May 4, 2020

VIA ELECTRONIC MAIL

Dr. Thomas Armitage, Designated Federal Officer, armitage.thomas@epa.gov
Dr. Michael Honeycutt, Chair
Board Members
Science Advisory Board
U.S. Environmental Protection Agency

Re: Comments on the Science Advisory Board's Review of the Environmental Protection Agency's Proposed Revisions to the Lead and Copper Rule

Dear Dr. Armitage, Dr. Honeycutt, and Members of the Science Advisory Board:

We appreciate the opportunity to comment on the Science Advisory Board's ("SAB's") review of the Environmental Protection Agency's ("EPA's") National Primary Drinking Water Regulations: Proposed Lead and Copper Rule Revisions, EPA-HQ-OW-2017-0300 ("Proposed Rule"). The Proposed Rule sets forth proposed revisions to the Lead and Copper Rule ("LCR") of the Safe Drinking Water Act ("SDWA") and is the first significant attempt to revise federal law governing lead in drinking water since 1991.

Earthjustice is a nonprofit environmental law organization that works in partnership with a wide range of community groups and national environmental and health organizations. Earthjustice urges SAB to perform a robust review of the Proposed Rule and to advise EPA where necessary adjustments must be made to ensure the LCR is revised in line with the best available science. The recommendations outlined below are discussed in greater detail in the extensive comments Earthjustice previously submitted on behalf of more than 30 organizations and individuals, *see* Docket No. EPA-HQ-OW-2017-0300-1469, attached hereto as Exhibit A.

Despite substantial scientific data demonstrating both the severe, irreversible impacts of lead exposure and the capacity of water systems to further reduce lead levels, several provisions in the Proposed Rule do not reflect evidence-based improvements. The Proposed Rule comes after years-long calls from public health experts and communities to update the LCR and is unlikely to be revised again in the near future. It is therefore imperative that SAB carefully and critically analyze the Proposed Rule to ensure it reflect scientific developments that have occurred over the span of the nearly three decades since enactment of the original rule.

Earthjustice urges SAB to analyze and advise EPA that the best scientific evidence requires changes to the Proposed Rule in four key areas. First, the evidence compels EPA to establish a Maximum Contaminant Level ("MCL") for lead no greater than 5 µg/L because EPA's previous science-based argument for failing to set an MCL is no longer valid. Second, EPA has no scientific basis to conclude that the agency's proposal to significantly slow the rate of lead service line replacement would preserve or strengthen consumers' current level of health protection. Third, the proposed revisions to the public education component of the LCR fail to

best protect those consumers of lead-contaminated water from the harms associated with drinking it in accordance with scientific evidence. And fourth, the proposed methods for testing for lead in schools and childcare facilities in the Proposed Rule are scientifically unsound.

1) **SAB should advise EPA that scientific evidence requires the agency to set a Maximum Contaminant Level for lead of no greater than 5 µg/L.**

SAB should advise EPA to set an MCL for lead no greater than 5 µg/L.[1] EPA does not have discretion as to whether to set an MCL. Rather, the SDWA prioritizes the setting of an MCL as the mechanism to regulate contaminants of drinking water,[2] and most contaminants regulated under the Act have an MCL.[3] The SDWA requires EPA to set an MCL for a contaminant "to prevent known or anticipated adverse effects on the health of persons"—thus, as close to the Maximum Contaminant Level Goal ("MCLG")—"to the extent feasible."[4] Because there are no safe levels of lead exposure, "the MCLG for lead is zero."[5] Countries around the world recognize that a maximum limit for lead in water should not be greater than 5 µg/L.[6]

SAB should advise EPA that its prior explanation for failing to set an MCL for lead is based on an outdated scientific analysis and conclusion that is no longer accurate.[7] Under the SDWA, EPA may specify a treatment technique, in lieu of an MCL, only if it is not "economically or technologically feasible" to determine the level of the particular contaminant in a public water system.[8] For those reasons, and because the MCLG for lead is zero, it is critical that SAB assess EPA's explanation that an MCL for lead is not feasible. Such an assessment will show that EPA's previous science-based argument as to why a treatment technique would protect the public better than an MCL no longer holds water. Decades ago EPA argued that "requiring public water systems to design and implement custom corrosion control plans for lead will result in optimal treatment of drinking water overall, i.e. treatment that deals adequately with lead without causing public water systems to violate drinking water regulations for other contaminants."[9] Advances since that time show that that assessment no longer holds.

Water quality experts today agree that multiple water quality objectives can be balanced when treating lead-contaminated water, rendering an MCL for lead both feasible and necessary. Indeed, the former Chief of EPA's Lead Task Force for the Agency's Office of Drinking Water

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[1] *See* Earthjustice *et al*., Comments (Exhibit A) 6–7, EPA-HQ-OW-2017-0300-1469.
[2] *See* 42 U.S.C. § 300g-1(b)(4)(B), § 300f(1)(C)(ii), § 300g-1(b)(7)(A).
[3] EPA, How EPA Regulates Drinking Water Contaminants (Last Updated Jan. 27, 2020), https://www.epa.gov/sdwa/how-epa-regulates-drinking-water-contaminants.
[4] 42 U.S.C. § 300g-1(b)(4)(B).
[5] EPA, Ground Water and Drinking Water (Last Updated Nov. 18, 2019), https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water.
[6] *See, e.g.,* Health Canada, Guidelines for Canadian Drinking Water Quality: Guideline Technical Document - Lead, (Mar. 2019), https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-lead/guidance-document.html#a1; European Commission Provisional Agreement on Adopting Proposal for a Revised Drinking Water Directive, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1519210589057&uri=CELEX:52017PC0753.
[7] *See* Exhibit A at 6–7.
[8] 42 U.S.C. § 300f(1)(C)(ii); *Id.* § 300g–1(b)(7)(A).
[9] *Am. Water Works Ass'n v. EPA*, 40 F.3d 1266, 1271 (D.C. Cir. 1994); *see also* Final Rule: Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 56 Fed.Reg. 26,487.

during the proposal and final promulgation of the 1991 LCR now urges EPA to set an MCL, stating that "[g]iven the restrictions on lead in new plumbing, the Agency's rationale in 1991 for rejecting the option to set an MCL at the tap no longer holds today. *As of 2020, it is possible that water systems can be held responsible for the sources of lead contamination in drinking water, specifically, corrosive water interacting with lead service lines.*"[10] Public water systems can also employ a variety of feasible techniques to keep lead levels below 5 µg/L. Such techniques include corrosion control, lead service line replacement, and provision of point-of-use household filters.[11] SAB should assess whether water systems can adhere to a lead MCL while meeting other drinking water standards under the SDWA and advise EPA accordingly.

2) **SAB should advise EPA that no evidence supports or justifies the agency's proposed extended timeline for lead service line replacement**.

SAB should assess how EPA's proposed changes to the lead service line replacement program will affect consumers' level of health protection and advise EPA accordingly. The SDWA forbids EPA from "backsliding" or revising its drinking water standards in a manner that provides weaker protections for public health.[12] The law therefore demands that the best available science demonstrate that EPA's Proposed Rule, if implemented, would be equally or more protective of public health than the current LCR.

SAB should advise EPA that no scientific evidence supports the agency's proposal to *decrease* the lead service line replacement rate following an action level exceedance.[13] EPA fails to propound sound scientific evidence that the agency's proposal to significantly slow the rate of lead service line replacement would provide the same or a greater level of health protection as the current rate.[14]

EPA currently requires water systems to meet an annual lead service line replacement rate of seven percent once they are compelled to replace lead service lines under the LCR.[15] Under the LCR, both partial lead service line replacements and lead service lines that have been 'tested out' can count towards satisfaction of a water system's annual lead service line replacement rate.[16] Lead service lines are 'tested out' when sampling shows lead concentrations at or below 15 µg/L throughout the lead service line.[17]

EPA now proposes to require water systems to annually replace only three percent of lead service lines—a far lower number of annual lead service line replacements than currently required.[18] Under the proposed rule, EPA would appropriately prevent both test outs and partial

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[10] Jeff Cohen, Comment on EPA's Proposed Revisions to the Lead and Copper Rule (Jan 22. 2020) (Attachment 1).
[11] *See generally* 84 Fed. Reg. 61,684 (proposing to require corrosion control treatment, lead service line replacement and provision of point of use devices, variously or simultaneously, to control lead levels in water.)
[12] 42 U.S.C. § 300g-1(b)(9).
[13] *See id.*
[14] *See id.*; *see also* Exhibit A 16–21.
[15] 40 C.F.R. § 141.84(b).
[16] *Id*. § 141.84(c), (d).
[17] *Id.*
[18] *See* 84 Fed. Reg. at 61,767.

lead service line replacements from counting towards satisfaction of a utility's annual lead service line replacement rate.[19]

But EPA fails to show that the agency's appropriate decision to no longer allow test outs and partial lead service line replacements to count towards satisfaction of a utility's annual lead service line replacement rate in conjunction with the proposal's significant slowing of the required rate of lead service line replacement would provide the same or a greater level of health protection as the current program.[20] First, EPA fails to even address the question that EPA is required to answer affirmatively by law: whether EPA's proposed changes would result in *equivalent or stronger protections for public health.*[21] Rather, EPA attempts to (unsuccessfully, as discussed further below) assess only the annual number of full lead service line replacements projected under the current rule versus the Proposed Rule. But to fully assess the effect of lead service line replacement on health, projected lead releases resulting from partial lead service line replacements must be factored in, because partial replacements may provide some health benefits over a long-term time horizon.[22]

Yet EPA has neglected to quantify or project lead releases resulting from partial lead service line replacements. Indeed, EPA admits that it is not feasible to factor such releases in, conceding that SAB "determined that the quality and quantity of data was inadequate to fully evaluate the effectiveness of partial lead service line replacement [PLSLR] in reducing drinking water lead concentrations."[23] As such EPA has not concluded, and would have no basis to conclude, that the agency's proposal to revise the annual rate of replacement downwards would result in equal or greater protections for public health, in accordance with the law.[24] SAB should therefore advise EPA that it is not possible for EPA to conclude that the agency's proposal to extend the timeframe for lead service line replacement will provide the same or greater level of health protection as the current LCR.

Second, even if the partial replacements could be completely discounted with respect to potential health effects—which they cannot—the number of full lead service line replacements the agency projects would be conducted under the current and Proposed Rule is based on flawed data and assumptions. EPA correctly states that "[w]hile the current rule requires seven percent LSLR after a lead ALE, the EPA is aware that compliance is not necessarily achieved by conducting full LSLR."[25] But it then incorrectly claims that "[a] Black and Veach [sic] survey of water systems found that LSLR was comprised of 72 percent partial replacements (USEPA, 2004b)."[26] And based on that inaccurate reading of the Black and Veatch study, EPA claims that its

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[19] *See id*. at 61,699.
[20] *See* 42 U.S.C. § 300g-1(b)(9).
[21] *See id.*
[22] *See* Sci. Advisory Bd., *SAB Evaluation of the Effectiveness of Partial Lead Service Line Replacements* 1–3 (Sept., 2011) (establishing that while partial lead service line replacements can result in significant short-term elevated lead levels, available scientific data is inconclusive as to whether or not partial lead service line replacements reduce blood lead levels over the long term.)
[23] 84 Fed. Reg. at 61,697.
[24] See Declaration of James Bono (Feb. 12, 2020) (Attachment 2) (henceforth "Bono Decl.").
[25] 84 Fed. Reg. at 61,699.
[26] *Id.*

> best professional judgement used in the proposed rule's economic analysis assumes that due to the cost savings of test-outs over LSLR, that 25 percent of CWSs serving more than 10,000 people would take an LSL sample before replacing the LSL, and that 80 percent of LSLs would meet the test-out criteria.[27]

Yet, far from supporting EPA's claims that lead service line replacement is "comprised of 72 percent partial replacements" and that "25 percent" of medium-sized and large water systems "would take an LSL sample before replacing the LSL," the Black and Veatch published survey results *cast doubt on these claims*. For example, EPA claims that the Black and Veatch survey data reflects data compiled from 41 water utilities.[28] But the data is from only *eleven* utilities. As the American Water Works Association ("AWWA"), which commissioned the survey, explained:

> During the fall of 2004, AWWA funded Black & Veatch to conduct a survey of 65 water utilities to document lead service line management strategies and replacement techniques. Forty-one utilities completed the survey. Of the forty-one respondents, eleven provided detailed information on:
>
> • Lead service line inventory and rates of replacement . . .
> • Mandatory lead service line replacement programs . . . [29]

EPA cannot make accurate projections regarding the number of partial replacements currently performed under the LCR based on the published survey data of the eleven responsive utilities. *See* Bono Decl. These eleven water systems represent 0.007 percent of the 151,000 public water systems that EPA lists as regulated in the United States. Eleven is generally considered too small a sample size to guarantee convergence of the estimate. *Id.* ¶¶ 16–18. Moreover, of the eleven utilities that reported usable data, only six "had components of a specifically designed lead service line replacement program."[30] Five utilities were "replacing lead service lines as needed or coincident with another construction project such as main replacement or street paving."[31] This further limits the data's usefulness to EPA since utilities conducting mandatory lead service line replacement under the LCR may have very different replacement practices than those conducting voluntary replacement.The published Black and Veatch survey data also is not known to be unbiased and is susceptible to multiple interpretations. Bono Decl. ¶¶ 19–21.

For all the above reasons and others discussed at pages 16 to 21 of comments by Earthjustice et al. on EPA's proposed revisions to the LCR, SAB should advise EPA that the Black and Veatch survey data cannot be used to support a position that the proposed extended

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[27] *Id.*
[28] EPA, *Economic Analysis for the Proposed Lead and Copper Rule Revisions* 4–26 (Oct. 2019).
[29] Am. Water Works Assoc., Strategies to Obtain Customer Acceptance of Complete Lead Service Line Replacement, 3 (2005) (emphasis added) (Attachment 3).
[30] *Id.*
[31] *Id.*

timeline for lead service line replacement is equal to or more health protective than the current one.

3) SAB should advise EPA that it could better prevent adverse effects on consumers' health by lowering the levels at which EPA proposes to inform consumers of health risks from lead exposure.

Under the SDWA, water systems must "identify and provide notice to persons that may be affected by lead contamination of their drinking water," without restriction, where such lead contamination originates within the water distribution system.[32] Yet the public education component of the Proposed Rule fails to fulfill that requirement. We therefore urge SAB to advise EPA that it must require notification to customers of lead detected in their water supply once *any level of lead* is detected.

EPA recognizes that adequately informing consumers of detrimental levels of lead contaminated water is critical to protecting health. And as EPA has acknowledged, there is no safe level of lead exposure.[33] Thus, to "provide notice to persons that may be affected by lead contamination of their drinking water," as the law requires, consumers must be informed of such harms when at risk—meaning, when consumers are exposed to any level of lead contamination. Yet the Proposed Rule mandates that consumers be informed of health risks from lead exposure *only when* the action level of 15 µg/L is exceeded. The action level is far too high and arbitrary for public education purposes. EPA acknowledges that the 15 µg/L standard is not health-based.[34] Indeed, consumers need useful information in order to take steps to limit their exposure to lead in drinking water, steps that could be the most effective risk reduction approach. Thus, SAB should advise EPA that in order to minimize known or anticipated adverse effects on the health through public education, water systems must be required to notify customers if *any* level of lead is detected in the customer's water supply.[35]

4) SAB should advise EPA that the agency's proposed methods for testing for lead in schools and childcare facilities are not sufficiently rigorous to meet established scientific standards.

SAB should advise EPA that the proposed methods for testing for lead in schools and childcare facilities in the Proposed Rule is scientifically unsound. Indeed, the provisions in the Proposed Rule fall short even of guidance EPA currently issues regarding protecting kids from lead exposure in those facilities. EPA has issued the "*3Ts for Reducing Lead in Drinking Water Toolkit*" ("3Ts Guidance"), which provides guidance to schools and childcare facilities on how to implement a lead in drinking water program.[36]

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[32] 42 U.S.C. §300g-6(a)(2).
[33] EPA, Integrated Science Assessment for Lead. (EPA/600/R-10/075F) (2013).
[34] EPA, Drinking Water Requirements for States and Public Water Systems (last updated Jan 31, 2020) https://www.epa.gov/dwreginfo.
[35] *See* 42 U.S.C. §300g-6(a)(2); Exhibit A at 31.
[36] *See* 84 Fed. Reg. at 61,706

The Proposed Rule fails to follow the best practices set forth in the 3Ts regarding the selection of outlets to be tested. The 3Ts guidance states that*if possible, every outlet used for drinking or cooking should be sampled. At a minimum, every outlet that is regularly used for cooking and drinking should be sampled.*[37] But under the Proposed Rule, community water systems are required to sample as follows:

(i) For schools: Two drinking water fountains, one kitchen faucet used for food or drink preparation, one classroom faucet, and one nurse's office faucet, as available.

(ii) For childcare facilities: One drinking water fountain and one of either a kitchen faucet used for preparation of food or drink or one classroom faucet.

SAB should advise EPA to change the Proposed Rule to require sampling of every outlet in schools and childcare centers used for drinking or cooking in order to minimize adverse health effects from lead-contaminated water. The 3Ts Guidance advises testing all outlets because unlike water that may be delivered via lead service lines into homes, plumbing from multiple sources at a school or childcare facility may contain lead and contribute to elevated lead levels at outlets across a given facility. As the 3Ts Guidance explains, "in addition to lead components in the plumbing system, lead solders or lead in the brass fittings and valves used in some taps, bubblers, and refrigerated water coolers may be sources of lead."[38] The 3Ts Guidance lists a number of examples of sites where lead contamination can occur, including "areas containing lead pipes or lead solder, areas of recent construction and repair in which materials containing lead were used…[and] areas of low flow and/or infrequent use."[39] Thus, the document advises, "[i]t is important to identify the locations of all such drinking water outlets."[40] Given the potential for lead to leach into drinking water from different lead-based fixtures and the varying size and number of drinking water outlets at a given school or childcare facility, the limited sampling protocol set forth in the Proposed Rule is not adequate to protect children and pregnant faculty from lead exposure. SAB should advise EPA to follow its own guidance and require sampling from *all* drinking water outlets within schools and childcare facilities.

SAB should also advise EPA to provide directives on prioritization of facilities to test in order to minimize adverse health effects. Under the Proposed Rule's provisions for testing in schools and day care facilities, some facilities may not be tested at all until 8 years after the rule is enacted, and the order of facilities tested would be completely discretionary.

Impacts from lead exposure are not felt equitably across the population. "[L]ead exposure is not equal for all children," but instead disproportionately impacts low-income and children of color.[41] One reason for such disparity is that "low income, minority communities still face aging

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[37] EPA, 3Ts for Reducing Lead in Drinking Water in Schools and Child Care Facilities: a Training, Testing, and Taking Action Approach (Revised Manual) (Oct. 2018), https://nepis.epa.gov/Exe/ZyPDF.cgi/P100VLI2.PDF?Dockey=P100VLI2.PDF.
[38] *Id.*
[39] *Id.*
[40] *Id.*
[41] Exhibit A at 35; EPA, EJ 2020 Action Agenda: The U.S. EPA's Environmental Justice Strategic Plan for 2016–2020, (May 2016), https://www.epa.gov/sites/production/files/2016-05/documents/052216_ej_2020_strategic_plan_final_0.pdf.

plumbing infrastructure that could contaminate their drinking water…"[42] And children from socioeconomically disadvantaged backgrounds not only have greater exposures to lead, but also suffer greater adversities from the same level of exposure.[43]

There is no clear accounting for the aforementioned health disparities under the Proposed Rule with respect to the time frame by which facilities will be tested. Thus, the order in which schools are tested needs to conform to a methodology that ensures facilities with kids most at risk are tested first. The Proposed Rule would not go into effect for at least three years once finalized, and community water systems will not be required to test some schools for an additional five years after that (based on the 20% annual sampling protocol).[44] As a result, some facilities may not be tested at all until 8 years after the rule is enacted.[45] The Proposed Rule, however, does not provide directives for determining which schools to test first for lead in water contamination.

Minimizing the health effects of lead contamination in children can be achieved only by prioritizing testing of facilities comprised of those children most impacted by lead contamination, and who suffer the greatest adversities from such contamination. SAB should therefore advise EPA to prioritize testing facilities with large numbers of children most at risk for and from lead contamination. More specifically, SAB should advise EPA to revise the Proposed Rule to better protect the testing order from disproportionately impacting low-income and children of color. EPA should require water systems to conduct an 'equity in prioritization' analysis in order to identify and prioritize the schools and childcare facilities that may be at highest risk for lead contamination. The 'equity in prioritization' analysis should focus on those schools and childcare facilities that may service children from environmental justice communities in order to determine appropriate public education and sampling protocols. Examples of factors that should be considered include:

(a.) the age of school or childcare facility;
(b.) the social demographics (e.g. socioeconomic status) of the school, childcare facility, and surrounding neighborhood; and,
(c.) an analysis of drinking water challenges in underserved communities.

* * *

Earthjustice appreciates EPA's and members of SAB's time and consideration of these comments and the comments it previously submitted on behalf of more than 30 organizations and individuals (*see* Exhibit A). For additional information, please contact Mekela Panditharatne at mpanditharatne@earthjustice.org, (203) 824-9794, Michelle Mabson at mmabson@earthjustice.org, (202) 797-5254 or Suzanne Novak at snovak@earthjustice.org, (212) 823-4981.

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[42] *Id*.
[43] Exhibit A at 35–37.
[44] 84 Fed. Reg. 61,684.
[45] Exhibit A at 36.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

National Primary Drinking Water Regulations: Lead and Copper Rule Revisions,

84 Fed. Reg. 69,695 (Dec. 19, 2019)

Comments of: Earthjustice * A Community Voice * Alliance of Nurses for Healthy Environments * Advocates for Children of New Jersey * Ashurst Bar/Smith Community Organization * Emily A. Benfer, Director, Health Justice Advocacy Clinic at Columbia Law School (for identification purposes only) * Buxmont Coalition for Safer Water * Childhood Lead Action Project * Children's Defense Fund – New York * Citizens Coal Council * Citizens for Alternatives to Radioactive Dumping (CARD) * Clean and Healthy New York * Clean Power Lake County * Coalition of Community Organizations * Conservation Law Foundation * Ecology Center * Sara Perl Egendorf * Environmental Health Strategy Center * Faith in Place Action Fund * GreenLatinos * Healthy Gulf * Healthy Schools Network * Huntington Breast Cancer Action Coalition, Inc. * Merrimack Citizens for Clean Water * Newark Water Coalition * Newburgh Clean Water Project * OVEC – The Ohio Valley Environmental Coalition * PolicyLink * Father Philip Schmitter * Sierra Club * St. Francis Prayer Center * Water You Fighting For? * Waterkeeper Alliance * Women's Voices for the Earth

Submitted via Regulations.gov

Docket No. EPA-HQ-OW-2017-0300

February 12, 2020

The undersigned groups and individuals submit these comments on the Environmental Protection Agency's National Primary Drinking Water Regulations: Proposed Lead and Copper Rule Revisions, EPA–HQ–OW–2017–0300. Commenters include individuals and community groups in areas affected by lead in drinking water contamination, and individuals, local organizations, and national organizations advocating for strengthened protections against the risks posed by lead in drinking water.

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INTRODUCTION

Lead exposure is the most significant environmental risk to the U.S. population. Lead is a dangerous neurotoxin for which there is no safe level of exposure. It is especially dangerous for pregnant women, infants, and children. Yet the drinking water for millions of people across the country is delivered through lead pipes, which naturally corrode when water flows through them.

The current Lead and Copper Rule ("LCR") is an important part of the Safe Drinking Water Act ("SDWA" or the "Act"). Yet the LCR is significantly flawed, both as written and implemented. The undersigned appreciate EPA's proposal to significantly overhaul the rule—EPA's first proposed comprehensive revision in decades. The proposal would take some important steps forward. EPA's proposed rule, however, does not go far enough to protect public health. And indeed, in some important aspects, the proposed rule would make the LCR *less* protective of public health than it is now.

The current LCR is a complicated regulatory scheme that does not require action until lead levels are much higher than EPA acknowledges are safe. Yet EPA fails to propose simplifying the scheme by setting a maximum contaminant level, which is feasible, required by the SDWA, and in line with how most contaminants are regulated. The proposal also inexplicably fails to lower the level at which remedial action must be taken.

The importance of replacing all known lead service lines cannot be overstated, since the risk of contamination is present whenever water makes contact with lead plumbing. Yet, the proposed revisions would *decrease* the rate at which lead service lines would need to be replaced. It also would allow some water systems to avoid replacement of lead service lines altogether.

Finally, we commend EPA for including in its proposal lead testing and public education requirements for schools and child care facilities. Children are most vulnerable to the harms from lead exposure and schools and child care facilities often present multiple risks for lead exposure. The proposal, however, fails to follow EPA's own best practices for testing and fails to require any remedial action when testing shows dangerous amounts of lead.

As discussed herein, many aspects of the proposed rule violate the law and/or fail to reduce the risk of exposure to drinking lead-contaminated water for millions of people. We urge EPA to make changes to its proposed revisions of the LCR in order to protect the public from the dangers associated with lead to the maximum extent possible—the directive underlying the Safe Drinking Water Act.

LEGAL STANDARDS

The SDWA directs EPA to set a "maximum contaminant level goal" ("MCLG") for each identified contaminant at a level at which no known adverse health consequences will occur.[1]

[1] 42 U.S.C. § 300g-1(b)(4)(A).

EPA set a MCLG of zero for lead because there is no safe level of lead exposure.[2] The Act requires EPA to set a "maximum contaminant level" ("MCL") for each contaminant as close to the MCLG as feasible.[3] Under the statute, "for the purposes" of establishing MCLs, "feasible" means "feasible with the use of the best technology, treatment techniques and other means which the Administrator finds . . . are available (taking cost into consideration)."[4]

Only if EPA determines that ascertaining the level of a contaminant will be either economically or technologically infeasible—for example, because no adequate testing procedure exists—may the Agency require systems to implement a "treatment technique" instead of an MCL.[5] The Lead and Copper Rule (LCR) is a treatment technique that must, under the Safe Drinking Water Act, "prevent known or anticipated adverse effects on the health of persons to the extent feasible."[6]

EPA must satisfy the SDWA's directive to determine and demonstrate that the revised LCR minimizes adverse health impacts "to the extent feasible."[7] The Act makes clear that any regulatory revision is a promulgation that must satisfy this threshold requirement.[8] The Administrator must also publish "an analysis of the . . . benefits and costs likely to be experienced as the result of compliance" with the standard.[9]

The Safe Drinking Water Act additionally prohibits EPA from "backsliding" or revising the LCR in a manner that would weaken protections for public health.[10] The Agency is therefore prohibited from issuing a standard that provides a lesser level of health protection to residents on the basis of a cost benefit analysis alone.[11]

EPA has no discretion to disregard these unambiguous statutory commands. Indeed, the standards set forth in the Administrative Procedure Act ("APA") apply to courts' review of EPA rules implementing the SDWA. Under the APA, courts must "hold unlawful and set aside" any agency action taken that is "in excess of statutory jurisdiction, authority, or limitations, or short of statutory right."[12]

The APA also prohibits EPA from making "arbitrary and capricious" decisions in promulgating revisions to the LCR.[13] Agency action is "arbitrary and capricious if the agency has relied on factors which Congress has not intended it to consider, entirely failed to consider an

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[2] EPA, Drinking Water Requirements for States and Public Water Systems (last updated Jan. 20, 2020), https://www.epa.gov/dwreginfo.
[3] 42 U.S.C § 300g-1(b)(4)(B).
[4] *Id.* § 300g-1(b)(4)(D).
[5] *Id.* § 300g-1(b)(7)(A).
[6] *Id.*
[7] *Id.*
[8] *Id.* § 300g-1(b)(9) ("Any *revision* of a national primary drinking water regulation *shall be promulgated* in accordance with this section . . .'') (emphasis added).
[9] *Id.* § 300g-1(b)(3)(C)(ii).
[10] 42 U.S.C. § 300g-1(b)(9) (". . . each revision shall maintain, or provide for greater, protection of the health of persons.").
[11] *See City of Waukesha v. EPA*, 320 F.3d 228, 240–41 (D.C. Cir. 2003).
[12] 5 U.S.C. § 706(2)(C).
[13] *Id.* § 706(2)(A).

important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise."[14] Courts "ensure that the EPA has examined the relevant data and has articulated an adequate explanation for its action" when reviewing rulemakings.[15] If EPA changes course from prior regulations, the agency "is obligated to supply a reasoned analysis for the change."[16] When EPA's "new policy rests upon factual findings that contradict those which underlay its prior policy," the agency must provide "a more detailed justification than what would suffice for a new policy created on a blank slate."[17]

I. MAXIMUM CONTAMINANT LEVEL

A. EPA must revise the proposal to set an MCL for lead of no greater than 5 µg/L

EPA must revise its proposal to replace its current approach to reducing lead exposure—that of a treatment technique—with a "maximum contaminant level" (MCL) no greater than 5 µg/L. The SDWA requires EPA to set an MCL for a contaminant "to prevent known or anticipated adverse effects on the health of persons"—thus, as close to the MCLG—"to the extent feasible."[18] Because there are no safe levels of lead exposure, "the MCLG for lead is zero."[19] Countries around the world recognize that a maximum limit for lead in water should not be greater than 5 µg/L.[20]

EPA is not permitted to continue to maintain a treatment technique as its mechanism for protecting the public from lead exposure in drinking water. EPA may specify a treatment technique, in lieu of an MCL, only if it is not "economically or technologically feasible" to determine the level of the particular contaminant in a public water system.[21] Because an MCL for lead is feasible taking into account the best technology, treatment techniques, and other means,[22] EPA may not, and should not, continue to have a treatment technique as its mechanism to protect the public from exposure to lead.

