Comments on the Benefits Assessment Supporting

USEPA's *National Primary Drinking Water Regulations: Proposed Lead and Copper Rule Revisions; Notice of Proposed Rulemaking*, 84 Fed. Reg. 61684

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I. Summary

The *Proposed Lead and Copper Rule Revisions* (hereinafter the Proposed LCRR) would significantly intensify the stringency of federal regulation with respect to the supply of drinking water by community water systems (CWSs) and nontransient noncommunity water systems (NTNCWSs). It is abundantly clear from reviewing the 91-page notice of proposed rulemaking, the 1,108-page Regulatory Impact Analysis (RIA), and numerous other supporting documents and references that USEPA has devoted extraordinary resources to develop the proposed rule and analyze its potential effects. This public comment focuses on the Agency's benefits assessment and takes its cost assessment as given.

The review herein shows that, even if USEPA's estimates of benefits are stipulated to be true and correct, the Proposed LCRR is a poor investment in improving the welfare of children, its intended beneficiaries. The reason is because it makes their families worse off. Drinking water is usually supplied by public utilities, but it is not a public good. Households obtain the benefits from reduced lead exposure, but they also pay for it via higher water bills. The amount they can expect to pay will exceed the value of the health benefits they hope to obtain.

USEPA analyzed four scenarios that differ by regulatory scope and discount rate. According to the RIA, benefits could be construed as exceeding costs only for the scenarios relying on a 3% discount rate. Because the choice of discount rate is the key variable at the margin, it would be useful to know the break-even discount rate at which net benefits become consistently negative. The RIA does not reveal this key piece of information.

The RIA reveals two other key insights, but only implicitly. First, continuing the suite of regulations that comprises the status quo – referred to here and in the RIA as the Current LCR – would unambiguously make children and their families worse off. Depending on regulatory scope and discount rate, annualized welfare losses range from $209 million to $390 million, with benefit/cost ratios ranging from 0.03 to 0.52. Second, if the alternative of sunsetting the Current LCR were considered, as Executive Order 12,866 § 1(b)(2) requires, the annualized net benefit of the Proposed LCRR from this alternative baseline would range from a low of –$578 million to a high of $42 million across the four scenarios examined.

The Proposed LCRR also includes numerous other provisions, but none of them is credibly represented as producing additional avoided IQ losses in children. Thus, to make a

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determination that the benefits of the Proposed LCRR justify its costs, the Agency must rely on non-quantified benefits.

For a number of reasons, the public should be skeptical of both non-quantified benefits and the benefit estimates reported in the RIA. No evidence is presented showing that the non-quantified health risks exist at relevant drinking water concentrations that comply with the Current LCR. Key assumptions were made in the estimation of monetized benefits that likely result in overestimation.

For USEPA, lead poses an "evergreen" risk. The practical consequence of promulgating the Proposed LCRR, based only on the record provided by USEPA, is to make lead exposure via drinking water, of any quantity and duration, to any person, a perpetual trump card that renders further regulation inevitable and regulatory analysis superfluous.

II. Introduction

These comments are limited to the benefits assessment in USEPA's Regulatory Impact Analysis (RIA) (U.S. Environmental Protection Agency 2019b) for this proposed rule (U.S. Environmental Protection Agency 2019a, hereinafter "Proposed LCRR"). USEPA's cost estimates are taken at face value. Other public commenters (e.g., the American Water Works Association), have access to more technical expertise and experience in engineering cost estimation.[2]

USEPA's economic analysis guidance unambiguously declares that opportunity cost is the preferred measure of benefits and costs, and explains why:

> Assessing opportunity costs is fundamental to assessing the true cost of any course of action…
>
> [O]pportunity costs consist of the value lost to society of all the goods and services that will not be produced and consumed if firms comply with the regulation and reallocate resources away from production activities and towards pollution abatement. To be complete, an estimate of social cost should include both the opportunity costs of current consumption that will be foregone as a result of the regulation, and also the losses that may result if the regulation reduces capital investment and thus future consumption (U.S. Environmental Protection Agency 2016b, pp. xiv-xv).

In short, *engineering* cost captures expenditures, but opportunity cost captures social benefits foregone. The RIA does not estimate opportunity cost.[3]

[2] AWWA believes that USEPA has mischaracterized the costs of the Proposed LCRR by, among other things, "grossly underestimat[ing] the cost of lead service line replacement" (American Water Works Association 2020, p. 117). If this is true, and recognizing that AWWA is referring to *engineering* cost, which always is lower than *opportunity* cost, the RIA grossly overestimates net benefits even if benefits are ignored.

