parents for nontoxic alternatives

October 28, 2015

To: The EPA National Drinking Water Advisory Council (NDWAC)
Re: Long-term revisions for the Lead and Copper Rule (LCR)

Dear Chair Jonas and members of the Council:

As a dissenting member of the Environmental Protection Agency (EPA) National Drinking Water Advisory Council (NDWAC) Lead and Copper Rule (LCR) working group, I herewith submit to NDWAC and to the official EPA record, my statement of dissent to the August 2015 "Report of the Lead and Copper Rule Working Group To the National Drinking Water Advisory Council."[1]

I share fully the working group's commitment to a revised LCR that maximizes the protection of public health. I also commend the working group for its bold and innovative idea of building a brand new rule that is based on proactive, rather than reactive, full lead service line (LSL) replacement. As I mention in my statement, I see this as a step in the right direction. Unfortunately, however, my extensive experience with lead in drinking water in Washington, DC and nationally, has led me to believe that the working group's specific recommendations for how to implement a forward-thinking LCR would leave consumers less protected from exposures to lead in drinking water than would a revised version of the current rule that closes its well-known loopholes.

Mirroring the structure of the working group's report, I explain my reasoning in the pages that follow under these four sections:

I. Proactive Full LSL Replacement
II. Public Education for Lead and Lead Service Lines
III. Improved Corrosion Control Treatment
IV. Monitoring Requirements

I would also like to highlight the following three points, in case they prove useful to NDWAC's deliberations:

- It is sometimes assumed that a concerted effort to protect consumers from lead in drinking water is now necessary solely because science has shown that even small exposures to lead can cause significant health harm, and the Centers for Disease Control and Prevention (CDC) recently lowered its 10 micrograms per deciliter "blood lead level of concern" to a 5 micrograms per deciliter "reference level." Although these developments are true, they make for a very incomplete justification for the need to strengthen the LCR at this time. Since the

[1] http://water.epa.gov/drink/ndwac/meetingsummaries/upload/ndwacmeetsummaug2015.pdf

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LCR was promulgated, almost 25 years ago, we have gained a more complete scientific understanding of lead corrosion and corrosion control than we had in the early 1990s, including a far better understanding about the forms, sources, and prevalence of lead in drinking water; the multiplicity of factors that can worsen lead release, including galvanic corrosion and physical disturbances of LSLs; the erratic, unpredictable, and difficult-to-detect release of lead particles; and the small- and large-scale public health harm that can result from inadequate or inappropriate applications of the current LCR. This information – coupled with insights from a) significant lead-in-water contamination eventsin cities like Washington, DC;[2] Durham, NC;[3] Greenville, NC;[4] Providence, RI;[5] and Flint, MI;[6] and b) individual PWSs' questionable implementation of the LCR[7] – has revealed that *lead in drinking water poses a serious, misunderstood, under-detected, and inadequately controlled health risk to consumers across the US. As such, revisions to address significant deficiencies and strengthen the rule are imperative and urgent.*

- Today we know that all US homes with lead-bearing plumbing materials face a risk of high lead in water, whether the PWS that serves them meets the LCR lead action level (LAL) or not. However, consumers in homes with LSLs (or homes that used to have LSLs) are *especially* vulnerable to long-term exposures, sometimes due to conditions that are extremely common and that are not controllable even with the best corrosion control treatment in place (e.g., physical disturbances of LSLs,[8] prolonged periods of no water use resulting from lack of occupancy and followed by re-occupancy, or routine low water use[9]). These conditions can cause disintegration of lead-bearing scales within pipes, which can in turn dislodge and pose an immediate and acute health risk to consumers analogous to lead paint exposure. It, therefore, seems advisable that NDWAC and EPA explore actions that can be taken by PWSs as soon as possible, and certainly before the final approval of the LCR long-term revisions, to alert the public to this exposure risk and offer guidance on appropriate health-protective measures.

- There is no doubt that the LCR is a uniquely taxing rule for regulated PWSs and the public alike, as it places responsibility on both to minimize consumer exposures to lead at the tap. We also know thatthe points of contact between PWSs and consumers in relation to the LCR can at times be challenging. The WG's report to NDWAC alone, for example, makes reference to consumers who refuse to participate in LCR-compliance tap sampling, or sample their water improperly, or decline their PWS access to their property for full LSL replacement. As complex as these challenges – and others that I heard during the NDWAC LCR WG's deliberations – might be, I worry about the unexamined assumptions they can foster among PWSs, EPA, States, and even NGOs regarding who "consumers" are, what they understand, what they care about, and how they react. Specifically, I worry that these

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[2] http://www.washingtonpost.com/wp-dyn/content/article/2009/01/26/AR2009012602402.html?sid=ST2009012700722&s_pos
[3] http://www.salon.com/2006/11/27/lead_3/
[4] http://www.salon.com/2006/11/27/lead_3/
[5] http://ripr.org/post/providence-water-board-halts-lead-pipe-replacement
[6] http://www.mlive.com/news/flint/index.ssf/2015/09/study_shows_twice_as_many_flin.html
[7] http://www.washingtonpost.com/wp-dyn/articles/A70942-2004Oct4.html; http://www.washingtonpost.com/wp-dyn/articles/A30896-2004Oct13.html
[8] http://pubs.acs.org/doi/abs/10.1021/es4003636
[9] http://www.ncbi.nlm.nih.gov/pubmed/22900550

assumptions create room for unsubstantiated and obfuscating generalizations that overlook a) weaknesses in the LCR whichleave consumers routinely uninformed and unprotected from preventable exposures to lead in water, b) PWS misinterpretations or misapplications of the rule that generate false assurances of safety and, when problems are uncovered, betray the public's trust, and c) extensively documented cases of consumers in jurisdictions that underwent significant lead-in-water contamination events, going to great lengths to understand the health risks of lead in water and the workings of the LCR, as well as to research, demand, and support scientifically-sound public-health-protective solutions (for more information see my dissenting statement).

Because the LCR is a "shared responsibility" rule that presumes collaboration, coordination, and trust between PWSs and consumers, I believe it is extremely important that those of us who have the privilege to participate in policy revisions deliberations stay alert to, and question, the climate of condescension and disrespect that can sometimes surface in connection to the very people that the LCR is intended to protect. I believe strongly that our ability to envision a closer and more transparent partnership between PWSs and the communities they serve will be necessary for developing revisions that make the LCR a better rule for all involved.

As I submit this statement of dissent, I declare that I have no conflicts of interest financial, personal, or professional – and that all my work with, and for, the EPA NDWAC LCR WG was carried out as a volunteer.

Should you have any questions, please do not hesitate to contact me.

Sincerely,

Yanna Lambrinidou

Yanna Lambrinidou, PhD
President

STATEMENT OF DISSENT

from the Report of the Lead and Copper Rule Working Group
to the EPA National Drinking Water Advisory Council

I. PROACTIVE FULL LSL REPLACEMENT

Today we know that lead service lines (LSLs) and partially replaced LSLs pose a serious and permanent risk to human health, whether or not:

1. A public water system (PWS) meets the Lead and Copper Rule (LCR) lead action level (LAL), or
2. A one-time test of water sitting in a LSL (or a partially replaced LSL) reveals non-detect or low lead-in-water levels.

For this reason, the National Drinking Water Advisory Council (NDWAC) LCR working group's (WG's) recommendation for a mandated proactive full LSL replacement program is a step in the right direction. It also supports the WG's principle that under the revised LCR, resources and actions ought to maximize the protection of public health. Few would dispute that when it comes to lead in water, complete removal of LSLs would constitute one of the most public-health-protective actions possible. It would also result in significant long-term cost and environmental benefits since the amount of phosphate-based corrosion control required would be much lower on a permanent basis than if the LSLs remain in service. This conclusion seems more obvious and pressing today than at any other time, as current understanding about the risks of partial LSL replacement suggests strongly that the practice of removing only a portion of a LSL is not prudent from either a public health or financial standpoint.

