements for the Nation (WIIN) Act. One opportunity resulting from the WIIN Act was the Section 2017 "Lead Testing in School and Child Care Program Drinking Water" grant program that allocated funds to each state to undertake work to assess the issue of lead exposure from drinking water, especially for children aged 6 years and younger. MassDEP applied for, and was awarded, a $967,000 US EPA grant under the WIIN Act and has continued its work with UMass to implement an Expanded Assistance Program (EAP), or Phase 3 of the Program. MassDEP and UMass began work on the EAP in January 2020 with a voluntary sign-up opportunity for public and private group EECFs and public elementary schools. Unfortunately, before sampling and analysis could begin, the COVID-19 pandemic severely impacted society such that hoped for progress in sampling of EECFs has been limited. The EAP has periodically received additional federal funding and the Program deadline has been extended, at least through June 2023, so expectations are for extensive work to be undertaken in the future.

S*WIG*

In response to the findings of the Phase 1 and Phase 2 Program that many schools do not have fixtures that supply drinking water with less than 1 ppb of lead, the Baker-Polito Administration worked again with the MA Clean Water Trust and MassDEP to launch the Clean Water Trust's School Water Improvement Grant (SWIG) program in early 2020. The initial phase of the SWIG program allocated nearly $1 million in grants to public schools for the purchase and installation of point of use filtered water taps to supply water with lead levels no greater than 1 ppb. The Trust subsequently received a $3 million US EPA grant to expand to private schools. Applicants must have tested tap water samples from existing fixtures either through the Program or in accord with its requirements in order to be eligible for a SWIG grant of $3,000 per eligible fixture. A second round of SWIG funding was made available in 2022 after which it transitioned to rolling applications.

2. Massachusetts Assistance Program Components

The components and summary of results of the 2016-2017 Phase 1 Program are described in the Phase 1 Final Report which can be found at:

https://www.mass.gov/doc/final-report-massachusetts-assistance-program-for-lead-in-school-drinking-water/download. Updated descriptions of program elements encompassing both Phase 1 and Phase 2 are presented below.

2.1 Partners/Personnel Implementing the Assistance Program

Direction and implementation of the Program is the responsibility of MassDEP personnel, largely in the Drinking Water Program of the Bureau of Water Resources. MassDEP entered into an Interdepartmental Service Agreement (ISA) with UMass for implementation of many components of the Program. UMass personnel included: 1) Program Directors to oversee implementation of the ISA; 2) Project Managers to coordinate implementation of the ISA including contracting with state-certified laboratories; 3) Technical Assistance Providers (TAPs) to work with school personnel (some direct and some via sub-contract). The responsibilities of UMass included: 1) preparing for and participating in periodic (weekly to bi-weekly) calls with MassDEP to discuss and coordinate implementation and progress of the Program; 2) working with MassDEP to finalize the informational materials for schools; 3) scheduling and conducting informational meetings for school systems to provide training on all aspects of the Program; 4) overseeing and assisting with sample collection and analysis; 5) coordinating laboratory services and the delivery of samples to labs; 6) support for sharing results with schools; and 7) follow-up technical assistance for the Program, including remedial action guidance.

The bulk of the Program elements have been implemented by teams from both MassDEP and UMass. The MassDEP team has included several technical staff, as well as a number of managers. The UMass Project Management team has included two Co-Principal Investigators/Project Directors, two Co-Project Managers; various UMass administrative staff provided additional support as needed.

The complexity and timeline of the Program, especially during Phase 1, required close coordination within MassDEP, and between MassDEP and UMass. Steps were taken to ensure that such coordination occurred. There have been weekly or bi-weekly meetings/calls involving the MassDEP personnel working directly on the Program (MassDEP team) and the UMass Program Directors and Project Managers to discuss Program implementation. Topics discussed during these meetings/calls included: 1) implementation priorities and strategies; 2) identification of issues arising during implementation that needed to be addressed/resolved; and 3) implementation reporting and tracking. In addition, the MassDEP team met weekly with MassDEP senior management to discuss: 1) the status of the Program, including reporting and tracking of ongoing efforts; 2) resource issues and demands; 3) Program costs and budget; 4) implementation priorities, strategies, and difficulties; and 5) issues arising during implementation that needed to be addressed/resolved. In addition, on a weekly basis, the MassDEP team provided MassDEP senior management with an internal report summarizing the number of: 1) participating communities; 2) participating school buildings; 3) Informational Meetings completed; 4) buildings where sampling was completed or scheduled; and 5) buildings with exceedances for lead and/or copper. The MassDEP team also met weekly to discuss on-going Program implementation issues, including identifying issues that needed to be raised and discussed with UMass and MassDEP senior management, and identifying, assigning, and tracking tasks required for continued implementation of the Program. The UMass management team, especially the Project Mangers, communicated extensively with TAPs to implement the facility specific work. The Masterfile of Program data was updated regularly (typically weekly) by UMass Program Management based on input from TAPs on work planned and completed and on the submission of analytical results by the laboratories.

2.2 Soliciting School/EECF Participants

MassDEP and other state agencies (DPH, DESE, DEEC) actively solicited public schools and EECFs to participate in the Program via email and print communications, including news media, in conjunction with available online resources. To be considered for the no-cost technical assistance (TA) and sampling and analysis of lead and copper, a school system representative submitted an online form containing pertinent information (school system name, code; names, locations, grade levels of schools; address, name, email, phone, position of contact person; etc.). MassDEP staff reviewed the applicant information and if accepted into the Program, directed UMass staff to contact the school system and begin Program implementation. UMass created a Masterfile of data for the approved Program participants, with one set of data focused on the school systems participating and a second much larger set that is focused on each school or EECF facility (building) that is included in the Program.

2.3 Preparing for Sampling and Analysis

A UMass Program Manager contacted each accepted school system to confirm participation in the Program and initiate contact between a TAP and the system to begin the Program. Key steps prior to collection of samples for analysis include an informational meeting, initiating use of the online MassDEP LCCA Program Management Tool, creating a plan and map of fixtures to be sampled, and providing access to technical resources.

2.3.1 Informational Meeting

Informational meetings (IM) were held so that the Program TAP could explain all elements of the Program to a school system, also known as a school district or school administrative unit. Some school districts have school facilities located in multiple communities while some communities have multiple school administrative units within their borders. Meetings were held in person, usually at a school within the school system. In total, 186 IMs were conducted during Phases 1 and 2 (147 and 39, respectively, June 2016 – May 2018). The Program encouraged school systems to invite informational meeting participation from superintendents, principals, facility directors, representatives of local Boards of Health, representatives of the local PWS, plumbing inspectors, school committee members, school nurses, and other interested local officials. The ~ 2-hour duration meetings provided attendees with the information necessary for school systems to implement the elements of the Program. Available information and required Program forms/resources, including fact sheets, a PowerPoint presentation, model forms and letters, the online LCCA Program Management Tool, the MassDEP web page, and the DPH FAQs, were reviewed as part of the informational meeting. These resources are listed in Table 2.1. Attendees varied between school systems, but in most cases included superintendents, principals, and facility directors. A subset of IMs was attended by PWS personnel, and a smaller subset was attended by elected officials, local health officers, and school nurses. The number of people attending IMs ranged from one to 25, but typical attendance was approximately five people. If the IM was held in a school building, the meeting was often followed by a water sample collection demonstration.