[3] The opportunity cost of engineering expenditures to comply with the Proposed LCRR is the value of benefits foregone, whether to water systems (which have higher-valued uses for these resources that must be

The accurate characterization of benefits and costs is critical for Agency compliance with Executive Order 12,866 (Clinton 1993) and its accompanying economic analysis guidance (Office of Management and Budget 2003). It also is essential for agency compliance with the regulatory budgeting elements of Executive Orders 13,771 and 13,777 (Trump 2017b, a) and their implementation guidance (Office of Management and Budget 2017a). Regulatory budgets differ from fiscal budgets because costs can only be estimated and they are not ground-truthed by statutory constraints, such as the Anti-Deficiency Act (Pub. L. 97–258, 96 Stat. 923). An agency therefore can easily evade the intended purposes of a regulatory budget by understating costs unless there is effective oversight that includes incentives for compliance and penalties for violation.

Accurate characterization of benefits and costs also is a key requirement of the Safe Drinking Water Act Amendments of 1996 (SDWA § 1412(b)(3)(A)-(B)). Biased estimates, in either direction, are simply incompatible with the statute.

III. Net Benefits Analysis for the Proposed LCRR

Because this public comment focuses on benefits, any analysis of *net* benefits necessarily is restricted to matters related to benefits assessment. Subsections A and B summarizes the RIA's estimates quantified benefits and net benefits, respectively. Subsections C, D, and E explain why these estimates should be treated with healthy skepticism.

A. Quantified ad Monetized Benefits from Reduced IQ Losses in Children

Baselines, costs, and benefits are presented in Chapters 4 through 6 of the RIA and compared in Chapter 7 (U.S. Environmental Protection Agency 2019b). Benefit estimates for several manifestations of avoided IQ losses in children are reported for both the low- and high-cost scenarios at discount rates of 3% (Exhibit 7-3) and 7% (Exhibit 7-4). Net benefits are presented in Exhibits 7-1 and 7-2).

The RIA attributes quantified and monetized benefits to two provisions of the Proposed LCRR: improved corrosion control treatment (CCT) and lead service line (LSL) replacement. However, the proposed rule includes numerous additional provisions, including new monitoring, public education, and LSL inventory requirements (U.S. Environmental Protection Agency 2019a, pp. 61687-61690). The RIA includes benefit estimates for none of these provisions. Without provision-specific estimates, it cannot be determined which of these additional provisions, if any, is likely to produce benefits (or net benefits). Not coincidentally, it also will be difficult, if not impossible, to conduct a retrospective review of their effectiveness or cost-effectiveness, as Executive Order 13,563 requires (Obama 2011, especially Sec. 6).

foregone to fund compliance) or households (which have higher valued uses of the additional money they must spend on drinking water).

B. Net Benefits

The RIA reports annualized negative net benefits for both the low- and high-cost scenarios at both discount rates. Annualized net benefits are positive only for an "incremental" estimate in which the Current LCR is used as the baseline.[4]

Incremental cost analysis is generally appropriate when multiple alternatives are considered, and they can be ordinally ranked in order of decreasing net benefits. But a key alternative is missing from this RIA, and without it, incremental net benefit calculations are misleading. That alternative is sunsetting the Current LCR.

The effect of including or excluding the sunset alternative is clearly visible when USEPA's annualized net benefit calculations are shown graphically. Each of the following four figures tells this story.

- In the low-cost scenario using a 3% discount rate (Figure A, Panel 1), the Proposed LCRR is reported to provide $79 million in annualized net benefits. This estimate requires that calculations be based on the status quo – i.e., continued implementation of the Current LCR. But the Current LCR produces annualized net *costs* of $364 million.
- If instead alternatives are arrayed in order of declining net benefits, sunsetting the Current LCR would be the first alternative considered (Figure A, Panel 2). According to the RIA, this would provide $364 million in annualized net benefits Measuring the incremental effect of the Proposed LCRR from this alternative baseline shows that it produces $285 million in annualized net *costs*.
- Worse outcomes obtain using the 7% discount rate (**Error! Reference source not found.**). The RIA reports that the Proposed LCRR has annualized net *costs* of $93 million (Panel 1). Like in Panel 1 ofFigure A, this requires using the Current LCR as the baseline. But according to the RIA, continuing the Current LCR produces $357 million in annualized net *costs*. Sunsetting the Current LCR, however, would stop this otherwise perpetual loss in social welfare. Using the sunset option as the baseline, the Proposed LCRR is reported to have annualized net *costs* of $451 million (Panel 2).
- For the high-cost scenario at a 3% discount rate (**Error! Reference source not found.**), the RIA reports annualized net benefits for the Proposed LCRR of $251 million (Panel 1). As before, this requires using the Current LCR as the baseline. But the RIA reports that the Current LCR produces annualized net *costs* of $209 million. Sunsetting the Current LCR would stop this flow of social welfare losses. From this alternative baseline, the Proposed LCRR would produce annualized net benefits of just $42 million (Panel 2).