However, the specifics of the WG's recommendation allow PWSs to delay full LSL replacement for decades, if not indefinitely, as well as to continue conducting partial LSL replacements, despite an extensive body of scientific research demonstrating that, under at least some circumstances, these replacements can pose a significant short- and long-term public health risk to consumers.[1]

For background, it is important to highlight that:

[1] Britton, A. and Richards, W.N., 1981. Factors Influencing Plumbosolvency in Scotland. *Journal of the Institute for Water Engineers and Scientists* 35(5):349-364; Cartier, C. et al. 2013. Impact of Treatment on Pb Release from Full and Partially Replaced Harvested Lead Service Lines (LSLs). *Water Research* 47(2):661-71; Cartier, C. et al. 2012. Effect of Flow Rate and Lead/Copper Pipe Sequence on Lead Release from Service Lines. *Water Research* 46(13):4142-52; St. Clair, J. et al. 2013. Long-term Behavior of Partially Replaced Lead Service Lines. Oral Presentation at CaNv-AWWA 2013 Inorganic Contaminants Symposium. Sacramento, CA, https://www.filesanywhere.com/fs/v.aspx?v=8b7062885d6770b6a4ad. Hu, J. et al. 2012. Copper-Induced Metal Release from Lead Pipe into Drinking Water. *Corrosion* 68(11):1037-1048; Wang, Y. et al. 2013. Effect of Connection Methods on Lead Release from Galvanic Corrosion. *JAWWA* 105(7): E337-E351; Triantafyllidou, S. and M. Edwards 2011, Galvanic Corrosion after Simulated Small-Scale Partial Lead Service Line Replacements *JAWWA* 103(9):85-99.

1. The LCR's lead-in-water monitoring requirement is intended to capture worst-case lead-in-water levels in highest-risk homes.[2]

2. The LCR's LSL replacement requirement is intended to function as a *remedial* measure that reduces or eliminates lead released from LSLs when corrosion control treatment (CCT) proves inadequate.

3. **According to a recent industry-funded study, if the sampling protocol used for LCR compliance purposes were designed to capture worst-case lead from LSLs, it is estimated that approximately 70% of PWSs with LSLs would exceed the LAL.[3] This means that today, in the majority of PWSs with LSLs, LSL homes face a lead-in-water problem severe enough to, under the 25-year-old LCR LAL, trigger remedial requirements (i.e., source water monitoring, optimization or possible re-optimization of CCT, public education, LSL replacement). Such requirements are not triggered today only because the sampling protocol used for LCR compliance purposes is no longer fit for capturing worst-case lead levels in LSL homes.[4] Moreover, the pre-flushing employed by many PWSs is designed to actually miss worst-case LSL lead.**

If the current LCR were revised to reflect current scientific understanding about how to a) capture worst-case lead-in-water levels in LSL homes, and b) ensure that the LCR's LSL replacement requirement constitutes a remedy and not a heightened risk to human health:

- The sampling protocol for LCR compliance purposes would be revised to target, and capture health risks from, LSL water, and
- Partial LSL replacement would be banned for both LCR-mandated "involuntary" replacements and PWS-imposed "voluntary" replacements (see

[2] The LCR states clearly that, "Targeting monitoring to worst-case conditions will help systems and States evaluate the reductions in contaminant levels achieved through treatment and determine when 'optimal' treatment is being maintained to the degree most protective of public health" (Federal Register, Vol. 56, No. 110 (1991), Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 26514).

[3] Slabaugh, R. 2014. Optimized Corrosion Control—An Estimate of National Impact (Power Point presentation). AWWA Water Quality Technology Conference (WQTC), New Orleans, LA, Nov. 16-20.

[4] The sampling protocol used for LCR compliance purposes was designed to capture primarily interior sources of lead (i.e., lead-containing solder and lead-containing brass) as well as some LSL water. Today, however, interior sources of lead have diminished because they contain a relatively limited mass of lead, and because many premise plumbing components have been replaced with components that contain lower levels of lead, especially in the pre-1986 sampling pool of residences (see Triantafyllidou & Edwards 2012, Table 1 and discussion; http://www.tandfonline.com/doi/abs/10.1080/10643389.2011.556556). On the other hand LSLs, which are 100% lead by weight, pose an *increased* risk to human health for many reasons (e.g., lead scale accumulates with time and can increasingly crack and flake with age, water conservation practices lengthen the contact time between water and LSLs, and the water in many PWSs is more corrosive due to higher chloride, the presence of chloramine, and the absence of chlorine) (see Marc Edwards' 2014 webinar talk to the NDWAC LCR WG; https://epawebconferencing.acms.com/p71sx757mi9/?launcher=false&fcsContent=true&pbMode=normal). In other words, today LSLs pose a far greater risk to human health relative to any other lead-bearing plumbing material in a PWS's distribution system, and this disparity is likely to increase with time.

also the *American Academy of Pediatrics*[5] and *Centers for Disease Control and Prevention*[6] 2011 calls for a moratorium on this replacement).

The NDWAC LCR WG's proactive LSL replacement recommendation includes neither of the above changes. Instead it proposes a dramatic departure from the LCR's current framework that:

- Ensures that PWSs with LSLs continue to conduct 90th percentile calculations based on tap samples that do not capture worst-case lead-in-water levels in LSL homes and, therefore, can continue to claim that they meet the LAL and can continue to not optimize (or re-optimize) their CCT, even when LSL homes dispense very high levels of lead and place consumers at significant health risk.

- Promotes the development of proactive full LSL replacement programs by all PWSs with LSLs that would trigger violations only when a PWS fails to conduct "meaningful" outreach to homeowners, and not when it fails to meet set goals of actually replacing LSLs.

- Is accompanied by a sorely anemic public education requirement (i.e., outreach to consumers in LSL homes "at least every three years" and when a new customer moves in), which ignores that today consumers in LSL homes are at daily risk of exposure to high levels of lead in their water and are, therefore, in need of *urgent* and *frequent* messaging about what they can do to protect themselves.

If implemented, this recommendation leaves room for long-term and indefinite delays of full LSL replacement. In fact, it makes such delays highly likely. Proactive full LSL replacement will be taxing for many PWSs in terms of needed time, resources, diverse and potentially escalating interventions, and coordination with multiple parties for years and decades to come, *even under the most favorable conditions* (i.e., with all the necessary funding, resources, and support in place). Adding to this burden PWS-specific limitations and obstacles that will most certainly arise in many, if not most, jurisdictions makes such a demanding initiative not "less" challenging than the LCR's current LSL replacement requirement, but challenging in a different way. For some PWSs the program might prove practically impossible, while for others it might take 2, and 5, and 8, if not more, decades to complete.

In fact, it may not be coincidental that the WG's recommendation to grant PWSs credit toward their full LSL replacement goals when they can demonstrate that a home with a presumed LSL does not actually have such a line, bears disturbing resemblance to the current LCR's "test-out" provision.[7] "Testing out" allows PWSs today to count a LSL that tests under the LAL in a one-time 1st-liter sample as

[5] http://yosemite.epa.gov/sab/sabproduct.nsf/177871EFC7607CD08525785C0050AAB1/$File/aapcomments.PDF
[6] http://water.epa.gov/drink/ndwac/upload/ndwacdec11122013.pdf
[7] Nakamura, D. 2004. WASA Avoided Replacing Lead Service Lines. *Washington Post* (2/11); http://www.washingtonpost.com/archive/politics/2004/02/11/was-avoided-replacing-lead-service-lines/d841f8d0-3530-45f1-a7b3-c66f2e948709/

"replaced" and to meet LCR LSL replacement requirements faster and with minimized expense while leaving the lead risk to many consumers unmitigated.