EPA's previous arguments as to why a treatment technique is required in lieu of an MCL do not hold water. Decades ago EPA argued that "requiring public water systems to design and implement custom corrosion control plans for lead will result in optimal treatment of drinking water overall, i.e. treatment that deals adequately with lead without causing public water systems

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[14] *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983).
[15] *Int'l Fabricare Inst. v. EPA*, 972 F.2d 384, 389 (D.C. Cir. 1992) (citations omitted).
[16] *State Farm* at 42.
[17] *FCC v. Fox Television Stations, Inc.*, 556 U.S. 502, 515 (2009).
[18] 42 U.S.C. § 300g-1(b)(4)(B).
[19] EPA, Ground Water and Drinking Water (Last Updated Nov. 18, 2019), https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water.
[20] *See, e.g.*, Health Canada, Guidelines for Canadian Drinking Water Quality: Guideline Technical Document - Lead, (Mar. 2019), https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-lead/guidance-document.html#a1; European Commission Provisional Agreement on adopting Proposal for a Revised Drinking Water Directive, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1519210589057&uri=CELEX:52017PC0753.
[21] 42 U.S.C. § 300f(1)(C)(ii); *Id.* § 300g–1(b)(7)(A).
[22] *See* 42 U.S.C. § 300g–1(b)(4)(D).

to violate drinking water regulations for other contaminants."[23] Advances since that time show that that is not the case. Many water quality engineers today agree that multiple water quality objectives can be balanced. Indeed, the former Chief of EPA's Lead Task Force for the Agency's Office of Drinking Water during the proposal and final promulgation of the 1991 LCR now urges EPA to set an MCL, stating that "[g]iven the restrictions on lead in new plumbing, the Agency's rationale in 1991 for rejecting the option to set an MCL at the tap no longer holds today. *As of 2020, it is possible that water systems can be held responsible for the sources of lead contamination in drinking water, specifically, corrosive water interacting with lead service lines."*[24]Public water systems can also employ a variety of feasible techniques to keep lead levels below 5 µg/L. Such techniques include corrosion control, lead service line replacement, and provision of point-of-use household filters. Both Madison, Wisconsin and Lansing, Michigan entirely replaced aging lead service lines and pipes.[25] EPA's implementation of an MCL could also include provisions by which a variance may be granted, when a specific showing of necessity has been made.

An MCL would also simplify EPA's efforts to protect public health from the risks associated with lead exposure. "The LCR is one of the most complicated drinking water regulations for states and drinking water utilities to implement," and thus to enforce.[26] It is also difficult for the general public to understand. *Id.* at 7.

An MCL would also more effectively protect consumers' health against the risks of severe and irreversible health impacts that can stem from even low-dose exposures to lead in drinking water. The LCR's 90th percentile lead action level, exceedance of which compels utilities to take remedial action to reduce lead levels, fails to correct extreme lead levels in drinking water when those high concentrations taper off at the 89th percentile.[27] The result is that many residents can be served by drinking water with dangerously high levels of lead without utilities being required to mitigate lead levels under the LCR. An at-the-tap MCL would comprehensively address different lead level distributions in the sampling pool by requiring the utility to take corrective action whenever a tap water sample indicates high levels of lead. And unlike an action level exceedance, exceeding the MCL would also cause the system to violate the LCR, which would provide better incentives for systems to proactively reduce lead levels throughout the distribution system.

II. LEAD ACTION LEVEL

A. EPA fails to propose to significantly lower the lead action level in violation of the SDWA.

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[23] *Am. Water Works Ass'n v. EPA*, 40 F.3d 1266, 1271 (D.C. Cir. 1994); *see also* Final Rule: Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 56 Fed.Reg. 26,487.

[24] Jeff Cohen, Comment on EPA's Proposed Revisions to the Lead and Copper Rule (Jan 22. 2020) (attached).

[25] *See* Kathryn Sarver, *Failure at the Faucet: A Proactive and Preventative Approach to Keep Lead Out of Drinking Water*, 51 U. Tol. L. Rev. 147, 167-68 (2019).

[26] *See* White Paper at 3-4, 6, 8, 18**,** https://www.epa.gov/sites/production/files/2016-10/documents/508_lcr_revisions_white_paper_final_10.26.16.pdf.

[27] *See* 40 C.F.R. § 141.80(c).

If EPA does not revise its proposal to implement an MCL—which it is required to do—it must significantly lower the lead action. EPA's failure to propose to significantly lower the lead action level violates EPA's obligation to set standards under the SDWA that reduce adverse impacts on human health "to the extent feasible."[28] The LCR currently has an "action level" of 15 µg/L.[29] The lead action level is a 90th percentile lead level—currently set far too high by EPA at 15 µg/L—exceedance of which compels water systems to take mandatory corrective actions to reduce lead levels in drinking water. That is, when more than 10 percent of tap water samples collected by a water system exceed 15 µg/L of lead, the system must take certain actions to protect residents from lead exposure, including installing and/or re-optimizing corrosion control treatment, replacing lead service lines at an annual replacement rate of seven percent, and conducting additional tap water monitoring for lead.[30]

EPA's lead action level is set too high to adequately protect public health. Indeed, EPA acknowledges that the 15 µg/L standard is not health-based.[31] EPA must lower the action level to at least 5 µg/L because it both will "prevent known or anticipated health affects" on human health and is feasible.[32]

Lowering the action level to 5 µg/L will reduce adverse impacts on human health. *See* Bellinger Decl. ¶¶ 12, 30. Indeed, lead exposure is the most significant environmental risk to the U.S. population. *See, e.g., id.* at ¶ 30. It is particularly dangerous for pregnant women and children. *See, e.g., id.* at ¶¶ 8, 15, 21–27.

Lead is known to cause severe health impacts at low-dose exposures, well below 5 µg/L. A substantial number of published, publicly available and peer-reviewed studies confirm that increases in drinking water lead levels contribute to increased blood lead concentrations and that severe harm to human health occurs at extremely low levels of exposure. Blood lead levels as low as 1 to 2 µg/dL, for example, have shown to be associated with adverse heart, kidney, neurological and reproductive effects.[33] Children with blood lead levels at 3 to 4 µg/dL, have demonstrated reductions in intelligence and increases in adverse attention-related behaviors.[34] Cohorts with average blood lead concentrations at 3 to 5 µg/dL suffer increased systolic blood

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[28] *See* 42 U.S.C. § 300g–1(b)(7)(A).
[29] 40 C.F.R. § 141.80(c)(1).
[30] 40 C.F.R. § 141.43, 141.84, 141.85-6(d)(4)(vi)(B).
[31] U.S. Envt'l Prot. Agency, *Drinking Water Requirements for States and Public Water Systems* (last updated Jan 31); *see also* Bellinger Decl. ¶ 16.
[32] *See* 42 U.S.C. § 300g– 1(b)(7)(A).
[33] *See, e.g.*, S.C. Cho et al., *Effect of Environmental Exposure to Lead And Tobacco Smoke on Inattentive and Hyperactive Symptoms and Neurocognitive Performance in Children*, 51 J. Child Psychol. Psychiatry, 1050–57 (2010); J.T. Nigg et al., *Confirmation and Extension of Association of Blood Lead with Attention-Deficit/Hyperactivity Disorder (ADHD) and ADHD Symptom Domains at Population-Typical Exposure Levels*, 51 J. Child Psychol. Psychiatry 1, 58–65 (2010); M.L. Miranda et al., *The Relationship between Early Childhood Blood Lead Levels and Performance on End-of-Grade Tests*, 115 Envtl. Health Perspectives. 8, 1242–1247 (2007).
[34] *See, e.g.*, R. Nicolescu et al., *Environmental Exposure to Lead, But Not Other Neurotoxic Metals, Relates to Core Elements of ADHD in Romanian Children: Performance and Questionnaire Data*, Envtl. Res.110, 476–483 (2010); J.T. Nigg et al., *Low Blood Lead Levels Associated with Clinically Diagnosed Attention-Deficit/Hyperactivity Disorder and Mediated by Weak Cognitive Control*, 63 *Biol. Psychiatry* 3, 325–341 (2010); B.P. Lanphear et al., *Cognitive Deficits Associated with Blood Lead Concentrations <10 µg/dL in US Children and Adolescents*, 115 Pub. Health Rep., 521–529 (2000).

pressure or risk of hypertension. Blood lead levels below 5 µg/dL also contribute to kidney toxicity, especially in susceptible populations.[35] Because of the severe health risks that extremely low levels of lead pose to children, the American Academy of Pediatrics has called for federal standards that would ensure that "water fountains in schools do not exceed water lead concentrations of more than 1 part per billion."[36]

Setting an action level at 5 µg/L is also "feasible."[37] EPA has previously described the detection level for lead as "close to" 1 µg/L, meaning that available sampling technologies can detect lead concentrations in drinking water at levels below 5 µg/L.[38] Canada, meanwhile, has established a "Maximum Acceptable Standard"—similar to a U.S. Maximum Contaminant Level—for lead at 5 µg/L at the tap, based on the feasibility of implementing such a maximum concentration threshold for water systems.[39]

That many more systems would be required to conduct lead service line replacement [LSLR] under the rule if the action level were lowered to 5 µg/L, at a higher cost than current requirements, is no bar to feasibility. EPA acknowledges that:

> There is widespread support at all levels for upgrading American's water infrastructure, including lead service line replacement. President Trump's 2020 budget proposes significant investment in infrastructure, directing $200 billion for priorities such as water infrastructure . . . EPA Administrator Andrew Wheeler signaled the Agency support of water infrastructure projects and their ability to create jobs, noting that since 2017 the EPA water infrastructure loans have totaled over $2 billion and will create 6,000 jobs . . . The EPA is also aware of many communities and water systems across the country that are choosing to conduct LSLR proactively.[40]

EPA has additionally "identified several types of assistance, such as loans and grants from the federal government or funded by rate revenue, as well as private funding partnerships" for the purposes of conducting full lead service line replacement.[41] Accordingly, to maintain compliance with the SDWA, EPA must lower its action level to 5 µg/L.[42]

EPA effectively concedes in the proposed rule that establishing an action level at 10 µg/L is "feasible" and thus it cannot justify failing to lower the action level to at least 10 µg/L. EPA proposes to introduce a 90th percentile "trigger level" at 10 µg/L, explaining "that meaningful

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[35] E.B. Ekong et al., *Lead-Related Nephrotoxicity: A Review of the Epidemiologic Evidence*, 70 Kidney Int., 2074–2084 (2006).
[36] Am. Acad. of Pediatrics, *With No Amount of Lead Exposure Safe for Children, the American Academy of Pediatrics Calls for Stricter Regulations* (June 20, 2016), https://www.aap.org/en-us/about-the-aap/aap-press-room/Pages/With-No-Amount-of-Lead-Exposure-Safe-for-Children,-American-Academy-of-Pediatrics-Calls-For-Stricter-Regulations.aspx.
[37] *See* 42 U.S.C. § 300g– 1(b)(7)(A).
[38] U.S. Envtl. Prot. Agency, Office of Water, 3Ts: Training, Testing, Taking Action 3 (Oct. 2018), https://www.epa.gov/sites/production/files/2018-09/documents/module_5_3ts_2-step_sampling_protocol_508.pdf (attached).
[39] *See* note 20 *supra* ("The MAC for lead is established based on feasibility rather than only health protection.").
[40] 84 Fed. Reg. at 61,698.
[41] *Id*. at 61,697 (*citing* Strategies for Achieving Full LSLR, docket EPA–HQ– OW–2017–0300).
[42] *See* 42 U.S.C. § 300g-1(b)(7)(A).

reductions in drinking water lead exposure could be achieved by requiring water systems to take a progressive set of certain actions to reduce lead levels at the tap" at that level.[43] Under the proposed rule, medium-sized and large water systems that exceed the trigger level would be required to: 1) install and re-optimize corrosion control treatment, just as systems are required to do under the current rule after exceeding the action level; and, 2) implement a "goal based" lead service line replacement program.[44] But the agency fails to compel water systems at the 10 µg/L threshold of lead detection to take additional feasible steps that would be more health protective, like replacing lead service lines on an enforceable timeline or performing additional lead testing.[45]

To comply with the SDWA, EPA must lower the action level significantly.[46] In failing to propose to lower the action level. EPA tries to evade the SDWA's requirements by asserting that the agency "is not revising the 1991 determination that achieving the action level of 15 µg /L is feasible." But EPA's assertion garbles and distorts the statutory test, which requires protection of public health "to the extent feasible."[47] Whether 15 µg/L is feasible is not at issue. The issue is whether there is a lower level that is more protective of public health that is feasible, which there is. EPA cannot avoid statutory mandates simply by declaring it is refusing to abide by them. EPA's failure to significantly diminish the action level is unlawful.[48]

B. EPA fails to explain declining to propose to lower the action level, in violation of the APA.

EPA violates the APA's prohibition on arbitrary and capricious actions by failing to adequately explain the agency's failure to lower the lead action level to 10 µg/L.[49] When "action involves a change in a settled course of agency behavior," EPA is obligated to "consider reasonably obvious alternative[s] ... and explain its reasons for rejecting alternatives in sufficient detail to permit judicial review."[50] EPA has failed to do so here.

The agency changes course by proposing that a 10 µg/L trigger level exceedance compel some, but not all, requirements that currently do and would continue to follow from a 15 µg/L action level exceedance. And a requirement that a trigger level exceedance compel the full suite of corrective actions following from an action level exceedance is a "reasonably obvious" alternative. But EPA fails to explain why it is not requiring systems with lead levels exceeding 10 µg/L at the 90th percentile to prevent adverse health effects to a fuller extent by, at minimum, meeting the requirements that EPA currently establishes for systems exceeding 15 µg/L at the

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[43] 84 Fed. Reg. at 61,691.
[44] *Id*. at 61,691, 61,756–57.
[45] The goal based lead service line replacement program proposed by EPA to apply to systems exceeding the 10 µg/L trigger level would give near-unfettered discretion to state agencies to approve replacement goals, regardless of weak or inadequate to protect health. *See generally* 84 Fed. Reg. at 61,756–57. And EPA's proposed consequences for failing to meet the 10 µg/L lead service line replacement goal are so tepid that they render the concept of a goal meaningless, flouting the agency's health protection mandate. *See id*. Thus, the required "trigger level" actions cannot meet the standard of protecting health "to the extent feasible." *See* 42 U.S.C. § 300g-1(b)(7)(A).
[46] *See* 42 U.S.C. § 300g– 1(b)(7)(A).
[47] *See id.*; 84 Fed. Reg. at 61,691, 61,756–57.
[48] *See* 42 U.S.C. § 300g-1(b)(7)(A).
[49] *See* 5 U.S.C. § 706(2)(A), (C).
[50] *Pub. Citizen v. Steed*, 733 F.2d 93, 100 (D.C. Cir. 1984).

90th percentile, including mandatory lead service line replacement on an enforceable timeline and reversion to a six-month monitoring cycle.[51]

EPA's failure to articulate any rationale supporting the agency's proposal to promulgate weaker requirements for systems with 90th percentile lead levels falling between 10 and 15 µg/L than for those exceeding 15 µg/L flouts the APA's mandate to conduct reasoned decision-making.[52] EPA does not provide any comparison of the characteristics of systems that have historically exceeded 15 µg/L on the one hand and systems that have historically exceeded 10 µg/L but fallen at or below 15 µg/L at the 90th percentile on the other hand that would justify their disparate treatment under the proposed rule. For example, the agency neglects to show or explain how the systems, as an aggregate group, differ, if they differ at all, in terms of population size, median number of lead service lines, geography, budgetary constraints, history of violations or other potentially salient characteristics sufficient to justify the rule's proposal to apply weaker requirements to systems with 90th percentile lead levels between 10 and 15 µg/L. EPA fails to perform or publish any analysis showing the number and nature of systems with 90th percentile levels between 10 and 15 µg/L. EPA also fails to demonstrate that financial and other barriers to lead service line replacement would be greater for this group of systems than for those exceeding 15 µg/L.[53] EPA's total neglect to address the agency's reason for establishing a two-tier standard for these systems violates the APA's prohibition on arbitrary and capricious decision-making.

III. LEAD SERVICE LINE INVENTORY

A. EPA's failure to require water systems to count the full number of lead service lines within their distribution systems would violate the SDWA.

EPA's proposal to require systems to conduct an incomplete, rather than full, lead service line inventory violates the agency's obligation to set standards that prevent adverse health effects "to the extent feasible,"[54] and undermine the very purpose of mandating an inventory in the first place. Although EPA proposes to mandate that all systems conduct a lead service line inventory, EPA also proposes to give utilities an escape hatch to avoid counting the full number of lead service lines within their distribution systems. EPA's proposed provisions pertaining to the mandatory lead service line inventories provide that:

> Service lines shall be categorized in the following manner: (i) Lead where either the water system portion, customer portion or both portions of the service line are made of lead or where the customer-owned portion is a galvanized pipe where the water system's portion is or was a lead service line. (ii) Non-lead where both the water system portion and customer portion are non-lead. (iii) *Unknown where the service line material is only known to be non-lead on either the water system portion or the customer portion of the service line or the service line material for both portions of the line is unknown.*[55]

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[51] *See* 5 U.S.C. § 706(2)(A), (C); *See also Steed*, 733 F.2d at 100.
[52] *See* 5 U.S.C. § 706(2)(A), (C).
[53] *See* 84 Fed. Reg. at 61,692.
[54] *see* 42 U.S.C. § 300g– 1(b)(7)(A).
[55] 84 Fed. Reg. at 61,755 (emphasis added).

EPA's proposal fails to accomplish its intent. EPA's proposed "unknown" categorization contravenes the SDWA's directive to EPA to promulgate regulations that protect public health "to the extent feasible."[56] Under EPA's proposal, water systems would satisfy EPA's proposed provisions by simply performing a cursory review of plumbing codes, permits and water system records and designating many or all service lines as "unknown."[57]

EPA's arguments as to why rampant categorization as "unknowns" will not occur do not hold water. EPA correctly proposes to require that service lines "listed as unknown in the initial inventory or the updated inventory . . . must be counted as lead service lines for purposes of calculating lead service line replacement rates as well as for issuing targeted public education to consumers served by a lead or unknown service line."[58] EPA suggests that, as a result, water systems will have incentive to collect and add to the inventory "information on the composition of service lines through their normal maintenance activities . . . because doing so would reduce the burden associated with other aspects of the rule"— namely, mandatory lead service replacement and notification to customers served by a lead service line when implementing a replacement program.[59] However, under the current and proposed rule, many systems will *never* be required to conduct mandatory lead service line replacement and would be likely to defer collection of identification information until compelled to do so by law. The water systems would accordingly have little incentive to take proactive steps to determine the location and existence of lead service lines until after a lead action level exceedance.

Under EPA's regulations, many water systems have not identified and inventoried the total number of lead service lines in their distribution systems and many consumers do not have the benefit of knowing whether they are served by a lead service line. As a result, as EPA notes, we do not have a precise national accounting of the number of lead service lines in America, although estimates range from 6.3 million to 9.3 million.[60] Although EPA cites this uncertainty as a reason for propounding the proposed revisions, the uncertainty would continue under EPA's proposed rule.[61]

Updating the rule to require a full, rather than an incomplete, lead service line inventory is essential to "prevent known or anticipated" adverse health effects.[62] As EPA notes, uncertainty regarding national and local estimates of lead service lines has an adverse health impact on consumers in myriad ways, including by hindering the procurement of funding for investment in lead service line replacement and other infrastructure improvements at the local, state and national level:

> Information about the numbers of LSLs in public water systems is critical to supporting various actions focused on reducing exposure to lead in drinking water. For example, the EPA is targeting funding and financing programs such as the Water Infrastructure Improvements for the Nation Act (United States, 2016) grant programs, the Drinking

[56] *See* 42 U.S.C. § 300g– 1(b)(7)(A).
[57] *See* 84 Fed. Reg. at 61,755.
[58] *Id*.
[59] *Id*. at 61,696.
[60] 84 Fed. Reg. at 61,694.
[61] *See id.*
[62] 42 U.S.C. § 300g– 1(b)(7)(A).

Water State Revolving Fund (DWSRF), and the Water Infrastructure Finance and Innovation Act (WIFIA) program to reduce lead exposure through infrastructure projects that include full LSLR. Water systems that have prepared an LSL inventory will be better able to demonstrate their priority for infrastructure financing assistance.[63]

Under the current and proposed rule, systems without knowledge or approximation of the full number of lead service lines in their distribution systems would be left to make initial financing and management decisions around implementing a replacement program without the benefit of knowing precisely how many lead service lines they will need to replace in the first year and over the course of the entire replacement period.

Counting the full number of lead service lines within the distribution system is also "feasible" within the meaning of the Safe Drinking Water Act.[64] Under the current rule, water systems with existing corrosion control treatment are required to "identify the initial number" of lead service lines in their distribution systems after exceeding the action level.[65] The "initial number" of lead service lines is defined as "the number of lead lines in place at the time the replacement program begins."[66] The current rule therefore requires utilities to go beyond merely reviewing plumbing codes, permits and water system records, and to take proactive measures to identify the *full number* of lead service lines in their distribution systems. Similar requirements have been adopted in Michigan, where water systems must submit a complete inventory together with a material verification methodology, including documentation of instances where customers denied access to private property to utility personnel to conduct an inspection of the customer-owned portion of the service line.[67]

To ensure that EPA's standards protect public health "to the extent feasible," EPA must require systems to identify the full number of lead service lines within their distribution systems.[68] EPA should additionally require systems to proactively perform physical inspections of all consumers' residences to identify any lead service lines present prior to completing the initial lead service line inventory. If water systems cannot identify service line materials by physical inspection, systems should certify to the primacy agency the reason for the utility's failure to do so. Imposing such a requirement should not displace utilities' obligation to continue to update lead service line inventories in the ordinary course of the utilities' operations.

B. EPA's failure to require water systems to perform a lead service line inventory within one year would violate the Safe Drinking Water Act.

EPA's proposal to allow water systems to complete and submit initial lead service inventories within three years of final rule publication is insufficiently protective of public health.[69] EPA must require water systems to complete lead service line inventories within one

[63] 84 Fed. Reg. at 61,694.
[64] 42 U.S.C. § 300g– 1(b)(7)(A).
[65] 40 C.F.R. § 141.84 (b)(1).
[66] *Id.*
[67] *See* 84 Fed Reg. at 61,695.
[68] *See* 42 U.S.C. § 300g– 1(b)(7)(A).
[69] *See* 84 Fed. Reg. at 61,755.

year of the final rule's publication, to ensure that the agency's final standards protect the public against "adverse health impacts . . . to the extent feasible."[70]

Conducting an inventory within one year is "feasible" within the meaning of the SDWA. The current rule requires water systems with existing corrosion control treatment to identify the full number of lead service lines in their distribution systems within one year of an action level exceedance.[71] Indeed, under the current rule, systems would in practice need to complete a full lead service line inventory within a few months in order to meet the rule's requirement to replace seven percent of the "initial number" of lead service lines in the distribution within one year of exceeding the action level.[72] Indeed, EPA relies on these very provisions to demonstrate that the agency's proposal is feasible.[73] EPA also notes that several states require water systems to perform lead service line inventories within one year or less and that at least one state has required water systems to fully map lead service lines *in a matter of months.*[74] Thus, EPA's own regulations and state laws demonstrate that it is "feasible" for water systems to conduct a full lead service line inventory with one year of initial rule promulgation.[75]

C. EPA fails to explain its proposal to decline to require water systems to perform a full lead service line inventory within one year, in violation of the APA.

In violation of the APA, EPA provides no adequate explanation for the agency's failure to propose to require water systems to complete and submit a full lead service line inventory within one year of final rule publication.[76] Part of the justification required when "action involves a change in a settled course of agency behavior," is that "the [agency] consider reasonably obvious alternative[s] ... and explain its reasons for rejecting alternatives in sufficient detail to permit judicial review."[77] EPA has failed to do so here. As discussed *infra*, systems are demonstrably capable of doing so— all systems are currently required, in certain circumstances, to count the full number of lead service lines in their distribution systems within a year under the Lead and Copper Rule and have done so in the past.[78] Several states require water systems to perform full lead service line inventories within one year or less.[79] EPA's failure to address or reckon with these obvious alternatives set forth in regulations and laws cited by the agency in its proposal flouts the APA's prohibition on arbitrary and capricious decision-making.[80]

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[70] 42 U.S.C. § 300g-1(b)(7)(A).
[71] 40 C.F.R. § 141.84(b)(1).
[72] *See id.*
[73] *See* 84 Fed. Reg. at 61,695 ("The EPA has determined it is feasible for water systems to prepare LSL inventories because . . . any water system that was required to begin LSLR under the current rule would also have been required to identify the initial number of LSLs in its distribution system at the time the replacement program begins pursuant to § 141.84(b)(1).")
[74] *See* 84 Fed. Reg. at 61,695 (noting that Illinois required CWSs to create LSL inventories within one year and Ohio to do the same within six months.)
[75] 42 U.S.C. § 300g-1(b)(7)(A).
[76] 5 U.S.C. § 706(2)(A), (C).
[77] *See Steed*, 733 F.2d at 100.
[78] *See* 40 C.F.R. § 141.84(b)(1).
[79] *See* 84 Fed. Reg. at 61,695.
[80] See 5 U.S.C. § 706(2)(A), (C).

IV. MANDATORY LEAD SERVICE LINE REPLACEMENT

A. EPA should require all water systems to fully replace lead service lines on an enforceable timeline.

EPA should require all water systems to replace all lead service lines on a mandatory schedule, regardless of lead levels, in order to comply with the SDWA's directive to set standards that will reduce adverse impacts on human health "to the extent feasible."[81] The LCR currently only requires water systems to replace service lines after installing corrosion control treatment and exceeding the lead action level and mandates that systems continue replacing lines for just two consecutive six-month monitoring periods at or below the action level.[82]

As EPA notes, estimates of the number of lead service lines in America range from 6.3 million to 9.3 million.[83] These lead service lines represent grave threats to human health. Indeed, public health experts identify replacing lead service lines as the single most important effort that can be undertaken to reduce lead levels in drinking water.[84] Even when water systems implement and consistently maintain optimal corrosion control treatment, lead service lines can release unsafe levels of lead into drinking water, putting residents at risk of a broad array of serious and irreversible health impacts, including cognitive, neurological and cardiovascular impairment. For example, when trucks drive over pipes or construction occurs overhead, the protective scale formed by the corrosion inhibitor can deteriorate or be displaced, causing unsafe levels of lead to enter water flowing through the distribution system.[85]

Provisions that EPA proposes elsewhere in the proposed rule demonstrate that full lead service line replacement for all, or most, water systems is feasible. EPA's proposed provisions for small water systems, for example, would require systems electing to fully replace lead service lines following a lead action level exceedance to do so within 15 years.[86] These systems would rightly need to continue replacing lead service lines until fully replaced regardless of whether subsequent testing showed them to be at or below the action level.[87]

Other discussion in EPA's proposed rule further bolsters the notion that mandatory lead service line replacement regardless of lead levels is "feasible" within the meaning of the SDWA.[88] In proposing "goal-based" lead service line replacement for water systems exceeding the "trigger level," EPA observes that "since 2017 the EPA water infrastructure loans have totaled over $2 billion and will create 6,000 jobs" and that "many communities and water

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[81] *See* 42 U.S.C. § 300g-1(b)(7)(A).
[82] 40 C.F.R. § 141.81, 141.84.
[83] 84 Fed. Reg. at 61,694.
[84] Pew Charitable Trust, *10 Policies to Prevent and Respond to Childhood Lead Exposure* (Aug. 30, 2017), https://www.pewtrusts.org/en/research-and-analysis/reports/2017/08/10-policies-to-prevent-and-respond-to-childhood-lead-exposure.
[85] Miguel Del Toral et. al, Detection and Evaluation of Elevated Lead Release From Service Lines: A Field Study (July 23, 2013), https://pubs.acs.org/doi/abs/10.1021/es4003636.
[86] 84 Fed. Reg. at 61,769–70.
[87] *Id.*
[88] 42 U.S.C. § 300g-1(b)(7)(A).

systems across the country that are choosing to conduct LSLR proactively."[89] EPA also proposes to require that all water systems create a lead service line replacement plan including a funding strategy identifying how water systems will pay for lead service line replacements through, for example, the "capital improvement fund or the use of a low-interest rate loan" from the federally funded Drinking Water State Revolving Fund.[90] EPA has additionally "identified several types of assistance, such as loans and grants from the federal government or funded by rate revenue, as well as private funding partnerships" for the purposes of conducting full lead service line replacement.[91]

Other provisions also demonstrate that requiring lead service line replacement on a mandatory enforceable schedule is feasible. Existing SDWA provisions would give reprieve to financially distressed systems. To address any concerns that a small number of water systems may not be able to secure financing to fully replace lead service lines, EPA can allow states to grant statutory variances to water systems that demonstrate economic distress and that fully document failed attempts to secure funding for full lead service line replacement through the Drinking Water State Revolving Fund and/or other sources of federal and state funding.[92]

B. EPA's proposal to extend the timeline for replacing lead service lines following an action level exceedance would violate the SDWA.

The SDWA forbids EPA from "backsliding" or revising its drinking water standards in a manner that provides weaker protections for public health.[93] EPA's proposal to decrease the lead service line replacement rate following an action level exceedance would weaken consumers' health protections in violation of the SDWA's anti-backsliding provision.[94]

EPA currently requires water systems to meet an annual lead service line replacement rate of seven percent once they are compelled to replace lead service lines under the LCR.[95] Under the current rule, both partial lead service line replacements and lead service lines that have been 'tested out' can count towards satisfaction of a water system's annual lead service line replacement rate.[96] Lead service lines are tested out when sampling shows lead concentrations at or below 15 μg/L throughout the lead service line.[97] Partial lead service line replacement occurs when the utility replaces only the portion of the lead service line falling on public property.