2.3.2 Online LCCA Program Management Tool

MassDEP developed the LCCA Program Management Tool (or Tool) as an online resource for schools and EECFs to manage their LCCA program of periodic sampling, analysis, results, and remedial actions (See Table 2.1 for online link URL). School/EECF systems eligible for free sampling and analysis as part of the Program, and systems seeking grants for filtered hydration station installation via the SWIG program, must use the LCCA Program Management Tool. All systems that conduct sampling and analysis at schools and EECFs are encouraged to use the Tool and follow Program protocols, independent of receiving financial support from the Program.

The Tool provides each school with a single secure online location to create and store critical LCCA documents, establish and maintain coded sampling locations, display and store sampling results (for multiple sample dates), and record remediation activities undertaken to decrease levels of lead and/or copper. Each school/EECF system is assigned a unique 12-digit PIN code that grants it private access to the Tool where records to track individual school/EECF facilities for their system are established. The basic structure of the record for a facility consists of four tabs: Notifications, Sampling Locations, Downloads, and Uploads.

The Tool displays notifications for sample locations for 1) Lead sampling results above 15 ppb; 2) Lead sampling results between 1 and 15 ppb; and 3) Copper sampling results above 1.3 ppm. Remedial actions (including date undertaken) for a location with a notification entered using a drop-down menu. Action options include: removed banned cooler; notice provided to customers; daily flushing; physically disconnected faucet from plumbing; replaced plumbing and/or fixture;

posted on faucet to prevent drinking/cooking. Results for sampling prior to remediation actions are displayed for the location.

The Sample Locations tab is used to enter each sample location, assign it a code, type, and description, and provides a link to the sample results and actions taken for each location. Once all the sampling locations are entered for a school, a user can use the Downloads tab to produce three reports that are very useful for an effective sampling event. The Sample Plan report produces a PDF of all the entered sampling locations. The Chain of Custody (CoC) report transfers all active sampling locations into a typical CoC template that can be carried into the field, completed during sampling, and provided to the laboratory along with the sample bottles. The Bottle Label report provides a file that can be used to print self-adhesive labels for the sample bottles. Finally, the Uploads tab allow schools to centralize the secure storage of important documents such as building maps, plumbing profiles, sampling plans, and completed CoC forms.

2.3.3 Sampling Plan and Map

Following the IM, a Sampling Plan consisting of a list and a map of all LCCA sample locations (i.e., taps or fixtures) was developed for each building included in the Program. The level of technical assistance required to develop the map and Sampling Plan varied widely. Some school systems completed documents on their own, some participated in completing documents with hands-on assistance by a Program TAP, and some school systems relied completely on a Program TAP. The time required to create a map of LCCA sample locations and corresponding Sampling Plan for a single school building ranged from 15 minutes to several hours, depending on the size of the school building and the number of sample locations in the building. The sample locations were entered, and scanned sampling plan maps uploaded, into the facility record in the Tool by UMass TAPs or school personnel. In most cases, school personnel required assistance from Program personnel on using the online Tool.

All locations where students had access to drinking water or where water was used for food preparation or medical care were labeled and included in the map of LCCA sampling locations. The most common type of fixture sampled was a classroom sink, which often included both a faucet and a water fountain for drinking. However, fixture types ranged from kitchen kettles and produce wash sinks to ice machines and hallway water fountains. Schools were encouraged to post signs near bathroom sinks and near other non-drinking water fixtures (such as janitor slop sinks) indicating that those faucets are intended for handwashing only; the Program provided thousands of adhesive signs for this purpose. Faucets where people are not expected to access water for drinking, food preparation, or medical care, and that are posted with signs, are not considered LCCA sample locations within the Program.

2.3.4 Technical Resources

MassDEP and DPH have prepared a wide range of technical resources that are publicly available online. Table 2.1 lists some of the key resources referenced and used in the Program.

2.4 Sampling, Analysis, Results Communication, and Follow-Up

After completion of the Sampling Plan, including full entry into the Tool, facilities were ready for sample collection followed by laboratory analysis, reporting of results, and follow-up actions. A UMass Program manager selected a previously UMass sub-contracted state certified laboratory to provide services for a school system; the MWRA Deer Island lab provided services for all schools in their service area, at no charge to the school or Commonwealth. The laboratory was directed to provide the required number of sample bottles to the school system or facility by a specified date; a UMass TAP typically facilitated sample bottle delivery.

2.4.1 Sampling

Advance preparation for sampling included the creation of CoC forms and sample bottle labels by Program personnel, making use of the Downloads features of the Tool to obtain files for printing of facility-specific forms to be completed during sampling. Information to be entered on the CoC form includes the school (or EECF) name and address, DESE (or DEEC) organization code, samplers' names, a row for data for each sample (identification number (by lab); first draw (P) or flush (F) designation; location information (ID number, type, description); date and time sampled (completed in the field for each sample)), analyses requested, and signature blocks for each person having custody of the sample from sample collection through delivery of the sample to the lab. A separate CoC form was used for each school building that was sampled, and each sample had a unique location code number and sample type identification on its label.

To ensure the validity of the sampling results and to ensure alignment with applicable US EPA guidance, sampling had to occur: 1) after more than eight hours but less than 18 hours of water stagnation prior to sample collection; 2) prior to any other use of water in the building; and 3) while the building was in normal use (e.g., not during vacations or other times when the building was not being used by the normal school-year population of students and staff). As a result, sampling generally occurred between 5:00 and 7:00 a.m., Tuesday through Friday, or on Saturday morning. The amount of time required to sample a building depended upon the number of fixtures to be sampled, the size of the building, the samplers' familiarity with the building, the experience of the samplers, the number of sampling teams, and the number of samplers on each sampling team. The level of technical assistance required to help schools conduct the sampling varied widely. Some school systems were able to sample on their own (often with the assistance of the local PWS), some systems participated in the sampling with hands-on assistance by a TAP, and some systems relied upon one or more TAPs to conduct the sampling aided by at least one school staff member to provide building access and fixture location assistance. In addition to the UMass TAPs, MassDEP staff and contractors were utilized in the sampling efforts when additional staff beyond the TAPs were required to meet the demand for sampling.

In accordance with applicable US EPA guidance, samples were collected in 250 milliliter wide-mouth plastic bottles supplied by the laboratory without pre-acidification. Generally, two samples were taken from each fixture, a first draw (or primary (P)) sample and a 30-second flush sample (F). The first draw sample was collected as soon as water flowed out of a faucet. The 30-second flush sample was collected after allowing the water to flow at a normal rate for 30 seconds following first-draw sample collection. Some fixtures had multiple closely connected water fixtures, such as a faucet and a water fountain on a classroom sink, two adjacent water fountains (high and low), or two adjacent water fountains and a bottle filling tap. In these cases, first draw samples were taken from all fixtures, while only one fixture was used to collect the flush sample since this flush sample was representative of the adjacent fixtures.