Significant and even indefinite delays under a regulatory scheme that does not render actual LSL replacement mandatory not only seem inevitable but would also risk:

1. **Not achieving the recommendation's intent of full LSL removal**
2. **Continuing to leave new generations of consumers in LSL homes inadequately protected from lead in water for years and decades to come, if not centuries, even while PWSs claim the water meets federal safety standards**
3. **Allowing PWSs with LSLs and suboptimal CCT to continue to use such CCT for years and decades to come, if not indefinitely.**

Comparing the WG's proactive full LSL replacement recommendation (which I will refer to as the "proposed LSL replacement program") with the current LSL replacement requirement, *if the latter were updated to reflect current scientific knowledge* (which I will refer to as the "existing LSL replacement program (without holes or loopholes)"),[8] it seems that the proposed LSL replacement program would provide stronger public health protection only under the following conditions:

- If the revised LCR mandated that PWSs *develop*, *obtain state approval for*, and *make transparent and easily accessible on the PWS's website* a full LSL replacement program, which would include:

  → Independently verified information about the PWS's legal authority to carry out replacement of plumbing materials (or hazardous plumbing materials) in private space (see original definition of "control" in LCR of 1991)
  → A prioritization scheme that targets for full LSL replacement neighborhoods with known or suspected LSLs, child care centers, areas with the highest blood lead levels (BLLs), and neighborhoods with homes that have been unoccupied for an extended period of time (the length of this period to be defined by EPA)
  → A financing scheme that makes private-side LSL replacement guaranteed for low-income customers.

  Such a requirement would help ensure that PWSs do indeed develop LSL replacement programs, that they use all available legal authority to carry out full LSL replacements, that they are accountable for following through with implementation, and that they implement these programs in such a way as to protect the most vulnerable populations first. Failure to achieve these objectives would trigger a violation or would return the PWS to the existing LSL replacement program (without holes or loopholes).

[8] Such an update would include a compliance sampling protocol that captures LSL lead in LSL homes and a ban on partial LSL replacement

- If the revised LCR mandated frequent delivery of clear and urgent messaging to consumers in all homes presumed to have LSLs about the risk they face from exposure to high levels of lead in their water and steps they can take to prevent exposure.

- If the revised LCR included a *clear, concrete, and objectively measureable definition* of a PWS's "meaningful" effort to work with homeowners.[9] Such a definition would help prevent PWSs from unfairly blaming homeowners for refusing private side LSL replacement, when the circumstances are such that homeowners are not adequately informed about the risks of lead in water or the benefits of full LSL replacement, have no capacity to cover the cost of the replacement, or are under the false impression that their water is safe because a one-time test showed lead levels below 15 ppb. Only when there is quantifiable evidence that a PWS has made "meaningful" progress as measured by clear, concrete, and objectively measurable criteria, and this evidence is easily accessible to the public, should failure to comply with the new provisions not trigger a violation or not return the PWS to the existing LSL replacement program (without holes or loopholes).

- If the revised LCR granted PWSs credit toward their full LSL replacement goals *only* for every full LSL replacement they actually conducted, and not for demonstrating that a home with a presumed LSL did not in fact have such a line. This would help prevent a loophole similar to the current "test-out" provision whereby PWSs would be able to devote extensive amounts of time establishing the lack of LSLs in neighborhoods that they have good reason to believe have few, if any, such lines, while at the same time delaying the implementation of actual full LSL replacement in neighborhoods that they have good reason to believe have a high concentration of LSLs. A loophole such as this may also create a perverse incentive for PWSs to characterize as "lead-free" service lines with sections or components of unknown or ambiguous composition.

- If the revised LCR included clear criteria that PWSs would need to meet to declare a service line free of lead (i.e., free of any lead pipe portions as well lead pigtails, goosenecks, or other lead-bearing fittings), and required that records on each home were made publicly available on the PWS's website and contained information on:

    → All the materials present between the water main and the entry into the home (e.g., connectors between the water main and the service

[9] I recommend strongly that such a definition be developed with input from homeowners who have personal experience with the LCR's LSL replacement requirement. PWSs have a history of blaming homeowners for refusing private side LSL replacement, shifting claims of LSL "ownership" when it suits them, and not adequately informing consumers about the risks of lead in water or the benefits of full LSL replacement (http://investigativereportingworkshop.org/investigations/toxic-taps/story/toxic-taps-lead-is-still-the-problem/). They also have a history of making full LSL replacement inaccessible to low-income homeowners and failing to disabuse consumers from the false impression that their LSL poses no health risk because a one-time test showed lead levels below 15 ppb.

line, portion of service line up to the meter, portion of service line from the meter to the exterior wall of the residence, portion of service line from the exterior wall into the home, etc.)

→ The methods and dates by which these materials were confirmed.

- If the revised LCR banned partial LSL replacement – a practice that can increase consumer risk of exposure to lead – and required PWSs that own or "control"[10] LSLs on private property to conduct and cover the cost of full LSL replacements during emergency repairs and water main work.

Short of the above conditions, the proposed LSL replacement program is likely to provide weaker public health protection than the existing LSL replacement program (without holes or loopholes), potentially causing significant health harm to many new generations of fetuses, infants, and young children and raising serious environmental justice questions and concerns.

II. Public Education for Lead and LSLs

In light of the fact that:

1. There is no safe level of lead in water
2. The LCR allows for:
    - 100% of homes sampled for LCR compliance to dispense any concentration of lead between 1-15 ppb
    - 10% of homes sampled for LCR compliance to dispense any concentration of lead whatsoever
3. The LCR allows PWSs exceeding the LAL to take up to 60 days to inform consumers about widespread contamination,

the LCR's compliance mechanism grants no individual consumer protection from chronic and acute exposures to lead in drinking water. In other words, under the LCR, consumers who want to be sure that the water they drink and cook with does not place them and their families at significant health risk from lead, are on their own to take precautionary measures. This means that public education about lead in water and the limitations of the LCR, including the limitations of CCT and one-time sampling, is vital for proper consumer action and, ultimately, for effective public health protection. Strong public outreach is urgent in all PWSs and even more so in PWSs with LSLs, most of which would exceed the LAL today if they sampled LSL water.

In light of the fact that today the vast majority of consumers are not aware that they are personally responsible for protecting themselves from lead in water, I concur with the NDWAC LCR WG's conclusion that a) a more robust public education requirement is needed, b) this requirement must be based on principles of consumer-centered risk communication, and c) to design this requirement, EPA ought to consult

[10] Based on the LCR 1991 definition of this term, which does not necessitate that the PWS pay for the private side replacement of the LSL.

a diverse group of experts with strong representation from consumers who have been directly affected by lead in water and the LCR.

Since at the present time we do not know if EPA will convene such a group of experts, and since the NDWAC LCR WG's recommendation goes further to make concrete suggestions for a revised public education requirement, I consider it my obligation to highlight what I perceive as a key deficiency in the WG's conceptualization of public education:

Today we know that all US homes with lead-bearing plumbing components face a risk of high lead in water, whether the PWS that serves them meets the LCR LAL or not. We must, after all, keep in mind that even with the most effective CCT possible and a successful proactive full LSL replacement program there are many *ordinary* conditions that can accelerate lead release (e.g., aging LSLs and lead-bearing solder, increase in water temperature, water conservation plumbing devices and practices, etc.). Consumers in homes with LSLs (or homes that used to have LSLs) are *especially* vulnerable to chronic and acute exposures to lead in water due to:

- Physical disturbances of LSLs (or pipes, such as galvanized iron, that have "absorbed" lead from such lines) caused by water- and non-water-related utility work.[11] In most jurisdictions such work takes place daily and can dislodge and release scale and sediment, which can contain excessively high levels of lead.