EPA now proposes to require water systems to annually replace only three percent of lead service lines—a far lower number of annual lead service line replacements than currently required.[98] On its face, EPA's proposal would extend from approximately 15 years to 34 years the time in which full replacement of lead service lines would be complete.

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[89] 84 Fed. Reg. at 61,698.
[90] *Id*. at 61,697.
[91] *Id*. (*citing* Strategies for Achieving Full LSLR, docket EPA–HQ– OW–2017–0300).
[92] *See* 42 U.S.C. § 300g-5.
[93] 42 U.S.C. § 300g-1(b)(9).
[94] *See id.*
[95] 40 C.F.R. § 141.84(b).
[96] *Id*. § 141.84(c), (d).
[97] *Id.*
[98] *See* 84 Fed. Reg. at 61,767.

Under the proposed rule, EPA would appropriately prevent both test outs and partial lead service line replacements from counting towards satisfaction of a utility's annual lead service line replacement rate.[99]

But EPA fails to show that the agency's proposal to significantly slow the rate of lead service line replacement would provide the same or a greater level of health protection as the current rate, as required by the SDWA.[100] Indeed, such a showing cannot be made.

First, the simple comparison of annual full lead service line replacements projected under the current and proposed rule—which relies on flawed data as discussed below—fails to actually address the question that EPA is required to answer affirmatively by law: whether EPA's proposed standard would result in *equivalent or stronger protections for public health.*[101] EPA has neglected to quantify or project lead releases resulting from partial lead service line replacements. *In fact, EPA expressly states that there is no scientific basis to do so.* EPA concedes that EPA's Science Advisory Board (SAB) "determined that the quality and quantity of data was inadequate to fully evaluate the effectiveness of partial lead service line replacement [PLSLR] in reducing drinking water lead concentrations."[102]

As the SAB explained:

> [t]he small number of studies available have major limitations (small number of samples, limited follow-up sampling, lack of information about the sampling data, limited comparability between studies, etc.) for fully evaluating PLSLR efficacy . . . [After short term elevated lead levels in several instances], [a]vailable data suggest that the elevated tap water lead levels tend to then gradually stabilize over time following PLSLR, *sometimes at levels below* and sometimes at levels similar to those observed prior to PLSLR.[103]

As EPA indicates, and the SAB assessment shows, the agency has no valid basis to conclude that, over the long term, partial lead service line replacements provide no health benefits. As such EPA has not concluded, and would have no basis to conclude, that the agency's proposal to revise the annual rate of replacement downwards would result in equal or greater protections for public health, in accordance with § 300g-1(b)(9).

Second, even if the partial replacements could be completely discounted with respect to potential health effects—which they cannot—the number of full lead service line replacements the agency projects would be conducted under the prior and current rule is based on flawed data and assumptions. EPA claims:

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[99] *See id*. at 61,699.
[100] *See* 42 U.S.C. § 300g-1(b)(9).
[101] *See id.*
[102] 84 Fed. Reg. at 61,697.
[103] EPA, Sci Advisory Bd., *SAB Evaluation of the Effectiveness of Partial Lead Service Line Replacements*,1-2 (Sept. 2011).

> While the current rule requires seven percent LSLR after a lead ALE, the EPA is aware that compliance is not necessarily achieved by conducting full LSLR. A Black and Veach survey of water systems found that LSLR was comprised of 72 percent partial replacements (USEPA, 2004b). The EPA best professional judgement used in the proposed rule's economic analysis assumes that due to the cost savings of test-outs over LSLR, that 25 percent of CWSs serving more than 10,000 people would take an LSL sample before replacing the LSL, and that 80 percent of LSLs would meet the test-out criteria.[104]

However, far from supporting EPA's claims that lead service line replacement is "comprised of 72 percent partial replacements" and that "25 percent" of medium-sized and large water systems "would take an LSL sample before replacing the LSL," the Black and Veatch published survey results that cast doubt on these claims. For example, EPA claims that the Black and Veatch survey data reflects data compiled from 41 water utilities.[105] But the American Water Works Association ("AWWA"), which commissioned the survey, states otherwise:

> During the fall of 2004, AWWA funded Black & Veatch to conduct a survey of 65 water utilities to document lead service line management strategies and replacement techniques. Forty-one utilities completed the survey. Of the forty-one respondents, **eleven** provided detailed information on:
>
> • Lead service line inventory and rates of replacement . . .
> • Mandatory lead service line replacement programs . . . [106]

EPA can make no accurate projections based on the published survey data. *See* Bono Decl. The data on which EPA purports to rely apparently reflects information provided by only *eleven* water systems. These eleven water systems represent 0.007 percent of the 151,000 public water systems that EPA lists as regulated in the United States. Eleven is generally considered too small a sample size to guarantee convergence of the estimate. *Id.* ¶ 16-18. The AWWA additionally notes that of the eleven utilities that reported usable data, only six "had components of a specifically designed lead service line replacement program."[107] Five utilities were "replacing lead service lines as needed or coincident with another construction project such as main replacement or street paving."[108] This further limits the data's usefulness to EPA since utilities conducting mandatory lead service line replacement under the LCR may have very different replacement practices than those conducting voluntary replacement. The published Black and Veatch survey data is also not known to be unbiased and is susceptible to multiple interpretations. Bono Decl. ¶ 19-21.

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[104] 84 Fed. Reg. at 61,699.
[105] EPA, *Economic Analysis for the Proposed Lead and Copper Rule Revisions* 4–26 (Oct. 2019).
[106] Am. Water Works Assoc., Strategies to Obtain Customer Acceptance of Complete Lead Service Line Replacement, 3 (2005) (emphasis added) (attached).
[107] Am. Water Works Assoc., *Strategies to Obtain Customer Acceptance of Complete Lead Service Line Replacement*, Appendix B (2005).
[108] *Id.*

EPA also appears to misrepresent the findings of the Black and Veatch survey, potentially overstating the prevalence of partial lead service line replacements for those eleven systems. EPA states that the survey finds that lead service line replacement "was comprised of 72 percent partial replacements."[109] But the published survey data is statistically unreliable. Bono Decl. ¶ 9-21. Even if the data were reliable, the survey's published findings, set forth below, demonstrate that the number of partial lead service line replacements conducted by the eleven reporting water systems may be far lower than EPA claims. *Id.* at ¶ 13.

EPA's proposal to decrease the lead service line replacement rate following an action level exceedance from an annual rate of 7 percent to 3 percent would weaken consumers' health protection in violation of the SDWA's anti-backsliding provision.[110] EPA has failed to show otherwise. While EPA should keep the part of its proposal that disallows partial line replacement and test-outs to count as full service line replacements, it must retain the LCR's required annual replacement rate at seven percent.

[109] 84 Fed. Reg. at 61,699.
[110] *See* 42 U.S.C. § 300g-1(b)(9).

Lead Service Line Inventory and Rates of Replacement

Presented in Table 1 is a summary of the inventory estimates of utility-owned lead service lines in 1992 and 2003 with the corresponding percent reduction attributable to service line replacement. Also provided is a qualifying statement as to the confidence level associated with the accuracy of the estimates. Table 2 presents similar information for customer-owned lead service lines. The utility numbers are consistent for both Tables 1 and 2.

Table 1. Estimated Inventory of Utility-Owned Lead Service Lines

Utility No.	1992 Lead Service Line Inventory	2003 Lead Service Line Inventory	Percent Reduction, %	Confidence in Inventory Estimate
1	36,000	20,000	44	High
2	9,000	3,300	63	Medium - High
3	283,000	280,000	1	Low
4	unknown	0	n/a	Low
5	10	0	100	High
6	0	0	0	High
7	1,000	200	80	Medium
8	unknown	0	n/a	Low
9	unknown	62	n/a	Low
10	7,000	3,100	56	High
11	12,744	11,351	11	Medium

Table 2. Estimated Inventory of Customer-Owned Lead Service Lines

Utility No.	1992 Lead Service Line Inventory	2003 Lead Service Line Inventory	Percent Reduction, %	Confidence in Inventory Estimate
1	36,000	20,000	44	High
2	15,000	5,800	61	Medium - High
3	unknown	unknown	n/a	Low
4	unknown	unknown	n/a	Low
5	1,250	800	36	High
6	unknown	unknown	n/a	Low
7	400	300	25	High
8	unknown	unknown	n/a	Low
9	unknown	unknown	n/a	Low
10	7,750	2,600	66	High
11	5,455	5,227	4	Medium

Source: Am. Water Works Assoc., *Strategies to Obtain Customer Acceptance of Complete Lead Service Line Replacement*, Appendix B (2005).

More recent data, representing the replacement of lead service lines in 2002 and 2003, is presented in Tables 3 and 4, respectively. The utility numbers are consistent for both Tables 3 and 4.

Table 3. Utility and Customer-Owned Lead Service Lines Replaced in 2002

Utility No.	No. of Utility-Owned Lead Service Lines Replaced	No. of Customer-Owned Lead Service Lines Replaced
1	2,000	2,000
2	680	820
3	250	Unknown
4	746	Unknown
5	0	15
6	0	18
7	400	10
8	0	6
9	Unknown	Unknown
10	539	642
11	150	190

Table 4. Utility and Customer-Owned Lead Service Lines Replaced in 2003

Utility No.	No. of Utility-Owned Lead Service Lines Replaced	No. of Customer-Owned Lead Service Lines Replaced
1	2,000	2,000
2	272	375
3	250	0
4	700	0
5	0	10
6	0	20
7	400	10
8	0	6
9	402	75
10	746	700
11	162	193

Of the 11 utilities, 6 had components of a specifically-designed lead service line replacement program. The others replace lead service lines as-needed or coincident with another construction project such as main replacement or street paving.

Source: Am. Water Works Assoc., *Strategies to Obtain Customer Acceptance of Complete Lead Service Line Replacement*, Appendix B (2005).

V. PARTIAL LEAD SERVICE LINE REPLACEMENT

A. EPA should strengthen protections against risks posed by partial replacement to protect public health in the final rule.

EPA should strengthen its proposed provisions pertaining to partial lead service line replacement, consistent with the agency's obligation to set standards that protect public health "to the extent feasible."[111] The SAB notes that "partial lead service line replacement is frequently associated with short-term elevated drinking water lead levels for some period of time after replacement . . ."[112] Minimizing health risks from partial lead service line replacements is critical.

Commenters support EPA's proposal to require water systems to replace the portion of the lead service line falling on public property when customers choose to replace the portion of the line falling on private property.[113] However, EPA wrongly proposes to give water systems "45 days from the day of their notification" to replace the public portion of the lead service line.[114] This would pose unacceptable risks to residents' health given that the SAB has observed the risk of elevated lead levels occurs in the months immediately following a partial lead service line replacement. Indeed, the 45 day delay that EPA proposes would wrongly allow consumers to be exposed to the risk of lead-contaminated water for a large percentage of the time period that the risk of lead exposure appears to be heightened due to partial replacement. Accordingly, EPA should require water systems to replace the public portion of the lead service line within 20 days or fewer, rather than finalizing the 45 day delay that the agency proposes here in order to prevent undue health harms.[115]

Commenters also support, but urge EPA to strengthen, its proposal to discount partial lead service line replacements from counting towards satisfaction of a system's mandatory annual lead service line replacement rate following an action or trigger level exceedance.[116] To protect public health, when systems seek to count full lead service line replacements towards their annual replacement rate, EPA should require that the system demonstrate that the utility has replaced both the public and private portions of the lead service line at or around the same time. This would help to avoid situations where utilities replace each portion of the service line as far as one year apart.[117]

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[111] 42 U.S.C. § 300g-1(b)(7)(A).
[112] Sci. Advisory Bd., *SAB Evaluation of the Effectiveness of Partial Lead Service Line Replacements* 1-3 (Sept. 28, 2011).
[113] 84 Fed. Reg. at 61,756.
[114] *Id.*
[115] *See* 42 U.S.C. § 300g– 1(b)(7)(A).
[116] 84 Fed. Reg. at 61,757.
[117] *See* 42 U.S.C. § 300g– 1(b)(7)(A).

B. EPA neglects to explain the agency's failure to propose a total ban on partial lead service line replace in violation of the APA.

EPA should implement a total ban on partial lead service line replacement in the final rule. EPA provides no adequate explanation for the agency's failure to prohibit partial lead service line replacement in violation of the APA.[118]

EPA's proposal to mitigate the short-term health impacts stemming from partial lead service line replacement is important but insufficient to fully protect public health. The agency proposes to require water systems that conduct partial lead service line replacement to perform "risk mitigation" efforts for several months after partial replacement occurs, including providing customer notification, flushing guidance, a pitcher filter and replacement cartridges to last three months, and additional lead sampling.[119] But these measures may not be effective to prevent harm. Pitcher filters may not be used by residents or may not be properly operated during the months-long period in which risk of heightened lead exposure peaks.

Under the APA, when "action involves a change in a settled course of agency behavior," the agency must "consider reasonably obvious alternative[s] ... and explain its reasons for rejecting alternatives in sufficient detail to permit judicial review."[120] The scientific data demonstrate that fully prohibiting partial lead service line replacement would be the most effective standard to protect public health. According to the SAB, "partial lead service line replacement is frequently associated with short-term elevated drinking water lead levels for some period of time after replacement, suggesting the potential for harm, rather than benefit during that time period."[121] Notwithstanding the SAB's findings—findings that EPA relies on in the proposed rule[122]— EPA fails to explain why the agency does not propose or consider banning partial lead service line replacement outright.[123] This failure violates the APA.

In describing the SAB's literature review, EPA concedes that "partial LSLRs have not been shown to reliably reduce drinking water lead levels and may even increase lead exposure in the short-term of days to months, and potentially even longer."[124] The agency also proposes to prohibit small water systems from conducting partial lead service line replacement when systems elect to replace lead service lines as a flexible compliance option after a lead action level exceedance.[125] And the state of Michigan recently prohibited partial lead service line replacements, indicating that such a blanket prohibition is "feasible."[126] Yet EPA failed to

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[118] *See* 5 U.S.C. § 706(2)(A), (C).
[119] 84 Fed. Reg. at 61,698.
[120] *See Steed*, 733 F.2d at 100.
[121] Sci. Advisory Bd., *SAB Evaluation of the Effectiveness of Partial Lead Service Line Replacements* 1–3 (Sept. 28, 2011).
[122] *See* 84 Fed. Reg. at 61,697.
[123] *See* 5 U.S.C. § 706(2)(A), (C).
[124] 84 Fed. Reg. at 61,697.
[125] *Id.* at 61,770.
[126] Mich. Dep't of Env't, Great Lakes, and Energy, *Partial Lead Service Line Replacement* Guidance, (May 2019*; see* 42 U.S.C. § 300g– 1(b)(7)(A).

"consider" the "obvious alternative" of propounding a total ban on partial lead service line replacements, in violation of the APA.[127]

VI. SMALL WATER SYSTEMS

A. EPA's proposal to weaken health protections for consumers served by small water systems would violate the SDWA.

The proposed rule would implement a suite of alternative compliance requirements for small water systems following a lead action level exceedance. Several of EPA's proposed provisions applying to small water systems would provide a weaker level of health protection to consumers than the level of health protection now guaranteed by the LCR, in violation of the SDWA's anti-backsliding provision.[128] EPA must strengthen these standards as required by law.

Under the current rule, any water system with existing corrosion control treatment exceeding the action level must: 1) replace lead service lines; and 2) re-optimize corrosion control treatment; and, 3) thereafter maintain optimized corrosion control treatment.[129] Any water system exceeding the action without existing corrosion control treatment must install optimal corrosion control treatment. The current rule also mandates all water systems conducting mandatory lead service line replacement to continue to replace lead service lines at an annual rate of seven percent per year until the elapse of two consecutive monitoring periods with 90th percentile lead or below 15 µg/L.[130]

But EPA's proposed rule allows water small water systems that exceed the action level to elect to do just part of what is currently required. For example, under EPA's proposed rule, small systems electing to replace lead service lines would not be required to perform any additional actions to control lead levels after subsequent action level exceedances.[131] These water systems would be excused from implementing and maintaining optimized corrosion control even if they also have copper pipes with lead solder and serve homes with lead-bearing plumbing.[132] This excusal violates EPA's anti-backsliding provision.[133]

EPA also proposes to allow small systems to elect to install and re-optimize corrosion control treatment after an action level exceedance. But EPA proposes to excuse small systems that elect to install corrosion control treatment from conducting lead service line replacement, which is now required along with such treatment after a second-time exceedance.[134] This weaker standard would unlawfully erode important public health protections, violating SDWA's anti-backsliding provision.[135]

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[127] *See Steed*, 733 F.2d at 100.
[128] *See* 42 U.S.C. § 300g-1(b)(9).
[129] 40 C.F.R. § 141.81, 141.84.
[130] *Id*.
[131] *See* 84 Fed. Reg. at 61,700.
[132] *See id*. at 61,770.
[133] *See* 42 U.S.C. § 300g-1(b)(9).
[134] *See* 84 Fed. Reg. at 61,771.
[135] *See* 42 U.S.C. § 300g-1(b)(9).

EPA's proposal would additionally unlawfully authorize small non-transient non-community water systems (NTNCWSs) to fail to take additional action to minimize lead levels even if, after fully replacing lead-bearing plumbing, the systems test with high lead levels in drinking water.[136] The provisions as written would therefore violate the SDWA's prohibition against backsliding.[137]

To rectify these violations, EPA must strengthen its proposed provisions. To avoid unlawful backsliding, EPA must require small systems continuing to exceed the action level after having fully replaced lead service lines to install and maintain optimal corrosion control treatment to control lead release.[138] And in order to optimally protect public health, EPA should also require small systems that sustain a lead action level exceedance while replacing lead service lines to implement a filter installation and maintenance program for at least two consecutive six-month monitoring periods where the systems' 90th percentile lead levels are at or below the action level.[139]

EPA must also require small systems electing to install optimal corrosion control treatment to begin conducting mandatory lead service line replacement after subsequent lead action level exceedances at an annual rate of seven percent per year.[140] EPA should require water systems to conduct full lead service line replacements only, prohibit partial replacements and discontinue the now permitted practice of allowing "test outs" to count under the annual replacement rate.[141] EPA should also require water systems to continue replacing lead service lines for four consecutive monitoring periods where 90th percentile lead levels are at or below the action level or permit water systems to continue fully replace lead service lines until none remain within their distribution systems.

To comply with the SDWA, EPA must require NTNCWSs that sustain a lead action level exceedance during or after replacing lead-bearing plumbing to install and maintain optimal corrosion control treatment to diminish residual lead levels stemming from lead service lines or copper pipes with lead solder remaining in the systems' distribution infrastructure. EPA must additionally require NTNCWSs with lead service lines to conduct mandatory lead service line replacement following subsequent action level exceedances.[142]

B. EPA should strengthen proposed provisions pertaining to small systems' installation and maintenance of POU devices.

EPA proposes that small systems may elect to install and maintain point-of-use devices ("POU devices" or "faucet filters") in lieu of systems implementing optimal corrosion control treatment and replacing lead service lines in their distribution systems.[143] EPA's proposed

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[136] *See* 84 Fed. Reg. at 61,770–71.
[137] *See* 40 C.F.R. § § 300g-1(b)(9).
[138] *See id.*
[139] *See* 84 Fed. Reg. at 61,770–71.
[140] *See* 40 C.F.R. § 300g-1(b)(9).
[141] *See* 84 Fed. Reg. 61,757.
[142] *See* 40 C.F.R. § § 300g-1(b)(9).
[143] 84 Fed. Reg. at 61,770–71.

requirements, however, are insufficiently robust to protect public health under the SDWA.[144] As written, EPA's proposed provisions fail to provide sufficient direction to utilities in how to "maintain" POU devices and ensure that devices are reducing lead levels at the tap. EPA should require systems to implement an adequately protective filter installation, maintenance, education and training program.

EPA proposes to require water systems electing to install and maintain POU devices to provide one certified POU device to each home and to monitor one-third of the POU devices each year within a three-year cycle.[145] EPA's proposed provisions provide that "[t]he POU device must be maintained by the water system to ensure continued effective filtration, including but not limited to changing filter cartridges and resolving any operational issues."[146]

EPA should promulgate more detailed and stringent provisions pertaining to POU device installation and maintenance. Faucet filters need to be properly installed and maintained by consumers to be effective in controlling lead levels. Indeed, faucet filters can and do fail to prevent lead release if residents do not receive proper training in how to operate the device. For example, a utility-implemented filter distribution program in Newark, New Jersey, demonstrates that improperly installed and maintained faucet filters fail to control lead release at the tap, and that such problems may be exacerbated among populations with low English literacy levels and high poverty rates.[147]

Thus, EPA should amend its proposal to require small water systems that elect to provide POU devices to, at minimum:

- Provide at least three POU devices to each household where necessary;
- Carry out household visits to assist residents with faucet filter installation and maintenance;
- Train consumers through active demonstration on how to properly install POU devices and cartridges;
- Provide language-accessible written educational materials to each household served; and
- Perform periodic filter inspection and education visits to ensure that POU devices are properly installed and maintained. [148]

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[144] *See* 40 C.F.R. § 300g-(b)(7)(A); § 300g-1(b)(9).
[145] 84 Fed. Reg. at 61,770.
[146] *Id.*
[147] *See* Elizabeth Thomas, *Newark Handing Out Bottled Water as Filters Appear to Fail to Protect Residents From Lead*, ABC News (Aug. 12, 2019), https://abcnews.go.com/Politics/newark-handing-bottled-water-filters-fail-protect-residents/story?id=64925237; *See also* Kristi Pullen Fedinick, Steve Taylor & Michele Roberts, *Watered Down Justice* (Sept. 2019), https://www.nrdc.org/sites/default/files/watered-down-justice-report.pdf.
[148] *See* Flint consent decree. *See* Consent Decree, Concerned Pastors for Social Action, et al. v. Khouri, et al., Case No. 2:16-cv-10277 (Mar. 27, 2017), https://www.nrdc.org/sites/default/files/flint-drinking-water-lawsuit-settlement-agreement-20170327.pdf (attached).

VII. OPTIMAL CORROSION CONTROL TREATMENT DEFINITION

A. EPA's proposal to change the definition of optimal corrosion control treatment from treatment that "minimizes" lead levels at users' taps to treatment that is effective at reducing lead levels to 10 µg/L violates the SDWA.

EPA's proposal to let systems off the hook from consistently reducing lead levels in drinking water by changing the definition of optimal corrosion control treatment from treatment that "minimizes" lead levels at users' taps to treatment that is effective at reducing lead levels to 10 µg/L only would weaken protections for public health in violation of the Act's anti-backsliding provision.[149] The LCR currently has several strong mandates to minimize lead levels to the furthest extent possible. The rule defines optimal corrosion control treatment as the treatment that "minimizes" lead concentrations, and "reduce[s] lead levels in drinking water to the *maximum extent feasible*."[150] Systems are tasked at all times with evaluating whether a system may "reduce lead levels even when 90 percent of tap samples are below 0.015 mg/L" by using "sophisticated treatment manipulations that might further reduce lead levels."[151] In order to ensure maximally effective lead reduction, systems must "install," and "continue to operate and maintain optimal corrosion control treatment."[152] All water systems with existing corrosion control treatment must also continuously "maintain corrosion control and mitigate the leaching of lead into the water system from lead water pipes."[153] These obligations secure important protection for public health.

EPA's new proposal, on the other hand, would erase systems' responsibility to continually reduce lead levels to the "maximum extent feasible," winding back protections guaranteed under the current rule.[154] More specifically, the proposed rule states that:

> A small or medium-size water system is deemed to have optimized corrosion control if the water system does not exceed the lead trigger level and copper action level during two consecutive 6-month monitoring periods conducted in accordance with § 141.86(b) and (d)(i) or does not exceed the lead trigger level and copper action level in monitoring conducted in accordance with § 141.86(b) and (d)(ii)(C) or (D). A small or medium-size water system is deemed to have reoptimized corrosion control if the water system does not exceed the lead trigger level and copper action level during two consecutive 6-month monitoring periods conducted in accordance with § 141.86.[155]

Thus, EPA's proposal to revise the definition of optimal corrosion control treatment would let systems off the hook from reducing 90th percentile lead levels below the 10 µg/L threshold and provide a lower level of health protection to consumers, in violation of the Safe

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[149] *See* 42 U.S.C. § 300g-1(b)(9).
[150] 40 C.F.R. § 141.82; 56 Fed. Reg. 26,460, 491 (June 7, 1991) (emphasis added).
[151] 56 Fed. Reg. at 26,492.
[152] 40 C.F.R. § 141.80(d)(1); 40 C.F.R. § 141.82(g); *see also Concerned Pastors*, 217 F. Supp. 3d 960, 964 (E.D. Mich. 2016).
[153] *Concerned Pastors* at 964; *see also* 40 C.F.R. §§ 141.81–.82(g).
[154] *See* 40 C.F.R. § 141.82; 56 Fed. Reg. at 26,491.
[155] 84 Fed. Reg. at 61,747.

Drinking Water Act.[156] EPA must clarify in the final rule that maintaining optimal corrosion control treatment under the rule requires water systems to minimize lead levels, even where lead levels fall below 10 μg/L at the 90th percentile and must eliminate any proposed provisions that state otherwise. Failing to do so would be unlawful.[157]

VIII. LEAD MONITORING

A. EPA should finalize and strengthen improvements to the Lead and Copper Rule's monitoring requirements.

EPA proposes, and should finalize, important improvements to the LCR's monitoring provisions. However, EPA must further strengthen the monitoring requirements to both ensure accurate lead detection and compel prompt, mandatory corrective action after high lead levels in drinking water are detected.

Commenters support EPA's proposal to mandate prioritizing lead sampling at sites with lead service lines rather than sites with copper pipes with lead solder because the best available science indicates that lead service lines are at the highest risk of releasing elevated levels of lead. Under the LCR, systems' 90th percentile lead levels— garnered from the sampling sites in the system's pool— determine whether systems must perform an array of corrective actions to reduce lead levels at the tap. It is therefore critical that the sampling pool consist of sampling sites at greatest risk of releasing elevated levels of lead; otherwise, serious lead contamination problems may go wholly undetected.

EPA's proposal rightly revisits the current rule's prioritization of sample sites for detecting elevated lead levels. The current LCR has a tiered system for prioritizing the selection of sampling sites, which was based on the apparent likelihood of the sites to release elevated levels of lead at the time of the rule's initial promulgation several decades ago.[158] The current definitions of Tier 1 and Tier 2 sites comprise both lead pipes and copper pipes with lead solder.[159] Tier 3 sites are at lower risk of lead leaching.[160]

EPA proposes that Tier 1 and Tier 2 sampling sites now be comprised entirely of lead service lines and that Tier 3 sites comprise of single family structures that "contain copper pipes with lead solder installed before the effective date of the applicable State's lead ban."[161] EPA explains that the agency is:

> basing its current proposal to revise the tiering criteria for lead solder on the increased understanding of corrosion mechanisms and sources of lead, in particular, lead from solder. . . . Additionally, given that it has been over 30 years since lead solder was banned in all jurisdictions, and considering lead solder's ability to leach lead is reduced

[156] *See* 40 U.S.C. § 300g-1(b)(9).
[157] *See id.*
[158] *See* 40 C.F.R. § 141.86.
[159] *Id.*
[160] *Id.*
[161] 84 Fed. Reg. at 61,703.

by age (USEPA, 1990), lead levels in samples collected from sites containing copper pipe with lead solder installed between 1983 and 1988 no longer present as significant a source of lead as assumed in 1991.[162]

The agency should finalize this proposed revision.

It is also important that EPA ensure that sampling is as accurate as can be. While the proposed rule takes some steps to improve sampling, it does not go far enough. Currently, water samplers often engage in practices such as pre-stagnation flushing and the removal or cleaning of faucet aerators prior to collecting lead samples that mask or dilute tested lead concentrations by removing particulate lead that consumers would ordinarily be exposed to in the course of daily life.[163] Indeed, many water systems distribute sampling instructions that suggest taking such actions prior to sampling.[164] These practices are inconsistent with the LCR's sampling regulations, which provide mandatory practices for sampling, including requiring "[e]ach first-draw tap sample. . . [to] have stood motionless in the plumbing system of each sampling site for at least six hours."[165] They are also inconsistent with the purpose of the sampling.

EPA rightly proposes to prohibit sampling instructions that call for pre-stagnation flushing and the removal or cleaning of faucet aerators prior to collecting lead samples.[166] EPA does not, however, prohibit these sampling practices outright. It should. EPA should issue an express requirement that tap samples be drawn from outlets that remained unflushed immediately prior to the water stagnation period and that faucet aerators remain untouched prior to testing. This express requirement would result in systems facing the possibility of incurring violations for documented sampling errors, and thus provide incentives for them to adequately train residents and utility personnel to fully comply with utility instructions.

Finally, EPA should require more frequent testing for all or the vast majority of water systems. EPA should eliminate reduced monitoring "triennial" cycles currently permitted under the rule for many water systems. Lead levels are highly variable.[167] But the LCR's monitoring regulations do not account for this variability. Under the current rule, small and medium-sized water systems can reduce their sampling frequency to three-year monitoring cycles after meeting the LCR action levels during two consecutive six-month sampling periods.[168] Large water systems similarly may reduce their sampling frequency to triennial monitoring cycles after meeting the action level for two consecutive six-month monitoring cycles and maintaining the range of designated values for optimal water quality parameters.[169]

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[162] *Id*.
[163] *See* EPA, Peter C. Gravatt, *Memorandum: Clarification of Recommended Tap Sampling Procedures for Purposes of the Lead and Copper Rule* (Feb. 29, 2016) https://www.epa.gov/sites/production/files/2016-02/documents/epa_lcr_sampling_memorandum_dated_february_29_2016_508.pdf.
[164] *See* id.
[165] 40 C.F.R. § 141.86(b).
[166] 84 Fed. Reg. at 61,766.
[167] *See* S. Masters et al., *Seasonal Variations in Lead Release to Potable Water*, 50 Envtl. Sci. Tech. 10 (May 17, 2016).
[168] 40 C.F.R. § 141.81.
[169] *Id*.