Bottle labels for each sample to be collected were prepared using facility-specific data from the online Tool. All sample bottle labels included the facility name, DESES (or DEEC) organization code, sampling date/time, sample location ID number, and whether the sample was a primary (or first draw) sample or a 30-second flush sample. Sample location ID numbers were followed by a "P" for primary samples or an "F" for 30-second flush samples (e.g., 001P, 001F). Each label corresponds to a sample location listed on the sample plan, sampling map, and CoC form. The sampling date and time entered on the label had to match those entered on the CoC form. Delivery of the samples to the laboratory was facilitated by a range of personnel: UMass TAPs, school or public water supplier personnel, and laboratory personnel.

2.4.2 Laboratory Analyses

UMass contracted with 12 commercial laboratories to analyze samples under the Program. In addition, the MWRA analyzed samples free of charge for Program participants within their service area. All of these laboratories were MassDEP-certified for conducting lead and copper analysis in drinking water, and the laboratories used US EPA approved methods, typically either inductively coupled plasma mass spectrometry (ICPMS) or graphite furnace atomic adsorption (GFAA). For each sample collected, two analyses were conducted, one for total lead and one for total copper; no field or laboratory filtration was conducted on the samples.

2.4.3 Results Reporting and Communication

To participate in the Program, laboratories were required to report all lead and copper sampling results through the MassDEP electronic reporting system (known as eDEP). Use of eDEP provided for an automated review of the submissions for both administrative completeness (e.g., all the required fields were populated, each field's data type matched the expected type, the organization code matched a known school), as well as technical sufficiency (e.g., each result was generated by a certified laboratory using an approved method with acceptable detection limits and holding times).

School systems were provided facility specific Excel files with first draw and flush sample lead and copper concentrations for each sample location. MassDEP extracted the approved facility specific data into a one row per result data file. During the Phase 1 Program, MassDEP emailed the extracted data file directly to school systems, highlighting in red color those results that exceeded 1.3 ppm for copper or 15 ppb for lead; such results are typically referred to as exceedances. During Phase 2, UMass personnel converted the raw facility data into an Excel file format that showed each sample location and associated results in a single row in a data table; exceedance results were also highlighted in red color and the total number of exceedances was presented in the data files. In Phase 2, UMass sent the results to the school system. In both Phase 1 and Phase 2, the email communications also explained the analytical results, offered supplemental materials to assist each school's communication efforts with its community, and identified MassDEP and UMass contacts for additional support. In addition, for any school with one or more fixture with exceedance results, DPH sent an email to the local health department and the school principal and superintendent offering materials and support on how best to communicate the health risks associated with exposure to elevated levels of lead and copper in drinking water.

Transparency was and continues to be a key aspect of the Program; this was emphasized during the IMs with school systems. Accordingly, sample results were published on EEA Data Portal two weeks after MassDEP emailed the results to the school. This two-week timeframe provided schools with a reasonable opportunity to conduct communications and outreach with students, families, staff, and other local stakeholders concerning the results and remedial actions.

2.4.4 Follow-Up Actions

School systems often contacted MassDEP or UMass after receiving sampling results to discuss the meaning and significance of the results. Most school systems with facilities with exceedance results also sought advice and assistance from MassDEP or UMass on the appropriate next steps, including implementing short-term and long-term remedial actions, conducting follow-up sampling, providing notification to the school community, and entering these actions into the Tool. Assistance was often of a technical nature, explaining to facility directors how to interpret laboratory results, and how to identify the likely causes of lead or copper exceedances. In certain instances, it was necessary to explain that numerous copper exceedances may be due to new copper plumbing or to electrical grounding connected to a copper pipe or to non-optimal corrosion control practices for the water supplied to the facility. In some instances, it was determined that schools had improperly sampled from fixtures that should be considered non-potable (sinks in science labs, art rooms, or janitor slop sinks), and therefore results were not indicative of lead and copper levels in drinking water. At times, it was necessary for Program personnel to help school personnel re-learn the use of the Tool after laboratory results came back, so that they could enter actions taken in response to sample locations that had exceedances. Some school system personnel needed reminders that they must use certified, eDEP compliant laboratories for follow-up sample analyses, that they should sample in accordance with Program guidelines , and that the costs of follow-up sampling and analysis were not covered by the Program. Throughout the Program, and especially in 2019 and 2020, MassDEP directed technical assistance questions from school systems that were and were not participating in the Program to UMass personnel, often for advice on use of the Tool and on the suitability of prior or planned sampling relative to the requirements of the Program.

As noted in the Phase 1 report, a number of local health departments, school nurses, principals, and superintendents contacted DPH for risk communication support. Many callers asked questions about health effects and blood lead level (BLL) testing. Some callers asked what advice to give to parents and staff with health questions. DPH recommended that parents and staff with general questions about lead or copper and health be directed to DPH for additional information. DPH advised callers that it is not necessary to test all children following the detection of lead or copper in school drinking water. However, if a child has never been screened for lead or if he or she has specific health concerns, parents and staff should consult with their doctors. DPH was requested to give presentations about the health effects of lead and copper at public meetings for three school districts and conducted training during a Massachusetts Facilities Administrators Association meeting. DPH continues to work closely with MassDEP in the ongoing Program work.

3. Work Undertaken & Findings - Phases 1 & 2 of the Assistance Program

Phases 1 and 2 of the Program were undertaken between May 2016 and June 2020, with all the sampling and analyses conducted between June 2016 and December 2018, and associated expenditure of most of the funds allocated in the ISA with UMass. Limited remaining funding (about $25K) was used between January 2019 and June 2020 to provide follow-up technical assistance only to school systems and to keep the MassDEP/UMass team and ISA mechanism available if new resources became available. UMass provided some support to the MassDEP application for the current US EPA WIIN Act funding for the EAP and in the period prior to initiation of the new ISA. UMass also provided some support as MassDEP worked with the Clean Water Trust to implement the SWIG program.

3.1 Summary of Phase 1, Phase 2 and Overall Work Conducted

Table 3.1 summarizes the Program sampling and analysis work, by phase and overall, with respect to communities, school administrative units (systems), buildings (facilities), sample locations (fixtures), and samples. All public-school facilities were eligible for the Program, serving students from pre-kindergarten through high school. Approximately 80% of the sampling work was undertaken in Phase 1 and 20% in Phase 2. In total, water samples were collected from 39,358 separate locations (fixtures) in 992 different buildings in 189 communities from 178 different school systems. Table 3.2 shows a list of fixture types and percent of total fixtures (locations). The most common type of tap sampled was a classroom faucet (~38%) followed by drinking water bubblers (29%) and water chillers (14%). Other fixture types included kitchen faucets, nurse's office sinks, and kitchen kettles.

The number of buildings per school system ranged from 1 to 76 while the number of locations per building ranged from 1 to 234, with an overall average of 40 fixtures (or taps) per building. Most commonly, two samples were collected from each tap, first draw (primary) and flush, but for about 14% of taps, a separate flush sample was not needed due to common adjacent plumbing supply to the taps. As such, a total of 67,908 samples were collected, ranging from 2 to 431 per building with an overall average of 68 per building. Averages for locations and samples per building were very similar for the 818 buildings in Phase 1 and the 174 buildings in Phase 2.