- Prolonged periods of no water use resulting from lack of occupancy. When unoccupied homes are subsequently re-occupied, they can pose an immediate and acute health risk to incoming residents due to the disintegration of lead-bearing scales and sediment in LSLs (or in pipes that have "absorbed" lead from such lines). The same type of disintegration can occur in homes with routine low water usage.[12]

For these reasons, effective public education ought to result in a change in consumers' *daily* water use practices that can minimize lead exposures at all times. This can be achieved through increased public understanding about the prevalence of lead in water, conditions that favor its release, the unpredictability of its release, health risks from ingestion, and steps to prevent exposure. **In other words, the LCR's public education requirement must aim at heightening consumer awareness about lead in water to the level that the current LCR tries to achieve following a LAL exceedance.[13]**

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[11] Del Toral, M. A. et al. 2013. Detection and Evaluation of Elevated Lead Release from Service Lines: A Field Study. *ES&T* 47(16): 9300–9307.

[12] Arnold, R., and M. Edwards. 2012. Electrochemical Reversal of Galvanic Pb:Cu Pipe Corrosion. *ES&T* 46(20): 10941-7.

[13] Evidence suggests that the current LCR public education requirement for PWSs that exceed the LAL is not effective at changing consumer behavior. I mention it as an example of intent (i.e., to achieve long-term behavior change) rather than effectiveness (Griffin and Dunwoody 2000, http://www.ncbi.nlm.nih.gov/pubmed/10938908; Melissa Essex Elliot's 2014 webinar presentation to the NDWAC LCR WG, https://epawebconferencing.acms.com/p2holvnbl4t/?launcher=false&fcsContent=true&pbMode=normal).

We must not forget that currently, comprehensive public education is mandated not because levels of lead in any individual home exceed zero ppb (the only concentration known to pose no risk to human health), but because over 10% of samples from targeted taps exceed the 25-year-old, non-public-health-protective LAL. This means that by the time comprehensive education is mandated, many consumers have been needlessly exposed to elevated levels of lead for prolonged periods of time. A further weakness (if not absurdity) in the rule's public education provision is that any given level of lead above the LAL in any given home may at one time fail to trigger the LCR's public education requirement and at another time succeed in doing so only because the contamination is found to be widespread. The inconsistency, therefore, between a) the only level of lead in water known to pose no risk to human health, b) actual levels of lead at consumer taps which often exceed zero ppb, and c) the LCR's "over 10%" prevalence criterion that triggers comprehensive public education only after harm has been done, highlights the need for ***a revised public education requirement that is proactively public-health-focused rather than reactively emergency-remediation-focused.***

To begin to visualize such a requirement, which similarly to public messaging about tobacco, alcohol, and drugs, would stress the increased vulnerability of fetuses, infants, and small children, it seems quite clear that we must first break out of outdated ways of thinking about public education. Consumer-centered risk communication best practices teach us two important lessons:

1. Information-heavy, long, non-personal, and non-actionable outreach messages delivered unidirectionally through a single channel of communication are ineffective.[14] Several studies have already documented the severe limitations of Consumer Confidence Reports (CCRs), while others have concluded that face-to-face communication as well as regular outreach and outreach through local grassroots organizations are far more successful at delivering desired messaging than written materials.[15,16]

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[14] See Melissa Essex Elliot's 2014 webinar presentation to the NDWAC LCR WG, https://epawebconferencing.acms.com/p2holvnbl4t/?launcher=false&fcsContent=true&pbMode=normal

[15] Griffin and Dunwoody 2000, http://www.ncbi.nlm.nih.gov/pubmed/10938908; Meyer-Emerick 2004, http://www.awwa.org/publications/journal-awwa/abstract/articleid/15098.aspx; Morrone et al. 2005, http://europepmc.org/abstract/MED/16121482; AWWA 2005, http://www.awwa.org/Portals/0/files/legreg/documents/StrategiesforLSLs.pdf; Blette 2008, http://www.ncbi.nlm.nih.gov/pubmed/18401128; Roy et al. 2015, http://www.ncbi.nlm.nih.gov/pubmed/26322750; Summary of Interviews Conducted Regarding WASA's Public Education on Lead in Water, http://archive.epa.gov/region03/dclead/web/html/pep_recommendations.html

[16] EPA's own guidelines for effective risk communication stress that messaging must explain clearly "the situation, the risks, and the remedies" ("Risk Communication in Action," pp. 12 and 17, http://nepis.epa.gov/Adobe/PDF/60000IOS.pdf). The NDWAC LCR WG's proposed CCR language fails to tell readers what the likelihood of lead in their water is, or what they can do to protect fetuses, infants, and young children from exposure. At the same time, without information about *how* to determine if they have lead-bearing plumbing, the text advises consumers with such plumbing to have their water tested *if they wish*. This message fails to convey the simple fact that if lead-bearing plumbing exists a) consumers are at risk of exposure, b) a one-time test may be misleading, and c) precautions in homes with pregnant women, infants, and young children are extremely important at all times. Another prime example of PWS-centered public education is the CCR's lead-in-water table, which keeps consumers in the dark about the actual risks to their health, even when the LAL is met. Today, the vast majority of consumers do not know what the LCR monitoring requirement is or what "ppb," "MCLG," "LAL," and "90th percentile" mean. When consumers lack this information, they are unable to make

2. For risk communication to achieve its intended goals, the public must be accepted and involved as a legitimate partner. According to the first of EPA's "Seven Cardinal Rules of Risk Communication," "First, people and communities have a right to participate in decisions that affect their lives, their property, and the things they value. Second, the goal of risk communication should not be to diffuse public concerns or avoid action. The goal should be to produce an informed public that is involved, interested, reasonable, thoughtful, solution-oriented, and collaborative."[17]

I am concerned that the specific suggestions in the NDWAC LCR WG's recommendation ignore these lessons, replicating the existing, ineffective scheme of public education that largely serves the interests of PWSs. Although such a scheme would allow PWSs to expediently "check the box" of regulatory compliance, it would also continue to leave consumers sub-optimally informed and ultimately unsupported in adopting new water-use practices for effective lead-exposure prevention. Specifically, all of the WG's recommendations involve unidirectional, written communications that are a) likely to be accessed only by consumers who are already sensitized to the problem of lead in water (e.g., National Clearinghouse), b) delivered as part of other, non-lead related informational packets and thus likely to receive diluted, if any, attention (e.g., CCR, letter to new customers), and c) delivered extremely infrequently (i.e., when a consumer becomes a new PWS customer, annually in the case of CCRs,[18] and approximately once every 3 years in the case of letters to residents in homes with LSLs). Additionally, the WG's recommendations include no call for mandatory outreach to caregivers and healthcare providers of vulnerable populations or low-income communities, and no partnerships between PWSs and consumers.

The compelling argument that the WG makes in support of a proactive full LSL replacement program – namely, that the LCR's LSL replacement requirement would be more effective if it were triggered under non-emergency conditions – is apt for public education as well. Proactive (and thus *non-crisis*) public education about lead in water that involves a) multiple channels of communication, b) regular frequency of messaging, and c) long-term partnerships with governmental, non-governmental, and local grassroots organizations devoted to children's health or to the welfare of low-income communities, with schools and daycare centers, as well as with community leaders and parent-to-be/parent groups, seems not only compliant with risk communication best practices but also imperative in the specific context of lead in drinking water and the LCR.[19] Such a requirement, which would intensify following a LAL (or "System Action Level") exceedance, could mandate that PWSs:

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sense of the data provided and assess a) the significance of 90th percentile values above or below the LAL, and b) what potential health risks from lead in water they might personally face.

[17] www.wvdhhr.org/bphtraining/courses/cdcynergy/content/activeinformation/resources/epasevencardinalrules.pdf

[18] In the case of the CCR, it must be noted that a) as more consumers sign up to have their water bills paid automatically and thus have less of an incentive to read regular mail from their water utility, and b) as more water utilities mail only a 1-page version of the CCR and leave it up to consumers to access the full version electronically, the number of consumers who will actually read the CCR is likely to drop further.