These reduced-frequency sampling periods pose unacceptable risks to residents. In cities such as Newark, astronomical levels of lead have gone unnoticed and unchecked for years on end because systems only report an exceedance of the lead action level to the state at the completion of the three-year monitoring period, even if alarmingly high levels of lead were detected in the first year.[170] Because of the established science on lead variability in drinking water and the risk to communities that prolonged monitoring periods pose, EPA should remove the rule's provisions that allow for reduced, three-year monitoring cycles. If EPA declines to fully eliminate triennial sampling cycles, EPA should significantly diminish the number of systems eligible for reduced three-year monitoring by imposing more stringent requirements for eligibility.

IX. EMERGENCY BOTTLED WATER AND FILTER PROVISION

A. EPA should require systems to provide bottled water and POU devices to all affected residents where lead levels reach extreme highs.

To protect public health, EPA should compel water systems to provide bottled water and POU devices to all affected residents in circumstances where systems' reported 90th percentile lead levels reach extreme highs. Bottled water and POU devices are critical to protect public health in such circumstances because it can take a long time for corrective action to take effect. Replacing lead service lines occurs over a protracted timeframe, often lasting many years. Similarly, optimizing corrosion control treatment is a process "that may take several months or even years."[171]

The SDWA provides strong support for such action. It authorizes the EPA Administrator to take action necessary to protect the public's health from an imminent and substantial endangerment created by contaminants in a public water system, including issuing orders regarding the provision of alternative water supplies where local and state authorities have failed to adequately act.[172] The Act's legislative history confirms that Congress intended "to confer completely adequate authority to deal promptly and effectively with emergency situations which jeopardize the health of persons" using public water systems.[173]

Indeed, EPA currently authorizes such relief under different circumstances. The LCR authorizes states to compel systems to provide bottled water and POU devices to all residents when states grant water systems temporary exemptions from a regulatory standard under the SDWA due to hardship and the exemption would otherwise pose "an unreasonable risk to

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[170] *See* Marisa Iati, *Toxic Lead, Scared Parents and Simmering Anger: A Month Inside a City Without Clean Water*, the Washington Post, (2019).
[171] *See, e.g.*, 56 Fed. Reg. 26,460, 26,473; U.S. EPA, *OCCT Evaluation and Technical Recommendations for Primacy Agencies and Public Water Systems* (*EPA OCCT Guidance*) 47 (Mar. 2016) ("The amount of time needed for the initial passivation dose to form adequate scale is unknown, and will vary depending on the system's specific water quality. . .").
[172] *See* 42 U.S.C. § 300i (a).
[173] H.R.Rep. No. 93-1185 (1974), reprinted in 1974 U.S.C.C.A.N. 6454, 6487.

health."[174] EPA should revise its proposal to similarly require bottled water and POU devices to be provided to residents when reported 90th percentile lead levels reach extreme highs.

X. IMPROVING RISK COMMUNICATION TO CUSTOMERS

Commenters support EPA's efforts in the Proposed Rule to increase public education to help realize the purposes of the LCR. Some of those efforts, however, need to be strengthened. The purpose of the public education improvements set forth in the Proposed Rule is to "inform consumers that the water system has exceeded the action level, provide information about the health effects of lead, the sources of lead in drinking water, actions consumers can take to reduce exposure, and explain why there are elevated levels of lead and actions the water system is taking."[175] Public education is also intended to raise awareness such that "consumers may take actions to reduce exposure to lead."[176]

Commenters support the proposed provisions to increase the frequency of communication, such as requiring customers to be notified within 24 hours when tap sample results exceed the 15 µg/L action level and requiring community water systems to notify customers and provide educational materials if water-related work is being conducted that could disturb existing lead service lines. The Proposed Rule, however, fails to mandate that such notifications be triggered when they need to be. EPA recognizes that "no safe level of lead exposure has been identified.[177] Yet EPA is proposing to inform consumers of health risks from lead exposure *only when* the action level of 15 µg/L is exceeded. The action level is far too high and arbitrary for public education purposes. Commenters thus strongly urge EPA to require water systems to notify customers if *any* level of lead is detected in line with its duty under the SDWA to minimize adverse health impacts "to the extent feasible."[178]

EPA must, at the very least, revise the Proposed Rule to make public education requirements prompted at the 10 µg/L trigger level. EPA admits that "…the lead action level [was established] in 1991 based on feasibility and not based on impact on public health. The proposed trigger level [of 10 µg/L] is also not a health based standard… The EPA proposes that *10 µg/L is a reasonable threshold to require [a] water system to undertake actions*."[179] But EPA does not propose that public education actions take place even at the trigger level. It should.

Commenters support the updated health effects language and updated information on lead service line replacement programs that would be required to be included in public education materials. But additional information should also be included. Water systems should be required to recommend steps a customer can take (e.g. install a water filter) to reduce lead exposure, while also explicit explaining that lead *cannot* be removed by boiling water. Such

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[174] 42 U.S.C. § 300 g-5; 40 C.F.R. § 142.57, § 142.62(f)-(h) (holding systems responsible in such circumstances for providing bottled water in "sufficient quantities" to "every person supplied by the public water system" via door-to-door delivery); *id.* § 142.62(h)(1), (6) (systems have "responsibility" to "operate and maintain" POU devices including by ensuring that all devices are "properly installed, maintained, and monitored").
[175] 84 Fed. Reg. at 61,701.
[176] *Id*.
[177] EPA, Integrated Science Assessment for Lead. (EPA/600/R-10/075F) (2013).
[178] *See* 42 U.S.C. § 300-1(b)(4)(B).
[179] *See* 84 Fed. Reg. at 61,691.

information can help better inform customers of their options and help them avoid taking the wrong steps—like boiling water—which has alarmingly been cited as an action customers have taken when informed of lead contamination in drinking water.[180] The proposed rule should also require water systems to include the contact information for the local health department (specifically, the health department the water system is required to conduct annual outreach to) as a way to inform customers where they can seek additional health information and assistance if concerned about lead exposure and health harms. Michigan's Lead and Copper Rule requires the inclusion of such language.[181] Public education materials should also include a link to EPA's website which can provide consumers with important and reliable information about lead in drinking water.

EPA should further require water systems to provide public education materials in appropriate language or languages based on the predominantly spoken language in that service area. For example, Michigan's Lead and Copper Rule requires public water suppliers "serving communities that have more than 10% non-English speaking customers" to provide "public education materials…in the appropriate language."[182]

Commenters support the Proposed Rule's increased public education requirements for homeowners, schools and child care facilities as a means to improve public awareness. The Proposed Rule, however, does not go far enough to provide risk communication that would drive a reduction in lead exposure—especially for pregnant women, formula-fed infants, and children who may be present in the household. The Proposed Rule should mandate dissemination of public education materials to sites where potentially vulnerable populations (e.g. children, pregnant women) frequent, such as community centers and libraries.

Commenters support the requirement for water systems to conduct annual outreach to state and local health agencies, healthcare providers, and caregivers to explain the sources of lead in drinking water, the health effects of lead, and to explore collaborative efforts. EPA should incorporate additional actions, however, to ensure that such outreach to the state and local health departments would result in to increased public awareness about lead in drinking water. Commenters urge EPA to revise the Proposed Rule to incentivize the development of a state and/or local drinking water advisory council.[183] The purpose of the state or local advisory council would be to work collaboratively with the water system and the state or local health department—along with the public—to plan and to aid in spreading public awareness regarding existing lead issues. The advisory council could also be instrumental in helping disseminate information regarding lead service line replacement updates.

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[180] *See* Marisa Iati, *Toxic Lead, Scared Parents and Simmering Anger: A Month Inside a City Without Clean Water*, the Washington Post, (2019).

[181] Mich. Lead and Copper Rule, Mich. Admin. Code R. 325.10410. *Public education regarding lead; consumer notice of lead and copper* (2019), https://dtmb.state.mi.us/ORRDocs/AdminCode/1928_2019-035EQ_AdminCode.pdf.

[182] *Id.*

[183] *See id.* 74–76. (Michigan Lead and Copper Rule section on public education regarding lead, which provides useful legislative language regarding the development and implementation of a statewide and/or local drinking water advisory council).

Finally, EPA is taking comment on whether it should require water systems "to distribute education materials to homes with unknown service lines to inform them of the potential for their lines to be made of lead and the actions they can take to reduce their exposure to drinking water lead."[184] Commenters support the dissemination of public education materials to homes with unknown service lines. This allows customers to be informed and to take actions that could prevent lead exposure. EPA should also require the inclusion of information explaining whether the water system plans to take steps to identify unknown lead service lines. Additionally, water systems should be required to share: (a) information on how to get water tested; (b) information on lead-free plumbing options; and, (c) information about getting a child's blood tested for lead.

XI. MONITORING FOR LEAD IN SCHOOLS AND CHILD CARE FACILITIES

A. EPA should revise its proposal to protect children in schools and child care facilities.

EPA is proposing an entirely new requirement for all community water systems to sample for lead at schools and child care facilities within its distribution system once every five years. According to EPA, the intent of the requirement is to inform and educate facilities about risks from lead plumbing at schools and licensed childcare facilities.[185]

Commenters support the proposal of testing for lead in the drinking water of school and child care facilities. There is widespread support among policymakers, states, and health advocates for increased federal oversight to reduce lead exposure in drinking water in schools and child care facilities.[186] Indeed, a number of states have already instituted similar sampling and public education programs and policies across the country.[187] But while we applaud EPA for taking the step to require monitoring for lead in schools and child care facilities, EPA does not go far enough to *protect* the millions of infants and children who may be exposed to lead in drinking water at these facilities.

According to the U.S. Department of Agriculture, children spend on average over six hours per day at school, not including time spent by children who attend before and after school care or activities.[188] Thirty million students participate in the National School Lunch program and about fifteen million students participate in a school breakfast program every school day. The Healthy, Hunger-Free Kids Act of 2010, requires schools participating in federally funded meal programs to make water available during meal periods at no cost to students.[189] Taken

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[184] *See* 84 Fed. Reg. at 61,735.
[185] *See* 84 Fed. Reg. at 61,707.
[186] *See* NDWAC Lead and Copper Working Group. (2015); Report of the Lead and Copper Working Group to the National Drinking Water Advisory Council—Final, https://www.epa.gov/sites/production/files/.2016-01/documents/ndwaclcrwgfinalreportaug2015.pdf*; See* Kunapuli, A et. al. Perspectives on State Legislation Concerning Lead Testing in School Drinking Water. (November 2018), https://centerforgreenschools.org/sites/default/files/resource-files/2018-Lead-in-School-Drinking-Water-Full-Final-20181108.pdf; *See* U.S. Government Accountability Office, K-12 Education: Lead Testing of School Drinking Water Would Benefit from Improved Federal Guidance. (July 2018) https://www.gao.gov/assets/700/692979.pdf.
[187] *See* Env't Am. Research & Policy Ctr., Get the Lead Out: Ensuring Safe Drinking Water for our Children at School. (March 2019),https://environmentamerica.org/sites/environment/files/reports/GetTheLeadOut_032119.pdf.
[188] *See* 84 Fed. Reg. at 61,707.
[189] *Id*.

together, schoolchildren may be exposed to lead in drinking water throughout the school day and may consume foods that have been prepared with lead contaminated water.[190]

In the wake of the Flint Water Crisis, more schools have tested for lead and have found widespread contamination across the country. In New York City, 83% of buildings tested for lead had at least one outlet that tested above 15 µg/L—the current action level for lead in drinking water in homes.[191] Of the 28 states that have an existing lead-in- drinking-water sampling program or policy and publicly releases sampling results, each has detected lead in drinking water.[192] Alarmingly, EPA estimates that 98,000 public schools and 500,000 child care facilities are not regulated under the SDWA and may not be testing for lead in drinking water.[193] The National Center for Education Statistics (NCES) states there are 98,277 public schools across the country (as of 2015–16).[194] According to NCES, there are an additional 34,576 private schools (as of 2015–16) in the U.S.[195] EPA must require an accounting of all public and non-public schools as well as child care facilities that will be covered by the proposed rule sampling provisions. Such accounting should delineate those schools and child care facilities that are transient non-community water systems that maintain their own water supply.

The SDWA requires EPA to minimize adverse health impacts "to the extent feasible."[196] And EPA has recently recognized how important it is for that directive to be realized with respect to children and lead. In 2016, EPA's Office of Water released a report entitled the Lead and Copper Rule Revisions White Paper that appears to be in response to the 2015 National Drinking Water Advisory Council recommendations.[197] The report states that "it is critical that EPA thoughtfully revise the LCR to strengthen the rule *to reduce exposure to lead* in drinking water, *especially for infants and children and communities bearing a disproportionate risk*."[198]

EPA's Proposed Rule does not do enough to address disproportionate impacts to children, especially those children who may face increased impacts to lead in a number of media, including in drinking water. These failures, and suggestions for improving EPA's proposal, are discussed in more detail below. We urge EPA to strengthen the proposal so that it will adequately protect public health, and especially the health of infants and children, who are most vulnerable to the harms from lead exposure.

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[190] *See, e.g.*, Bellinger Decl. ¶ 8.
[191] NYC Department of Education, Water Safety: 2017 NYC DOE Water Test Results. (2017), https://www.schools.nyc.gov/about-us/reports/water-safety.
[192] Environment America Research & Policy Center, Get the lead out: ensuring safe drinking water for our children at school. (March 2019), https://environmentamerica.org/sites/environment/files/reports/GetTheLeadOut_032119.pdf.
[193] EPA, Lead in Drinking Water in Schools and Childcare Facilities. (updated March 15, 2019), https://www.epa.gov/dwreginfo/lead-drinking-water-schools-and-childcare-facilities.
[194] U.S. Department of Education, National Center for Education Statistics, *Digest of Education Statistics, 2017* (NCES 2018-070). (2019), https://nces.ed.gov/fastfacts/display.asp?id=84.
[195] *Id.*
[196] 42 U.S.C. § 300g–1(b)(4)(B).
[197] EPA, Lead and Copper Rule revisions white paper. (Oct. 2016), https://www.epa.gov/sites/production/files/2016-10/documents/508_lcr_revisions_white_paper_final_10.26.16.pdf.
[198] *Id.*(emphasis added).

B. EPA's proposed requirements for testing at 20% of K-12 schools and licensed child care facilities should establish a prioritization analysis to address environmental justice concerns.

The current LCR does not include any monitoring or public education requirements for schools and child care facilities served by community water systems. The Proposed Rule would change that and require community water systems to "conduct lead in drinking water testing and public education at 20% of K-12 schools and licensed child cares in [a given] service area every year. . . . Sample results and public education must be provided to each sampled school/child care, Primacy Agency, and local or State health department."[199] Water systems also would be required to "conduct directed public education to schools and child care facilities served by the water system, including any facilities that are consecutive water systems if those schools or child care facilities were constructed prior to January 1, 2014."[200] For the 25 states that do not currently have a mandated lead sampling and monitoring program at schools and child care facilities, the Proposed Rule lays out a roadmap for testing. It does not, however, address crucial environmental justice concerns.

Blood lead levels well below 10 µg/dL have been linked to attention deficit hyperactivity disorder, lower educational attainment, and negative behavior problems, and decrements in IQ points.[201] Lead exposure in early childhood is associated with long-lasting changes in brain structure and function.[202] And the adverse impacts of early-life exposure to lead on neuropsychological function, educational achievement and behavior are persistent for decades.[203]

Impacts from lead exposure, however, are not felt equitably across the population. Lead exposure disproportionately impacts low-income and children of color.[204] In 2015, EPA's National Environmental Justice Advisory Committee, along with the Office of Environmental Justice, published the *EJ 2020 Action Agenda: The US EPA's Environmental Justice Strategic Plan for 2016-2020* that explained that "lead exposure is not equal for all children."[205] The plan outlines existing disparities in childhood blood lead levels among low-income children ages 1-5 years old compared to non-low income children, and explains the need to work toward eliminating such disparities (using data from the US Center for Disease Control and Prevention's (CDC) National Health and Nutrition Examination Survey (NHANES)).[206] The report also explains that "low income, minority communities still face aging plumbing infrastructure that could contaminate their drinking water…"[207] And not only do children from socioeconomic

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[199] *See* 84 Fed. Reg. at 61,687.
[200] *Id*. at 61,769.
[201] CDC, Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. (Jan. 4, 2012), https://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf.
[202] Bellinger Decl. ¶ 24.
[203] *Id*. ¶¶ 25-26.
[204] *Id*. ¶¶ 23-24.
[205] EPA, EJ 2020 Action Agenda: The U.S. EPA's Environmental Justice Strategic Plan for 2016–2020, (May 2016), https://www.epa.gov/sites/production/files/2016-05/documents/052216_ej_2020_strategic_plan_final_0.pdf.
[206] *Id*.
[207] *Id*.

disadvantaged backgrounds have greater exposures to lead, but they also suffer greater adversities from the same level of exposure.[208]

Such racial and economic disparities have also been seen with school testing across different neighborhoods in the same city. In 2017, a report published by the U.S. Government Accountability Office found—nearly three years after the onset of the lead-in-water crisis in Flint, Michigan—that 41% of school districts serving 12 million students, had not tested for lead in the twelve months prior to the survey.[209] After that public health crisis, however, some states and school districts, including Washington, DC, began testing their water for lead. But the testing paradigm in Washington, DC provides a cautionary tale for how environmental disparities can persist even in the wake of a growing crisis. Parents at some schools in DC were alerted to lead issues within a day of the crisis, whereas other schools, largely in working class areas, did not alert parents for up to ten days.[210]

EPA's Proposed Rule does not provide directives for determining which schools to test first, which could result in similar troubling disparities in prioritization. Given that the rule will not go into effect for at least three years once finalized, and that community water systems will not be required to test some schools for an additional five years after that (based on the 20% annual sampling protocol), some facilities may not be tested at all until 8 years after the rule is enacted. Under the Proposed Rule, which schools will not be tested for 8 years will be totally discretionary.

EPA should revise its proposal to better protect the testing order from disproportionately impacting low-income and children of color. In addition to requiring community water systems to provide a record of all schools and child care facilities to the state, EPA should require water systems to conduct an 'equity in prioritization' analysis in order to identify and prioritize the schools and childcare facilities that may be at highest risk for lead contamination. The 'equity in prioritization' analysis should focus on those schools and child care facilities that may service children from environmental justice communities in order to determine appropriate public education and sampling protocols. Examples of factors that should be considered include:

(a.) the age of school or child care facility;
(b.) the social demographics (e.g. socioeconomic status) of the school, child care facility, and surrounding neighborhood;
(c.) an analysis of drinking water challenges in underserved communities.

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[208] Bellinger Decl. ¶¶ 23-24.
[209] U.S. Gov't Accountability Office, K-12 Education: Lead Testing of School Drinking Water Would Benefit from Improved Federal Guidance. (July 2018). https://www.gao.gov/assets/700/692979.pdf (According to the report, "43% of districts, serving 35 million students, tested for lead. Of those, 37% found elevated levels and reduced or eliminated exposure. 16% did not know if they had tested.").
[210] The Ctr. for Pub. Integrity, Schools Fail Lead Tests While Many States Don't Require Testing at All. (Aug. 22, 2017), https://publicintegrity.org/environment/schools-fail-lead-tests-while-many-states-dont-require-testing-at-all/.

C. EPA's protocol for testing for lead in schools and child care facilities should be revised to require testing at all outlets and establish an "action level" at which remedial steps are required.

The proposed provisions for schools and childcare facilities fall short even of guidance the EPA currently issues regarding protecting kids from lead exposure in those facilities. Under the Proposed Rule, before sampling, the community water system is required to notify each of the school and child care facilities of their plans to sample and provide the EPA's *3Ts for Reducing Lead in Drinking Water Toolkit* ("3Ts*"*), which provides guidance to schools and child care facilities on how to implement a lead in drinking water program.[211] The 3Ts guidance provides tools for facilities to consider, including expanded sampling, stakeholder communication, and *remediation options*.[212]

The LCR proposal, however, is not consistent with the guidance EPA provides in the 3Ts. For example, under the Proposed Rule, community water systems are required to sample as follows:

> *(i) For schools: Two drinking water fountains, one kitchen faucet used for food or drink preparation, one classroom faucet, and one nurse's office faucet, as available.*
>
> *(ii) For child care facilities: One drinking water fountain and one of either a kitchen faucet used for preparation of food or drink or one classroom faucet.*

But EPA's own *3Ts for Reducing Lead in Drinking Water in Schools* guidelines provide that:

> *"If possible, every outlet used for drinking or cooking should be sampled. At a minimum, every outlet that is regularly used for cooking and drinking should be sampled.*[213]

The 3Ts advises testing all outlets because unlike water that may be delivered via lead service lines into homes, plumbing from multiple sources at a school or child care facility may contain lead and contribute to elevated lead levels at outlets across a given facility. As the 3Ts guidance explains, "in addition to lead components in the plumbing system, lead solders or lead in the brass fittings and valves used in some taps, bubblers, and refrigerated water coolers may be sources of lead."[214] The 3Ts guidance lists a number of examples of sites where lead contamination can occur, including "areas containing lead pipes or lead solder, areas of recent construction and repair in which materials containing lead were used…[and] areas of low flow and/or infrequent use."[215] Thus, the document advises, "[i]t is important to identify the locations of all such drinking water outlets."[216]

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[211] *See* 84 Fed. Reg. at 61,706
[212] Id. at 61,707.
[213] EPA, 3Ts for Reducing Lead in Drinking Water in Schools and Child Care Facilities: a Training, Testing, and Taking Action Approach (Revised Manual). (2018), https://nepis.epa.gov/Exe/ZyPDF.cgi/P100VLI2.PDF?Dockey=P100VLI2.PDF.
[214] *Id.*
[215] *Id.*
[216] *Id.*

Due to the varied nature of existing lead sources within a school or child care facility, EPA must not codify a dangerously inconsistent sampling protocol into law as currently proposed. If testing does not occur at every outlet within a facility, then the source of lead may be missed entirely. This sampling protocol is severely flawed and must be revised in the final rule in alignment with EPA's own 3T's guidance.

In order to comport with its own guidance in the 3Ts, EPA must also revise the Proposed Rule to set a minimum threshold at which remedial action must occur at a level that provides the greatest public health protection. If a community water system tests for and detects lead above the threshold, the facility should, at the very least, be required to immediately take the affected outlet(s) offline until the lead source is identified and remedied. The 3Ts guidance supports this recommendation by advising facilities to: "Shut off problem outlets, [i]f initial sample results from an outlet exceed, the remediation level, the outlet can be shut off or disconnected until the problem is resolved."[217] In addition to permanently reducing or eliminating sources of lead, EPA should also require community water systems to install NSF International certified POU devices on affected faucets and taps. Additionally, up-to-date electronic data management guidance, bolstered by improved federal financial and technical support, could standardize practices for data collection, database development, and reporting to improve timely identification of elevated lead levels in school tap water, thus limiting lead exposure from school water outlets.

EPA's Proposed Rule carves out two exceptions to the requirement for community water systems to adhere to the proposed sampling protocol that raise concerns. The exceptions, entitled *Alternative School Sampling Programs* would allow the following:

1. "If Local or State law or regulations require schools and childcare facilities to be tested, either the school or the water system, in a way that is at least as stringent as paragraphs (a) through (c) of this section, the water system may execute that program to comply with the requirements of this section."[218]

2. "The water system must include documentation in the report required in § 141.90(i) if a school or child care facility refuses entry or otherwise declines to allow the system to conduct the monitoring or education requirements of this section."[219]

Commenters support the allowance for states to continue to implement existing or new programs to test for lead in drinking water at schools and child care facilities. However, that exception, in conjunction with the proposal's failure to mandate action as strict as those recommended in its own 3Ts document, will result in a continued lack of standardization of approaches to combatting lead in drinking water in schools and child care facilities across the nation, and a continued lack of remediation in facilities in many states. A 2019 report, *State Approaches to Testing School Drinking Water for Lead in the United States*, describes the 24

[217] *Id.*
[218] *See* 84 Fed. Reg. at 61,769.
[219] *Id.*

states (including Washington, DC) that have developed statewide school drinking water lead testing initiatives as of February 2018, and provides an overview of state programs as well as a summary of the findings on lead in drinking water in schools in 12 of states.[220] The report shows that there is wide variety in programs in the different jurisdictions.[221] In 2018, the U.S. Green Building Council (USGBC) published a report entitled *Perspectives on State Legislation Concerning Lead Testing in School Drinking Water*. USGBC commissioned the study and report in recognition of the insufficiency of existing federal laws to protect students and teachers from lead contamination in drinking water.[222] The study was undertaken as a means to "inform state legislators and advocates as they consider new state laws to address lead contamination in drinking water" and provided an analysis of the effectiveness of existing laws, including the "coverage of schools, implementation of testing, risk communication, and disclosure."[223] The study concluded that while it's important for states to require lead testing, nearly half of state laws fail to ensure a reduction in the risk of lead exposure.[224] Furthermore, some state testing programs are voluntary and/or only require one-time testing as opposed to continued surveillance. Federally mandated remedial action is therefore imperative. EPA must ensure that the requirements for a state to apply to waive the proposed rule sampling protocol are explicitly stated in a publicly available guidance or a checklist to states.

These reports provide examples of states and facilities that could choose to continue to implement their own program under the exception. According to both reports, there is no uniformity in states' approaches to create and oversee programs to test for elevated lead in school drinking water. Findings suggest that specific, standardized practices for collecting samples of tap water and testing them for lead, combined with financial and technical assistance, could lead more states to adopt programs with the 3Ts' recommended practices for limiting lead exposure in school drinking water. Given that most states already follow some subset of protocols addressed in the first edition of the 3Ts guidance, the lack of a concrete action level is problematic and creates inconsistencies as identified by varied data from existing state programs. An additional element that both reports discuss is the allowable concentration of lead in drinking water—or what can effectively be called an "action level" that if exceeded, would be cause for remediation to take place. The majority of states at least reference EPA's action level of 15 µg/L, whereas other states continue to rely on the 20 µg/L recommended in the 2006 version of the 3Ts guidance while three states set levels as low as 5 µg/L.[225] EPA should establish a lead monitoring and remediation protocol that is at least as stringent as current state level programs.

Commenters are also concerned that the second exception, which allows schools and child care facilities to decline lead testing, will create loopholes for schools or child care

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[220] Cradock AL, et al. *State Approaches to Testing School Drinking Water for Lead in the United States*. Boston, MA: Prevention Research Ctr. on Nutrition and Physical Activity at the Harvard T.H. Chan School of Pub. Health. (2019), https://www.hsph.harvard.edu/prc/projects/school-research/early-adopters.
[221] *Id.*
[222] Kunapuli, A et al., *Perspectives on State Legislation Concerning Lead Testing in School Drinking Water*, (Nov. 2018), https://centerforgreenschools.org/sites/default/files/resource-files/2018-Lead-in-School-Drinking-Water-Full-Final-20181108.pdf .
[223] *Id.*
[224] *Id.*
[225] Cradock et al., *State Approaches to Testing School Drinking Water for Lead in the United States.*

facilities to opt out of identifying and managing potential lead contamination issues. Individual facilities have the right to decide not to grant entry to the water system to perform lead sampling. Nevertheless, if a school and/or child care facility chooses to decline lead testing then the refusal should be provided to the local school boards, the health department, and the state. The language in the proposed rule states "A CWS would have to certify that it has completed the notification and sampling requirements…the certification would include…the number of schools and child care facilities that have refused sampling."[226] Commenters urge EPA to require the names and locations of all schools and child care facilities be provided publicly—including an explanation as to why the facility refused testing.

D. The proposed public education requirements for schools should be strengthened.

Finally, the Proposed Rule's public education requirements for schools and child care facilities with identified lead in drinking water are also flawed. First, the proposal mandates that the community water system provide the sampling results (including information regarding potential remedial recommendations) only to each facility, the local or State health department, and the primacy agency. It does not, however, require dissemination of the information to occupants of the school or child care facility (e.g. students, teachers, facility workers) or to parents and guardians. Instead, the onus to disseminate sampling results falls on the individual facility, creating a public education gap. EPA should require community water systems to inform not only the school, health department, and state of test results, but also parents, guardians, teachers and other occupants of these buildings. Second, the Proposed Rule fails to specify information about remedial options that must be included with the sampling results. It states that "water systems shall provide analytical results as soon as practicable…to the school or child care facility, along with information about remedial options…"[227] But it does not specify or provide exact language regarding the remedial options that *shall be* shared. The Proposed Rule should be revised to list specific examples of potential short and long term remedial options for water systems that must be disseminated to schools and child care facilities.