[4] Estimates of benefits and costs for the Current LCR assume that existing LCR regulations are retained indefinitely.

- Much worse results are reported for the high-cost scenario at a discount rate of 7% (The RIA reports that the Proposed LCRR would impose $189 million in annualized net *costs* (Panel 1). Adopting the Sunset Option would bring these losses to a halt. From that alternative baseline, the Proposed LCRR is reported to impose annualized net *costs* of $578 million (Panel 2).

In short, only with a discount rate of 3% using the Current LCR as the baseline can the Proposed LCRR be construed as producing positive annualized net benefits. And to get there, one must ignore the estimated $209 million to $365 million in annualized net social *costs* imposed by the Current LCR.

Despite these results, which are taken directly from the RIA, the Agency says:

> The Administrator has determined that the quantified and non-quantified benefits of the proposed LCR revisions justify the costs (U.S. Environmental Protection Agency 2019ap. 61734).

The Agency does not dispute its own calculations. Rather, it is relying on non-quantified benefits to more than make up the difference.

For that to make sense, however, non-quantified benefits must dominate the benefits of avoided losses in children's IQ, the *sine qua non* of the Proposed LCRR. The RIA devotes chapter after chapter explaining the data, baseline, and models used to estimate reductions in children's blood lead levels (BLLs) and avoided decrements in children's IQ. The RIA also confirms that the reduction in children's IQ losses is the fundamental purpose of the proposed rule. But these benefits are, by themselves, insufficient to justify both the Proposed LCRR and the Current LCR.

It is a well-established principle in behavioral economics that rational decision-making requires ignoring sunk costs (Arkes and Blumer 1985; Thaler 1999; Jolls et al. 1998). USEPA should give serious consideration to stanching the endless welfare losses that the Current LCR imposes and refrain from adding to the suffering by not promulgating the Proposed LCRR.