Approximately 97% of the 992 buildings sampled in the Program were supplied water by a local public water supplier (PWS). The MWRA provided water to 14% (137) of the 961 buildings that received PWS-supplied water, and provided free laboratory testing for samples from those facilities (6,175 samples). The remaining 3%, or 31, school buildings (17 in Phase 1 and 14 in Phase 2), were independent MassDEP certified PWSs. As a PWS, the school must comply with the requirements of the Lead and Copper Rule. Program findings provide additional information to MassDEP and the school-PWS to enable supply of water with the lowest possible levels of lead and copper.

As of December 2018, over 99% of the available funding for the Program had been utilized. During 2019 and until June 2020, the remaining funds were utilized to maintain the technical assistance capability at UMass Amherst. In May of 2019, MassDEP issued new guidance to schools in accord with the October 2018 US EPA revised "3Ts" guidance for schools. MassDEP indicated that there is no safe level of lead in drinking water and that schools should have a goal of reaching the lowest levels of lead possible, using less than 1 ppb as the goal. As a result, many school systems asked for technical guidance to achieve the new lead goal. Phase 2 technical assistance was provided to over 40 different school systems, with contact initiated directly with UMass technical staff or after referral from MassDEP Drinking Water Program Staff. School system personnel often needed advice on which taps to sample, how to use the Tool, laboratories to utilize, and remediation steps to undertake.

During 2019, MassDEP applied for and was awarded US EPA WIIN Act funding to continue to assess levels of lead in drinking water accessed by children, with special focus on children under 6 years of age. Other state agencies and UMass assisted MassDEP with the application for funding. Also, in 2019, the Clean Water Trust's SWIG program was developed with major input from MassDEP and its Program partners. Formal work under Phase 2 of the Program ended in June 2020, allowing for a six-month overlap period to initiate the new US EPA WIIN grant funded EAP which formally began in January 2020.

Table 3.1: Summary of Assistance Program Work Conducted

Category	***Phase 1***	***Phase 2***	***Combined***
Communities	153	43	***189****
School Systems	140	39	***178*****
Buildings	818	174	***992***
Sample Locations	31,865	7,493	***39,358***
Locations per building: Range	1 to 234	3 to 140	***1 to 234***
Locations per building: Average	39	43	***40***
Samples Collected	55,914	11,994	***67,908***
Samples per building: Range	2 to 431	6 to 214	***2 to 431***
Samples per building: Average	68	69	***68***

* Seven communities had school/systems or facilities in both Phase 1 and Phase 2

** One system had school buildings in both Phase 1 and Phase 2.

Table 3.2 Location (Fixture) Types and Percent of Total

Location Type	**Code**	**Percent**
Classroom Faucet	CF	37.6
Drinking Water Bubbler	DW	29.6
Water Cooler (chiller unit)	WC	13.5
Kitchen Faucet, Cold	KC	6.6
Other Location	OT	4.1
Nurse's Office Sink	NS	2.9
Bathroom Faucet	BF	2.7
Kitchen Kettle	KK	1.9
Home Economics Room, Cold	EC	0.8
Kitchen Ice Maker	KI	0.4
Kitchen Kettle, Hot	KZ hot	0.02
Service Connector	SC	0.02

3.2 Summary and Discussion of Combined Phase 1 and 2 Findings

The sampling and analyses conducted for the Program have provided an extensive set of data for the levels of lead and copper in first draw and 30-second flush samples for potable water taps in Massachusetts schools. The data are analyzed with respect to buildings, type of fixture, first draw versus flush samples, and overall. All data are available publicly via the MA Executive Office of Energy and Environmental Affairs (EEA) Data Portal, with a targeted web page for accessing the lead and copper in schools data at:
https://eeaonline.eea.state.ma.us/Portal/#!/search/leadandcopper

Analysis of results in this report compares results to the 15 ppb lead AL and the 1.3 ppm copper AL, as well as the 1 ppb lead level of concern for the overall primary and flush sample data sets.

3.2.1 School Buildings

Table 3.3 and Figure 3.1 summarize building-based results with respect to a building having one or more samples with levels greater than 15 ppb for lead, greater than 1.3 ppm for copper, both lead and copper greater than the LCR Action Levels, or no samples exceeding these levels. Table 3.3 shows that results for Phases 1 and 2 were very similar. For the overall Phase 1 and Phase 2 results, Figure 3.1 shows that 39% of buildings had at least one sample with lead greater than 15 ppb but no copper level exceedances, 4% of buildings had at least one sample with copper level greater than 1.3 mg/L but no lead exceedances, 29% of buildings had exceedances for both lead and copper, and 28% of buildings had no samples with lead or copper exceedances. With respect to the 1 ppb lead level of concern, 98% of buildings had at least one lead level greater than 1 ppb. 20 buildings (2%), usually with a relatively small number of sample locations, had all lead samples with levels at or less than 1 ppb.

Table 3.3 Building Results*

Category	***Phase 1***	***Phase 2***	***Overall***
% with at least one Pb > 1 ppb	97	99	98
% with at least one Pb > 15 ppb	40	32	39
% with at least one Cu > 1.3 ppm	3	9	4
% with at least one Pb > 15 ppb and Cu > 1.3 ppm	29	30	29
% with no Pb > 15 ppb and no Cu > 1.3 ppm	28	29	28