XII. ENVIRONMENTAL JUSTICE ANALYSIS

A. EPA's cursory environmental justice analysis violates the law.

EPA failed to conduct a satisfactory environmental justice analysis in support of the Proposed Rule as required by law. "To the greatest extent practicable and permitted by law," federal agencies, including EPA, "shall make achieving environmental justice part of [their] mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of [their] programs, policies, and activities on minority

[226] *See* 84 Fed. Reg. at 61,709.
[227] *Id*. at 61,769.

populations and low-income populations."[228] Failure of an agency to adequately conduct the required analysis is challengeable in court.[229]

EPA fails to "identify" and is wholly silent on the disproportionate adverse impact that certain proposed provisions would have on minorities and low-income communities, in violation of the law.[230] EPA proposes here to let systems off the hook from conducting now-mandatory lead service line replacements, a rollback that would result in disproportionate harms for minority populations. As Commenters explained above, EPA's proposal for small water systems and proposal to extend the timeline for replacing lead service lines would both provide a weaker level of health protection to consumers than the level of health protection now guaranteed by the LCR, in violation of the SDWA's anti-backsliding provision. EPA acknowledges that lead exposure stemming from leaching from lead service lines disproportionately impacts low-income and minority communities.[231] But EPA wholly fails to acknowledge or address the magnified impact of the rule's purported backsliding on minority and low-income populations, flouting the agency's obligations under law.[232]

EPA's environmental justice analysis in the Proposed Rule also violates the APA's prohibition against "arbitrary and capricious" action.[233] The analysis consists of cursory, conclusory summations, plainly inadequate to support its contention that the Proposed Rule complies with Executive Order 12,898.[234] EPA both fails to "identify" with sufficient precision the disproportionately high impacts the Proposed Rule would impose on low-income and minority communities and further fails to "address" those impacts.[235] EPA in its Proposed Rule fails to require water systems to pay for replacement of the portion of the service line running under private property.[236] EPA concedes that as a result "[t]he LSLR provision may be less likely than the CCT provision to address baseline health risk disparity among low-income populations because LSLR may not be affordable for low-income households."[237] Despite this, EPA summarily concludes that because "EPA estimates that corrosion control treatment changes will account for most of the benefits, health risk reduction benefits will be more uniformly distributed . . ." This vague statement does not deny that minority and low-income communities would be disproportionately negatively impacted by specific provisions in the Proposed Rule, nor does it deny that minority and low-income communities would suffer a disproportionate adverse impact under the proposed rule as a whole. But EPA makes no gestures towards fulfilling its legal obligation to identify the nature and extent of the anticipated disparity in health impacts. Indeed, EPA fails to estimate the numbers of low-income and minority households that

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[228] Exec. Order 12,898, 59 Fed. Reg. 7629 (Feb. 11, 1994).
[229] See, e.g., Communities Against Runway Expansion, Inc. v. F.A.A., 355 F.3d 678, 689 (D.C. Cir. 2004) ("The [agency] exercised its discretion to include the environmental justice analysis in its NEPA evaluation, and that analysis therefore is properly subject to arbitrary and capricious review under the APA.").
[230] Exec. Order 12,898, § 1–101.
[231] Abt Associates, Environmental Justice Analysis for the Proposed Lead and Copper Rule Revisions 22 (Oct. 22, 2019) (finding that "higher-than-expected proportions of children in minority households and/or low-income households live in housing built during decades of higher LSL usage.")
[232] Exec. Order 12,898, § 1–101.
[233] *See* 5 U.S.C. § 706(2)(A).
[234] *See id.*
[235] *See id.*
[236] 84 Fed. Reg. at 61,697.
[237] *See Id.*

would be unable to afford lead service line replacement under the Proposed Rule. EPA also does not quantify the incentives (or disincentives) for utilities to provide financial assistance to residents to conduct replacements, nor does the agency assess the impact on vulnerable populations of failing to fully prohibit partial lead service line replacement. And EPA makes no attempt to address these disparate impacts by proposing policies to mitigate the resulting harm to vulnerable communities. EPA must do so.

Submitted by:

Earthjustice
A Community Voice
Alliance of Nurses for Healthy Environments
Advocates for Children of New Jersey
Ashurst Bar/Smith Community Organization
Emily A. Benfer, Health Justice Advocacy Clinic at Columbia Law School (for identification purposes only)
Buxmont Coalition for Safer Water
Childhood Lead Action Project
Children's Defense Fund – New York
Citizens Coal Council
Citizens for Alternatives to Radioactive Dumping (CARD)
Clean and Healthy New York
Clean Power Lake County
Coalition of Community Organizations
Conservation Law Foundation
Ecology Center
Sara Perl Egendorf
Environmental Health Strategy Center
Faith in Place Action Fund
GreenLatinos
Healthy Gulf
Healthy Schools Network
Huntington Breast Cancer Action Coalition, Inc.
Merrimack Citizens for Clean Water
Newark Water Coalition
Newburgh Clean Water Project
OVEC – The Ohio Valley Environmental Coalition
PolicyLink
Father Philip Schmitter
Sierra Club
St. Francis Prayer Center
Water You Fighting For?
Waterkeeper Alliance
Women's Voices for the Earth

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

National Primary Drinking Water Regulations: Lead and Copper Rule Revisions,

84 Fed. Reg. 69,695 (Dec. 19, 2019)

ATTACHMENT 1

COMMENT BY JEFF COHEN on EPA's Proposed Revisions to the Lead and Copper Rule (Jan 22. 2020)

Submitted via Regulations.gov

Docket No. EPA-HQ-OW-2017-0300

February 12, 2020

22 January 2020

Jeff Cohen
San Francisco CA

I worked for the US EPA in various programs and capacities between 1980 and 2008. Between late 1989 through 1992 I managed the Lead Task Force for the Agency's Office of Drinking Water. Our work included finalizing the 1991 Lead and Copper Rule. I am a member of the Environmental Protection Network an organization of former EPA professionals who will be submitting separate comments that cover different aspects of the November 2019 proposed revisions.

Consideration for Maximum Contaminant Level

When the current rule was established in 1991, elevated levels of lead in tap water were found in water systems with corrosive water, primarily in homes connected by lead service lines, and in homes with sources of lead outside the control of the utility -- newly installed lead solder used to connect interior copper pipes, and newly installed brass faucets (plumbing fixtures had up to 8% lead content during that period).

Data at the time indicated that in many cases lead levels at the tap would likely continue to be highly variable even after a system did everything within its control using best available technology. In considering various regulatory approaches, the Agency selected corrosion control treatment requirements as the most effective approach to limit tap water lead levels rather than a Maximum Contaminant Level (MCL), based on concern there would be no direct way to assign liability and establish the compliance status of a public water system for an MCL exceedance at the tap,

The 1991 rule was designed to identify and control high-risk scenarios, e.g., sampling was restricted to first draw samples from homes with lead solder installed after 1982 and homes with lead service lines. The proposed revision recognizes that today, sources of lead within household plumbing have largely been eliminated[1], viz., sampling priorities are for homes with lead service lines.

For this same reason, the Agency should again consider establishing an MCL for lead instead of the current treatment technique approach. Given the restrictions on lead in new plumbing, the Agency's rationale in 1991 for rejecting the option to set an MCL at the tap no longer holds today. *As of 2020, it is possible that water systems can be held responsible for the sources of*

[1] Lead solder was banned in the U.S. in 1986, and as of 2014 The Reduction of Lead in Drinking Water Act prohibits plumbing products used for potable water that are not lead-free (<0.25% lead content).

lead contamination in drinking water, specifically, corrosive water interacting with lead service lines.

Under an MCL approach, implementation and oversight would be significantly streamlined compared to the current rule and the proposed revisions, while continuing to provide comprehensive public health protection:

<u>Streamlined Implementation</u>

- Sampling would be focused on homes with lead service lines
- The MCL could be established as either a single data point or as a statistical value similar to the action level (e.g., 90th percentile above 10 ppb)
- Exceedance of the MCL would put the burden on the water system to:
    - install/improve corrosion control immediately
    - continue regular monitoring at high risk sites
    - inform the public of the exceedance and how to mitigate their own exposures, and offer assistance in replacing lead service lines
    - demonstrate (within a fixed time period) that the exceedance is not under their control (i.e., 100% of all lead service lines are privately owned)
- As long as the MCL exceedance persists (e.g., measured on a calendar year basis), the water system would have to replace 7% of their lead service lines every year

<u>Streamlined Oversight</u>

- Water systems would be responsible for meeting the MCL
    - States (or EPA) would <u>not</u> need to review corrosion control studies or make decisions on corrosion control treatment options
    - States can prioritize enforcement based on exceedance metrics (e.g., lead levels, duration)
    - EPA can reduce regulatory specifications related to corrosion control, eliminating potential for confusion
    - Eliminates uncertainties about compliance obligations and variability in enforcement/oversight capabilities in different states

The complexity in both the current rule - however necessary at the time - and the recent proposal creates potential for confusion and delays in implementation. Many of us scientists, engineers, and policymakers who worked hard on protecting the public from lead recognize and applaud the Agency staff and state programs in the significant reductions in lead levels in drinking water over the past several decades since the current rule was issued. However, the gaps in oversight demonstrated in Newark, NJ and Flint also must be recognized. EPA should fully review the option presented here as a way to fill these gaps.

Thanks for the work you do – Jeff Cohen

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

National Primary Drinking Water Regulations: Lead and Copper Rule Revisions,

84 Fed. Reg. 69,695 (Dec. 19, 2019)

ATTACHMENT 2

DECLARATION OF DAVID C. BELLINGER. Ph.D., M.Sc.

Submitted via Regulations.gov

Docket No. EPA-HQ-OW-2017-0300

February 12, 2020

IN THE UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

SAFER CHEMICALS, HEALTHY FAMILIES et al., *Petitioners,*	)	Docket No. 17-72260
v.	)	Consolidated with Docket Nos. 17-72501, 17-72968, 17-73290, 17-73383, 17-73390
U.S. ENVIRONMENTAL PROTECTION AGENCY et al., *Respondents.*	)	
IPC INTERNATIONAL, INC. et al., *Respondents-Intervenors.*	)	

DECLARATION OF DAVID C. BELLINGER, Ph.D., M.SC.
IN SUPPORT OF PETITIONERS' OPENING BRIEF

I, DAVID C. BELLINGER, do hereby affirm and state:

Introduction and Qualifications.

1. I am a Professor of Neurology at Harvard Medical School and a Professor in the Department of Environmental Health at the Harvard T.H. Chan School of Public Health in Boston. I hold appointments as a Senior Research Associate in Neurology and a Senior Attending Psychologist at Boston Children's Hospital. I am a licensed Psychologist in the Commonwealth of Massachusetts.

2. I obtained a Ph.D. in Psychology at Cornell University in 1977 and an M.Sc. in Epidemiology at the Harvard School of Public Health in 1987.

3. My primary research focus is chemical and metabolic factors that perturb the developing nervous system. Since 1979, I have studied children's lead exposure and its associated health effects. My work has been funded primarily by grants from the National Institutes of Health. I have published more than 400 articles in peer-reviewed scientific and medical journals, with more than 100 of these focusing on aspects of lead exposure and toxicity. I have given invited lectures on the toxicities of lead and other environmental chemicals in more than two dozen countries.

4. I am recognized as an authority on lead exposure and toxicity and am regularly asked to serve on both national and international advisory committees. These include committees of the National Academies of Sciences and Medicine, the Centers for Disease Control and Prevention (CDC) (Advisory Committee on Childhood Lead Poisoning), and the World Health Organization (WHO) (Joint Expert Committee on Food Additives and Contaminants, Foodborne Disease Epidemiology Reference Group). Currently, I chair the guidelines development workgroup at the WHO that is formulating recommendations to member states regarding the diagnosis, treatment, and prevention of lead poisoning. In 2015, I was selected by the government of Hong Kong to be the technical advisor to a

commission investigating an episode of lead contamination of water. In 2016, the *New England Journal of Medicine* asked me to prepare a perspective on the episode of lead-contaminated water in Flint, Michigan, and in 2017, the *Journal of the American Medical Association* asked me to provide an editorial to accompany a paper on adult outcomes of childhood lead exposure.

5. From 2010 to 2017, I was the President of the International Society for Children's Health and the Environment. I have also served as the Associate Editor for children's health for the journal *Environmental Health (2013-2017)*, and was the inaugural editor-in-chief of the journal *Toxics* (2012-2018).

6. A more complete description of my educational and work experience, as well as a complete list of my publications, is attached to this declaration as Exhibit A.

7. By virtue of my training, experience, research, advisory committee work, and knowledge of pertinent scientific literature, I am considered by my peers as an expert on lead toxicity and the sources and health effects of lead exposure. All of the information set forth in this declaration is based upon my education, personal knowledge, and experience.

Sources of Lead Exposure

8. Lead is often characterized as a "multimedia" pollutant because of the ubiquity of exposure and the diversity of ways in which it occurs. The major

pathways include air, water, dust, soil, and paint. Ingestion of lead-containing paint remains the most common cause of clinical lead poisoning in children. Lead-contamination of water is due primarily to the presence of lead-containing water pipes and other infrastructure, especially in older homes and cities. Exposure can occur when contaminated water is consumed or used in cooking. Lead in household dust is a major source of exposure, particularly to children. There are many ways in which dust can become contaminated. The sources can be small chips of leaded paint, lead that settles from the air, or lead in soil that is tracked into a home. The typical hand-to-mouth activities of children can make lead-contaminated household dust particularly hazardous. Exposure to lead begins before birth, as lead easily passes across the placenta so that a fetus is exposed to the same amount of lead as the woman carrying the fetus.

9. Although some former major uses of lead have been curtailed or eliminated over the past several decades (e.g., as a fuel additive and as a constituent of residential – but not industrial – paint), large reservoirs of lead remain in the environment as legacies of its historical uses. For example, millions of U.S. homes still contain some lead-containing paint, and the concentration of lead in soil can be high primarily due to decades of atmospheric deposition from combusted fuel but also to industrial sources. Although the use of lead as a key component of lead-acid batteries for vehicles, it continues to be used in a variety of

products such as wheel weights, vinyl blinds, pigments, ammunition, cable sheathing, lead crystal glass, and radiation protection.

10. An individual's blood lead concentration reflects exposure from all current sources and pathways, as well as, to some extent, past exposures. This is because lead absorbed by the body can remain in the body for years in long-term storage sites, such as bones.

11. Lead stored in bones can be released back into blood, where it can affect the function of soft-tissue organs such as the brain and kidneys. Because lead and calcium share some key chemical features, conditions that involve mobilization of calcium from bone may also mobilize lead. These include pregnancy, lactation, menopause, and certain medical conditions such as osteoporosis. In light of the multiple exposure pathways for lead, an accurate characterization of an individual's risk of suffering harmful effects from lead requires consideration of the contributions of all potential pathways of exposure. Focusing narrowly on only one or a few potential pathways will not be sufficient to protect public health.

12. All exposure to lead is, in principal, preventable. We know how individuals are exposed, the damage lead does to biological systems, and how to reduce exposure.

Health Effects of Lead Exposure

13. Lead does not serve any biological purpose in the human body, so the "natural" concentration of lead in blood is essentially zero.

14. Thousands of science studies have established the toxicity of lead to biological systems and elucidated some of the major mechanisms. With regard to neurotoxicity, for example, lead interferes with programmed cell death (apoptosis), which is an important process of normal brain development; impairs energy production in the mitochondria; causes imbalances between the body's production of free radicals and its antioxidant defenses; impairs the production of heme, a component of hemoglobin, the red cell protein that carries oxygen to the body's tissues; and interferes with many processes by which neurons communicate with one another and establish functional brain circuits.

15. The view of "how much lead is too much" has undergone steady revision since the 1960s, when a blood lead concentration of 60 µg/dL was considered the upper limit of "normal." This "action level" was reduced to 40 in 1971, 30 in 1975, 25 in 1985, and 10 in 1991. Each reduction stimulated a new round of scientific and medical studies to determine whether the new level provided an adequate margin of safety. Each time, the answer was "no."

16. A wide consensus now exists that there is, in fact, no "safe" level of lead exposure, i.e., no threshold below which exposure is harmless. Although

humans can be harmed by exposure to lead at any age, young children are considered to be the most vulnerable subgroup of the population, and the developing nervous system is considered to be the most vulnerable organ. This is because the brain develops rapidly in utero and early childhood, and because lead is known to perturb many of the complex processes involved.

17. The relationships between lead exposure and health effects are now well established. In children, a blood lead concentration greater than 100 micrograms per deciliter (µg/dL) can be fatal, while a concentration of 80 to 100 µg/dL can produce brain damage (encephalopathy) that can leave a child with significant permanent neurological impairments. At lower concentrations, adverse effects are also observed on kidney function, the formation of red blood cells, and in calcium and vitamin D metabolism. Even in children with a blood lead concentration that is not associated with clinical signs and symptoms, so-called "subclinical" impairments are evident and manifested as lower IQ scores, poor academic achievement, and behavioral disorders.

18. Although policy changes and public education in recent decades have produced substantial reductions in the blood lead concentrations of the U.S. population, research conducted over the same period has identified adverse health effects at lower and lower concentrations. This shows that the problem has by no

means been solved, and that lead toxicity continues to cause significant health harms in the U.S. population.

19. Because of the absence of a threshold for lead's adverse effects on human health, in 2012 the CDC eliminated its "action level" for lead, which was health-based.[1] Because a threshold could not be identified, a health-based standard could not be set. Instead of a health-based standard, the CDC now uses a statistically-defined "reference level," which corresponds simply to the 97.5th percentile of the distribution of the blood lead concentrations of U.S. children. In 2012, this was 5 µg/dL. (For the same reason, in 2013, the Food and Agriculture Organization/WHO Joint Expert Committee on Food Contaminants and Additives withdrew its recommended Provisional Tolerable Weekly Intake of lead.[2]) The CDC reference level will be reconsidered every 4 years and, if necessary, revised in light of the most two most recent nationally-representative health surveys conducted by the US. National Center for Health Statistics (the National Health and Nutrition Examination Survey, or NHANES).

20. A 2012 systematic review conducted by the National Toxicology Program, which coordinates toxicology research and testing for the U.S. Department of Health and Human Services, concluded that the evidence is sufficient to conclude that even blood lead concentrations less than 5 µg/dL are associated with adverse neurological effects in children, including reduced

intelligence (IQ), reduced cognitive function, reduced academic achievement, and behavioral problems such as Attention Deficit Hyperactivity Disorder (ADHD).[3] .

21. The relationship between blood lead concentration and outcomes such as IQ loss has a nonlinear form, such that the decline in IQ per microgram per deciliter increase in blood lead concentration is greater at concentrations below 10 µg/dL than at concentrations between 10 and 30 µg/dL.[4] Although the decline over recent decades in population blood lead concentrations represent a remarkable public health success, large numbers of children still have concentrations that are now known to be associated with some compromise of brain function.

22. Children living in communities of color shoulder a disproportionate share of the health burden caused by excess lead exposure. Historically, lead poisoning has been viewed as a disease of inner-cities. These areas tend to have older housing stock containing lead paint. Lead concentrations in soil remain high as a result of the decades-long practice of adding lead to vehicle fuels.

23. Children from backgrounds of socioeconomic disadvantage suffer greater adverse educational impacts from lead exposure than do children from more advantaged backgrounds. Thus, poor children not only tend to have greater exposures but they suffer greater adversities from the same level of exposure.

24. Neuroimaging studies of young adults show that lead exposure in early childhood is associated with long-lasting changes in brain structure and

function. Specifically, studies have found that childhood lead exposure is associated, in a dose-related manner, to alterations in the volumes of gray matter regions of the brain, particularly the prefrontal cortex, changes in white matter structure, changes in metabolite ratios, and changes in functional activation patterns during task performance.

25. The adverse impacts of early-life exposure to lead on neuropsychological function and educational achievement are persistent. One recent study found that a higher blood lead concentration at age 11 years was associated with lower IQ and lower socioeconomic status at age 38 years.[5] In other words, individuals who, as children, suffered greater lead exposure achieved less educational and occupational success as adults

26. Multiple studies suggest that greater childhood lead exposure places an adult at greater risk of violence and aggression and even arrests. This association is most likely the result of a complex chain involving lead-related impairments in impulse control and executive functioning, ADHD, and reduced educational success.

27. Lead is also a reproductive toxicant, and increased exposure has been associated with reduced fertility, pregnancy-induced hypertension, spontaneous abortion, and reduced growth of the fetus. In 2010, the U.S. CDC recommended follow-up testing, patient education, and environmental, nutritional, and behavioral

interventions of a pregnant woman with a blood lead concentration of 5 µg/dL or greater in order to reduce the lead exposure of the fetus and newborn.[6]

28. Adult lead exposure is likewise associated with adverse health effects. In adults, greater lead exposure is associated with greater blood pressure and other indices of cardiovascular health (heart rate variability), reductions in kidney function, and cognitive impairments.

29. The human epidemiological studies of lead's toxicities are supported by an extensive literature of experimental studies conducted in several animal species, including non-human primates. For obvious ethical reasons, human observational studies cannot involve random assignment of participants to exposure groups, limiting the extent to which causal inferences can be drawn. Studies using animal models are not subject to this same limitation, however, and the consistency between the findings of the animal and human studies increases confidence that the adverse associations observed in the human studies reflect a causal impact of lead.

Conclusions

30. Based on current knowledge, lead exposure remains the most significant environmental risk to the U.S. population. This is a result of the combination of the near universality of some exposure to lead and the absence of a threshold for its toxicity. This means that everyone's brain health is being harmed

to some extent by lead. Any measures that reduce exposures to lead will help to reduce the magnitude of these harms. The impact is illustrated by analyses showing that the total number of IQ points lost by U.S. preschool children as a result of lead exposure exceeds the total numbers of IQ points lost as a result of many other pediatric diseases and conditions, including brain tumors, congenital heart disease, iron deficiency, traumatic brain injury.[7] While these latter conditions are associated with substantial impacts on the IQ scores of individual affected children, the low incidences of these conditions reduces their impact on the distribution of IQ scores in the entire population. In the case of lead, all individuals suffer some adverse impact, though modest in magnitude at the level of most individuals, and therefore contribute to the total population morbidity.

31. Although substantial progress has been made in reducing population exposures to lead, recent findings, including the absence of a threshold and the greater relative impacts of lower compared to higher exposures, strongly support the conclusion that continued vigilance is required. The episode of water contamination in Flint, Michigan illustrates that the potential for widespread exposure remains due to the continued presence of large amounts of lead in the human environment. Many communities have since identified their own water contamination risks, indicating that Flint's water crisis was not an anomaly but merely the "tip of the iceberg."

32. Lead toxicity will continue to endanger the health of the U.S. population until a comprehensive strategy is developed to mitigate existing reservoirs of lead (including paint, soil, water distribution systems) and to prevent the introduction of "new" lead into the environment. To be fully effective, this strategy must address the multitude of sources and pathways of human exposure.

I declare under penalty of perjury that the foregoing is true and correct.

David C. Bellinger, Ph.D., M.Sc.

February 26, 2018
Date

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[2] Food and Agriculture Organization/World Health Organization Joint Expert Committee on Food Additives. Evaluation of Certain Food Additives and Contaminants. 73rd Report, WHO Technical Report Series, No. 960, 2011. (http://whqlibdoc.who.int/trs/WHO_TRS_960_eng.pdf)

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[5] Reuben A, Caspi A, Belsky DW, Broadbent J, Harrington H, Sugden K, Houts RM, Ramrakha S, Poulton R, Moffitt TE. Association of childhood blood lead levels with cognitive function and socioeconomic status at age 38 years and with IQ change and socioeconomic mobility between childhood and adulthood. Journal of the American Medical Association 2017;317(12):1244-1251.

[6] Ettinger AS, Wengrovitz AG. Guidelines for the Identification and Management of Lead Exposure in Pregnant and Lactating Women. Atlanta, GA: Centers for Disease Control and Prevention, 2010.

[7] Bellinger DC. A strategy for comparing the contributions of environmental chemicals and other risk factors to neurodevelopment of children. Environmental Health Perspectives 2012;120(4):501-7.

Exhibit A

to the Declaration of David C. Bellinger, Ph.D., M.Sc.
in Support of Petitioners' Opening Brief

David C. Bellinger

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Education

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1977 Ph.D. Psychology, Cornell University
1987 M.Sc. Epidemiology, Harvard School of Public Health

Post-Doctoral Training

1977-1978 Department of Psychiatry, University of Rochester School of Medicine, Rochester, NY; funded by an individual PHS (NIMH) Post-Doctoral Fellowship
1978-1979 Department of Psychology, Boston University, Boston, MA
1984-1985 Neuropsychology Apprentice, Community Neurodevelopmental Clinic, Massachusetts Mental Health Center

Licensure

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Faculty Academic Appointments

1977-1978 Public Health Service Postdoctoral Fellow, Department of Psychiatry, University of Rochester School of Medicine
1978-1979 Public Health Service Postdoctoral Fellow, Department of Psychology, Boston University
1983-1987 Instructor in Neurology (Psychology), Harvard Medical School
1987-1994 Assistant Professor of Neurology (Psychology), Harvard Medical School
1994-2003 Associate Professor of Neurology (Psychology), Harvard Medical School
2003- Professor of Neurology, Harvard Medical School

2004-	Professor in the Department of Environmental Health, Harvard School of Public Health
2013-	Professor of Psychology in the Department of Psychiatry, Harvard Medical School

Appointments at Hospitals/Affiliated Institutions

1979-1983	Research Associate in Psychiatry, Children's Hospital Boston
1983-2003	Research Associate in Neurology, Children's Hospital Boston
1991-2000	Director of Research, Behavioral Pediatrics Fellowship Program, Children's Hospital Boston
1998-	Research Consultant, Clinical Neuropsychology Training Program, Children's Hospital Boston
2002-	Consultant, Pediatric Environmental Health Specialty Unit (PEHSU), Children's Hospital Boston
2003-	Senior Research Associate in Neurology, Children's Hospital Boston
2005-	Senior Associate in Psychology, Children's Hospital Boston

Committee Service

Hospital

2007-2011	Committee on Clinical Investigation (Institutional Review Board), Children's Hospital Boston

Regional/ Local

1987	Advisory Committee on Childhood Lead Poisoning, City of Boston, Office of the Mayor
1987	Task Force on Lead and Reproductive Outcome, Governor's Advisory Committee on Lead Poisoning, MA Department of Public Health
1987	Technical Advisory Committee, Lead-in-Soil Demonstration Project, Cooperative Agreement: City of Boston, U.S. Environmental Protection Agency
1991-1992	Public Health Advisory Committee, Strategic Plan for the Elimination of Childhood Lead Poisoning, MA Department of Public Health
1994-1996	Local Health Commission 2000, MA Department of Public Health

National

1989-1993	Committee on Measuring Lead Exposure in Critical Populations, National Research Council/National Academy of Sciences
1990-	Technical Advisory Committee, Alliance to End Childhood Lead Poisoning
1990-91	Consultant, Advisory Committee on Childhood Lead Poisoning, Centers for Disease Control
1996-1997	Child Health Workgroup, Child Health Initiative, Agency for Toxic Substances and Disease Registry
1997	Consultant, Science Advisory Board, U.S. Environmental Protection Agency, Mercury Report to Congress
1997	Chairman, Expert Workshop Regarding Medical Monitoring in Bunker Hill, Idaho, Agency for Toxic Substances and Disease Registry (three meetings)

1998	Office of Science and Technology Policy, Scientific Issues Relevant to Assessing Health Effects from Exposure to Methylmercury
1999-2001	Consultant, Case Management Workgroup, Advisory Committee on Childhood Lead Poisoning, Centers for Disease Control and Prevention
1999-2000	Committee on Toxicological Effects of Mercury, National Research Council/ National Academies
2000-2001	Subcommittee on Submarine Escape Action Levels, National Research Council/ National Academies
2001-2002	Committee on Evaluation of Children's Health: Measures of Risk, Protective and Promotional Factors for Assessing Child Health in the Community, Institute of Medicine/National Academies
2001-2002	Development and Behavior Working Group, National Children's Study, NICHHD
2001-2005	Thimerosal and Neurodevelopmental Disorders Oversight Committee, National Immunization Program, U.S. Centers for Disease Control and Prevention
2002-2004	Work Group on Health Effects of Blood Lead Levels < 10 µg/dL, Advisory Committee on Childhood Lead Poisoning, US Centers for Disease Control and Prevention
2002-2005	Federal Advisory Committee, National Children's Study, NICHD
2004-2010	Work Group on Lead and Pregnancy, Advisory Committee on Childhood Lead Poisoning, US Centers for Disease Control and Prevention
2004-2006	Committee on Nutrient Relationships in Seafood: Selections to Balance Benefits and Risks, Institute of Medicine/National Academies
2006-2007	Member, Human Studies Review Board, U.S. Environmental Protection Agency
2011-	Work group on Level of Concern, Advisory Committee on Childhood Lead Poisoning, US Centers for Disease Control and Prevention
2011-	Consultant, Neurological Devices Panel, Medical Devices Panel, Center for Devices and Radiological Health, U.S. Food and Drug Administration
2012	Gastro-Intestinal Drugs Advisory Committee, Center for Drug Evaluation and Research, U.S. Food and Drug Administration
2015-	Committee on Inorganic Arsenic, National Research Council/National Academies

International

1993	World Health Organization/International Programme on Chemical Safety Task Group on Environmental Criteria for Lead, Brisbane, Australia
1997	World Health Organization/International Programme on Chemical Safety, Consultation on Methods Used to Study Neurobehavioral Development of Children Exposed In Utero to Methylmercury, Montreal, Canada
1998-1999	WHO Temporary Advisor, Joint FAO/WHO Expert Committee on Food Additives and Contaminants, Work Group on Methyl Mercury, Rome, Italy
1999-2000	WHO Temporary Advisor, Joint FAO/WHO Expert Committee on Food Additives and Contaminants, Work Group on Cadmium, Geneva, Switzerland