[19] The imperative of bidirectional communication in government messaging about environmental health is discussed extensively in the 2010 Education & Communication Working Group Report that was developed as part of the ATSDR/CDC "National Conversation" initiative, http://www.resolv.org/site-

1. Develop, update, and post online a comprehensive database of local stakeholders
2. Create a taskforce that draws from this database and places heavy emphasis on broad representation from low-income neighborhoods, neighborhoods with a high concentration of LSLs, and parent-to-be/parent groups
3. In partnership with such a taskforce, develop a locally-appropriate, long-term, and multimedia public education program that meets well-defined EPA requirements
4. Hold at least one annual meeting with all stakeholders, including any other interested members of the public and PWS staff, to go over such matters as the mechanics of lead in water, health risks of exposure, the LCR, key messaging for consumers, and the like, and generate new ideas for improved community outreach and involvement.

First and foremost, however, attention must be paid to the content of public education. Consumers have a right to *clear*, *straightforward*, and *unambiguous* information about a) what health harm is associated with exposures to lead in water of fetuses, infants, and small children, and b) the fact that, under the LCR, it is up to them to take appropriate precautions if they want to prevent exposures. In summary, the content of the messaging must be truthful and complete; not offer false assurances about the safety of the water when a PWS complies with the LCR; not make scientifically unsubstantiated statements downplaying the risks of lead in water relative to lead in paint, soil, and dust; and not mislead consumers into believing that there are simple answers when there aren't (e.g., that any one-time test below 15 ppb indicates that the water is safe to drink and cook with, or that a visual inspection of a service line inside a home showing "no lead" means that the entirety of the service line is lead-free). **In cases where a child is diagnosed with elevated BLLs, consumers also have a right to a comprehensive inspection of their service line material as well as comprehensive lead-in-water testing, whether or not the health department's environmental risk assessment identifies the presence in the child's environment of lead-containing paint, soil, or dust. Similarly, in cases where tap sampling at an individual home exceeds the proposed "household action level," consumers also have a right to a comprehensive assessment of the source/s of the lead.**

Finally, consumers have a right to access freely and easily *all* lead-related information pertaining to their jurisdiction, including *all* tap-sampling results with complete addresses and dates of collection,[20] sampling protocols, CCT, full

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nationalconversation/files/2011/02/Education_and_Communication_Final_Report.pdf. EPA's 1990 guidance for developing effective community-based public education programs is also still relevant and a very useful resource ("A Primer: Developing a Community-Based Public Education Program on Lead in Drinking Water").

[20] Rather than presuming that consumers who have their water sampled for lead want their results to remain private – a presumption that we know protects PWS cherry-picking of homes for LCR-compliance sampling – chain-of-custody forms must ask each and every resident to declare if they wish their results to remain private or if they grant the PWS permission to make them public. This question ought to include an explanation about the benefits of transparency for PWS accountability and public health protection, especially in the context of EPA's OECA principles for highly effective regulations (http://www2.epa.gov/sites/production/files/2014-09/documents/next-gen-compliance-strategic-plan-2014-2017.pdf). For residents who choose to have their results

disclosure of invalidated samples and reasons behind invalidations, as well as how a utility achieves compliance with the LCR, what LCR "compliance" actually means (and doesn't mean) for public health, what constitutes a proper lead-in-water sampling program, and what constitutes a proper lead-in-water sampling protocol. **We must remember that transparency is especially important under the LCR's "shared responsibility" regime. In fact, as cases like Washington, DC; Chicago, IL; Flint, MI; New Orleans, LA; and others have shown, it is the *only* mechanism by which the LCR can become a meaningful regulation.** This is because it offers the public a way to ensure, beyond the rudimentary checks by primacy agencies, that their PWS is carrying out properly its side of the rule's "shared responsibility" regime and providing the maximum public health protection it can. As the above cases illustrate, the public has repeatedly played the decisive role in discovering widespread lead-in-water problems in their jurisdictions, often long after contamination has begun. Free and easy access to information about lead holds promise for allowing consumers to become true and informed partners in the LCR, for PWSs to be trustworthy and accountable drinking water providers, and for public health to receive the proactive protection that the LCR intends.

III. IMPROVED CCT

CCT is "the most important element"[21] in the LCR's treatment technique, because it comprises the main method by which PWSs are required to achieve the rule's public-health-protective goal. The intent of the LCR's CCT requirement is CCT "optimization." This is defined as CCT that reduces lead-in-water levels at the tap to "***the lowest levels feasible***"[22] or that "***minimizes*** the lead and copper concentrations at users' taps while ensuring that the treatment does not cause the water system to violate any national primary drinking water regulation."[23] Under the LCR, optimized CCT is required as the first and primary line of defense against elevated levels of lead in consumer homes in:

- All small- and medium-size PWSs that exceed the LAL, and
- All large PWSs, whether they exceed the LAL or not.

The only conditions under which PWSs are *not* required to install optimized CCT are:

- In small- and medium-size PWSs, when they meet the LAL for two consecutive 6-month monitoring periods, and
- In all PWSs, when they can demonstrate that the difference between the '90th percentile lead-in-water level at consumer taps and the highest level of lead in their source water is less than or equal to 5 ppb for two consecutive 6-

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kept private, the LCR ought to require PWSs to release redacted home addresses plus a code that is unique to each home and makes possible comparisons between sampling pools from one sampling round to the next.

[21] Federal Register, Vol. 56, No. 110 (1991), Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, p. 26479.

[22] Federal Register, Vol. 56, No. 110 (1991), Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, p. 26477, emphasis added.

[23] Federal Register, Vol. 56, No. 110 (1991), Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, p. 26462, emphasis added.

month monitoring periods.[24]

In other words, under the LCR, "optimized CCT" has two meanings. For small- and medium-size PWSs it refers to treatment that allows the PWS to meet the LAL. For large PWSs it refers to treatment that achieves the lowest possible levels of lead at consumer taps without violating any other national primary drinking water regulation. Because source water tends to be free of lead, most large PWSs can forgo CCT when their 90th percentile lead-in-water level is less than or equal to 5 ppb.[25]

Starting in 1993, all large PWSs were required to develop and implement a CCT program by taking the following seven steps: 1) Conducting initial lead-in-water and water quality parameter(WQP)[26] monitoring at consumer taps for two consecutive 6-month periods; 2) Conducting corrosion control studies; 3) Proposing to state primacy agencies optimal CCT and receiving approval for this treatment; 4) Installing optimal CCT; 5) Completing follow-up lead-in-water monitoring at consumer taps; 6) Proposing to state primacy agencies optimal WQPs and receiving approval for these parameters; and 7) Operating in compliance with optimal WQPs and continuing to conduct tap sampling.[27]

There are two reasons why this requirement is relevant today:

- **First, it illustrates the interdependent, always in dialogue, and always vulnerable-to-change relationship between optimal CCT and lead-in-water levels at the tap.** Under the LCR, lead-in-water levels in consumer homes must guide and inform determinations about what type of CCT can be deemed "optimized" in any given PWS. Optimized CCT, in turn, must achieve required lead-in-water level reductions at all times (i.e., below the LAL for small/medium PWSs and as low as feasible for large PWSs). Because the LCR's ultimate goal "is to provide maximum human health protection by reducing the lead and copper levels at consumers' taps to as close to the MCLG as is feasible,"[28] the rule requires routine tap monitoring even *after* optimized CCT is installed. This monitoring is intended to demonstrate the effectiveness of the treatment employed. It is also designed as an ongoing protective measure to ensure that any inadvertent rise in lead is promptly detected. This is because PWSs are dynamic, not static. Planned and

[24] Federal Register, Vol. 56, No. 110 (1991), Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, p. 26480 and Federal Register, Vol. 65, No. 8 (2000), National Primary Drinking Water Regulations for Lead and Copper, p. 1960; The Federal Register of 1991 includes a third exception: when a PWS of any size can demonstrate "to the satisfaction of the State that the system has conducted activities equivalent to the corrosion control requirements needed to demonstrate that the system has installed optimal treatment" This exception was designed for PWSs that had installed optimized CCT prior to the LCR's promulgation. It is no longer applicable today.