*818 Buildings Phase 1; 174 Buildings Phase 2; 992 Buildings Overall

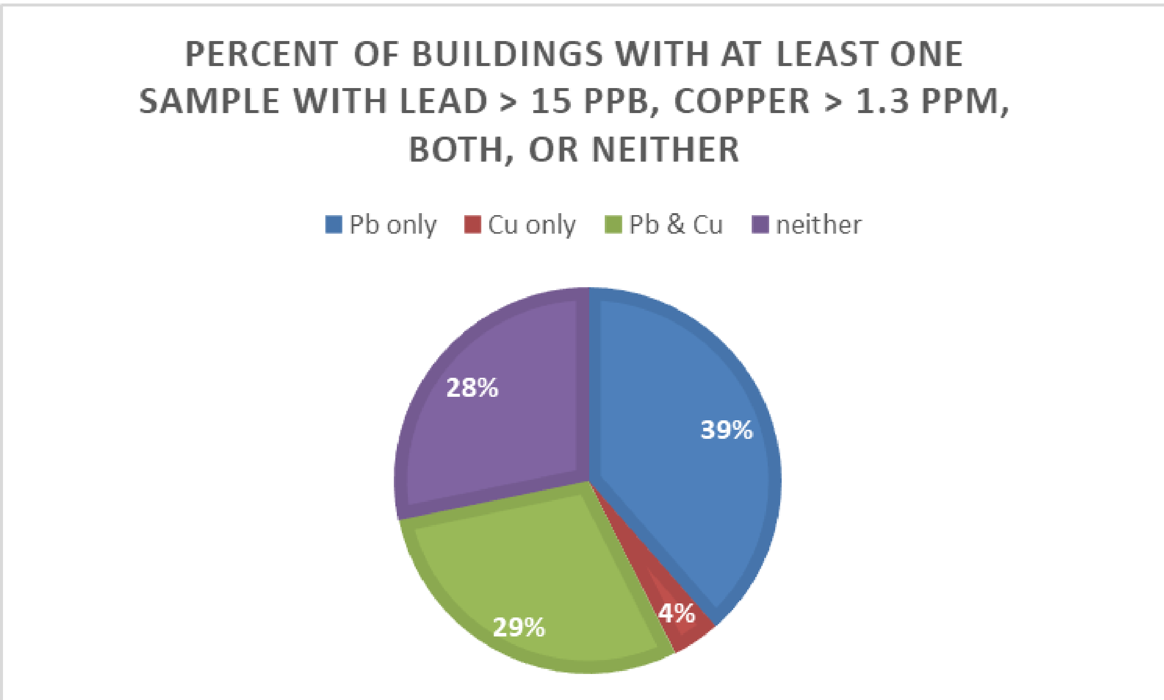


Figure 3.1 Analysis of overall results based on number of buildings (total of 992)

Within a school building, the levels of lead and copper can vary greatly between fixtures and for first draw versus flush samples. For example, Figure 3.2 shows results for school "A" (constructed in 2003) with 85 sample locations; first draw and flush sample concentrations for lead by location are in the top panel while the copper data are in the lower panel. The school had 18 first draw samples with lead exceeding 15 ppb and most other first draw samples with lead between 4 and 15 ppb. The 30-second flush samples show dramatically lower lead levels, often below 2 ppb; the average lead level decreased from 12.5 ppb for first draw samples to 3.2 ppb for flush samples. The results for copper show that only one first draw sample exceeded 1.3 ppm, with most results between 0.3 and 1 ppm. In contrast to the lead results, the 30-second flush samples did not have significantly lower copper levels (both averaged ~ 0.6 mg/L), probably reflecting the ubiquitous occurrence of copper plumbing material throughout the building and a lower impact of water stagnation.

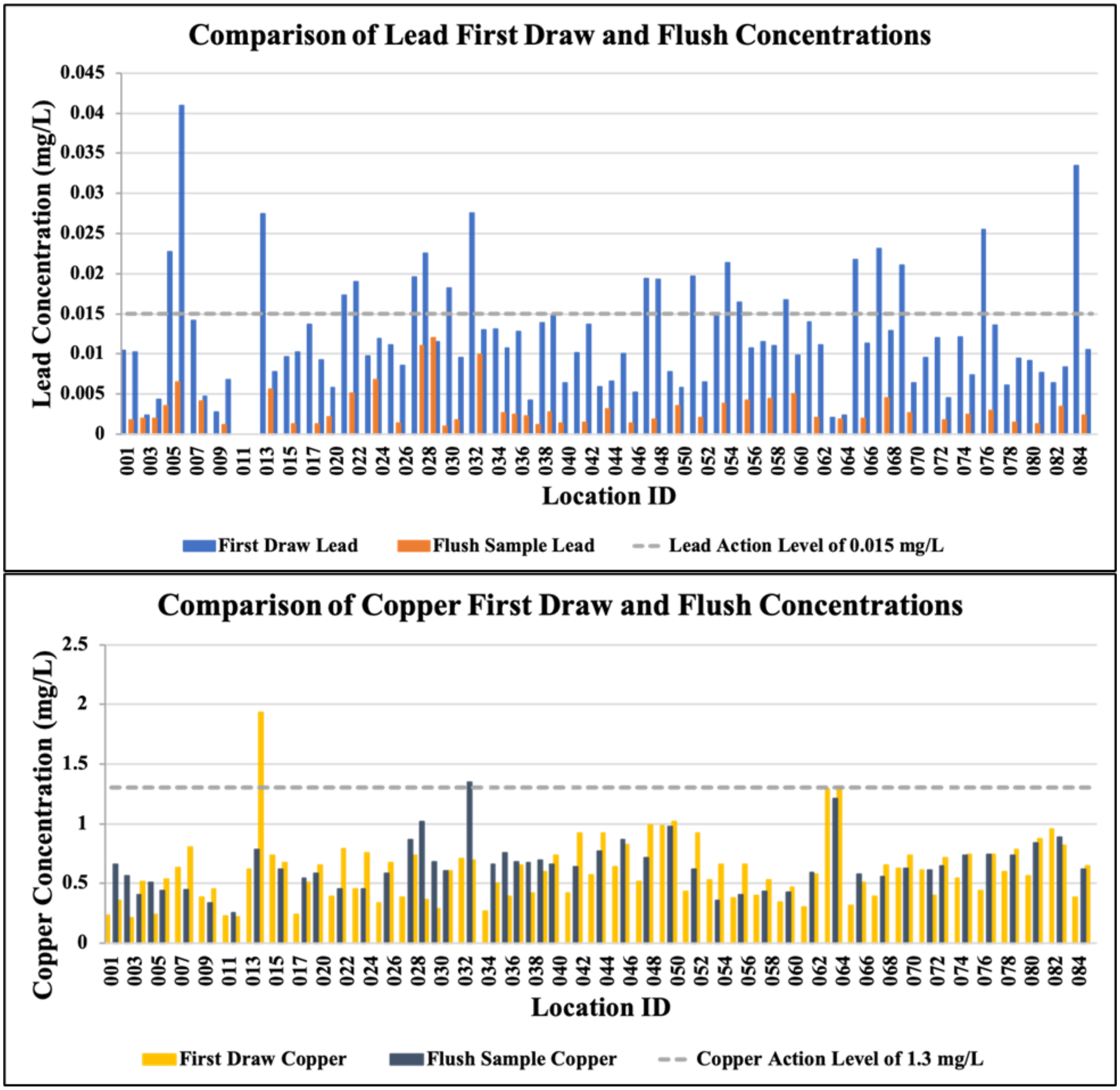


Figure 3.2 Lead (top) and copper (bottom) concentrations by location for first draw and flush samples for an example of school "A"

3.2.2 Influence of Building Age

Data for the year of school construction, or significant upgrade/addition, were obtained for about 800 of the schools sampled. The distribution of the number of schools constructed in each year between 1878 and 2018 is shown in Figure 3.3. Building booms between 1950 and 1980, and from 1995 to 2005, are seen in the data.

