DAY ONE PROJECT

American Rescue Plan Funding: A Playbook for Efficiently Getting the Lead Out

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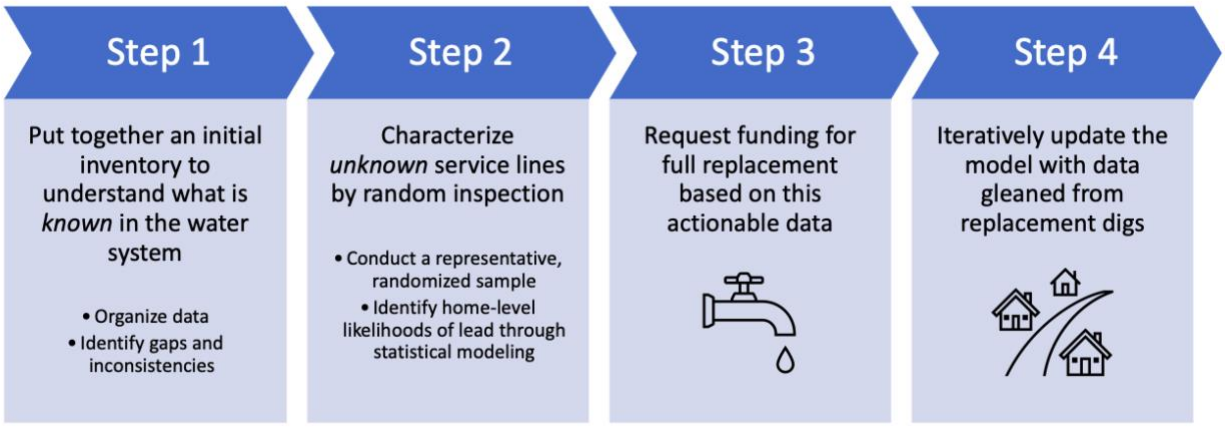
Summary

Lead is a neurotoxin that continues to harm communities across the country. Though new uses of lead in paint, gasoline, and pipes have been banned for several decades, lead in legacy products and materials remains in communities, posing an ongoing threat to human and economic development. Anywhere from 6 to 10 million residential lead service lines (LSLs), for instance, are still in use nationwide.

Funding included in American Rescue Plan (ARP) grant programs gives cities and states the opportunity to finally eradicate lead contamination in water lines. These steps outlined in this memo (and summarized in the figure below) represent a data-driven approach to rid American communities of the pernicious effects of lead contamination in water systems. This approach builds on research from the University of Michigan and subsequent implementation by BlueConduit in more than 50 cities in the United States and Canada.



Challenge and Opportunity

The American Rescue Plan (ARP),[1] passed by Congress on March 6, 2021, infuses $350 billion into the Coronavirus Relief Fund and includes language that explicitly allows states and communities to use these dollars to "make necessary investments in water, sewer, or broadband infrastructure." Lead remediation is specifically referenced as an expenditure category in two places in the Treasury Department's guidance for the use of ARP funds: (1) Services to Disproportionately Impacted Communities and (2) Drinking Water Infrastructure.

One of the greatest barriers to lead service line (LSL) replacement is knowing how many and which pipes need to be replaced. Outdated, missing, or incomplete records mean that many water systems cannot answer these questions. When the state of Michigan asked utilities to submit estimates of service line materials, about 40% of the state's service lines (equivalent to 1 million pipes) were categorized as "unknown." Without reliable information about pipe materials, utilities do not know where to

[1] National Conference of State Legislatures. (2021). American Rescue Plan Act of 2021. March 9.

direct replacement efforts. Utilities often excavate pipes with the intent to replace them, only to discover that a copper pipe was already in the ground. The alternative can also be true: utilities believe that a pipe is made of copper only to discover later that it was made of lead. The only way to verify service line materials with 100% certainty is to visually inspect multiple segments of a pipe, which can cost thousands of dollars for a single pipe and take a significant amount of time. Using a data-driven approach to inventory and locate LSLs will allow utilities to plan and execute efficient service line replacement programs.