Figure A: Annualized Net Benefits (3%), Low-Cost Scenario

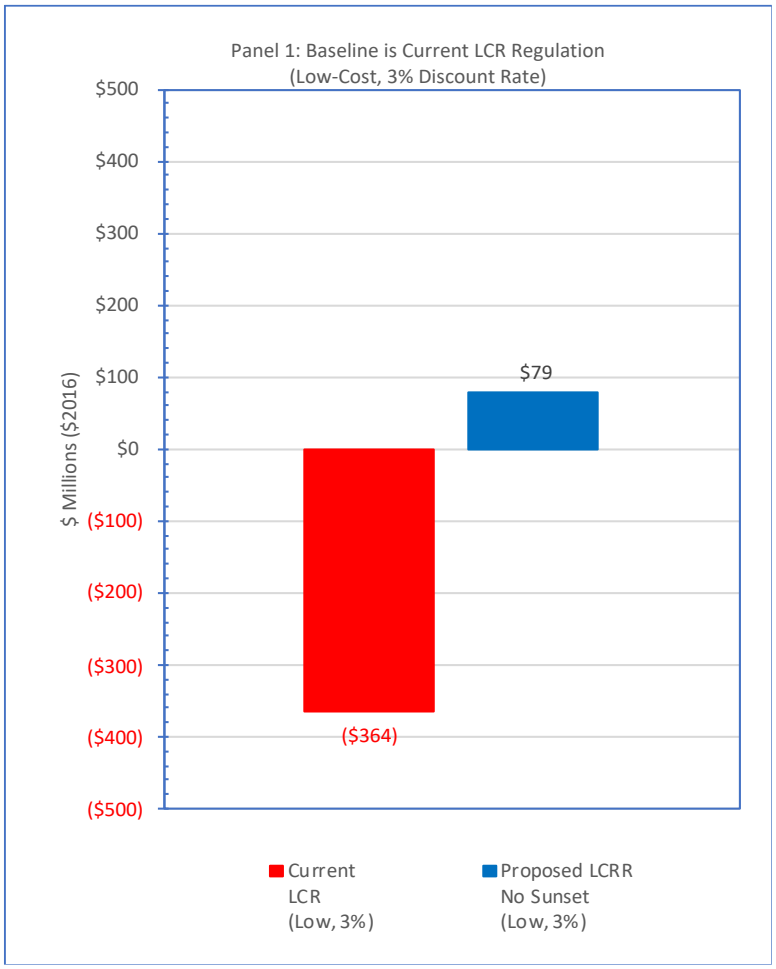
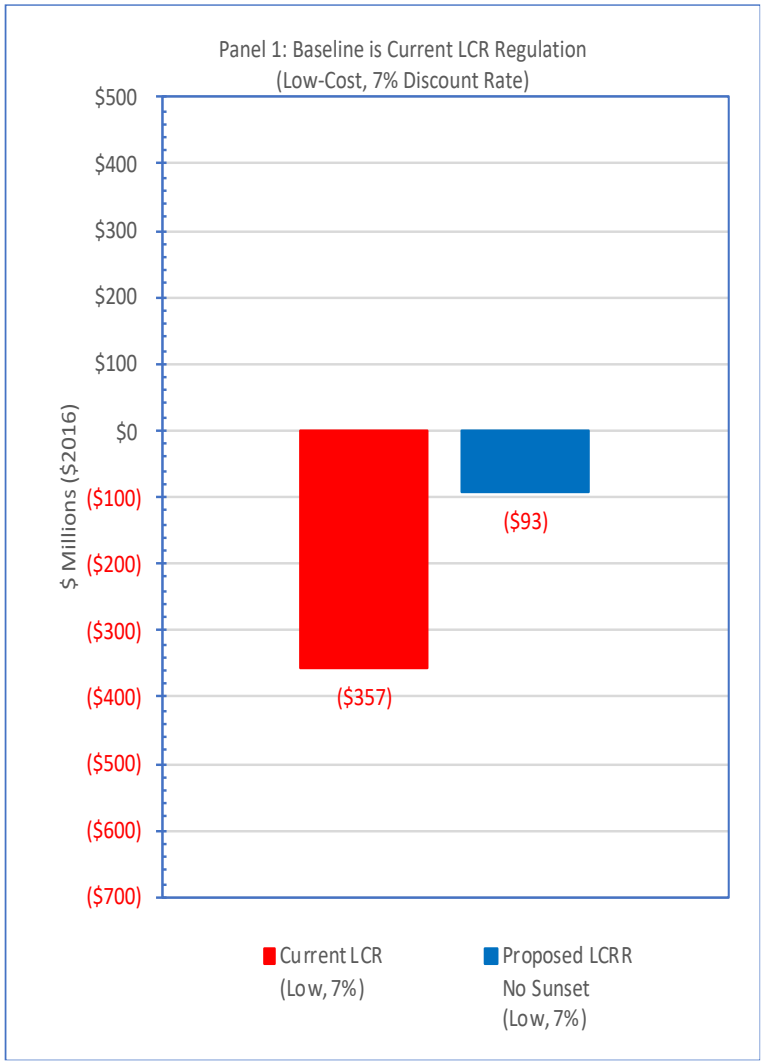