[25] This is because the highest level of lead in source water is usually zero.

[26] These parameters were pH, alkalinity, calcium, conductivity, orthophosphate (if the corrosion inhibitor was phosphate-based), silica (if the corrosion inhibitor was silicate-based), and temperature (http://water.epa.gov/lawsregs/rulesregs/sdwa/lcr/upload/LeadandCopperQuickReferenceGuide_2008.pdf)

[27] Federal Register, Vol. 56, No. 110 (1991), Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, p. 26550.

[28] Federal Register, Vol. 56, No. 110 (1991), Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, p. 26478.

unplanned changes to source water, treatment, plant operations, and the distribution system[29] may have impacts on lead levels at the tap that are not always predictable or may not always be sufficiently understood by PWSs. These changes can result in lead-in-water elevations even in PWSs whose optimized WQPs remain stable. **In other words, optimized CCT remains "optimized" as long as it continues to reduce effectively lead-in-water levels in consumer homes. By extension, CCT that is deemed "optimized" at one point in time cannot be assumed to continue to be "optimized" in the future *only* because the WQPs involved remain within established ranges.**[30]

This fact alone exposes perhaps the most significant weakness in the current LCR's compliance mechanism: that a PWS is deemed compliant with the rule if it manages to maintain its WQPs within the "optimized" ranges designated by the state. Conversely, a PWS is deemed in violation of the LCR if its WQPs fall outside these ranges. The problem with this mechanism is that it may have nothing to do with lead levels at consumer taps. In other words, it "punishes" PWSs for failure to maintain conditions that "control" the quality of the water in consumer homes only to a limited degree. Conversely, it "rewards" PWSs for success in maintaining the same conditions, even when lead-in-water contamination in their jurisdiction is widespread and maybe even worsening. Since 1991, for example, only 172 PWSs have failed to maintain optimized WQP ranges. But over 6,000 PWSs have exceeded the LAL and, therefore, have placed large numbers of consumers at significant public health risk.[31] The

[29] For example, increases with time in accumulation of lead scale in LSLs, increases in exposed iron in water mains that can impact lead release, or even something as simple as a storm that can increase or decrease chloride levels in the water, which can also impact lead release.

[30] The LCR of 1991 explains clearly the rationale and importance of assessing and adjusting CCT on the basis of direct feedback from lead-in-water levels at consumer taps: "Several commenters objected to using tap samples for measuring the effectiveness of corrosion control. These commenters were concerned that it would be difficult to ascertain whether a reduction in lead levels, measured at the tap after installing corrosion control, is a result of treatment or simply due to the aging of solder. They argued that water systems should be allowed alternative methods, such as the use of pilot plant studies or pipe loops to show the effectiveness of corrosion control. EPA agrees that water systems should use pipe loops, metal coupon, partial system tests, or other evaluative schemes to assist in determining the most effective corrosion control treatment. The Agency encourages water systems investigating different corrosion control treatments to first conduct research in the laboratory, whenever possible, before implementing system-wide corrosion control, and it anticipates that the majority of systems serving greater than 50,000 people will follow such procedures. **Although pipe loop and pilot plant studies can assist in planning a treatment strategy and predicting trends, they cannot be expected to predict the precise lead and copper levels at the tap** for numerous reasons including: (1) The aging effects of pipe scales, (2) the nature of preexisting pipe deposits not governed by lead or copper chemistry alone, (3) differences in surface chemistry between new and used pipes or faucets, and (4) disturbances of deposits when pipe from the field is pulled and used in the laboratory tests. Thus, **relying solely on laboratory studies to predict the effectiveness of corrosion control treatment would not indicate the levels of lead or copper at taps. Because of these problems and because EPA's goal is to reduce exposure to lead or copper in drinking water, it is essential to collect tap samples to determine if lead and copper levels at the tap decrease or increase after application of full-scale treatment and not to rely solely on laboratory studies to determine the effectiveness of treatment. Tap sampling after installation of corrosion control treatment is also necessary to evaluate whether lead service line replacement or additional public education is required**" (Federal Register, Vol. 56, No. 110 (1991), Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, pp. 26460-26564, emphasis added).

[31] See Miguel Del Toral's 2014 webinar presentation to the NDWAC LCR WG (https://epa.connectsolutions.com/p71sx757mi9/).

former group of PWSs violated the LCR. The latter group did not. One of the 6,000+ PWSs was the Washington, DC Water and Sewer Authority (DC WASA), which in 2001-2004 allowed elevated levels of lead in the water to go unchecked, in an event that is now acknowledged to have caused lead poisoning in hundreds (and perhaps thousands) of children.[32]

- The second reason the seven-step requirement is relevant today is that, according to EPA lead corrosion expert Mike Schock, **to date no large PWS has conducted step 2 as mandated by the Rule. That is, "by no legitimate scientific definition"[33] has any large PWS carried out corrosion control studies to identify CCT that results in the *lowest possible levels of lead at consumer taps* without violating any other national primary drinking water regulation.** Instead, for almost two decades now, large PWSs and the primacy agencies overseeing them have deemed CCT "optimized" simply when 90th percentile values have met the LAL, regardless of the PWSs' ability to achieve further lead-in-water reductions. This constitutes a gross misinterpretation of the LCR, which from a public health perspective becomes even more troubling when one considers that a) the mandated 1st-draw sampling protocol does not capture worst-case lead in LSL homes, and b) many PWSs with and without LSLs use pre-flushing and thus likely underestimate their 90th percentile value.

Based on this background, it would seem that a meaningful improvement in the LCR's CCT requirement would at the very least a) ensure that all PWSs conduct proper lead-in-water monitoring targeting highest-risk homes, b) build conditions under which large PWSs are required to minimize lead-in-water levels to the lowest degree possible, c) mandate corrective actions when lead-in-water levels exceed the LAL (or "System Action Level"), and d) link to a compliance mechanism that corresponds to lead levels at the tap and increases public health protection.

The NDWAC LCR WG's recommendations for improved CCT do none of the above. Although they include several good ideas for more robust WQP monitoring (e.g., more frequent, more representative of the distribution system, in accordance with advancing science, with greater vigilance for unexpected WQP changes), they also:

- Lack any requirement that mandates the use of an ongoing feedback loop between WQPs and lead-in-water levels in consumer homes.

- Overlook the recent industry-funded study, which found that if the sampling protocol used for LCR compliance purposes were designed to capture worst-case lead from LSLs, approximately 70% of PWSs with LSLs would exceed the LAL. This means that CCT in these PWSs may be deemed "optimized" even when a true "worst-case" sampling would result in a LAL exceedance. When it comes to PWSs with LSLs, the WG's proposal that PWSs that can

[32] Edwards, M., et al. 2009. Elevated Blood Lead in Young Children Due to Lead-contaminated Drinking Water: Washington, DC, 2001–2004. *Environmental Science and Technology* 43(5):1618–1623.
[33] Mike Schock, personal email communication, 6/25/15

show three rounds of monitoring results meeting the LAL should be considered "optimized" under the revised rule seems unscientific and, from a public health perspective, indefensible. The same can be said for the proposal that three rounds of monitoring results that meet the LAL should continue to place PWSs on reduced lead-in-water monitoring.

- Overlook the fact that for PWSs that monitor in a manner that misses worst-case lead levels (i.e., through pre-flushing, aerator removal, and other means), 90th percentile lead-in-water values are likely underestimated. This means that CCT in these PWSs may be deemed "optimized" even when a true "worst-case" sampling would result in a LAL exceedance. When it comes to these PWSs, the WG's proposal that PWSs that can show three rounds of monitoring results meeting the LAL should be considered "optimized" under the revised rule seems unscientific and, from a public health perspective, indefensible. The same can be said for the proposal that three rounds of monitoring results that meet the LAL should continue to place PWSs on reduced lead-in-water monitoring.