Pairing ARP funding with policies and processes aligned with statistical best practices will enable state and local governments to make real progress on tackling persistent, problematic lead contamination in legacy water systems. Leveraging statistical best practices delivers short- and long-term benefits to communities. In the short term, communities will be able to create an actionable service line inventory that meets the requirements of the EPA's Lead and Copper Rule. In the long term, these inventories will become tools to guide efficient replacement programs, track progress toward replacing 100% of LSLs, and communicate progress to residents. Communities that establish, maintain, and continuously update service line inventories will be able to plan and implement future infrastructure projects. Having detailed information on hand about service line materials will allow communities to identify the presence of potentially hazardous materials sooner and initiate mitigation efforts to protect residents' health.

Estimating service line materials among "unknown" service lines requires a representative, uniformly random set of verified data points.[2] Statistically, only such a representative set of verified service points will truly reflect the whole system. This playbook outlines the process for utilities to better understand their service line inventory.

Implementing these approaches is not without challenges. Utilities may be unfamiliar with statistical approaches to service line replacement and/or may lack access to technical expertise needed to implement such approaches. Promoting transparency and shared understanding is critical in securing stakeholder buy-in.

Plan of Action

This section presents a plan of action for pursuing statistically driven LSL replacement. The Biden-Harris administration could provide this plan as guidance to state and local governments considering using ARP funding for remediating lead in water systems. We also emphasize that while this plan is designed and presented in the context of LSL replacement, it could be adapted to other types of remediation efforts, including those intended to achieve lead abatement in paint and soil. The administration could use the plan as the foundation for a broader effort to eliminate lead in American communities, wherever it might be. A federal "Data-Driven Approach for Eradicating

[2] While water systems already have data about the materials, it is critical to understand that that information may not be reflective of the water system. See FAQ for a deeper explanation of the importance of representative data.

Lead" involving a diverse coalition of stakeholders (including water associations, community groups, local universities, and foundations) would raise the profile of legacy lead contamination as a public health issue while simultaneously providing a rational and modern pathway towards a lead-free future for all.

The plan of action is divided into two "Playbooks": one targeted at state and local government, and one targeted at water systems.

Playbook for State and Local Governments

The playbook below comprises a preferred and an alternative approach that state and local governments can take for allocating ARP funding to statistically driven LSL replacement. Regardless of how state and local governments allocate ARP funds, statistically driven approaches to LSL replacement need to be understood to be successful. State and local governments should invest in outreach and engagement campaigns targeted at a variety of stakeholders (e.g., water systems, community residents, foundations, advocacy groups, and policymakers). The purpose of these campaigns is to explain the rationale behind statistically driven LSL replacement, showcase methods, demonstrate benefits, and generally establish credibility and build trust.

Preferred approach: Designate an initial tranche of funding for a pipe inspection grant program, followed by a second tranche to support pipe replacement.

Step 1. Establish a pipe inspection grant program.

This grant program would fund water systems to conduct inspections at a representative (i.e., uniformly random) set of unknown service lines. Most water systems have many service lines of "unknown" material in their inventories. Inspecting a representative set of pipes is the most efficient and cost-effective way for water-system operators to estimate the total number of LSLs in a community. State and local governments can establish pipe inspection grant programs with only a small amount of ARP funding.

An example of such a program is Michigan's recently established Drinking Water Asset Management (DWAM) Grant,[3] which provides funds to water systems for inventorying pipes, setting replacement timelines, and implementing replacement programs. The state has made an initial $36.5 million available through the program, awarding a maximum of $1 million per applicant.

Step 2. Allocate funding to water systems for LSL replacement based on data collected through inspections from Step 1.

LSL replacement will require a larger amount of ARP funding, though the ratio of pipe-inspection costs to pipe-replacement costs will vary depending on the prevalence of

[3] Michigan Department of Environment, Great Lakes, and Energy. (n.d.). Drinking Water Asset Management (DWAM) Grant.

LSLs in a community. For instance, in Flint, MI the cost of pipe inspections was less than 1% of the cost of the community's subsequent LSL replacement program.

If state and local governments cannot allocate ARP funding via the two-part structure described above, they can adopt the following approach.

Alternative approach: Over-allocate ARP funding for LSL replacement but allow excess funds to be used to pursue other ARP priorities.

Step 1. Allocate ARP funding to water systems based on the cost of replacing all unknown service lines and known LSLs.

This approach will almost certainly result in funding over-allocation since many unknown service lines will be revealed to be made of non-lead materials. Water system operators should still conduct representative inspections of unknown service lines prior to initiating any large-scale replacement program.

Step 2. Allow water systems to reallocate excess ARP funds to other allowable uses.