Figure B: Annualized Net Benefits (7%), Low-Cost Scenario



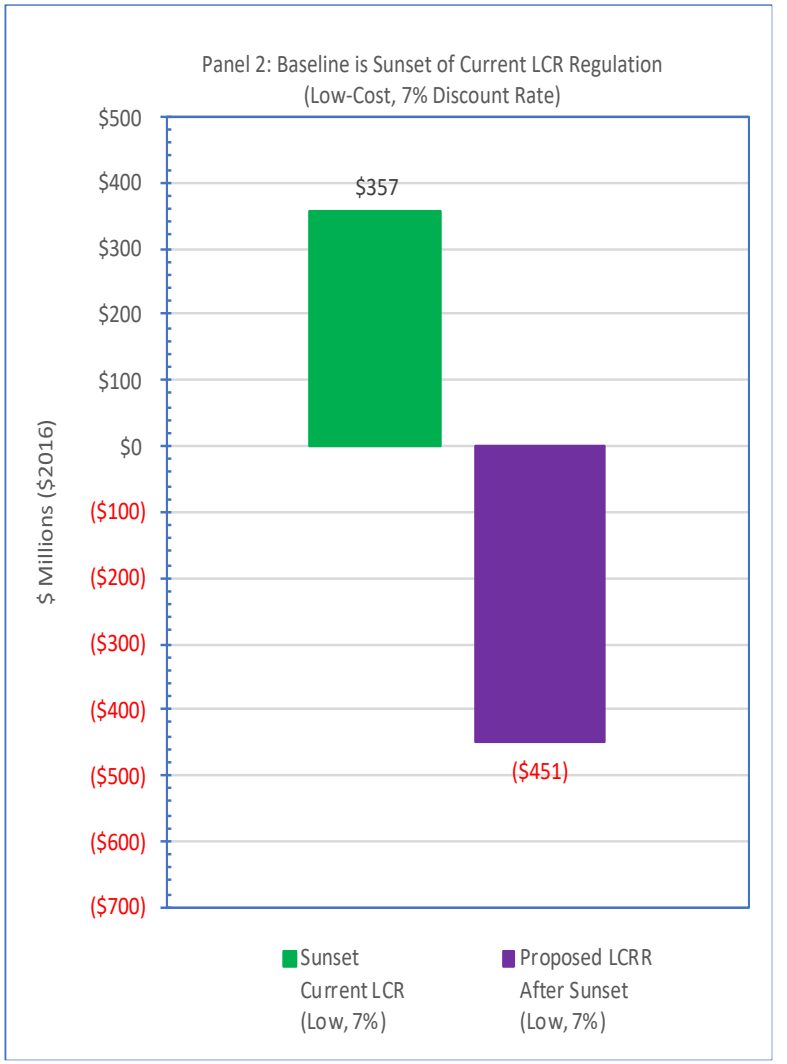


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Figure C: Annualized Net Benefits (3%), High-Cost Scenario