2002	World Health Organization/International Programme on Chemical Safety, Project to Update the Principles and Methods for the Risk Assessment of Chemicals in Food, London, England
2002-2003	WHO Temporary Advisor, Joint FAO/WHO Expert Committee on Food Additives and Contaminants, Work Group on Methylmercury, Work Group on Cadmium, Rome, Italy
2004-2005	Member, Joint FAO/WHO Expert Committee on Food Additives and Contaminants, Rome, Italy
2007-	Member, World Health Organization, Foodborne Disease Burden Epidemiology Reference Group (core group, Chemical Task Force, Source Attribution Task Force, Country Burden Task Force)
2009	Consultant, European Food Safety Authority, Use of the Benchmark Dose Approach in Risk Assessment
2009-2010	WHO Temporary Advisor, 72nd Joint FAO/WHO Expert Committee on Food Additives and Contaminants, Rome, Italy
2009-2010	WHO Temporary Advisor, 73rd Joint FAO/WHO Expert Committee on Food Additives and Contaminants, Geneva, Switzerland
2011-	WHO Guidelines on the Prevention and Management of Lead Poisoning, World Health Organization (Chairperson)
2011-	Member, WHO Expert Advisory Panel on Food Safety, World Health Organization
2014-	Member, Biology and Medicine Panel, Research Grants Council, University Grants Committee, Hong Kong

Other Professional Activities
Federal Advisory (peer review)

1985	Grant Proposal Reviewer, National Science Foundation
1986	National Institute of Environmental Health Sciences, site visit team/ special study section
1987	National Institute of Environmental Health Sciences, site visit team/special study section (two occasions)
1988	Safety and Occupational Health Study Section; site visit team/special study section (Chairperson)
1990	National Institute of Environmental Health Sciences, site visit team/special study section (two occasions)
	Grant Proposal Reviewer, U.S. Environmental Protection Agency
1991	ad hoc member, Toxicology 2 Study Section
1992	ad hoc member, Human Development and Aging 3 Study Section, (two occasions)
	ad hoc member, special study section, National Institute on Alcohol Abuse and Alcoholism
1993	National Institute of Environmental Health Sciences, site visit team/special study section (two occasions)
	ad hoc member, Human Development and Aging 3 Study Section
	ad hoc member, Epidemiology and Disease Control Study Section

1994	Peer Review Promotion Panel, U.S. Environmental Protection Agency, Office of Health and Environmental Assessment
1995	Grant Peer Review, U.S. Agency for International Development, Office of Policy and Programs (Research)
	Grant Peer Review, Agency for Toxic Substances and Disease Registry (2 occasions)
	National Center for Research Resources, site visit team for General Clinical Research Center
	ad hoc member, Behavioral Medicine Study Section
1996	ad hoc member, Human Development and Aging-3 Study Section
1997	Special Emphasis Panel, National Institute of Environmental Health Sciences
1998	National Institute of Environmental Health Sciences, special study section
	National Institute of Environmental Health Sciences, site visit team/special study section
1999	ad hoc member, Biobehavioral and Behavioral Processes Study Section-6
2000	Grant Proposal Reviewer, Agency for Toxic Substances and Disease Registry
2002	Chairperson, special study section, Biobehavioral and Behavioral Processes-4
2006	Special Emphasis Panel for Children's Environmental Health Centers, NIEHS, U.S. EPA
2011	Special Emphasis Panel, Developmental Pharmacology, Center for Scientific Review, NIH
2012	Special Emphasis Panel, ViCTER Program, NIEHS
2013	Special Emphasis Panel, Neonatal Intensive Care, NIH
2015	ad hoc member, Neurological, Aging, and Musculoskeletal Epidemiology Study Section
2015	member, GeoHealth Hub Network study section
2016	Special Emphasis Panel, Time-Sensitive R21 Applications, NIH
2016	ad hoc member, Neurological, Aging, and Musculoskeletal Epidemiology Study Section
2016-2020	member, Neurological, Aging, and Musculoskeletal Epidemiology (NAME) Study Section, National Institutes of Health

Membership on External Advisory Committees: Foundations, Centers, Research Programs

1994-	Comparison of Cognitive Abilities in Children Exposed in Utero to Anticonvulsant Drugs, PI: Lewis Holmes, MD, Massachusetts General Hospital
1994-2006	Superfund Toxic Substances Research Center, Richard Monson, MD, Harvard School of Public Health
1995-	Scientific Board, Foundation for Children of the Copper Basin, Legnica, Poland
1997-2003	Hawaii Heptachlor Research and Education Foundation, Honolulu, HI
1998-	Children's Environmental Health Center, "Exposures and Health of Farmworker Children in California, PI: Brenda Eskenazi, PhD, University of California, Berkeley, School of Public Health
1999-2004	Steering Committee (Chairman), Mercury-Associated Neurobehavioral Deficits in Children, PI: Philippe Grandjean, MD, PhD, University of Southern Denmark
2000-2001	Verification of Techniques for Assessing Neurobehavioral Deficits in Children Exposed to Neurotoxicants, PI: Philip W. Davidson, PhD, University of Rochester School of Medicine

2001-2014	Center for Children's Environmental Health, PI: Frederica Perera, PhD, Columbia University School of Public Health
2006-	T32 Training Program in Pediatric Environmental Health, PI: Philip J. Landrigan, MD/Robert Wright, MD, Mount Sinai School of Medicine
2007-2012	Early Autism Risk Longitudinal Investigation Network, Science Advisory Board, PI: Craig Newschaffer, PhD, Drexel University
2007-	Environmental Epidemiology Training Grant, PI: Roberta F. White, PhD, Boston University School of Public Health
2008-14	Scientific Advisory Board, Autism Speaks
2016	Science Policy (Medicine and Public Health) Workgroup, Hillary for America campaign
2016-	Impact of Prenatal Insecticide Exposure on Neurodevelopmental Trajectories in a Thai Birth Cohort: Building Exposure Science and Neurodevelopmental Research Capacity in Thailand," PIs: Dana Boyd Barr, Ph.D. and Nancy Fiedler, Ph.D.
2017-	Board of Directors, Silent Spring Institute, Newton, MA

Other

1984	Consultant, Children's Television Workshop
1986	Grant Proposal Reviewer, March of Dimes Foundation
1987	Grant Proposal Reviewer, March of Dimes Foundation
1988-1994	Science Director, Lead-in-Soil Demonstration Project, Cooperative Agreement: City of Boston, U.S. Environmental Protection Agency
1990-1994	Assistant Editor, TOMES plus Information System Editorial Board (Toxicology, Occupational Medicine & Environment Series)
1990	Behavioral Teratology Expert Panel on coffee/caffeine, National Coffee Association
1990	California Department of Health Services, Reproductive and Cancer Hazard Assessment Section
1991	David and Lucile Packard Foundation study group on Toxins, Development, and Health
1995	Grant proposal reviewer, Guggenheim Foundation
2008	Grant proposal reviewer, Canadian Northern Contaminants Program
2009	Grant proposal reviewer, Qatar National Research Fund
2013	Grant proposal reviewer, Danish Agency for Science, Danish Council for Strategic Research
2014	Grant proposal reviewer, Agence Nationale de la Recherche, France

Training Courses Provided (Neurodevelopmental Assessment of Children)

2003	Sri Ramachandra Medical College, Chennai, India
2007, 2008	Muhimbili Hospital, Dar es Salaam, Tanzania
2009	Research Institute for Tropical Medicine, Manila, The Philippines (Tacloban, Leyte)
2009	St. John's Research Institute, Bangalore, India
2010	University of Guadalajara, Mexico (Lake Chapala, Jalisco)

2010-2011 Dhaka Community Hospital, Dhaka, Bangladesh
2014 Ifakara Health Institute, Ifakara, Tanzania
2015 Muhimbili Hospita, Dar es Salaam, Tanzania
2016 Mongolian National University of Medical Sciences

Community Service Related to Professional Work

1992-1995 Elected member, Board of Health, Needham MA (chairman 1994-1995)
1993-1996 Physical and Biological Sciences Study Committee, Board of Selectmen, Needham MA
1994-1995 Solid Waste and Recycling Advisory Committee, Board of Selectmen, Needham MA
1995 AIDS Committee, Board of Health, Needham MA
1995-1996 Mental Health and Mental Retardation Advisory Committee, Board of Health, Needham MA

Editorial Positions

1995-2001 Editorial Board, Neurotoxicology and Teratology

2001-2004 Section Editor, Epidemiology, Neurotoxicology and Teratology

2005- Editorial Board, Neurotoxicology and Teratology

2007- Editorial Board, Neurotoxicology

2008- Editorial Board, Open Environmental Sciences

2008- Editorial Board, Clinical Epidemiology and Risk Assessment

2009- Editorial Board, Nutrition and Dietary Supplements

2010-2013 Editorial Board, Environmental Health

2010- Editorial Board, Polish Journal of Environmental Studies

2011- Editorial Board, World Journal of Clinical Pediatrics

2011-2017 Editorial Board, Environmental Health Perspectives

2011- Editorial Board, Safety and Health at Work

2012-2018 Editor-in-Chief, Toxics

2013-4 Editorial Board, World Scientific Journal (Public Health)

2013-2017 Associate Editor for Children's Environmental Health, Environmental Health

2014 Academic Editor, Medicine

Professional Organizations

2010-2017 President, International Society for Child Health and the Environment

Manuscript Reviewer

Academic Pediatrics, Academic Press/Elsevier, Acta Paediatrica, Agency for Toxic Substances and Disease Registry, Ambulatory Pediatrics, American Journal of Epidemiology, American Journal of Obstetrics and Gynecology, American Journal of Industrial Medicine, American Journal of Public

Health, American Journal of Tropical Medicine and Hygiene, Annals of Epidemiology, Annals of Neurology, Annals of Thoracic Surgery, Archives of Environmental Contamination and Toxicology, Archives of Environmental Health, Archives of Environmental and Occupational Health, Archives of Pediatrics and Adolescent Medicine, Asia-Pacific Journal of Public Health, Basic and Clinical Pharmacology and Toxicology, Biodemography and Social Biology, Biological Psychiatry, Biological Trace Element Research, BioMed Research International, BMC Pregnancy and Childbirth, BMJ Open, BMC Public Health, Brain, British Journal of Psychology, British Medical Journal, Cardiology in the Young, Cell Biology and Toxicology, Chemical Industry & Chemical Engineering Quarterly, Chemosphere, Child and Adolescent Psychiatry and Mental Health, Child: Care, Health, and Development, Child Neuropsychology, Children, Youth, and Environment, Circulation, Clinical Chemistry, Clinical Interventions in Aging, Clinical Pediatrics, Cochrane Reviews, Congenital Heart Disease, Cortex, Developmental Medicine and Child Neurology, Developmental Neuropsychology, Early Human Development, Economics and Human Biology, Environmental Health, Environmental Health Insights, Environmental Health Perspectives, Environmental Impact Assessment Review, Environmental International, Environmental Pollution, Environmental Research, Environmental Science and Technology, Environmental Toxicology and Pharmacology, Epidemiology, European Environment Agency, European Heart Journal, European Journal of Clinical Nutrition, European Journal of Pediatrics, Genes, Brain and Behavior, Health & Place, Health Psychology, Heart, Human and Veterinary Toxicology, Human and Ecological Risk Assessment, Indian Journal of Medical Research, International Journal of Circumpolar Health, International Journal of Environmental Research and Public Health, International Journal of Epidemiology, International Journal of General Medicine, International Journal of Hygiene and Environmental Health, JAMAPediatrics, Journal of Affective Disorders, International Journal of General Medicine, International Journal of Medicine and Medical Sciences, Journal of Autism and Developmental Disorders, Journal of Dental Research, Journal of Developmental and Behavioral Pediatrics, Journal of Environmental Management, Journal of Epidemiology and Community Health, Journal of Exposure Science and Environmental Epidemiology, Journal of Great Lakes Research, Journal of the International Neuropsychological Society, Journal of Neurodevelopmental Disorders, Journal of Pediatric Psychology, Journal of Occupational and Environmental Hygiene, Journal of Occupational Medicine and Toxicology, Journal of the American Medical Association, Journal of the International Neuropsychological Society, Journal of Pediatrics, Journal of the Neurological Sciences, Journal of Thoracic and Cardiovascular Surgery, Journal of Toxicology, Lancet, Lancet Neurology, Life Sciences, Medicine, Mental Retardation and Developmental Disabilities Research Reviews, Mount Sinai Journal of Medicine, National Institute of Occupational Safety and Health, Neuropediatrics, Neuropsychology, Neurotoxicology, Neurotoxicology and Teratology, New England Journal of Medicine, Occupational and Environmental Medicine, Paediatric and Perinatal Epidemiology, Pediatric Research, Pediatrics, Pediatrics International, Perspectives in Biology and Medicine, PLoS Medicine, PLoS One, Polish Journal of Environmental Medicine, Psychological Bulletin, Psychological Reports/Perceptual and Motor Skills, Regulatory Toxicology & Pharmacology, Research in Developmental Disabilities, Reviews of Environmental Contamination and Toxicology, Risk Analysis, Scandinavian Journal of Work, Health, and the Environment, Science of the Total Environment, Scientific World Journal, Scientifica, Seychelles Islands Medical and Dental Journal, The Clinical Neuropsychologist, The Open Environmental Journal, The Scientific World Journal, Systematic Reviews, Theoretical Biology and Medical Modeling, Thorax, Toxicological Sciences, Toxicology and Applied Pharmacology, Toxicology and Industrial Health,

Trace Substances in Environmental Health, United Nations Environment Programme, Western Journal of Medicine, Western Journal of Nursing, World Journal of Pediatrics, Yale University Press

Awards and Honors

1971	B.A. magna cum laude with Highest Honors, Williams College
1970	Phi Beta Kappa, Williams College
1977	Phi Kappa Phi, Cornell University
1985-1990	National Institute of Environmental Health Sciences Research Career Development Award
1996	MillerComm Lecturer, University of Illinois at Urbana-Champaign
2008	Elsevier Distinguished Lecturer, Neurobehavioral Teratology Society
2011	M.I.N.D. Institute Distinguished Lecturer, University of California-Davis
2011	Jakob Hooisma Plenary Lecture, International Neurotoxicology Association
2011	Environmental Health Perspectives, Reviewer of the Year
2013	Newburger-Bellinger Cardiac Neurodevelopmental Award (inaugural recipient, with Jane W. Newburger)
2013	Bernstein Lecturer, Department of Psychiatry, Boston Children's Hospital
2013	Environmental Health Perspectives, Reviewer of the Year
2016	Child Health Advocate Science Award, Children's Environmental Health Network
2016	John F. Rosen Memorial Lecture, Montefiore Medical Center
2016	Elected Fellow, Collegium Ramazzini, Carpi, Italy

Report of Funded Projects

Major research interests

- developmental impact of early metabolic and chemical insults to the nervous system
- neuropsychological toxicology
- neurodevelopmental sequelae of pediatric cardiac surgery

Narrative Description: I am a developmental psychologist, with additional training in epidemiology, and devote 100% of my time to hospital-based and epidemiological research and teaching. The principal contexts in which I have studied the functional consequences of early metabolic and chemical insults to the developing nervous system are: field studies of neuropsychological toxicology and clinical studies of children undergoing cardiac surgery. In the former context, I have studied lead, methyl mercury, metallic mercury, cadmium, fluoride, and manganese neurotoxicity. In the latter context, I have studied the neurodevelopmental sequelae associated with intra-operative factors such as the vital organ support technique and the strategies used to manage acid-base balance and hematocrit.

Funding Information (Principal Investigator Only):

Past

1983-1986 Developmental Effects of Environmental Lead Exposure.
National Institute of Child Health and Human Development, R01 HD17407
The goal of this project was to extend follow-up to 4 years of age of a birth cohort to

understand the relationship between children's exposure to lead and their neurodevelopment.

1985-1990 Neurodevelopmental Effects of Low Level Lead Exposure
National Institute of Environmental Health Sciences; Research Career Development Award, K04 ES00138
This RCDA salary award supported me as I sought additional training in neuropsychology at the Community Neurodevelopment Clinic at the Massachusetts Mental Health Center and a master's degree in Epidemiology from the Harvard School of Public Health.

1987-1990 Late Neuropsychologic Cost of Childhood Lead Exposure
National Institute of Environmental Health Sciences; subcontract from the University of Pittsburgh School of Medicine, R01 ES04095
The goal of this project was to estimate the economic costs associated with childhood lead exposure.

1988-1992 Environmental Lead and Children's Psychologic Function.
National Institute of Child Health and Human Development, R01 HD25114
The goal of this project was to extend follow-up to 10 years of age of a birth cohort to understand the relationship between children's exposure to lead and their neurodevelopment.

1991-1993 Low-Level Lead Exposures and Childhood Behavior Problems.
National Institute of Environmental Health Sciences, R01 ES05482
The goal of this project was to analyze data from a large cohort of children for whom lead concentration in shed deciduous teeth and cord blood was measured and evaluated in relation to teacher ratings of the children's school behavior.

1992-1994 An Evaluation of Developmental Disabilities in Relation to Environmental Exposures in Groton, Massachusetts.
Agency for Toxic Substances and Disease Registry; subcontract from Massachusetts Department of Public Health, H75/ATH198373
The goal of this project was to determine whether children living in proximity to a site contaminated by trichloroethylene showed neurodevelopmental deficits compared to community controls.

1996-2001 Neurodevelopmental Bases of Learning Disabilities.
National Institute of Child Health and Human Development; PI Core C and Project 2, P50 HD33803
The goal of this center grant was to evaluate low-level information processing in 7-11

year old children referred to the Learning Disabilities Program at Boston Children's Hospital and community controls.

1996-2006 Health Effects of Dental Amalgams in Children.
National Institute of Dental Research; subcontract from New England Research Institutes, U01 DE11886
The goal of this randomized trial was to determine whether the use dental amalgam (which contains elemental mercury) or composite resin to restore caries was associated with different neuropsychological and renal outcomes in children.

1997-2001 Neuropsychological Outcomes of Neonatal Brain Injuries.
National Institute of Neurological Diseases and Stroke; subcontract from Columbia Presbyterian Medical Center, R01 NS36285
The goal of this project was to evaluate neuropsychological outcomes of children born prematurely.

1998-2003 Lead Dose Biomarkers, Reproduction, and Infant Outcome.
National Institute of Environmental Health Sciences; subcontract from Brigham and Women's Hospital, R01 ES07821
The goal of this project was to evaluate the relationship between biomarkers of prenatal lead exposure and children's birth outcomes, growth, and neurodevelopment.

2001-2006 Neurobehavioral Sequelae of Cardiac Surgery.
National Heart, Lung, and Blood Institute, R01 HL64951
The goal of this project was to compare the neuropsychological outcomes of children with an atrial septal defect that was repaired either surgically or by means of a transcatheter device.

2003 Manganese Neurotoxicity in Children.
Harvard University Milton Fund
The goal of this pilot project was to evaluate the relationship between hair manganese level and the neuropsychological outcomes of 10 and 11 year old children living in the area of a Superfund hazardous waste site in Oklahoma.

2004-2009 Interdisciplinary Training: Neurodevelopmental Toxicology.
National Institutes of Health, T32 MH073122
The purpose of this training grant was to provide training in the disciplines involved in assessing neurodevelopmental toxicity in children: toxicology, neurodevelopment, exposure assessment, nutrition, genetics, social context.

Current

2008-2013 Metal Exposures and Children's Preschool Neurodevelopment.
National Institute of Environmental Health Sciences, R01 ES016283
Total direct costs: $2,134,286
The goal of this project is to conduct neurodevelopmental outcomes at age5-7 years of children in a birth cohort in Ottawa County, Oklahoma, the location of the Tar Creek Superfund site.

2010-2015 Superfund Metal Mixtures, Biomarkers, and Neurodevelopment.
National Institute of Environmental Health Sciences P42 ES16454
Total direct costs: $7,380,370
The goal of the 6 projects and 3 cores of this Center grant is to conduct biomedical and environmental science research on the impact of children's exposures to environmental metal contaminants (lead, arsenic, manganese) on their neurodevelopment, including gene-by-environment interactions, as well as to understand the routes and pathways of exposure.

2010-2015 Effects of general anesthesia vs. regional anesthesia on infant neurodevelopment and apnea
National Institute of Child Health and Human Development, R01 HD061336
Total direct costs: $1,650,499
The goal of this randomized clinical trial is to determine whether the use of general anesthesia versus regional anesthesia in children undergoing inguinal hernia repair is associated with different neurodevelopmental outcomes at age 2 years and different apnea outcomes post-operatively.

Report of Local Teaching and Training

Undergraduate and Graduate Students

Undergraduate degree:
Board of Honors Tutor, Department of Psychology, Harvard University (one of a select number of non-department members allowed to chair a thesis committee)

- Cinthia Guzman (1999-2000); Role: Committee member
- Farhana Sharmeen (2006-2007): Role: Committee member (chair)

Master's degree:
- C. Paula Weiss, Tufts University (1982); Role: committee member
- Paul Beckinsale, University of Adelaide (Australia) (1991); Role: Outside examiner
- Jane Burns, University of Adelaide (Australia) (1993); Role: Outside Examiner

Doctoral degree:

- Rivka Perlman, Boston University (1982-1984);private practice; Role: Committee member
- C. Paul Weiss, Boston College (1982-1984); Role: Committee member
- Alan Schell, Boston University (1987-1990); Role: Committee member
- Rohko Kim, Harvard School of Public Health (1993-1995); Role: Committee member
- Rebecca Ovadia, Harvard Graduate School of Education (1994-1996); Role: Committee member
- Karen Visconti, Boston University (1996-1998); Role: Committee member
- Nuala McGrath, Harvard School of Public Health (2001-2002); Role: Committee member
- Adrienne Ettinger, Harvard School of Public Health (2001-2003); Role: Committee member
- Russell Roberts, Griffiths University (Australia) (2002); Role: Outside Examiner
- Pradeep Rajan, Harvard School of Public Health (2004-2006); Role: Committee member
- Shakira Franco, Harvard School of Public Health (2004-2006), Role: Committee member
- Ananya Roy, Harvard School of Public Health (2005-2008), Role: Committee Chair
- Birgit Claus, Harvard School of Public Health (2006-2010), Role: Committee member
- Sara Cabelli, Harvard School of Public Health (2007-2011), Role: Committee member
- Timothy Ciesielski, Harvard School of Public Health (2009-2011), Role: Committee member
- Gamola Fortenberry, University of Michigan School of Public Health, committee member
- Jannah Tauheed, Harvard School of Public Health (2012-), Role: Committee chair
- Johanna Calderon, Universite Paris Descartes. Role: Member of Thesis Jury
- Kathryn Taylor, Harvard School of Public Health (2014-), Role: Committee member
- Kelsey Gleason, Harvard T.H. Chan School of Public Health (2015-), Role: Committee member

Post-Graduate Students:

1991-2001	Director of Research, Behavioral Pediatrics Fellowship, Children's Hospital; approximately two new fellows per year in 3-year program
1997-1999	Marinelle Payton, M.D., Ph.D.
2003-2005	Gehan Roberts, M.D., Behavioral Pediatrics Fellowship Program (Children's Hospital Boston)
2004-2008	Patricia Stram, M.D., Behavioral Pediatrics Fellowship Program (Children's Hospital Boston)
2004-2009	Director, Interdisciplinary Postdoctoral Training Program in Neurodevelopmental Toxicology, Department of Environmental Health, Harvard School of Public Health (5 fellows)
2007-2010	Maryse Bouchard, Ph.D.
2008-2010	Mena Nabih Fawzy Bassily, M.D.
2011-2012	Joe Braun, Ph.D.
2014-2016	Johanna Calderon, Ph.D.

Formal Teaching of Peers:

1985 Primary Care Pediatrics, one lecture
1989 Human Teratogens, one lecture
1989 Pediatrics: Progress and Promise, one lecture
1991 Child Neurology, one lecture
1992 Brain Injury and Pediatric Cardiac Surgery, one lecture
1994 Human Teratogens, one lecture
1995 Human Teratogens, one lecture
2011 Human Teratogens, one lecture
2001 Advances in Pediatric Health Care, one lecture
2001 Cardiology, (Children's Hospital of Philadelphia), one lecture
2003 Human Teratogens, one lecture
2003 Annual Update on Pediatric Cardiovascular Disease (Children's Hospital of Philadelphia), one lecture
2004 Annual Update on Pediatric Cardiovascular Disease (Children's Hospital of Philadelphia), one lecture
2004 Human Teratogens, one lecture
2006 Neonatal Update: Cardiac Issues in the Neonate (University of Massachusetts Medical Center)
2007 Human Teratogens, one lecture
2008 Human Teratogens, one lecture
2009 Human Teratogens, one lecture
2013 Human Teratogens, one lecture
2015 Human Teratogens, one lecture

Local Invited Presentations:
No presentations below were sponsored by outside entities.

1984 Department of Behavioral Sciences, Harvard School of Public Health
1984 Grand Rounds, Department of Pediatrics, Massachusetts General Hospital
1992- Guest lecturer in Environmental and Occupational Epidemiology, Harvard School of Public Health (1-3 lectures/year)
1992 Metals Epidemiology Group, Harvard School of Public Health
1992 Joint Program in Neonatology, Brigham and Women's Hospital
1995 Psychiatric Statistics Group, Harvard School of Public Health
2004 Grand Rounds, Department of Obstetrics and Gynecology, Massachusetts General Hospital
2005 Grand Rounds, Department of Psychiatry, Children's Hospital Boston
2005 Neonatal Epidemiology Clinical Research Seminar, Beth Israel Deaconess Medical Center

Report of Regional, National and International Invited Teaching and Presentations

Invited Teaching Presentations/ Seminars:

Regional

No presentations below were sponsored by outside entities

1979 Department of Psychology, Boston University

1983 Grand Rounds, Department of Pediatrics, University of Massachusetts

1985 Boston Institute for the Development of Infants and Parents

1985 Grand Rounds, Departments of Pediatrics and Pediatric Neurology, Boston City Hospital

1987 New England Consortium of Childhood Lead Poisoning Prevention programs, Newport, RI

1988 Department of Environmental Health, University of Connecticut

1991 Grand Rounds, Department of Child Psychiatry, Bradley Hospital, CT

1991 Grand Rounds, Department of Obstetrics and Gynecology, Worcester Memorial Hospital

1991 Boston Institute for the Development of Infants and Parents

1992 Department of Neuropsychology, North Shore Children's Hospital, MA

1993 Grand Rounds, Department of Medicine, Nashoba Hospital, MA

1994 Department of Community Health, Brown University

1995 Longwood Behavioral Neuroscience Seminar

1996 Grand Rounds, Department of Pediatrics, Cambridge Hospital, MA

1998 Boston Institute for the Development of Infants and Parents

2000 Department of Pediatrics, Boston Medical Center

2000 Department of Psychiatry, University of Massachusetts Medical Center

2002 Department of Pediatrics, Boston Medical Center

2004 Department of Environmental Health, Boston University School of Public Health

2004 Department of Pediatrics, Boston Medical Center

2005 Longwood Behavioral Neuroscience Seminar

2005 Neuropsychology Rounds, North Shore Children's Hospital

2008 Research Laboratory, US Environmental Protection Agency, Research Triangle Park, NC

2009 Department of Environmental Health, Boston University School of Public Health

National

No presentations below were sponsored by outside entities

1992 Grand Rounds, Department of Pediatrics, Dartmouth-Hitchcock Medical Center, NH

1993 Institute of Comparative and Environmental Toxicology, Cornell University

1996 Grand Rounds, Department of Pediatrics, University of Illinois College of Medicine

1997 Department of Preventive Medicine, Environmental Toxicology Program, University of Wisconsin

1998 Grand Rounds, Department of Pediatrics, Medical University of South Carolina

2000 Institute of Comparative and Environmental Toxicology, Cornell University

2002 Grand Rounds, Department of Pediatrics, University of California-Davis Medical Center

2003 Department of Epidemiology, University of North Carolina School of Public Health

2005 Department of Environmental and Occupational Health, University of Washington School of Public Health

2005 Environmental and Occupational Health Sciences Institute, Rutgers University

2006 Department of Nutrition, Children's Hospital of Philadelphia

2006 Department of Cardiology, Children's Hospital of Philadelphia

2008 Neurotoxicology Division, National Health and Environmental Effects

2009 Center for Drug Evaluation and Research, U.S. Food and Drug Administration, Silver Spring, MD

2011 Division of Nutritional Sciences, Cornell University, Ithaca, NY

2011 M.I.N.D. Institute, Distinguished Lecturer Series, University of California at Davis, Davis, CA

2013 Superfund Research Program, Brown University School of Medicine

2016 Interdisciplinary Environmental Toxicology Program, University of Illinois, Champaign-Urbana

2016 Grand Rounds, Department of Pediatrics, Montefiore Medical Center

2017 Grand Rounds, Department of Pediatrics, Oregon Health Sciences University, Portland, OR

2017 Department of Cardiology, Oregon Health Sciences University, Portland, OR

2018 Grand Rounds, Department of Environmental Medicine, Icahn School of Medicine at Mount Sinai, New York, NY

International

No presentations below were sponsored by outside entities

1994 Institute of Pharmacology, University of Zurich, Switzerland

2004 Department of Environmental Health Engineering, Sri Ramachandra Medical College, Chennai, India

2009 Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania

2009 St. John's Institute for Population Health and Clinical Research, Bangalore, India

2010 Faculty of Health Sciences, Simon Fraser University, Vancouver, BC, Canada

2012 Department of Cardiology, Children's Hospital of Fudan University, Shanghai, People's Republic of China

2013 Department of Cardiology, Children's Hospital of Fudan University, Shanghai, People's Republic of China

2013 Department of Cardiology, Hopital Necker-Enfants Malades, Paris, France

2014 Department of Cardiology, Xiamen Children's Hospital, Xiamen, People's Republic of China

2015 Department of Toxicology, Universidad de la Republica Oriental del Uruguay, Montevideo, Uruguay

2016 Department of Environmental Health, Mongolian National University of Medical Sciences, Ulaan Baatar, Mongolia

Invited Conference Presentations:

Regional

No presentations below were sponsored by outside entities

1982 Lead in gasoline: Adverse health effects.
Massachusetts Department of Public Health.

1982 Lead poisoning in children: An environmental hazard.
Massachusetts Department of Public Health.

1986 Neurodevelopmental toxicity of lead.
Annual meeting of Directors, Mental Retardation Research Centers, NICHHD, Boston, MA.