Conducting representative pipe inspections and applying statistical modeling will enable water-system operators to determine how much of the initially allocated ARP funding they actually need to replace problematic service lines. Excess funding could be redirected to other water, sewer, and broadband needs as permitted by the Treasury Department.

Playbook for Water Systems

Because the large amount of infrastructure funding available through the ARP provides a historic opportunity, water system operators need to ensure the greatest return on their investment. This can be achieved by planning budgets and programs based on clear, actionable data. Like the playbook for state and local governments, the playbook for water systems comprises a preferred and an alternative approach to statistically driven LSL replacement. Again, water-system operators should invest in community outreach and stakeholder engagement campaigns regardless of which approach is used. For instance, data on predicted and confirmed LSL locations can be incorporated into address-searchable and interactive online maps that communicate crucial information to affected households and communities. Information on replacement plans and progress can be posted on online dashboards as well. Making LSL data transparent and easily available builds trust and empowers residents to engage productively with water utilities and local government agencies.

Preferred approach: Conduct initial inventory and modeling prior to applying for ARP funding.

Step 1. Assemble an initial inventory to understand what is known in the water system.

This includes organizing existing data and identifying gaps and inconsistencies. Many cities have already done this to meet state regulations or in anticipation of the federal Lead and Copper Rule revisions.

Step 2. Characterize unknown service lines using a statistically driven approach.

As explained in the playbook for state and local governments, water systems should conduct physical inspections at a representative set of unknown service lines to verify pipe materials. Data from the representative inspection can be integrated into a statistical model to predict likely LSL concentration and locations across a water system.

Step 3. Use an actionable inventory to set a budget, create a plan for system-wide LSL replacement, and apply for funding.

This inventory will enable water systems to better estimate how many service lines contain lead, where those lines are located, and how much replacement will cost. Armed with these estimates, water systems can then submit compelling proposals for ARP funding.

Step 4. Iteratively update LSL predictions with data from pipe replacement digs.
Combining data from initial inspection of a representative set of service lines with data from replacement digs enables machine-learning models to improve predictions of LSL number and location over time (Figure 1).

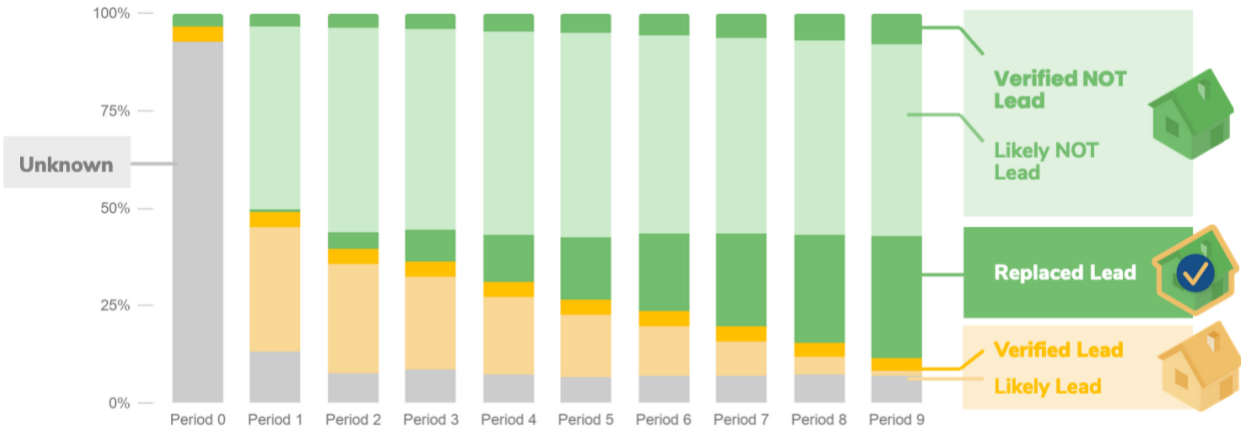


Figure 1. *Illustration of iterative model used to inform LSL replacement.*

If a water system is not able to perform representative inspections and/or build a statistical model of predicted LSL distribution prior to applying for ARP funding, the following approach can be used.

Alternative approach: Request funding to replace all known LSLs and all unknown service lines, but plan to use excess funding to pursue other infrastructure needs.

Step 1. Assemble an inventory of all service lines using existing data.

The existing data will indicate whether each pipe in the system is known to contain lead, known not to contain lead, or is of unknown material. Again, it is likely that there will be a high number of "unknowns".