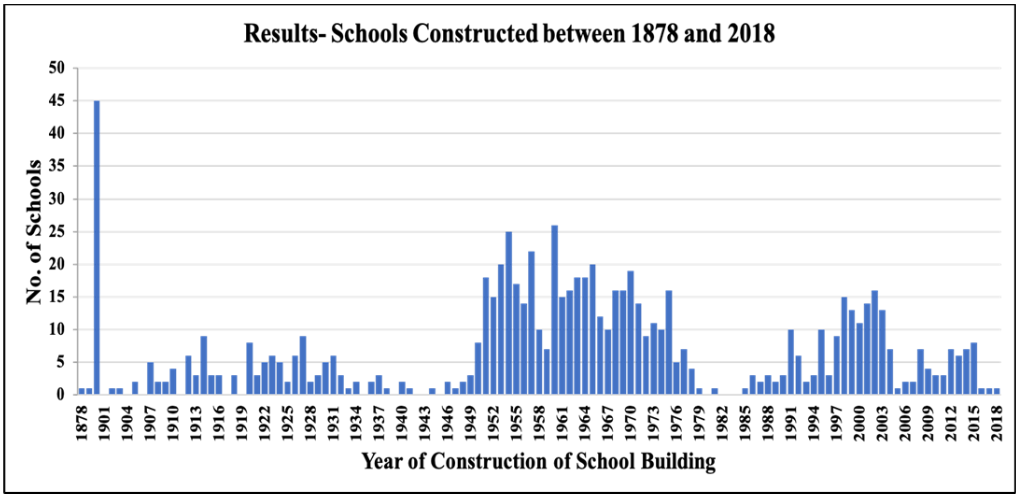
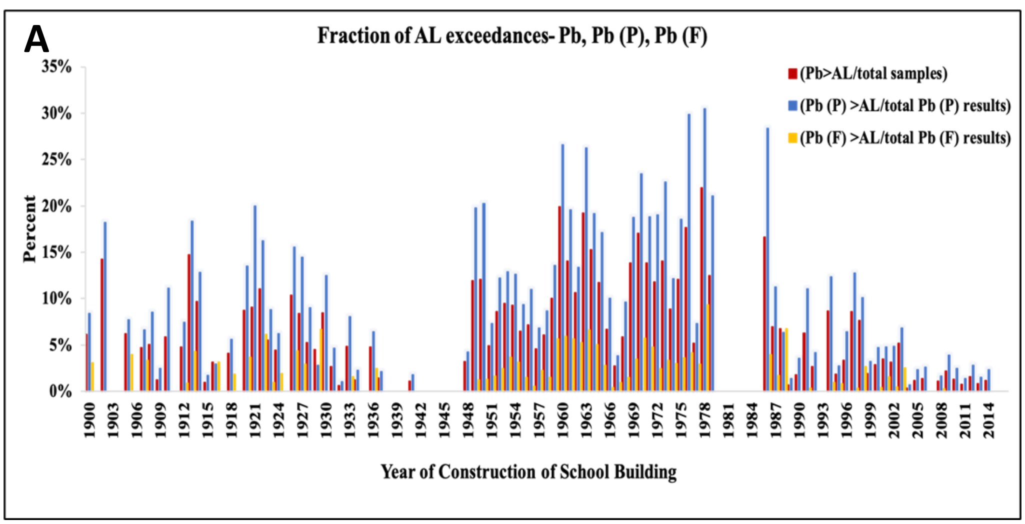


Figure 3.3 Distribution of school construction year.

Figure 3.4 shows the percent of samples from all schools for a particular year that exceeded either 15 ppb for lead (A) or 1.3 ppm for copper (B) for all samples, first draw only samples, and flush only samples. Figure 3.4 A shows a decrease in percentage of samples exceeding the AL for lead over time. This data could suggest a possible beneficial impact on decreasing lead levels of the federal actions to decrease lead in plumbing material (1986) and improve corrosion control treatment via the Lead and Copper Rule (1991). However, additional information regarding upgrades to the plumbing in each building is needed to have a better correlation between building construction year and exceedances. In the case of copper, there is no clear impact of building age on percentage of samples exceeding ALs, as seen in Figure 3.4 B.



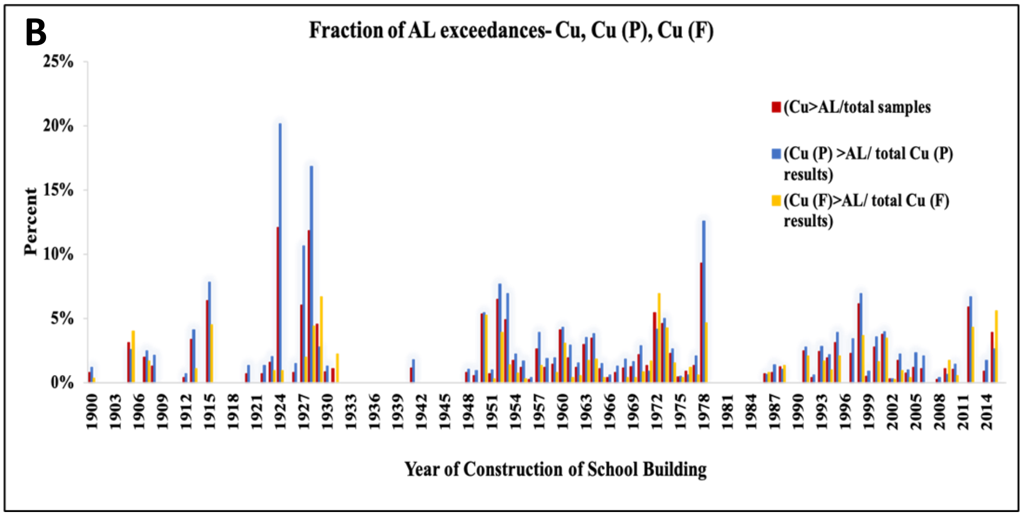


Figure 3.4 Percent of samples exceeding 15 ppb lead (A, top) or 1.3 ppm copper (B, bottom), for overall, first draw, and flush samples, by year of school construction

3.2.2 Distribution of Lead and Copper Levels and Effects of Flushing

As shown in Table 3.1, nearly 68,000 samples were collected during Phase 1 and Phase 2 from the 992 school buildings, averaging 68 samples per building from 40 different sample locations (but the range is large, from 2 to 432 samples and from 1 to 234 locations, per building). It is useful to examine the distribution of sample concentrations for both lead and copper, and to differentiate between first draw and flush samples.

Figure 3.5 shows histograms for percent of samples with lead concentrations in the stated ranges for first draw and for flush samples separately. A line for the cumulative distribution is also shown.