- Lack any trigger for a mandated comprehensive evaluation of *all* the factors that contributed to a LAL (or "System Action Level") exceedance and for mandated corrective actions following such an exceedance.

- Limit violations to PWS "failures" that often have no direct connection to actual lead-in-water problems in consumer homes or to locally-specific CCT interventions necessary to address such problems (i.e., the violations are, for all PWSs, *failure to notify/consult* with primacy agency about CCT reevaluation when the treatment or source water change; for large PWSs, *failure to review* CCT manuals issued by EPA; and for small/medium PWSs, *failure to assess CCT or make adjustments* when such actions are recommended by the state *on the basis EPA guidance manuals*).

I am concerned that a CCT requirement such as this will not only fail to fix known weaknesses in the LCR but will also officially release PWSs from regulatory responsibilities that are already mandated by the rule but are not enforced in practice (e.g., requiring worst-case lead-in-water sampling; requiring minimization of lead-in-water levels at consumer taps in large PWSs). Similarly, I am concerned that a CCT requirement such as this will stop short of mandating actions that current scientific understanding suggests are necessary (e.g., installation and maintenance of CCT that takes into account *all* the factors, and interactions between these factors, that in each PWS accelerate lead release).

There are probably many different schemes that can strengthen the LCR's CCT requirement. Any effective scheme must include at a minimum a) robust lead-in-water monitoring, b) lead release minimization in large PWSs, c) mandated implementation of appropriate corrective actions following a LAL (or "System Action Level") exceedance, and d) a regulatory compliance mechanism that links CCT to lead levels at the tap.

One example of such a scheme might be the following:

For all PWSs, mandated routine lead-in-water tap monitoring that targets highest-risk homes and uses an EPA-prescribed sampling protocol that is devoid of steps known to hide lead,[34] and that is coupled with comprehensive lead-in-water transparency requirements (see "public education" section above). For those PWSs that exceed the LAL (or "System Action Level")

a. A comprehensive study of *all* the factors that contributed to the exceedance (not just the short list of WQPs in the current LCR)
b. Corrective actions from a toolbox of options that includes CCT "optimization"/"re-optimization," that PWSs navigate with guidance from EPA and primacy agencies, and that achieve the following goals:
    - For small/medium PWSs, a 90th percentile value below the LAL (or "System Action Level")
    - For large PWSs, the lowest possible 90th percentile value without violating any other national primary drinking water regulation.
c. Once the proper goal is achieved, setting optimal WQP ranges for *all* relevant parameters, as appropriate for each specific system, which would then be monitored on a regular basis.
d. When a PWS notices "significant" changes, as defined by EPA, in either WQPs or 90th percentile values, requiring mandatory increased tap monitoring and initiating a "find and fix" approach that mandates making all necessary CCT adjustments or taking other appropriate actions.

A similar scheme could apply to PWS changes in treatment or source water. This type of requirement could be accompanied by a compliance mechanism that triggers violations when a PWS fails to carry out the above steps.

IV. Monitoring Requirements

The Safe Drinking Water Act (SDWA) of 1974 was passed "to assure that the public is provided with safe drinking water."[35] The mechanism for achieving this goal is national primary drinking water regulations (NPDWRs) that set maximum contaminant levels (MCLs) or treatment techniques (TTs) for "contaminants which, in the judgment of the Administrator, may have any adverse effect on the health of persons."[36] NPDWRs incorporate criteria and procedures "to assure a supply of drinking water which dependably complies with"[37] the specific requirements set by each NPDWR.

The LCR is a TT NPDWR that requires PWSs to reduce consumers' exposure to lead in drinking water "to the lowest levels feasible."[22] The main vehicle through which the rule assures that this goal is achieved is "comprehensive tap sampling at homes

[34] See EPA's current definition of a "proper" sample (http://web.archive.org/web/20121108142048/http://www.epa.gov/ogwdw/lcrmr/pdfs/memo_lcmr_samplingrequirements_1104.pdf).
[35] Public Law 93-523, Dec. 16, 1974, p. 1660.
[36] Public Law 93-523, Dec. 16, 1974, p. 1661.

specifically targeted for their potential to contain elevated levels of lead [...].'"[37] This type of sampling aims at confirming that in PWSs *without* CCT, CCT continues to not be needed, and in PWSs *with* CCT, the treatment used is "optimized" (see definitions of "optimal" CCT above).

In the final rule, EPA acknowledges the unique demands that tap sampling places on PWSs, and offers a lengthy rationale for the rigorous requirement. Emphasizing the variability of lead release from one home to another and one time to another, the agency explains why sampling that fails to target highest-risk homes and worst-case levels of lead in those homes, can miss extensive lead-in-water contamination and can result in PWS failure to comply with the requirements of both the LCR and the SDWA. In response to "numerous" commenters' objections to the highest-risk-home requirement, EPA provides the following response:

> "...the requirement to collect samples from locations that are most likely to have high concentrations of lead and copper in drinking water is reasonable and necessary given the nature of the problem of corrosion byproducts. Other contaminants regulated under the SDWA usually do not require monitoring at high-risk locations or at residential taps, since the occurrence of the contaminant will usually not change as it travels through the distribution system. In contrast, lead and copper levels in drinking water are not distributed uniformly. ***If random samples throughout the distribution systems were allowed to be collected, [...] areas with serious lead and copper problems in household drinking water could be missed.*** EPA believes that these high-risk locations should be accounted for in a monitoring plan to better ensure that high levels of lead are detected and that the system institutes treatment that provides uniform and adequate levels of public health protection throughout the distribution system."[37]

Further emphasizing the necessity of knowing worst-case lead-in-water levels at consumer taps in order to be able to a) assess the need, adequacy, and effectiveness of CCT, and b) ensure that PWSs achieve the public health protective goals of the rule, EPA makes the case for a specific sampling protocol that captures "higher than average" lead release in a distribution system. It states:

> Moreover, the rule contains other procedures to ensure that excessive lead and/or copper levels would be detected in monitoring by requiring, for example, sampling of the first liter of water from the tap after water has been standing for at least 6 hours, conditions under which higher than average contaminant levels are likely to occur.[4] ***Targeting monitoring to worst-case conditions will help systems and States evaluate the reductions in contaminant levels achieved through treatment and determine when "optimal" treatment is being maintained to the degree most protective of public health. EPA believes that given the difficulties associated with accurately characterizing lead and copper levels at the tap, the final monitoring protocol will "assure a supply of drinking water which dependably complies with" the treatment components of this rule.*** [37]

These excerpts illustrate how the LCR connects public health protection to worst-case tap monitoring, worst-case tap monitoring to CCT

[37] Federal Register, Vol. 56, No. 110 (1991), Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, p. 26514.

installation/optimization, and CCT installation/optimization back to public health protection. This triangle comprises the cornerstone of the LCR's TT and represents a PWS's most minimal and fundamental responsibility toward public health protection under the current regulation: ensuring that lead-in-water levels at the tap stay low through tap monitoring and CCT.[38] It is obvious, that strengthening the LCR's ability to protect public health necessitates, among other things, strengthening its tap-monitoring requirement to ensure that it yields scientifically reliable information about worst-case lead-in-water levels at highest-risk homes. This can, in turn, yield scientifically reliable information about the need or adequacy of CCT, which is crucial for effective public health protection.

The WG's recommendation for a new tap-monitoring requirement, however, takes the rule in the opposite direction by suggesting a regime that makes a reliable evaluation of CCT practically impossible.[39] The

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[38] Which is to be installed and maintained following a LAL exceedance in small/medium PWSs, and at all times in large PWSs.