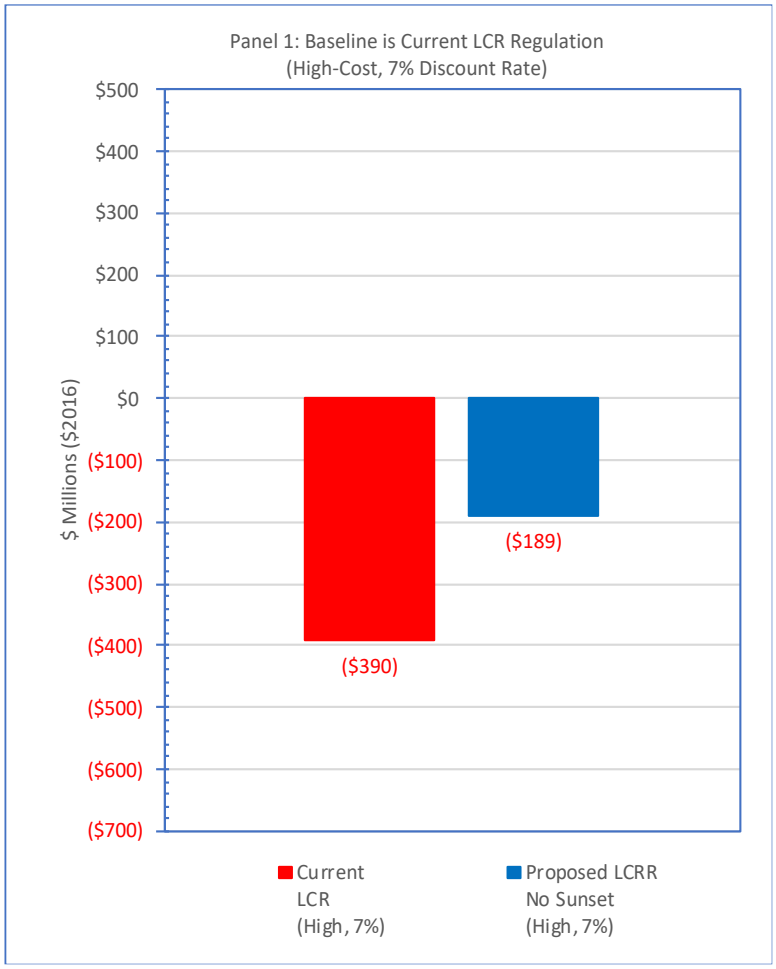

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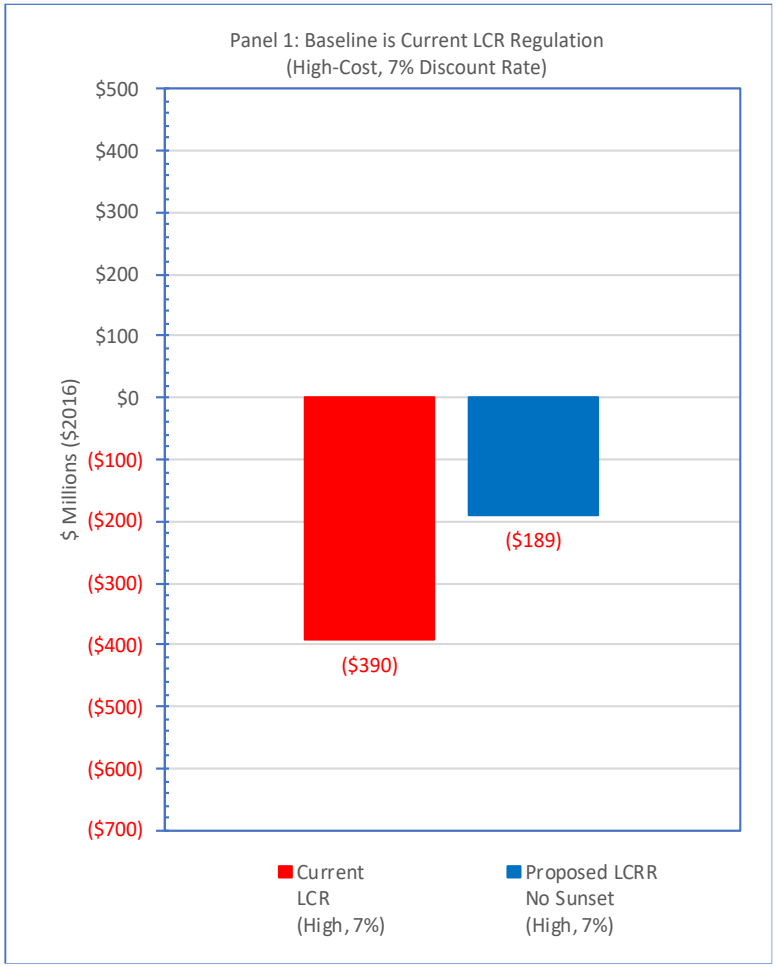
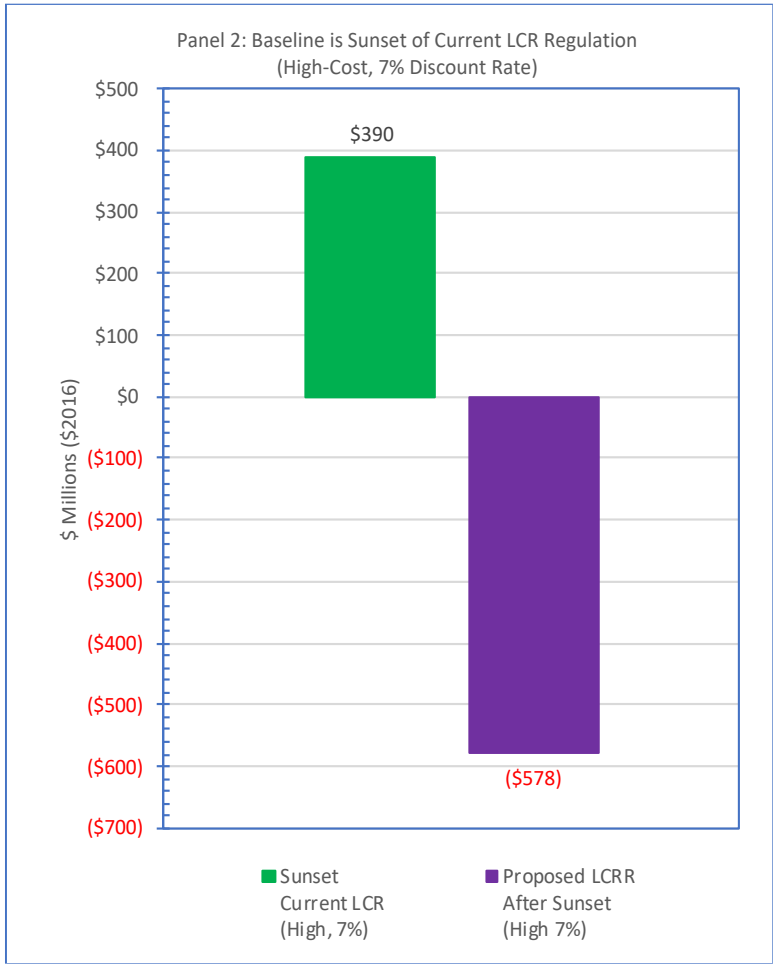
Figure D: Annualized Net Benefits (7%), High-Cost Scenario





C. Reasons to be Skeptical of USEPA's Monetized Benefit Estimates

The results reported in Section III.B above assume that USEPA's benefits assessment is unbiased – i.e., that it is not influenced by institutional or personal policy preferences, and it is equally likely to under- or overstate the true but unknown amounts. As noted in Section II, there is justifiable concern that costs may be significantly understated. Below it is shown that the assumption of unbiasedness may be unjustified with respect to benefits as well.

1. Reliance on unrepresentative data

The RIA modeled water lead levels (WLLs) at the tap to establish the baseline exposure level. However, the Agency did not have much data to work with. The RIA reports that data came from only 15 water systems in the U.S. and Canada, with U.S. data coming only from the Northeast and upper Midwest. According to the Agency, these data "do not fully represent water quality conditions, chemistry differences in pipe scale, and treatment practices across all US regions"; "[t]here was not enough information to include housing age, which may be related to additional sources of lead"; and "the original studies were conducted for different reasons by different entities and sometimes varied in sampling methods." In an extraordinary understatement, the RIA acknowledges that "these issues may limit generalizability" (U.S. Environmental Protection Agency 2019b, p. 6-17, internal references omitted).