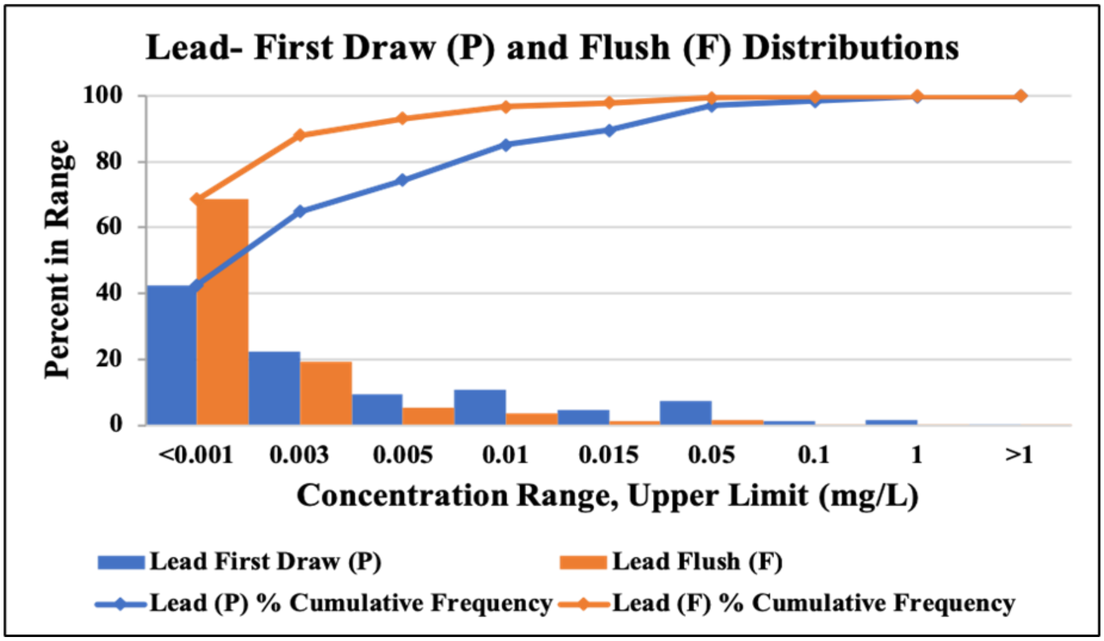


Figure 3.5 Lead concentration distribution, % in range, first draw and flush samples

Figure 3.6 shows the same data but for only three concentration ranges. The results show that 42.4% of first draw samples have lead levels less than 1 ppb and that this increases to 68.5% for flush samples. Also, 47.1% of first draw samples were in the 1 to 15 ppb range with 10.5% greater than 15 ppb. Flushing decreased the fractions in the 1 to 15 ppb and >15 ppb ranges to 29.4% and 2.1%, respectively. The MassDEP goal is for 100% of samples to have lead levels less than or equal to 1 ppb.

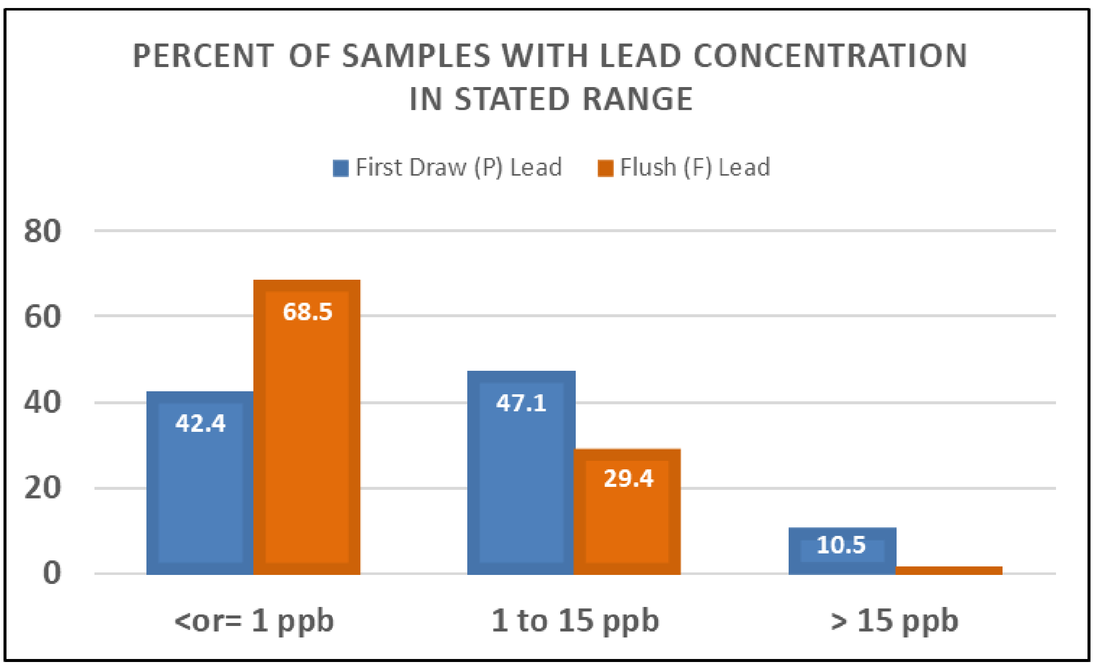


Figure 3.6 Percent of samples in three lead concentration ranges, first draw and flush samples

A similar histogram for the copper results is shown in Figure 3.7. For both first draw and flush samples, the most common concentration range is 0.1 to 0.5 ppm (51 and 43%, respectively). Relatively few samples had copper concentrations that exceeded the copper Action Level of 1.3 ppm, 3.4% for first draw samples and 2.0% for flush samples. Data analysis (not shown) shows no correlation between levels of copper and lead in samples, reflecting the complex interaction between variable plumbing material types and bulk water quality.

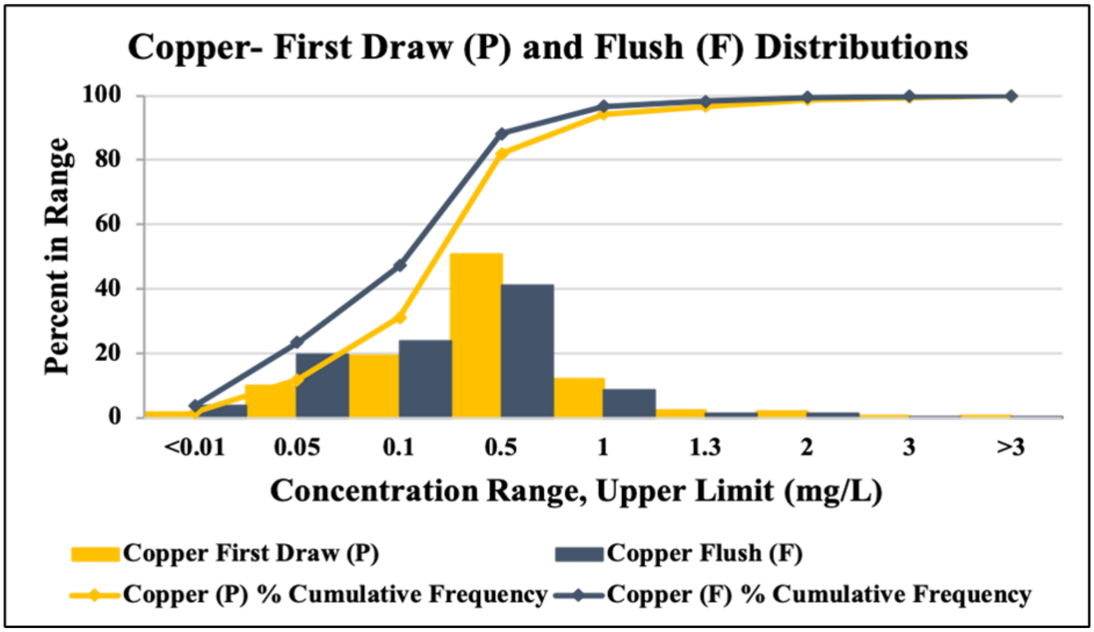


Figure 3.7 Copper concentration distribution, % in range, first draw and flush samples

3.2.3 Fixture Based Results

Figure 3.8 provides fixture-type based analysis of results. The green bars show the Table 3.2 data for percent of all sample locations by fixture type; the classroom faucet (CF, 38%), drinking water bubbler (DW, 30%) and water cooler (WC, 14%) types capture 82% of all fixtures. Figure 3.9 also shows the percent of samples with levels greater than 15 ppb for lead and 1.3 ppm for copper on a fixture basis, for first draw (P) and flush (F) samples separately.