[39] The recommendation is also based on three puzzling critiques of the current tap sampling requirement. Namely that:

1) PWSs have difficulty recruiting customers to take LCR compliance samples. The implication is that customers are indifferent and a challenge for PWSs to engage. Indeed, in the absence of robust and consumer-centered public education with honest messaging about the health risks of lead in water, and in light of PWSs' regular assurances that the water they deliver meets federal safety requirements, it should be of little surprise that many residents decline participation in LCR compliance sampling. But, as Flint, MI in the fall of 2015 demonstrated, when consumers are alerted to the possibility that a lead hazard may be present in their water, they themselves are likely to organize sampling events that can result in the collection of hundreds of samples in a short period of time. Washington, DC in the summer of 2003 demonstrated the same phenomenon, when residents established through neighborhood listservs initiatives for information sharing to try and establish the location of the contamination, which homes were getting tested, which homes were receiving their test results, what the results were, and if children drinking the water had been diagnosed with elevated BLLs. Washington, DC also demonstrated that when a PWS is motivated enough to collect lead-in-water tap samples, it can achieve extraordinary resident participation (6,118 samples from LSL homes alone during one single summer). For additional information, see "Lead testing results for water sampled by residents" (http://flintwaterstudy.org/information-for-flint-residents/results-for-citizen-testing-for-lead-300-kits) and Nakamura, D. 2004. "Water in D.C. Exceeds EPA Lead Limit Random Tests Last Summer Found High Levels in 4,000 Homes Throughout City." *Washington Post* (Jan. 31), http://www.ewatertek.ca/htm%20files/washingtonpost_com%20Water%20in%20D_C_%20Exceeds%20EPA%20Lead%20Limit.htm.

2) Customers implement sampling protocols inconsistently. To my knowledge, to date there is neither any study nor any recorded evidence demonstrating that customer sampling "inconsistencies" are a widespread problem or that they yield unreliable lead-in-water results. In fact, it is unclear to me what the "inconsistencies" about which the WG is concerned even are. The indisputable and troubling fact, however, is that *improper* sampling and reporting for LCR-compliance is occurring routinely and systematically and is, in all likelihood, resulting in underestimations of 90th percentile calculations, not due to consumer errors but due to PWS irregularities in the rule's implementation. See, for example, the Michigan Department of Environmental Quality's (MDEQ) lead-in-water sampling protocol (http://www.michigan.gov/deq/0,4561,7-135-3313_3675_3691-9677--,00.html), which includes a pre-flushing instruction, and which was adopted by the Flint, MI PWS, as well as the following *Washington Post* investigations: Leonnig, C. D. and D. Nakamura, 2004 "Several U.S. Utilities Being Investigated for Lead: Water Agencies Have Hidden or Misrepresented Test Results, Records Show" (http://www.washingtonpost.com/wp-dyn/articles/A30896-2004Oct13.html); Leonnig, C. D. et al., 2004. "Lead Levels in Water Misrepresented Across U.S.: Utilities Manipulate or Withhold Test Results to Ward Off Regulators" (http://www.washingtonpost.com/wp-dyn/articles/A7094-2004Oct4.html). PWS resistance to abandon pre-flushing and the NDWAC LCR WG's failure to recommend that pre-flushing be banned, make the WG's stated desire for "a more powerful check" on CCT not only unconvincing but also confusing. After all, the WG's own recommendation for a new tap monitoring requirement calls for the continuation of customer sampling and the use of different sampling protocols per household. This, if anything, would increase inconsistency of sampling, and perhaps even make consumer participation overwhelming and, ultimately, more difficult.

regime is built on volunteer customer-initiated tap sampling, includes all types of homes regardless of their risk in relation to lead in water, and allows each resident to select a sampling protocol from a menu of options.

Although customized tap sampling to identify individual problems in individual residences, such as reoccupied homes that have been unoccupied for extended periods of time, seems like a very good idea, it is defensible only as an *addition* to and not *replacement* of the current tap-monitoring requirement.[40] Replacing the current tap-monitoring requirement with the WG's recommended program woulddismantle the LCR's 3-point cornerstone (i.e., public health protection - tap sampling in worst-case homes - CCT) and free PWSs from their primary responsibility to ensure that CCT is installed when needed, and always optimized when installed. Moreover, it could further mislead residents into believing that a one-time sample can provide meaningful insights into the safety of their water in the past, present, and future.

Contrary to the WG's claims, and as EPA explained in the final rule, random tap sampling can miss serious lead-in-water contamination. EPA didn't even consider the possibility of the use of multiple types of sampling protocols – a scheme that, by any scientific standard, would make it impossible to conduct a meaningful analysis of results, draw reliable conclusions about lead contamination problems system-wide, assess the effectiveness of CCT, and make informed decisions about needed interventions. Indeed, if the tap sampling recommended by the WG were used during the Washington, DC and Flint, MI lead-in-water crises, the high lead levels could easily have been missed as both cities have many homes with lead levels below 15 ppb.

Equally troubling is the WG's recommendation for regulatory compliance that centers on WQPs staying within their state-designated ranges, despite the well-known fact that a PWS's success on this front offers no assurance whatsoever that lead levels at consumer taps are as low as the LCR requires them to be. Simply put, current scientific understanding about lead corrosion and corrosion control provides no support for such a compliance scheme.

In summary, if adopted, the WG's tap-monitoring recommendations would result in sampling that can routinely miss large-scale lead-in-

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3) Sampling results vary based on the sampling protocol used and the configuration of a home's plumbing: Variation in lead-in-water levels within and between homes as well as in connection to different sampling protocols is a well-known fact about the nature of lead release that EPA acknowledged in the LCR of 1991 and discussed explicitly in the agency's justification for the rule's tap monitoring requirement (see example excerpt above). This is neither new information nor a challenge that signals the need for an entirely different tap sampling scheme.

[40] Moreover, sampling protocol/s would need to be determined with guidance from the PWS/EPA on a case-by-case basis (homes with LSLs, for example, would require different sampling methods than homes without LSLs; homes that used to have a LSL would require different sampling methods than homes that never had a LSL). Leaving sampling protocol decisions such as these to residents seems highly problematic, if not outright inappropriate, because most residents do not have the training (and should not be expected to have the training) to assess what method of lead detection is most appropriate for their home's plumbing configuration and history.

water contamination, just as we saw recently in Flint, MI; further jeopardize the public's health; and undermine the LCR as a NPDWR.

I propose that strengthening the LCR's tap monitoring requirement would necessitate at the very least:

- Ensuring that PWSs do indeed target highest-risk homes and can provide evidence that these homes meet the rule's highest-risk criteria.

- Mandating explicitly in rule language one sampling protocol for PWSs with no LSLs (i.e., based on a 1st-draw sample) and one sampling protocol for PWSs with LSLs (to be determined by EPA), and explicitly banning modifications (additions or deletions of any sort) including those known to artificially lower lead levels (e.g., pre-flushing, aerator removal). Mandating the collection of samples that reflect how water is normally used in homes (e.g., requiring large-mouthed sampling bottles, which better reflect how water is drawn into cups and pots) and requiring samples to be collected with cold water tap fully open. PWSs with LSLs exceeding the LAL (or "System Action Level") should be required to take corrective steps and finally optimize CCT for LSLs (see Section III above).

- Mandating annual tap monitoring, unless and until a PWS establishes a documented history, as defined by EPA, of 90th percentile lead levels a) below the LAL (or "System Action Level") for small/medium PWS, and b) at the lowest concentration feasible for large PWSs, *through tap monitoring that targets highest-risk homes and uses a proper sampling protocol, targeting LSLs when present.*

- Banning sample invalidation after a sample is analyzed.[41]

- Requiring full transparency of all matters related to lead in water, including sampling pools, sampling protocols, documentation of LSL materials, lead-in-water monitoring results, and sample invalidations.

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[41] A 2004 EPA memo already prohibits this practice (http://water.epa.gov/lawsregs/rulesregs/sdwa/lcr/memo_nov22-2004.cfm).