1986 Lead and Learning Disabilities: The Effects of Lead on Learning and Development.
A Panel Discussion. Massachusetts Department of Public Health and the Conservation Law Foundation, Boston, MA.

1986 The epidemiology of childhood lead exposure.
"Lead exposure among black children in Boston", Trotter Institute, University of Massachusetts at Boston.

1987 Low-level lead exposure during pregnancy
New England Consortium of Childhood Lead Poisoning Prevention Programs, Newport, RI.

1988 Childhood lead poisoning
Connecticut Association of Housing Code Enforcement Officials, Niantic, CT.

1990 Long term effects of exposure to low levels of lead during childhood.
"Connecticut's Environmental Health Concerns '90", Storrs, CT.

1991 Chronic low concentration lead encephalopathy.
"Environmental and Occupational Disease: A State-of-the-Art Conference for Pathology

Educators", Sugarbush, VT.

1992 Effects of lead poisoning on cognitive development in children.
Second Annual Housing Court Conference. "Getting the Lead Out: How & Why", Massachusetts Trial Court Judicial Institute and The Housing Court Department.

1993 Lead and child development.
State-of-the-Art Lecture, Society for Behavioral Pediatrics, Providence, RI.

1995 Neuropsychology and neurotoxicity: Lessons from lead.
Massachusetts Neuropsychological Society First Annual Spring Symposium, Boston, MA.

1995 Neurodevelopmental effects of low-level lead exposure in children.
American Trial Lawyers Association Annual Convention, Boston, MA.

1995 Developmental neurotoxicity of low-level lead exposure/ Keynote address
Raymond D. Adams Conference, "Lead Poisoning: Prevention, Research and Treatment", Shriver Center, Waltham, MA.

1997 Lead and children's neuropsychologic function.
Massachusetts State Lead Nurses Association Annual Conference, Westboro, MA.

2000 Environmental chemicals and children's development.
"Emerging Issues for Internationally Adopted Children", The Parent Network for the Post Institutionalized Child, Quincy, MA.

2008 Estimation and interpretation of neurobehavioral benefits and risks of seafood consumption in children.
(Workshop on Risks of PCB Exposure and Benefits Associated with Consumption of Marine Fish.)Massachusetts Department of Public Health and Harvard School of Public Health, Boston, MA

2008 Current lead research.
Getting to Zero: Eliminating Childhood Lead Poisoning in Rhode Island, Warwick, RI

2009 The expanding view of lead-associated morbidities in children.
"Toxic Environmental threats to Children's Development: What We Know and What We Can Do," Annual Conference, Boston Institute for the Development of Infants and Parents, Boston, MA

2012 Developmental signatures of children with congenital heart disease. Cardiac Neurodevelopmental Symposium, Boston, MA

2016 Epidemiology of Lead Poisoning. Local Environmental Action 2016, Boston, MA

2016 A Public Health Perspective on Lead Poisoning, Harvard Law School

National

No presentations below were sponsored by outside entities

1982 Studies in low-level lead toxicity.

Presented as part of a symposium: "Problems in Psychological Development: Brain Mechanisms in Cause and Cure", Columbia University, New York, NY.

1984 The Boston Prospective Lead Study.
Second International Conference on Prospective Lead Studies, Cincinnati, OH.

1984 Developmental effects of prenatal and early postnatal lead exposure.
Second International Conference on Prospective Lead Studies, Cincinnati, OH.

1987 Low-level lead toxicity and child development: The importance of age at exposure, age at outcome assessment, and social class.
"Health Effects of Lead Exposure: New Research Findings", Annual Meeting of the Center Grant Directors, National Institute of Environmental Health Sciences, Rochester, NY

1987 Prospective studies of prenatal and early postnatal lead exposure.
"Preventing Lead Poisoning in Young Children: New Perspectives on a Persistent Problem", Health Officers Association of California, San Francisco, CA.

1987 Risk Assessment in Reproductive and Developmental Toxicology.
Workshop, National Center for Toxicological Research, Little Rock, AR.

1987 Low-level lead toxicity and child development: The importance of age at exposure, age at outcome assessment, and social class.
National Advisory Council of the National Institute of Environmental Health Sciences, Research Triangle Park, NC.

1987 Low-level lead exposure and child development.
"Childhood Lead Poisoning: Current Perspectives", Indianapolis, IN.

1987 Effects of lead on pregnancy.
"Childhood Lead Poisoning: Current Perspectives", Indianapolis, IN.

1988 Lead-the silent epidemic: A conference on an environmental hazard.
School District of Philadelphia and Philadelphia Citizens for Children and Youth, Philadelphia, PA.

1988 Prenatal lead exposure: Effects on neonatal status and early growth and development.
Fourth Annual Conference for Prevention of Mental Retardation and Developmental Disabilities, Buffalo, NY.

1988 Low-level lead exposure as a risk factor for developmental, neuropsychologic, and academic dysfunction in children.
"NIEHS Research Highlights", Directors' Meeting, ILO/UNEP/WHO International Programme on Chemical Safety, Research Triangle Park, NC.

1989 Effects of lead on cognitive development: Results from the Boston Study.
"Advances in Lead Research: Implications for Environmental Health", National Institute of Environmental Health Sciences, Research Triangle Park, NC.

1988 Low-level lead exposure and children's health: An epidemiologic perspective/ Keynote address
Genetic and Environmental Toxicology Association of Northern California, San Francisco,

CA

1989 Prenatal/early postnatal exposure to lead and risk of developmental impairment.
"Research in Infant Assessment", Association for Children with Learning Disabilities, Miami Beach, FL.

1989 Status Report: Boston Prospective Lead Study.
EPA/ILZRO Lead Developmental Effects Workshop, Research Triangle Park, NC.

1989 Summary of recent research findings..
"Lead Poisoning and its Prevention: A Medical Update", Baltimore City Health Department, Baltimore, MD

1989 Cognitive sequelae of low level lead exposure: Implications of recent findings.
"Updates on Developmental and Behavioral Pediatrics", American Academy of Pediatrics, Chicago, IL.

1990 Lead Poisoning: Implications of new research.
192nd Annual Meeting of the Medical and Chirurgical Faculty of Maryland, Ellicot City, MD.

1990 Lead-associated learning impairment.
Education Commission of the States National Forum and Annual Meeting, Seattle, WA.

1990 Neurotoxicants and learning disabilities in children.
Second Scientific Assembly for Environmental Health, Houston, TX.

1990 The long term effects of exposure to low doses of lead in childhood..
Western New York Regional Conference on Childhood Lead Poisoning Prevention, Geneseo, NY

1991 Ongoing prospective studies-Neurobehavioral effects.
"Getting the Lead Out: Priorities for the 1990's- Research and Clinical Management" 12th Annual Scientific Meeting of the Universities Occupational and Safety and Health Educational Resource Center, Rutgers University, New Brunswick, NJ.

1991 Neurotoxicant exposure and learning disabilities in children.
First Annual Environmental Health Conference, Houston, TX.

1991 Neurobehavioral effects of lead.
"Preventing Childhood Lead Poisoning: The First Comprehensive National Conference", Alliance to End Childhood Lead Poisoning, Washington, DC.

1991 Behavioral and psychological indices of lead neurotoxicity in children.
Ninth International Neurotoxicity Conference, "New Dimensions of Lead Neurotoxicity: Redefining Mechanisms and Effects", Little Rock, AR.

1992 Developmental and cognitive toxicity of lead: Recent data and their interpretation.
"Controversies in screening and treatment of lead poisoning", American Academy of Pediatrics, San Francisco, CA.

1993 Childhood lead intoxication: A case study of the contribution of neurobehavioral toxicology to public policy debates/ Keynote address
Neurobehavioral Teratology Society, Tucson, AZ.

1993 Recent studies of lead and child development.
Society for Environmental Geochemistry and Health, New Orleans, LA.

1993 Lead and child development.
Pennsylvania Childhood Lead Poisoning Prevention Programs, Harrisburg, PA.

1994 Current research and the uses and limits of neuropsychological evidence in childhood lead cases.
Mealey's National Lead Litigation Conference 1995, Philadelphia, PA.

1994 Developmental effects of lead poisoning.
"Childhood Lead Poisoning Prevention: Making A Difference", Philadelphia, PA.

1996 Getting the lead out: A case study of environmental pollution and child development.
MillerComm96 lecture, University of Illinois at Urbana-Champaign, IL.

1997 What psychologists, teachers, and parents need to know about lead, health, and learning/ Keynote address
"Look Out for Lead '97", Madison, WI.

1997 Effect modification in epidemiologic studies of neurotoxicants.
"Environmental Factors: Modulators of Development", Neurobehavioral Teratology Society, Palm Beach, FL.

1997 Health consequences of very low lead concentrations/ Keynote address
"Lead in the Northwest 2: Changing Solutions to an Emerging Problem", Portland OR.

1997 Neurobehavioral toxicity of childhood lead exposure.
Fourth Annual New York State Lead Conference, Purchase, NY.

1997 Assessing neurobehavioral effects of environmental toxicants on children: Options and issues.
"EPA/NHEERL Workshop on the Assessment of Health Effects of Pesticide Exposures in Young Children", El Paso, TX.

1998 Current status of the Boston Circulatory Arrest Study.
"'98 Outcomes: Cardiovascular Surgery and Neurobehavioral Outcomes", Key West, FL.

1998 Developmental effects of lead.
"Children at Risk: Environmental Health Threats in the Great Lakes Region", Chicago, IL.

2000 Epidemiologic considerations for a national longitudinal study of endocrine disruptors in children.
New York Institute of Medicine, New York City.

2000 Assessment of developmental neurotoxicity in humans. Presented as part of the symposium "Interpretation of Data on Developmental Neurotoxicity". 40th Annual Meeting of the Teratology Society, Palm Beach, FL

2000 Methyl mercury and PCB studies: A look at the big picture
18th International Neurotoxicology Conference, Colorado Springs, CO.

2000 School performance in children with congenital heart disease

American Heart Association 73rd Scientific Sessions, New Orleans.

2001 Human neurobehavioral testing in the chemical risk assessment process.
Children's Environmental Health-Developing a Risk Assessment Framework, Monterey, CA.

2002 Recent findings on the effects of lead on children's health and development.
15th World Congress, International Physicians for the Prevention of Nuclear War and the Physicians for Social Responsibility, Washington, D.C.

2002 Recent studies on the health effects of methylmercury.
42nd Annual Meeting of the Teratology Society, Scottsdale, AZ

2002 Children's exposures to chemicals: Incorporating neurodevelopment in the risk assessment process/ Keynote Address
Fourth Annual UC Davis CEHS Conference for Environmental Health Scientists, Napa, CA

2003 Neurobehavioral studies of environmental toxicants: What do we need to do next?
Children's Environmental Health: Identifying and Preventing Environmental Health Threats to Children, Washington, D.C.

2003 Lead and children's neurodevelopment.
5th National Conference on Tar Creek, Miami, Oklahoma

2003 Update on the reproductive risks of prenatal exposure to lead.
43rd Annual Meeting of the Teratology Society, Philadelphia, PA

2004 What is an adverse effect?
21st International Neurotoxicology Conference, Honolulu, HI

2004 Mercury in seafood: potential health risks.
Global Environmental Change: The Science and Human Health Impacts: A Course for Senior Congressional Staff, Warrenton, VA

2004 Environmental toxicants and child development. New Perspectives on Pediatric Brain Injury
Children's Memorial hospital and Feinberg School of Medicine, Northwestern University, Chicago, IL

2004 Exposure to metals and neurodevelopmental disorders in children.
International Meeting for Autism Research, Sacramento, CA

2004 Discussant, How do prenatal exposures affect intelligence?
Society for Epidemiologic Research, Salt Lake City, UT

2004 Lead neurotoxicity in children: A research update.
A Clinical Summit: Lead Throughout the Life Cycle, Alameda County Childhood Lead Poisoning Prevention Program, Oakland, CA

2004 How safe is our seafood: Toxicology 101
Seafood Summit, Chicago, IL

2005 Mercury and children's health: From research to policy to practice.

Controversies and Advances in Pediatric Environmental Health, Seattle, WA

2005 A pilot study of metal exposures and neuropsychological function in school-age children.
7th National Conference on Tar Creek, Miami, OK

2006 Children's cognitive health: The influence of environmental chemical exposures.
13th International Symposium on Functional Medicine, Tampa, FL

2006 Balancing the risks and benefits of maternal seafood consumption during pregnancy.
Eighth International Conference on Mercury as a Global Pollutant, Madison, WI

2006 The Influence of the social environment on the outcomes of chemical exposures.
23rd International Neurotoxicology Conference: Neurotoxicity in Development and Aging, Little Rock, AR

2006 Neuropsychological effects of dental amalgam in children: A randomized trial.
23rd International Neurotoxicology Conference: Neurotoxicity in Development and Aging, Little Rock, AR

2006 Lead and pregnancy: epidemiology, health effects, and risk factors/ Keynote address
The New York City Forum on Lead Poisoning and Pregnancy, New York City Department of Health and Mental Hygiene, New York, NY

2007 Contaminants in the north: Fish consumption.
Alaska Forum on the Environment, Anchorage, AK

2007 Impact of childhood lead poisoning on learning and behavior.
Legislative Informational Forum on Childhood Lead Poisoning, Hartford, CT

2007 Environmental neurotoxicants and child development: Decomposing the variability in dose-effect relationships.
Symposium, Integrated Toxicology and Environmental Health Program, Duke University, Durham, NC

2007 Impaired cognition in adolescent survivors of the arterial switch operation: The Boston Circulatory Arrest Trial. Autism, ADHD, and behavioral problems following neonatal and infant heart surgery.
Children's Hospital of Philadelphia, Philadelphia, PA

2007 Interpretation of small effect sizes in neurotoxicological studies: characterizing individual versus population risk.
The 11th Meeting of the International Neurotoxicology Association, Pacific Grove, CA

2007 Pediatric lead toxicity: A research update.
They Run Better Unleaded: Childhood Lead Poisoning Prevention in Southern Nevada, Area Health Education Center of Southern Nevada, Las Vegas, NV

2007 Lead neurotoxicity and socioeconomic status: Conceptual and analytical issues.
24th Meeting of the International Neurotoxicology Conference, San Antonio, TX

2008 Environmental neurotoxicants.
45th Annual International Conference of the Learning Disabilities Association, Chicago, IL

2008 Effects of neurotoxicants on children's learning.

45th Annual International Conference of the Learning Disabilities Association, Chicago, IL

2008 Balancing the benefits and risks of seafood consumption.
47th Annual Meeting of the Society of Toxicology, Seattle, WA

2008 The Cardiovascular Neurodevelopment Program at Children's Hospital Boston.
Pediatric Cardiac Neurodevelopmental Program Planning Session. Emory University School of Medicine/Children's Healthcare of Atlanta, Atlanta, GA

2008 Lessons learned from the Boston Circulatory Arrest Trial.
Conference on Anesthesia and Neurodevelopment in Children, Columbia University, New York, NY

2008 Developmental neurotoxicity: The vulnerability of the developing brain.
5th National Seminar on the Development and Integration of Mitigation Evidence. Habeas Assistance and Training Counsel Project, Defender Services Division, Administrative Office of the U.S. Courts, Baltimore, MD

2008 Pediatric lead poisoning: A research update.
45th Annual Education Meeting, Nevada Environmental Health Association, Las Vegas, NV

2008 Epidemiology of functional CNS deficits.
48th Annual Meeting, Teratology Society, Monterey, CA

2008 Interpretation of epidemiologic studies of neurotoxicity: Conceptual and analytical issues.
32nd Annual Meeting, Neurobehavioral Teratology Society, Monterey, CA (Elsevier Distinguished Lecture)

2008 Developmental neurotoxicity.
29th Annual Capital Punishment Training Conference, NAACP Legal Defense Fund, Warrenton, VA

2008 Recent science on health impacts of lead.
10th National Conference on Tar Creek, Miami, OK

2008 Developmental neurotoxicity: The vulnerability of the developing brain.
Federal Capital Defense Strategy Session, Phoenix, AZ

2009 The vulnerability of the developing brain.
Annual meeting of the CACJ/CPDA Capital Case Defense Seminar, Monterey, CA

2009 Neurotoxicants.
Annual meeting of the CACJ/CPDA Capital Case Defense Seminar, Monterey, CA

2009 Options for pediatric neurocognitive assessment.
Exploration of the Development of Standardized Pediatric Neurological Assessments. FDA Staff College, Rockville, MD

2009 Chemical exposures and children's brain development.
Detox Your Toy Box. Friends School, Portland, ME

2009 Balancing the health benefits and risks of seafood consumption. Presented as part of the symposium, Benefits and Risks from the Sea: Balancing Nutritional Benefits with

Toxicological Risks
Annual meeting of the American Public Health Association, Philadelphia, PA

2009 Lead and neurodevelopment: Old metal, new questions.
Pediatric Environmental Health Scholars Annual Meeting, Academic Pediatric Association, Reston, VA

2010 Susceptibility and vulnerability (with Schwartz J, Glass T). Strengthening Environmental Justice Research and Decision Making: A symposium on the Science of Disproportionate Environmental Health Impacts
US Environmental protection Agency, Washington, D.C.

2010 Overview of neurodevelopmental outcomes in children with congenital heart disease.
Pediatric Assessments of Neurological and Neurocognitive Function for Cardiovascular Devices, US Food and Drug Administration, Silver Spring, MD

2011 Developmental neurotoxicity: The vulnerability of the developing brain.
Deepening our Understanding of Recurring Mitigation and Mental Health Themes, Habeas Corpus Resource Center, San Francisco, CA

2014 Lead in bullets.
15th Tar Creek Environmental Conference, Miami, OK

2014 Implications for Adolescence.
3rd Cardiac Neurodevelopmental Symposium, Atlanta, GA

2014 Lifelong Effects of Childhood Lead Exposure on Cognition and Risk of Alzheimer's Disease
International Society for Children's Health and the Environment, Whidbey Island, WA

2016 Psychosocial and Psychiatric Functioning in Congenital Heart Disease
American Academy of Pediatrics, San Francisco, CA

2017 A Population Perspective on the Neurodevelopmental Toxicity Associated with Environmental Chemicals
10th Annual Winter Symposium, Children's Environmental Health Center, Icahn School of Medicine at Mount Sinai, New York, NY

International

No presentations below were sponsored by outside entities

1986 Low-level lead exposure and early development in socioeconomically advantaged urban infants.
International Workshop on Effects of Lead Exposure on Neurobehavioral Development. Edinburgh, Scotland.

1989 Neuropsychologic effects of lead exposure on children/ Keynote address
"Environment, Health, and Lead", Sounion, Greece.

1992 Prospective studies of developmental lead toxicity.

Collegium Ramazzini, Carpi, Italy.

1994 Lead neurotoxicity.
First International Congress on Environmental Medicine, Duisberg, Germany.

1994 The neuropsychological toxicity of lead exposure in children.
Annual Conference of the Foundation for Children of the Copper Basin, Legnica, Poland.

1994 Lead neurotoxicity: Research questions/ Keynote address
"Ecological and Health Problems of Children in a Polluted Environment", Foundation for Children of the Copper Basin, Legnica, Poland.

1996 Epidemiological research design issues in environmental neurotoxicological study.
"International Conference on Environment, Life Elements and Health-Longevity", Beijing, People's Republic of China.

1996 The neuropsychological and behavioral toxicity of childhood lead exposure.
"'96 International Symposium on Prevention of Childhood Lead Poisoning", Shanghai, People's Republic of China.

1997 Epidemiologic studies of lead neurotoxicity in children.
"What on Earth: A National Symposium on Environmental Contaminants and the Implications for Child Health," Ottawa, Canada.

1998 Biological markers of lead exposure in women and children and subclinical health effects.
"Indo-US Workshop on Lead and Other Heavy Metals: Sensitive Populations at High Risk", Lucknow, India.

1998 Recognition of the unique susceptibilities of children to environmental pollutants: Recent progress in the United States. Keynote address
Annual Conference of the Foundation for Children of the Copper Basin, Legnica, Poland.

1998 Lead neurotoxicity in children.
Beijing Children's Hospital, Beijing, People's Republic of China.

1998 Epidemiological research design issues in environmental neurotoxicity: Examples from lead studies.
"98 International Symposium on Childhood Lead Poisoning Prevention", Shanghai, People's Republic of China.

1999 Neuropsychological complications following cardiac surgery in children.
2nd International Symposium on the Pathophysiology of Cardiopulmonary Bypass, Aachen, Germany.

2000 Indices of neurotoxicity in children: Moving beyond IQ.
IX International Conference, Child and Environmental Hazards, Foundation for Children of the Copper Basin, Legnica, Poland.

2000 Long-term neurological follow-up of children with congenital heart disease
German Society of Pediatric Cardiology, Berlin, Germany.

2000 US View from the National Academy of Sciences Committee on Toxicological Effects of Methylmercury

US-Japan Workshop on Human Health Effects of Low Dose Methylmercury Exposure, Minamata, Japan.

2001 Toxicological Effects of Methyl Mercury in Children: US Risk Assessment Perspective
X Anniversary International Conference, Foundation for Children of the Copper Basin, Legnica, Poland

2002 Neurodevelopment in children with congenital heart disease.
International Symposium on Developmental Pediatrics, Shanghai Children's Medical Center, People's Republic of China

2003 Neurobehavioral effects of lead on children.
Advances in Lead Toxicology, Sri Ramachandra Medical College and Research Institute, Chennai, India

2003 Subtle neurological effects on populations: Epidemiological and clinical perspectives.
An Ecosystem Approach to the Health Effects of Mercury in the Great Lakes Basin, Windsor, Ontario, Canada

2005 Interpreting the significance of deficits on neurobehavioral tests. What is an adverse effect?/ Keynote address
9th International Symposium on Neurobehavioral Methods and Effects in Occupational and Environmental Health, Gyeongju, South Korea

2005 Interpreting the significance of small effect sizes in epidemiological studies: Population versus individual risk.
8th International Symposium on Endocrine Disruption 2005, Okinawa, Japan

2006 Pesticide exposures and children's neurodevelopment in Ecuador.
Pruebas Neuroconductuales en Ninos Expuestos a Plaguicidas, Heredia, Costa Rica

2006 Neurodevelopmental outcomes in children with congenital heart disease.
41st Annual Meeting, Association of European Paediatric Cardiology, Basel, Switzerland

2006 Lead neurotoxicity in children: Knowledge gaps and research needs.
Neurotoxic Metals: Lead, Mercury and Manganese: From Research to Prevention, A Satellite Meeting of the 28th International ICOH Congress, Brescia, Italy

2007 Variability in late outcomes: reducing uncertainty.
PPTOX: International Conference Fetal Programming and Developmental Toxicity, Torshavn, Faroe Islands

2007 Developmental neurotoxicity of environmental chemicals: Where are we today?
36th Annual Meeting of the Child Neurology Society, Quebec City, Canada

2007 Factors affecting susceptibility to lead toxicity: Reducing uncertainty in predicting outcomes.
19th Annual Meeting of the International Society for Environmental Epidemiology, Mexico City, Mexico

2008 Multi-causality: Co-causal factors and neurodevelopmental disorders.
Multi-Causality and Complexity: Implications for Evaluating Evidence and Precautionary

Prevention, European Environment Agency, Copenhagen, Denmark

2008 Source attribution issues with regard to chemicals in food.
Source Attribution Task Force of the Foodborne Disease Burden Epidemiology Reference Group, World Health Organization, Kuala Lumpur, Malaysia

2008 Environmental chemicals and child development.
XXVIVth International Congress of Psychology, Berlin, Germany

2011 A framework for estimating the contribution of environmental chemicals to children's neurodevelopment.
26th Annual Mortimer D. Sackler Winter Conference in Developmental Psychobiology, Herradura, Costa Rica

2011 Lead exposure in Bangladesh.
9th International Conference on Arsenic. Health and Water Supply Management, Affordability, and Sustainability. Dhaka Community Hospital, Dhaka, Bangladesh

2011 Recent studies on the effects of lead on children, dose-effect relationships, and modifiers of risk.
XVII International Conference, Foundation for Children of the Copper Basin, Legnica, Poland

2011 Comparing the neurodevelopmental burdens associated with chemicals and other risk factors.
XVII International Conference, Foundation for Children of the Copper Basin, Legnica, Poland

2011 A comparative analysis of the neurodevelopmental burden associated with children's exposures to chemicals and other risk factors.
13th International Neurotoxicology Association Meeting & 11th International Symposium on Neurobehavioral Methods and Effects in Occupational and Environmental Health, Xi'an, China (Jakob Hooisma Memorial Lecture)

2012 CNS effects of lead on children.
International Congress on Occupational Health, Cancun, Mexico

2012 Steps toward estimating the global burden of disease associated with methylmercury exposure.
Chemical and Toxin Task Force, Foodborne Disease Burden Epidemiology Reference Group, World Health Organization, Bilthoven, The Netherlands

2012 Lessons from the Boston Circulatory Arrest Trial.
The 4th Shanghai Symposium on Pediatric cardiovascular Disease, Shanghai, People's Republic of China

2012 Congenital Heart Disease and Neurodevelopment-An Overview.
The 4th Shanghai Symposium on Pediatric Cardiovascular Disease, Shanghai, People's Republic of China

2012 The Cardiac Neurodevelopment Program at Boston Children's Hospital.
Training in Pediatric Cardiology, Ministry of Health, Shanghai, People's Republic of

China

2013 Assessing the Public Health Import of Children's Exposures to Metals.
XII Symposium on Metal Ions in Biology and Medicine, Punda del Este, Uruguay

2014 Children's Vulnerability to Environmental Chemicals. 1st Latin American Conference on Clinical and Laboratorial Toxicology, Port Alegre, Brazil

2014 Characterizing the Public Health Importance of Children's Exposures to Environmental Chemicals. 1st Latin American Conference on Clinical and Laboratorial Toxicology. Port Alegre, Brazil

2014 Important Considerations in Neurobehavioral outcome Studies. International Anesthesia Research Society, Montreal, Canada

2014 Neurodevelopmental Outcomes in Children after Repair of Congenital Heart Disease.
5th Shanghai Symposium on Pediatric Cardiovascular Disease, Shanghai, People's Republic of China

2014 Lead and Child Development.
Environment and Child Brain Development, Centre for Research in Environmental Epidemiology, Barcelona, Spain

2014 Beyond Neuropsychology.
Environment and Child Brain Development, Centre for Research in Environmental Epidemiology, Barcelona, Spain

2014 Emerging Issues in Lead Neurotoxicology, International Society of Environmental Epidemiology Asia Chapter, Shanghai, People's Republic of China

2014 Estimating the Neurodevelopmental Burden of Children's Exposures to Environmental Chemicals. International Society of Environmental Epidemiology Asia Chapter, Shanghai, People's Republic of China

2014 Boston Children's Hospital Cardiac Neurodevelopment Program, Xiamen Children's Hospital, Xiamen, People's Republic of China

2015 Lessons from the Boston Circulatory Arrest Study.
3rd Oriental Congress of Pediatrics, Shanghai, People's Republic of China

2015 Characterizing the Public Health Impact of Children's Exposures to Chemicals.
International Symposium on Environmental Medicine, Taipei, Republic of China

2015 Mercury: Health Effects, Regulatory Standards, and Advisories. Subregional Workshop for Enhancing Capacity in Environmentally Sound Management of Mercury Waster, Montevideo, Uruguay

2017 The Global Burden of Children's Exposures to Neurotoxic Chemicals. 3rd International Conference on Public Health, Kuala Lumpur, Malaysia (keynote address)

2017 Enhancing Executive Functioning in Children with Congenital Heart Disease. 6th Shanghai Symposium on Pediatric Cardiovascular Disease, Shanghai, People's Republic of China

Report of Scholarship

1. **Bellinger D**. Socialization experiences of children in Israeli kibbutzim. Teaching of Psychology 1974; 1: 92-94. (film reviews)

2. **Bellinger D**. The Harper and Row Developmental Film Series. Behavioral and Social Science Teacher 1974; 1: 139-142. (film reviews)

3. **Bellinger D**. Changes in the explicitness of mothers' directives as children age. Journal of Child Language 1979; 6: 443-458.

4. **Bellinger D**. Consistency in the pattern of change in mothers' speech: Some discriminant analyses. Journal of Child Language 1980; 7: 469-487.

5. Needleman H, **Bellinger D**, Leviton A. Does lead at low dose affect intelligence in children? A reply to Ernhart et al. Pediatrics 1981; 68: 894-896.

6. Needleman H, **Bellinger D**. The epidemiology of low-level lead exposure. Journal of the American Academy Child Psychiatry 1981; 20: 496-512.

7. **Bellinger D**, Needleman H. Low level lead exposure and psychological deficit in children. In: Wolraich M, Routh D, editors. Advances in Developmental and Behavioral Pediatrics, vol. 3. Jai Press, 1982, pp. 1-49.

8. Needleman H, Leviton A, **Bellinger D**. Lead-associated intellectual deficit. New England Journal of Medicine 1982; 306: 367. (letter)

9. **Bellinger D**, Berko Gleason J. Sex differences in parental directives to young children. Sex Roles 1982; 8: 1123-1139.

10. **Bellinger D**, Needleman H. Lead and the relationship between maternal and child intelligence. Journal of Pediatrics 1983; 102: 523-527.

11. **Bellinger D**, Needleman H, Bromfield R, Mintz M. A follow-up study of the academic attainment and classroom behavior of children with elevated dentine lead levels. Biological Trace Element Research 1984; 6: 207-223.

12. **Bellinger D**, Needleman H, Leviton A, Waternaux C, Rabinowitz M, Nichols M. Early sensory-motor development and prenatal exposure to lead. Neurobehavioral Toxicology and Teratology 1984; 6: 387-402.