But USEPA generalized anyway, to which it added excess precision that leads to all sorts of misunderstanding, not the least of which is the false impression of accuracy. For example, despite the absence of evidence that its simulated drinking water tap concentrations are accurate to the nearest 1 μg/L, the Agency reported them to the nearest 0.01 μg/L (± 5 ppt) (U.S. Environmental Protection Agency 2019b, Exhibit 6-12).[5]

2. Reliance on data from water systems not in compliance with the current LCR attributes to the Proposed LCRR benefits that the Current LCR should have achieved

USEPA has promulgated multiple rounds of LCR regulations beginning with its 1991 rulemaking (U.S. Environmental Protection Agency 1991), the composite of which is referred to in the RIA as the Current LCR. When proposing follow-up regulations, an agency may not count benefits from preventing risks that were previously claimed to be prevented (Office of Management and Budget 2017b). Nor is it proper for an agency to project perfect compliance with a baseline regulation, then argue that additional regulation is justified because compliance was less than perfect. In both cases, benefits would be (at least) double-counted, a practice

[5] Regarding the problem of excess precision, see Belzer (2012, Sec. IV.C, especially the example on p. 26):

> Psychology students were training rats to run mazes. In the final report, they noted "33.3333% of the rats learned to run the maze. 33.3333% of the rats failed to learn. And the third rat escaped" (from Grumbine 2008).

that is clearly forbidden under federal economic analysis guidance (Office of Management and Budget 2003; U.S. Environmental Protection Agency 2016b) and widely accepted advice from experienced benefit-cost professionals (Dudley et al. 2017).[6]

These principles notwithstanding, the RIA relies on WLL data from Flint, Michigan and the District of Columbia during periods in which these water systems were noncompliant with the Current LCR (U.S. Environmental Protection Agency 2019b, Exhibit 6-1; pp. 6-6, 9-5 [fn 100]). It appears likely that some benefits attributed to the Proposed LCRR might properly be assigned instead to the Current LCR, unless of course they are already counted in the Current LCR, in which case they should be removed from the estimate for the Proposed LCRR.[7]

3. Reliance on unusual consumer behavior that happens to maximize modeled WLLs overstates exposure, risk, and benefits

The RIA estimates baseline exposure using simulated data of lead concentrations in drinking water populated with data from a number of different sources of varying quality. It was not reported whether the data reflected full compliance with the 1991 LCR, subsequent regulations, and changes in lead concentrations due to other factors. One thing is clear, however: The Agency assumes high baseline WLLs. Its model relies on the "fifth cumulative one-liter sample drawn from a household tap after stagnation" (approximately 30 seconds after flushing) to predict peak lead concentration,[8] which according to the RIA is the liter with the highest lead concentration.[9]

Fortunately, actual consumer practices are inconsistent with, and appear to be safer than, USEPA's assumed 30-second flush. Katner et al. (2018) reports that only 21% of

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[6] The problem of double-counting in federal benefit-cost analysis has a long history. For a dated but remarkably relevant example of federal agencies engaging in this practice, see Berkman and Viscusi (1973).

[7] A useful task, not performed in the RIA and beyond the scope of this public comment, is to compare the benefits estimated by USEPA for its 1991 and subsequent regulatory actions with the benefits estimated in the RIA for the Current LCR.

[8] U.S. Environmental Protection Agency (2019b, Exhibit 6-3) graphically displays for a particular residence the relationship between lead concentration and cumulative liters after last stagnation period. The lead concentration after five liters is more than three times greater than the concentration in the first liter, and more than 20 times greater than the lead concentrations for the third liter and every liter after the seventh. The expected value depends on actual household conduct, including the expected value stagnation time, which the RIA does not report.

Peak concentrations do not reflect expected values, which are required by Agency guidance for economic analysis (U.S. Environmental Protection Agency 2016b) and are required for human health risk assessments prepared in compliance with statutory text enacted in 1996 (423 U.S.C. § 1412(b)(3)(B)(ii) (USEPA shall specify "the *expected* risk or *central estimate* of risk for the specific populations" [emphasis added]).