Step 2. Request funding for replacing all known LSLs and all unknown service lines.

As explained in the playbook for state and local governments, this approach will mean that water system will request funding in excess of what will be needed for replacement. A risk here is that the higher the funding request, the less likely it is to be fully granted.

Step 3. Characterize unknown service lines.

This can be done by combining data from representative inspections with other information about the parcels in the water system. In this approach, though, characterization of unknown service lines begins after ARP funding has already been requested and/or secured.

Step 4. Use excess funding for other ARP priorities.

Once water system operators have collected enough data to be confident in the amount of funding that will be needed to replace all LSLs, excess funding can be reallocated to other water, sewer, and broadband needs as permitted by the Treasury Department.

Frequently Asked Questions

1. What levers can policymakers use to accelerate adoption of statistically driven LSL replacement?

The federal Lead and Copper Rule requires every water system in America to create a service line inventory. State primacy agencies with Safe Drinking Water Act authority have discretion over how they implement this rule. One of the main concerns that utilities have with the revised Lead and Copper Rule is the requirement that every service line be physically inspected in order to determine its material composition. The U.S. Environmental Protection Agency (EPA) and/or state agencies should issue guidance on how government agencies and water-system operators can apply fundamental principles of statistics and data science as an alternative to physically inspecting each service line. Michigan's Department of Environment, Great Lakes, and Energy has already done this.[4] Providing this option would allow agencies and system operators to spend fewer resources on building an inventory and more resources on replacing harmful LSLs.

2. How might the info presented in this memo help cities fulfill requirements that are part of the EPA's Lead and Copper Rule Revisions?

EPA's Lead and Copper Rule Revisions introduce new service line inventory requirements, mandating that every drinking water system develop a service line inventory by 2024. The inventory is a parcel-by-parcel listing of service lines and their material composition. All water utilities must also regularly update their inventories as LSLs are replaced or other service line materials are verified through the course of regular maintenance. The new inventory requirements mark the first time that water utilities have been required to provide this information to regulatory agencies in such a detailed way. The data- collection and -management practices outlined in this memo offer a cost-effective and efficient way for utilities to fulfill these requirements.

3. What other actions can maximize the impact of statistically driven LSL replacement?

Statistically driven LSL replacement can be coupled with community-education effort to reduce resident exposure to lead as much and as quickly as possible. A recent article in *Wired* magazine[5] explains how Toledo, Ohio is marrying these complementary actions.

4. Why are statistical methods needed to find LSLs?

Records of the material composition of water service lines are often missing, inaccurate, or outdated. The uncertainty created by unreliable data makes it difficult for cities and water systems to plan cost-effective LSL replacement programs. Using

[4] Michigan Department of Environment, Great Lakes, and Energy. (n.d.). Complete Distribution System Materials Inventory Overview. Drinking Water and Environmental Health Division.
[5] Fussell, S. (2021). An Algorithm is Helping a Community Detect Lead Pipes. *Wired*, January 14.

statistical best practices, data scientists can design predictive models that determine how likely it is that a given parcel will contain an LSL. Output from these models helps government agencies and water system operators decide where to prioritize pipe replacement efforts without extensive and costly exploratory digs.

5. Why is it essential that utilities gather representative data?

Utilities often have and use data on service line materials from water mains that have recently broken, distribution lines or service lines that have been recently replaced, or places where other construction occurred. Since the proportion of LSLs found at these service points may differ from proportion of LSLs in existence at other service points, these data can yield a substantial under- or over-estimate of the number of LSLs in a water system. Data from a representative (i.e., uniformly random) set of inspections is essential for minimizing bias in LSL predictions.

6. How many homes should a water system inspect to have enough data for reliable predictions?

The number of inspections that should be conducted will vary based on water system size, amount of existing reliable data on service line materials in a water system, the budget available for conducting inspections, and state guidance. State-level guidance in Michigan requires all water systems to inspect service lines at a representative set of homes. Communities with fewer than 1,500 service lines of unknown material are required to inspect 20% of their unknown service lines. In larger communities, the number of inspections that a water system must conduct is capped at 385.

7. How should data on service lines be collected?

Service lines are divided into two sections: (1) the public portion from the water main to the curb box and (2) the private portion from the curb box to the water meter. These portions are often made of different materials, so it is important that material-composition data be collected on both sections. One way to collect comprehensive data is by conducting both a hydrovac inspection at the curb box (to see the private and public side of the service line) as well as an in-home inspection at the water meter (to confirm the composition of the private side).