For classroom faucets (CF), 14.6% of first draw lead levels exceeded 15 ppb as compared with the 10% of all first draw samples that exceeded 15 ppb for lead. However, kitchen kettles (KK) and kitchen kettles-hot (KZ, hot) taps had the highest percentages of first draw samples exceeding 15 ppb for lead (27 and 40%), although the number of samples from these fixture types constitute a small fraction of the total samples. Regarding copper results, relatively few samples exceeded the AL of 1.3 ppm. However, the fixture types kitchen kettles, home economics room (EC) and kitchen kettle-hot had much higher percentages of first draw samples exceeding the 1.3 ppm copper AL than was observed for all first draw samples.

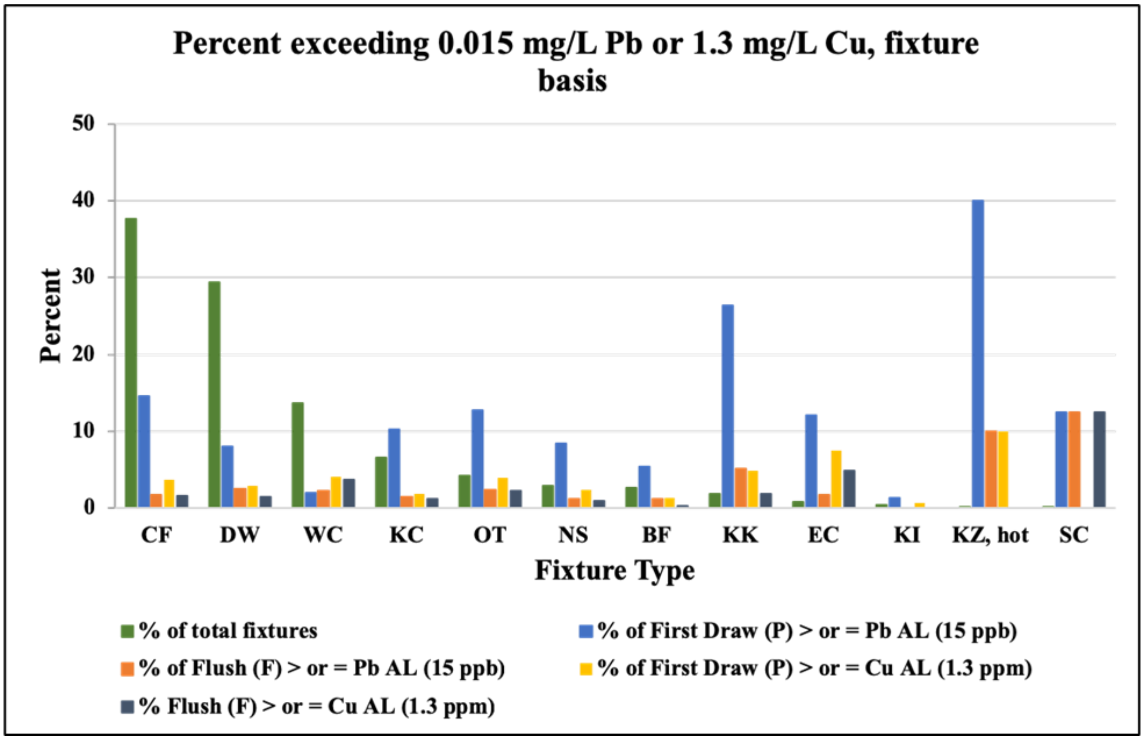


Figure 3.8 Percent of fixture types, and percent of first draw and flush samples exceeding 15 ppb lead or 1.3 ppm copper by fixture type. See Table 3.1 for fixture type definitions.

Overall, the fixture-based results showed that classroom faucets and kitchen fixtures had the highest lead levels in first draw samples. Therefore, for these fixtures, targeted fixture remediation and the implementation of flushing routines is recommended. Water cooler (WC) locations were the third highest percent of sites sampled and results showed that after flushing, there was a slight increase of percent exceeding the AL for Pb and no change for Cu, perhaps reflecting the often significant volume of stored water in a WC.

3.4 Recommendations

MassDEP recommends that schools and childcare facilities follow the extensive guidance available on the MassDEP website. Key components include:

- Conduct sampling and water quality analysis for all drinking water fixtures at least once every three years.
- Discontinue use of fixtures that yield lead levels of 15 ppb or greater.
- For all fixtures that yield lead levels greater than 1 ppb and less than 15 ppb, take remedial action to decrease lead levels to no greater than 1 ppb. Such actions may include;
    - Replacement of plumbing material (fixtures, piping)
    - Installation of fixtures with point-of-use lead removal filters
    - Short-term and temporary improvement of water quality by always flushing a fixture prior to using the water
- Follow MassDEP guidance for flushing of building water systems following periods of building closure prior to consumption of drinking water

4.- List of Informational/Technical Resources

Resource	***URL for Online Location***
MassDEP Assistance Program	https://www.mass.gov/assistance-program-for-lead-in-school-drinking-water
MassDEP Presentation on setting up an LCCA Program for schools	http://leadandcoppercontrolact.donahue-institute.org/LCCA_Framework_4.26.18/story_html5.html
MassDEP Sampling for Lead and Copper at Schools and Childcare Facilities	https://www.mass.gov/guides/sampling-for-lead-and-copper-at-schools-and-childcare-facilities
Informational Meeting Presentation	https://www.mass.gov/doc/informational-meeting-presentation-for-lead-in-school-drinking-water-from-massdep-and-umass/download
LCCA Program Management Tool	https://script.google.com/a/macros/madwpdep.org/s/AKfycbxP99K-Cd5B3ioE7nswn0peOEndcGrXwVk6zJcS5iHxzGO55B1k/exec
MassDEP YouTube video on sampling for lead at Schools/EECFs	https://www.youtube.com/watch?v=Ea7sYV_7oAA&list=PLJn2AKOcYr7lutGJB-UfDKtQPF_o_249m&index=15
MassDEP Follow-Up Steps for Schools and EECF with Lead Detections Over 1 ppb of Copper Results Over the Action Level	https://www.mass.gov/guides/follow-up-steps-for-schools-and-eecf-with-lead-detections-over-1-ppb-or-copper-results-over
MassDEP 3Ts Follow-Up Actions Chart	https://www.mass.gov/doc/lead-in-school-drinking-water-program-3ts-follow-up-actions-chart/download
Lead and Copper in School DW Sampling Results	https://www.mass.gov/service-details/lead-and-copper-in-school-drinking-water-sampling-results
US EPA 3Ts Document	https://www.epa.gov/ground-water-and-drinking-water/3ts-reducing-lead-drinking-water-toolkit
DPH Lead in DW for Schools/EECFs Fact Sheet	https://www.mass.gov/doc/lead-in-drinking-water-for-schools-and-childcare-facilities-english/download