13. Rabinowitz M, Leviton A, **Bellinger D**. Home refinishing, lead paint, and infant blood lead levels. American Journal of Public Health 1985; 75: 403-404.

14. Rabinowitz M, Leviton A, Needleman H, **Bellinger D**, Waternaux C. Environmental correlates of infant blood lead levels in Boston. Environmental Research 1985; 38: 96-107.

15. **Bellinger D**, Leviton A. Waternaux C, Allred E. Methodological issues in modeling the relationship between low-level lead exposure and infant development: Examples from the Boston Lead Study. Environmental Research 1985; 38: 119-129.

16. Needleman H, **Bellinger D**. The developmental consequences of childhood exposure to lead: Recent studies and methodological issues. In: Lahey B, Kazdin A, editors. Advances in Clinical Child Psychology, vol. 6. New York: Plenum Press; 1984, pp. 195-220.

17. **Bellinger D**, Needleman H. Prenatal and early postnatal exposure to lead: Developmental effects, correlates, and implications. International Journal of Mental Health 1985; 14: 78-111.

18. **Bellinger D**, Leviton A, Needleman H, Waternaux C, Rabinowitz M. Low-level lead exposure and infant development in the first year. Neurobehavioral Toxicology and Teratology 1986; 8: 151-161.

19. Leviton A, **Bellinger D**. Is there a relationship between otitis media and child development? In: Kavanagh J, editor. Otitis Media and Child Development. Parkton, MD: York Press, 1986, pp. 99-106.

20. **Bellinger D**, Leviton A, Rabinowitz M, Needleman H, Waternaux C. Correlates of low-level lead exposure in urban children at two years of age. Pediatrics 1986; 77: 826-833.

21. **Bellinger D**, Leviton A, Waternaux C, Needleman H, Rabinowitz M. Longitudinal analyses of pre- and postnatal lead exposure and early cognitive development. New England Journal of Medicine 1987; 316: 1037-1043. (abstracted in 1988 Yearbook of Perinatal/Neonatal Medi**C**ine)

22. Rabinowitz M, **Bellinger D**, Leviton A, Needleman H, Schoenbaum S. Pregnancy hypertension, blood pressure during labor, and umbilical cord blood lead concentration. Hypertension 1987; 10: 447-452.

23. Rabinowitz M, **Bellinger D**. The soil lead-blood lead relationship among Boston children. Bulletin of Environmental Contamination and Toxicology 1988; 41: 791-797.

24. **Bellinger D**. Fetal lead exposure. Health and Environment Digest 1988; 2: 3-5.

25. Needleman H, **Bellinger D**. Commentary: Recent developments. Environmental Research 1988; 46: 190-191.

26. **Bellinger D**, Matthews J. In utero exposure to lead: Sources, assessment and sequelae. Genetic Resource 1988; 4: 21-26.

27. **Bellinger D**, Leviton A, Waternaux C, Needleman H, Rabinowitz M. Low-level lead exposure, social class, and infant development. Neurotoxicology and Teratology 1988; 10: 497-503.

28. **Bellinger D**, Leviton A, Waternaux C. Lead, IQ, and social class. International Journal of Epidemiology 1989; 18: 180-185.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

National Primary Drinking Water Regulations: Lead and Copper Rule Revisions,

84 Fed. Reg. 69,695 (Dec. 19, 2019)

ATTACHMENT 3

3Ts: TRAINING, TESTING, TAKING ACTION MODULE 5: CONDUCTING SAMPLING AND INTERPRETING RESULTS

Submitted via Regulations.gov

Docket No. EPA-HQ-OW-2017-0300

February 12, 2020

Module 5: Conducting Sampling and Interpreting Results

2-Step Sampling at the Tap

Communication Plan: Don't forget to communicate your plans to test your facility, and to prepare for communicating results. Results should be shared regardless of the lead level detected.

2-Step Sampling at the Tap

EPA recommends that schools and child care facilities conduct a 2-step sampling procedure to identify if there is lead in the outlet (e.g., faucet, fixture, or water fountain) or behind the wall (e.g., in the interior plumbing). These samples should be taken after an 8 to 18-hour stagnation period.

Please note that this section contains recommendations that are generalized for typical plumbing configurations. The **Detailed Fixture Evaluation** contains details on types of fixtures and targeted sampling.

STEP 1

250-mL First Draw Sample

Take a 250mL first draw sample at all taps used for consumption to identify potential lead in the fixture.

STEP 2

250-mL Flush Sample

If the result of Step 1 is high, take a 30-second flush sample to identify lead in the plumbing behind the fixture.

These samples can be taken in the same sampling event, which can reduce cost, and provide you with more information on lead levels. If not taking these samples at the same time, and elevated lead levels have been found in Step 1, the water should not be consumed while preparing to take the follow-up flush sample. More information on immediate steps is in **Module 6**.

Helpful Tip…

For further potential cost savings, you or the lab can collect, preserve, and hold (but not analyze) the second sample at the same time the first sample is collected, then analyze only selected Step 2 samples based on review of the Step 1 results. Most commercial labs will "Hold" samples until the client advises to dispose (at nominal cost) or analyze those samples.

Step 1: Initial First Draw Samples

Take first draw samples from fixtures throughout the building that are used for human consumption. EPA strongly recommends that you collect these samples from all outlets used for drinking or cooking, prioritizing the high-risk outlets (i.e., fixtures that are known to or potentially contain lead and fixtures that are used most frequently). The plumbing profile will help pinpoint those high-risk fixtures and to prioritize sample collection.

Important: schools and child care facilities should not use sample results from one outlet to characterize potential lead exposure from all other outlets in their facility. This approach could miss localized lead problems that would not be identified.

The first draw sample identified in Step 1 is representative of the water that may be consumed at the beginning of the day or after infrequent use. This protocol maximizes the likelihood that the highest concentrations of lead will be found because the first 250-mL sample is collected after overnight stagnation (the water sat in the pipes for at least 8 hours).

Procedures for initial outlet samples are shown below:

- All samples should be collected before the facility opens and before the fixtures have been used (EPA recommends an 8 to 18-hour stagnation period).
- One 250-mL sample should be taken at each fixture. Note this is a first-draw sample. Therefore, collect the sample immediately after opening the faucet or valve.
- Compare all sample results to prioritize follow-up sampling and remediation. Outlets with elevated lead levels should not be made available for consumption.

STEP 1

250-mL First Draw Sample

Take a 250mL first draw sample at all taps used for consumption to identify potential lead in the fixture.

High Results Due to Particulate Lead

If initial first draw sampling results reveal high lead levels in the 250-mL sample for a given outlet, a contributing source of the elevated lead levels could be the debris in the aerator or screen of the outlet. By cleaning the aerator or screen and retesting the water following the initial first draw sampling procedures, you can identify whether or not the debris is contributing to elevated lead levels.

Determining aerator/screen debris contribution:

Scenario 1: The initial sample result is 19 ppb; you decide to see if the aerator is contributing to lead in the water. After cleaning out the aerator, you take another first-draw sample. The results come back less than or close to the detection level (e.g., 1 ppb). This result indicates that the debris in the aerator was likely contributing to elevated levels in the fixture. Continue to clean the aerator on a regular basis; continued use of the outlet should be acceptable. However, please note that without regular maintenance, this outlet may serve water with elevated lead levels.

Scenario 2: The initial sample result is 22 ppb; you decide to see if the aerator is contributing to lead in the water. After cleaning out the aerator, you take another first-draw sample. The second sample result is very close or equivalent to the 22-ppb sample. Since the initial sample and post-cleaning first-draw sample results are similar, the problem is likely not the aerator.

Scenario 3: The initial first draw sample result is 60 ppb; you decide to see if the aerator is contributing to lead in the water. After cleaning the aerator, you take another first-draw sample. The post-cleaning sample result is 25 ppb. Although the results are lower, they are still high; this indicates that the aerator is likely a contributing source and that the outlet itself and/or the plumbing upstream of the aerator are contributing as well. If this situation occurs, the school should take this fixture offline, and continue with 2-step sampling, or consider the Detailed Fixture Evaluation in Appendix D to target the additional contributing sources.

* When taking a second first-draw sample, please remember to follow the same sampling procedure as the initial first-draw sample. Ensure that fixtures and outlets have been out of use for 8-18 hours, sampling before students arrive at the facility.

Picture of an aerator with particulate

Step 2: Follow-Up Flush Samples

If initial test results reveal elevated lead, follow-up flush testing described in Step 2 is recommended to determine if the lead contamination results are from the fixture or from interior plumbing components. Follow-up flush samples generally involve the collection of water from an outlet where the water has run for 30 seconds.

The purpose of Step 2 is to pinpoint where lead is getting into drinking water (i.e., fixtures versus interior plumbing) so that appropriate corrective measures can be taken.

Procedures for initial outlet samples are shown below:

- As with initial first draw samples, follow-up flush samples are to be taken before a facility opens and before any water is used. For best results, flush samples from different outlets that are in close proximity should be collected on different days. For drinking fountains or other fixtures that are manifolded closely together, a single flush sample may be representative of the shared interior plumbing.
- The sampler should be careful to maintain a consistent rate of flow when collecting flush samples.
- Open up the tap and let the water run for 30 seconds. Then, take a 250mL sample. Make sure to label this sample bottle as the flush sample.

STEP 2

250-mL Flush Sample

If the result of Step 1 is high, take a 30-second flush sample to identify lead in the plumbing behind the fixture.

Sampling Dos and Don’ts

Do:

- Follow the instructions provided by the laboratory for handling sample containers to ensure accurate results.
- Assign a unique sample identification number to each sample collected. Use a coding scheme to help differentiate samples, and don’t forget to label each sample bottle.
- Collect all water samples before the facility opens and before any water is used. The water should sit in the pipes unused for at least 8 hours but not more than 18 hours before a sample is taken.
- Learn how water flows in your facility. If there are multiple floors, it is typically recommended to sample from the bottom floor and continue up. Start sampling closest to the main and work away.

Don’t:

- Remove aerators prior to sampling. Potential sources of lead may be missed if aerators are removed, since debris could be contributing to the lead in drinking water if particles containing lead are trapped behind aerator screens.
- Flush water prior to sampling, unless instructed to do so. Flushing can be a tool to improve water quality, especially after long holidays or weekends. However, flushing prior to sampling may cause results showing lower-than representative lead levels in the water. See **Flushing Best Practices Factsheet** for more information.
- Close the shut-off valves to prevent their use prior to sample collection. Minute amounts of scrapings from the valves can produce results showing higher-than-representative lead levels in the water.

Don’t forget to maintain a record!

Recording sample information is critical to tracking and managing water quality year-over-year.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

National Primary Drinking Water Regulations: Lead and Copper Rule Revisions,

84 Fed. Reg. 69,695 (Dec. 19, 2019)

ATTACHMENT 4

AMERICAN WATER WORKS ASSOCIATION

STRATEGIES TO OBTAIN COMPLETE LEAD SERVICE LINE REPLACEMENT

Submitted via Regulations.gov

Docket No. EPA-HQ-OW-2017-0300

February 12, 2020

For the American Water Works Association's Strategies to Obtain Complete Lead Service Line Replacements document, please visit http://www.awwa.org/Portals/0/AWWA/Government/StrategiesforLSLs.pdf?ver=2013-03-29-132027-193

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

National Primary Drinking Water Regulations: Lead and Copper Rule Revisions,

84 Fed. Reg. 69,695 (Dec. 19, 2019)

ATTACHMENT 5

DECLARATION OF DR. JAMES W. BONO

IN SUPPORT OF COMMENTERS ON THE PROPOSED REVISIONS TO THE LEAD AND COPPER RULE

Submitted via Regulations.gov

Docket No. EPA-HQ-OW-2017-0300

February 12, 2020

DECLARATION OF DR. JAMES W. BONO

IN SUPPORT OF COMMENTERS ON THE PROPOSED REVISIONS TO THE LEAD AND COPPER RULE

I, Dr. James W. Bono, do declare as follows:

1. I am a Senior Vice President for Economists Incorporated, an economic consulting firm with specialties in the fields of law and economics, public policy, and business strategy. As part of this role, I conduct economic analyses, formulate and execute bid strategies for spectrum auctions, and engage in quantitative research on a wide range of topics. I have worked at Economists Incorporated since November 2013.

2. From 2008 to 2012, I was an Assistant Professor of economics at American University, where I researched and taught in areas spanning the intersection of microeconomics, game theory, machine learning, and statistics. I am the co-author of over fifteen publications and white papers in these fields. I have published articles in numerous academic journals, including the Review of Behavioral Economics, Journal of Artificial Intelligence Research, and Managerial and Decisions Economics.

3. I earned my PhD in Economics with a focus on Microeconomics from the University of California Irvine. I also hold a Bachelor of Arts in International Studies with a minor in Mathematics from American University in Washington, D.C.

4. A more complete description of my educational and work experience, as well as a list of my publications, is appended as Exhibit A to this declaration.

5. The opinions and conclusions set forth in this declaration are based upon my education, personal knowledge, and experience as well as my review of the literature, the Proposed Rule, and the document attached as Exhibit B.

Documents Relied On and Overall Conclusions

6. I have reviewed the Environmental Protection Agency's ("EPA") Proposed Rule entitled National Primary Drinking Water Regulations: Proposed Lead and Copper Rule Revisions ("Proposed Rule.") I particularly reviewed sections of the Proposed Rule that discusses a 2004 Black and Veatch survey about lead service line replacement.

7. I have also reviewed a report published by the American Water Works Association ("AWWA") entitled "Strategies to Obtain Customer Acceptance of Complete Lead Service Line Replacement" (hereinafter "AWWA Report"),[1] which is attached hereto as Exhibit B. The AWWA Report published survey results from the 2004 Black and Veatch survey referenced by EPA in the Proposed Rule.

8. The Proposed Rule claims that a 2004 Black and Veatch survey found that lead service line replacement ("LSLR") "was comprised of 72 percent partial replacement" without further clarification. In my professional opinion, the survey data is unreliable because the data is ambiguous – that is, susceptible to multiple interpretations – has a small sample size, and is not known to be unbiased with respect to the calculations made by EPA.

9. It is my opinion that EPA's claim that lead service line replacement as reflected in the Black and Veatch survey data "was comprised of 72 percent partial replacement," cannot be concluded from the Black and Veatch survey data reported by AWWA.

Survey Data is Susceptible to Multiple Interpretations

10. According to the AWWA Report, AWWA "funded Black & Veatch to conduct a survey of 65 water utilities to document lead service line management strategies and replacement techniques."[2] However, only 11 of the 65 water utilities provided detailed information on lead service line inventories and replacements in 2002 and 2003. For each of those 11 water utilities, AWWA reported data on the number of utility-owned service lines replaced and the number of customer-owned utility lines replaced.

11. The information reflected in the AWWA Report is reproduced in Table 1.

[1] Am. Water Works Association, *Strategies to Obtain Customer Acceptance of Complete Lead Service Line Replacement* (2005).
[2] *Id.* at 3.

Table 1: AWWA Reported Lead Service Line Replacements for 2002 and 2003

Utility No.	Utility-Owned LSLRs (2002)	Customer-Owned LSLRs (2002)	Utility-Owned LSLRs (2003)	Customer-Owned LSLRs (2003)
1	2000	2000	2000	2000
2	680	820	272	375
3	250	Unknown	250	0
4	746	Unknown	700	0
5	0	15	0	10
6	0	18	0	20
7	400	10	400	10
8	0	6	0	6
9	Unknown	Unknown	402	75
10	539	642	746	700
11	150	190	162	193

12. The data in the AWWA Report, reproduced in Table 1, are ambiguous and permit multiple interpretations. They do not directly report the total number of full and partial replacements. In order to know the percentage of all LSLRs that are partial versus full using this data, one needs to know the ownership structure of the replaced lines and whether the customer-owned replacements were on the same or different lines as the utility-owned replacements. But the Report did not convey that information. Accordingly, it is not possible from the data to conclude how many replacements were full lead service line replacements ("FLSLR") versus partial lead service line replacements ("PLSLR").

13. To illustrate the data's ambiguity on this point, consider Utility No. 2, reporting 680 utility-owned LSLRs and 820 customer-owned LSLRs in 2002. In one extreme, where all lines are comprised of a utility-owned portion and a customer-owned portion and the utility-owned replacements only took place where there were also customer-owned replacements, this would mean that 680 full replacements and 140 partial replacements took place.[3] Applying this interpretation to the data for the 11 reporting systems in the AWWA Report, partial replacements in the years 2002 and 2003 constituted no more

[3] Note that it would seem reasonable for the utility to replace the utility-owned segment everywhere that the customer-owned segment was replaced. However, this is inconsistent with the data because it implies there would be at least as many utility-owned replacements as customer-owned replacements. In fact, six of the 11 utilities reported fewer utility-owned replacements than customer-owned replacements.

than 34% and 37%, respectively, of LSLR (see Table 2).[4] Another possible interpretation is that some of the utility-owned replacements are full replacements where the utility owns the entire line. Because we also do not know if, in some instances, the reporting utility owned the entire line, it is possible that the estimation that 140 partial replacements took place is too high. It is clear that there are multiple ways to interpret the data reported by AWWA to come up with a percentage of partial replacements.

Table 2: Percentage of Partial Replacements Assuming Maximal Overlap between Utility and Customer-Owned Replacements

Utility No.	Est. Total Replacements (2002)	Est. Partial Replacements (2002)	Est. Total Replacements (2003)	Est. Partial Replacements (2003)
1	2000	0	2000	0
2	820	140	375	103
3	250	250	250	250
4	746	746	700	700
5	15	15	10	10
6	18	18	20	20
7	400	390	400	390
8	6	6	6	6
9	0	0	402	327
10	642	103	746	46
11	190	40	193	31
Totals	**5087**	**1708**	**5102**	**1883**
% Partial		**34%**		**37%**

14. The data are also unclear about the interpretation of the entries marked "Unknown." We do not know whether these are missing values or marked as "Unknown" by the respondents.

15. It is important to keep in mind that the accuracy of any calculation using this data is further complicated by different ways the respondents may have interpreted the survey prompt. Survey respondents regularly make unexpected interpretations of survey prompts, and in this instance there was ample room for alternative interpretations. For

[4] Note that in arriving at these numbers I have treated entries marked "Unknown" from Table 1 as zeros. This is reflected in the estimates for Utility Nos. 3, 4, and 8 in Table 2.

example, a respondent may *not* have assumed, as I did above, that the utility and customer-owned segments in a full replacement could be reported separately in the survey as different lines. Some respondents could have interpreted the survey instructions as referring to full lines only, so they may have reported replacements of full lines that include customer-owned segments as a single replacement in the customer-owned replacement category and not reported the utility-owned segment at all.

Survey Sample is too Small and not Known to be Unbiased

16. It is also my opinion that the cited data from the AWWA Report cannot be relied upon to infer the general tendency of water systems to use partial versus full LSLRs because the sample size is too small and no showing has been made that the sample is unbiased with respect to this question.

17. When performing a scientific survey intended to create a representative statistical sample of a population, two considerations are paramount: first, the sample size must be sufficiently large so that statistics computed from it are reliable, and second, the sample must be unbiased with respect to the population under study.

18. With regard to the first consideration, it is a standard result of statistical theory that a sample average is a better estimate of the population mean when the sample size is large. In this case, the sample size is only 11—and potentially as small as eight if observations marked as "Unknown" are discarded. While there is no "threshold" sample size that guarantees an estimate is sufficiently accurate (convergence properties depend on the underlying population distributions which are unknown here) an estimate formed from a sample of 11 or eight is very likely to be inaccurate in the general case.

19. With regard to the second consideration, sampling methods must ensure that the 65 water systems selected for the AWWA study do not systematically differ from the population of water systems nationwide in any meaningful way. The AWWA report does not contain details on the sampling methods used to select those 65 water systems.

20. Even if it could be demonstrated that the Black and Veatch sampling methods were unbiased, however, such a demonstration would still be insufficient to demonstrate that the final sample of 11 (or eight) usable responses were *also* unbiased. This is because

there may be some correlation between a water system's likelihood of providing a usable response to these questions and their actual responses to these questions. For example, a water system may be more likely to provide usable data on LSLRs if it has replaced a greater percentage of its lead service lines. If this were the case, then the sample would be biased, and using the sample data to calculate the percentage of partial replacements would likely also be biased.

21. In general, the burden is on the user of the survey data to demonstrate that the sample is unbiased. In this case, no such demonstration has been made. I declare under penalty of perjury that the foregoing is true and correct.

Dated: February 12, 2020

James W. Bono

EXHIBIT A

CURRICULUM VITAE OF DR. JAMES W. BONO

JAMES W. BONO

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EDUCATION

Ph.D., University of California Irvine, Economics – Microeconomics, 2008

B.A., American University, International Studies, Mathematics Minor, 2003

POSITIONS

Senior Vice President, Economists Incorporated, San Francisco CA, 11/2013 – current

Conducting economic analysis for litigation matters, public policy, and business strategy; Formulating and executing bid strategies for spectrum auctions; Engaging in fundamental quantitative research on a wide range of topics.

Independent Research Consultant, San Francisco CA, 9/2012 – 10/2013

Guiding economic research projects for applications in the National Airspace System, including air carrier competition, technology adoption, and air safety. Creating custom mathematical models and software at the intersection of microeconomics, game theory, machine learning, statistics, and behavioral economics.

Assistant Professor of Economics, American University, Washington DC, 9/2008 – 8/2012

Conducting original research at the intersection of microeconomics, game theory, machine learning, statistics, and behavioral economics, including grant writing and managing research assistants. Teaching microeconomics at the PhD and Masters levels. Teaching game theory at the undergraduate level. Supervising dissertation research.

SELECT PUBLICATIONS

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BT/EE, UK, strategy and preparation for the 2.3 & 3.4 GHz Auction. 2016 to 2018.

AT&T, Mexico, strategy and preparation for the AWS-3 Auction. 2016.

FarEasTone, Taiwan, strategy and preparation for the 2600 MHz auction. 2015.

AT&T, USA, strategy and preparation for the U.S. 600 MHz Incentive Auction. 2015 to 2017.

Mobile Virgin (Vcom LTD) strategy and preparation for the Bahamas Telecommunications Liberalization auction. 2015.

Globalive Wireless, Canada, strategy and preparation for the Canada AWS3 Auction. March 2015.

Globalive Wireless, Canada, strategy and preparation for the 2.6 GHz Auction. April 2015 to May 2015.

AT&T, USA, strategy and preparation for the AWS-3 Auction, July 2014 to January 2015.

Etisalat and Ufone, Pakistan, strategy and preparation for the 2.1 GHz 3G and 1.8 GHz 4G Auction, February 2014 to May 2014.

Research for NASA to develop air traffic control systems that manage GPS link-loss in localized systems of unmanned air vehicles. June 2014 ongoing.

Author, PyNFG – A Python Package for Modeling and Solving Network Form Games, 2013. Developed for NASA.

Conceived, designed, implemented and released software for use by researchers in economics, engineering and computer science under the GNU Affero GPL. Ongoing management of the software development project and its team of contributors.

Senior Research Engineer, SGT Inc., NASA Ames Research Center, Moffet Field, CA 2012

Game theoretic analysis of the impact of NextGen automation technologies on air safety in the National Airspace System. Model definition and software implementation of multiple air safety scenarios.

Subject Matter Expert, SGT Inc., NASA Ames Research Center, Moffett Field, CA 2010

Statistical modeling of pilot/air-traffic-control bargaining. Developing recommendation system to optimize bargaining outcomes with respect to National Airspace System objectives.

Subject Matter Expert, QSS Group, NASA Ames Research Center, Moffett Field, CA 2008

Developing a market mechanism for allocating the National Airspace among airlines during Ground Delay Programs.

WHITE PAPERS

- with A. Ingraham, S. Ravi, and C. Sojourner (October 2019), "Comments on the Design of the Rural Digital Opportunities Fund Phase I Auction", *Social Science Research Network*. https://papers.ssrn.com/abstract=3480800
- with A. Ingraham, S. Ravi, W. Schwartz, and C. Sojourner (September 2019) "An Analysis of Allocation Phase Pricing and Clock Round Price Increases in the Canadian 600 MHz Auction," *Social Science Research Network.* *https://papers.ssrn.com/abstract=3463933*
- with A. Ingraham (November 2018) "Rationalizing the 3.4-3.8 GHz Spectrum in the United Kingdom," *Social Science Research Network.* *https://papers.ssrn.com/abstract=3463894*
- with A. Ingraham (November 2017) "An Auction Design for Millimeter Wave Spectrum," *Social Science Research Network.* *https://papers.ssrn.com/abstract=3463864*

OTHER POSITIONS & EXPERIENCE

Scientific Committee, "From Game Theory to Game Engineering," Oxford University 2009

Co-organized a multidisciplinary workshop of game theorists, engineers and statisticians at the Oxford-Man Institute.

Graduate Chair, Institute of Mathematical Behavioral Sciences, UC Irvine 2006-2008

Served as liaison between faculty and graduate students in IMBS;

Organizer and Chair, 5th Annual IMBS Graduate Student Conference, UC Irvine 2007

Organized and chaired a conference to showcase mathematically oriented graduate research in economics, finance, political science, cognitive science and psychology.

GRANTS

Co-Principal Investigator, Research Grant, NASA, 2014

"Event-Driven Game Theory for Next Generation Air Traffic Safety." $250,000 over three years.

Co-Principal Investigator, Research Grant, NASA, 2011

"Modeling of Airline Behavior Using Strategic, Agent-Based Approaches." $1,000,000 over two years.

Co-Principal Investigator, Research Grant, Army Research Office, 2010

"A New Information-Theoretic Approach for Modeling Games and Interactive Behavior." $50,000

Co-Principal Investigator, Research Grant, National Science Foundation, 2010

"Expanding Capabilities for Research and Research Training at American University through Shared High-Performance Computing." $260,745

AWARDS & FELLOWSHIPS

- Research Associate, Info-Metrics Institute, American University, 2010
- Jean Claude Falmagne Dissertation Award, 2008
- 1st Place Sanli, Pastore & Hill Excellence in Economics Writing Award 2007
- Best Paper IMBS Graduate Research Conference and Contest, UC Irvine 2007
- The Social Sciences Annual Fund Fellowship, UC Irvine 2007

- Outstanding Graduate Scholar Award, Economics Department, UC Irvine 2006-2007
- Research Fellowship, IMBS, UC Irvine 2005-2007
- Research Fellowship, Economics Department, UC Irvine 2005-2007
- The School of Social Sciences Fellowship, UC Irvine 2003-2007
- Phi Beta Kappa National Honor Society 2003
- David L. Boren Scholar 2000

PRESENTATIONS

- 14th Annual European Spectrum Management Conference, Brussels, 2019.
- 7th Annual Americas Spectrum Management Forum, Washington DC, 2018.
- Transportation Research Board Annual Meetings, Washington DC, January 2013. invited speaker.
- Tech Talk, MITRE Corporation, January 2013. invited speaker.
- Department of Computational Social Sciences Seminar Series, George Mason University, November 2011. invited speaker.
- "Modeling and Analyzing the Impact of Airline Competition and Collaboration on Air Traffic Management," INFORMS Annual Meetings, November 2011, Charlotte, NC. invited speaker.
- Smart Grid Seminar Series, Center for Nonlinear Studies, Los Alamos National Laboratories, March 2011. invited speaker.
- Economics Department Seminar Series, Howard University, March 2011. invited speaker.
- "Aviation Policy: Evaluation of Congestion Management Alternatives," INFORMS Annual Meetings, November 2010, Austin, TX. invited speaker.
- "Info-Metrics: Theory and Applications," Info-Metrics Institute, American University, Washington DC, September 2010. invited speaker.
- NASA Ames Research Center, Moffett Field, CA, September 2010. invited speaker.
- "Decentralized Control in Systems of Strategic Actors" Workshop, Extension and Working Program, Santa Fe Institue and Center for Nonlinear Studies, August 2010, invited speaker.
- Biennial Conference of the International Society for Business and Industrial Statistics, Portoroz, Slovenia, July 2010, invited speaker.

- Third International Conference on Social Computing, Behavioral Modeling, and Prediction, National Institute of Health, March 2010
- "From Game Theory to Game Engineering," Oxford University, September 2009, invited speaker.
- Midwest Economics Association Annual Meetings 2009

TEACHING

Co-Created *Bachelor of Science in Mathematics and Economics*, American University, 2010

Served on small committee to create new undergraduate degree program students for top PhD programs in economics.

Created *ECON/MATH-345: Introduction to Game Theory*, American University, 2009

Designed, proposed and implemented an undergraduate course in game theory. Cross-listed in Economics and Mathematics departments.

Participated, *NSF and AEA Sponsored Teaching Innovations Program*, Santa Fe, NM 2009

Participated in two-day workshop to develop innovative and interactive teaching methods to the economics curriculum; included

Graduate Courses: Microeconomic Theory (ECON-500); Microeconomic Analysis II (ECON-713); Introduction to Mathematical Economics (ECON-505)

Undergraduate Courses: Introduction to Game Theory (ECON/MATH-345)

Undergraduate Adviser: approx. 25 students per year

Dissertation Committee Member: Mike Martell, completed 2010

SPOKEN LANGUAGES

- Chinese (intermediate)
- English (native)

PROGRAMMING LANGUAGES

- Matlab
- Python
- Visual Basic

- Stata

PROFESSIONAL ASSOCIATIONS

- INFORMS
- American Economics Association
- Midwest Economics Association
- Econometric Society

EXHIBIT B

STRATEGIES TO OBTAIN CUSTOMER ACCEPTANCE OF COMPLETE LEAD SERVICE LINE REPLACEMENT

For the American Water Works Association's Strategies to Obtain Complete Lead Service Line Replacements document, please visit http://www.awwa.org/Portals/0/AWWA/Government/StrategiesforLSLs.pdf?ver=2013-03-29-132027-193