8. How can data science advance more equitable service line replacement?

One of the keys to an equitable service line replacement program is allocating replacement resources to neighborhoods with the highest LSL concentrations. Best practices from statistics and data science can provide a comprehensive and unbiased picture of the distribution of LSLs in a community, ensuring that resources go where they are most needed. Additional policy interventions that city governments can implement to ensure equity in replacement programs include banning partial service line replacements and ensuring that utilities can pay for replacement of entire service lines (including private portions).

9. What is the biggest obstacle to statistically driven LSL replacement?

The biggest obstacle is simply the fact that most utilities do not have experience with this type of approach and are unfamiliar with the benefits it can provide. Past and existing service line replacement programs have tended to either take a relatively scattershot approach to replacement, and/or precede replacement efforts with large, costly exploratory digs. ARP funding presents an opportunity to expand awareness and use of statistically driven LSL replacement.

10. What are the compliance and reporting responsibilities of cities that receive ARP funding?

The U.S. Department of the Treasury published compliance and reporting guidelines[6] for ARP funding recipients. These guidelines outline recipients' compliance responsibilities, communicate reporting requirements, and recommend best practices where appropriate. The guidelines include lead remediation as an acceptable expenditure category.

11. How could the ARP funding plan of action described above complement funding that may become available for LSL replacement via the bipartisan infrastructure bill currently under discussion?

The Biden administration has called for replacement of 100% of the country's LSLs. The bipartisan infrastructure bill currently being negotiated by Congress includes specific funding for LSL replacement. By dedicating ARP funding to support LSL inventory programs, state and city governments can encourage water systems to use inspection results as part of make more compelling grant applications. Water systems that have already completed service line inventories ahead of the ratification of the infrastructure bill will be best positioned to receive funding for LSL replacement and will be able to remove hazardous LSLs with greater speed and accuracy.

12. What services and providers can states and localities use to conduct data collection and analysis?

Many organizations and companies are ready to support state and local governments in designing and implementing LSL inventory and replacement programs. BlueConduit (the authors of this paper) provides these data services, as do many other consulting firms. Most data-management platforms currently used by cities and states to manage their assets can be adapted to support data collection and analysis.

13. Where can I learn more about statistically driven LSL replacement?

BlueConduit collaborated with the Association of State Drinking Water Administrators (ASDWA) to write an in-depth white paper detailing best practices for using data science to guide LSL replacement.

[6] U.S. Department of the Treasury. (2021). *Compliance and Reporting Guidance: State and Local Fiscal Recovery Funds*. Version 1.1.

About the Authors

Ian Robinson has been the Managing Director of BlueConduit since 2019. He co-authored a white paper with the Association of State Drinking Water Administrators on principles for using statistical modeling in service line inventory and replacement. Ian oversees BlueConduit's efforts in supporting communities in their service line replacement programs. He graduated from the University of Michigan's Ross School of Business and School of Natural Resources and Environment with an MBA/MS, and served as a Peace Corps Volunteer in Ecuador from 2009–2012.

Brig. Gen. (ret.) Michael McDaniel, J.D., MSS, M.A.S.S. is the Director of Government & Customer Relations at BlueConduit. In 2016, Gen. McDaniel was appointed by the Mayor of Flint and the Governor of Michigan to oversee the city's service line replacement program. In 2016–2017, his teams used the output of a statistical machine-learning model to overcome uncertainty around service line materials. During his two years in Flint, Gen. McDaniel's teams replaced more than 6,200 lead service lines. Gen. McDaniel is currently Director of Homeland Security (HS) Law programs at WMU-Cooley Law School. He has focused on critical infrastructure protection and remediation both as Deputy Assistant Secretary for Homeland Defense Strategy, Prevention and Mission Assurance at the Pentagon and as Michigan's first Homeland Security Adviser. Gen. McDaniel is widely recognized as a strong advocate of clean water for all.

BlueConduit

BlueConduit is a water analytics company that has developed cutting-edge, predictive machine-learning methods to resolve uncertainties around service line material composition and empowers local officials with information to enable efficient lead service line (LSL) removal. BlueConduit's model estimates how many service lines are in a system, their material composition, and where they are located, thereby helping government agencies and water system prioritize inventory and replacement projects.

About the Day One Project

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