[9] There is some corroborating empirical evidence that fifth-liter draws maximize lead concentrations in water systems that are compliant with the Current LCR. See Katner et al. (2018, Table 5), showing that in a convenience sample conducted in New Orleans, about five times as many samples exceeded the USEPA action level after a 30-second flush than exceeded it at first draw.

households surveyed in New Orleans flushed their taps, and among those who did, 69% flushed their taps less than 30 seconds. If this convenience sample is representative for New Orleans residents, the flush time used in the RIA applies to no more than 15% of households. Other empirical estimates suggest that USEPA's modeling assumption is even less representative of reality. For a different convenience sample, Riblet et al. (2019) found that full flushing was rare (3.4%) and especially so at the tap (0.26%).[10]

This implies that the RIA relies on WLLs derived from uncommon household practices and generally exceed the expected value of the WLL distribution in actual use. More interesting, household practices have not been materially affected by public education efforts recommending 30-second flush times. Katner et al. (2018) conclude that prolonged and repeated flushing "may also not be practical, cost-effective, or sustainable over the long term, especially in cities with declining water resources and/or rising water rates." In any case, the benefits of new public education requirements included in the Proposed LCRR appear dubious given that prior public education efforts have not performed well.

4. Reliance on data obtained from precautionary risk management metrics leads to upwardly biased benefit estimates

The Current LCR requires water systems to report 90th percentile lead concentrations, a risk management metric, and the RIA relies on these compliance monitoring data. While a central tendency measure (the geometric mean) was used, a central tendency measure of an upper-bound risk management metric is different from a central tendency measure of the actual WLL distribution. Regardless of the merits of regulating based on values from the upper-tail, it should go without saying that it is inappropriate to base a benefits assessment on data obtained from a precautionary risk management reporting system.[11]

5. Short-term increases in WLL after LSL replacement are not taken into account

The RIA assumes that immediate and permanent reductions in WLLs will result from LSL replacement. In addition to concerns about timing, noted in Paragraph 6 below, the effectiveness of LSL replacement is more complex than USEPA assumes for its benefits assessment. In particular, the extent to which WLL reductions will occur at all is complicated by uncertainty about the actual source of lead found in residential tap water. By assuming that 100% of it comes from water system service lines, USEPA implicitly attributes none of it to on-premises lead pipes, solder, and fixtures.

[10] With respect to the source of lead, Riblet et al. (2019) found it to be primarily located within the premises, not the water system service line. This highlights the variability of real-world situations.

[11] An empirical distribution could be so skewed that the 90th percentile equals the expected value. The 90th percentile is appropriate in such a case – but *only* in such a case.

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Further, there is evidence that both full lead service line replacement (LSLR) and partial lead service line replacement (PLSLR) may result in short-term increases in WLL. The USEPA Science Advisory Board raised this issue in a review:

> In studies of full LSLR and PLSLR, the evaluation periods have been too short to fully assess differential reductions in drinking water lead levels… Both full LSLR and PLSLR generally result in elevated lead levels for a variable period of time after replacement. The limited evidence available suggests that the duration and magnitude of the elevations may be greater with PLSLR than full LSLR (U.S. EPA Science Advisory Board 2011, p. 2).

The RIA neither cites this SAB review nor substantively addresses its members' concerns.

6. Reductions in WLLs after CCT optimization will be gradual, not immediate

USEPA's model assumes perfect and immediate implementation of CCT throughout a water system's service area, with immediate changes in WLLs:

> In the case of a CCT installation of optimization, the entire population of a model PWS will move to the new CCT status at the same time. The EPA also assumes that the entire PWS moves to the drinking water lead concentration, assigned to POU when this option is implemented by the PWS, which implies that everyone is properly using the POU. Thus, a corresponding change in the concentration of lead in drinking water will occur for the entire PWS population in the year the change is implemented (U.S. Environmental Protection Agency 2019b, p. 6-20, internal references omitted).[12]

The convenience of this assumption is obvious, but it clearly overstates the rate at which CCT optimization (or point-of-use [POU] device adoption) could lead to lower WLLs. Modeled post-regulation WLLs will be lower-bounds, not expected values. This will bias the benefit estimate upward, and because the bias occurs early in the 35-year time horizon for the benefits assessment, the magnitude of the bias will be disproportionately large in present value terms.

7. Reductions in BLLs after WLL reductions will be gradual, not immediate

In addition to assuming that WLLs decline immediately after implementation of CCT, the RIA also assumes that children's BLLs decline immediately when WLLs are reduced:

> For LSL replacement, the portion of the population corresponding to the number of households undergoing LSL replacement each year will change to the lower drinking water (*and blood lead*) levels in the year the LSL is replaced (U.S. Environmental Protection Agency 2019b, p. 6-20 [emphasis added]).

[12] Pages 6-10 through 6-20 in U.S. Environmental Protection Agency (2019b) all have page "6-20" in the footer. For this reference and the one that follows, the correct page numbers are used.

Like the assumption of immediate WLL reduction with CCT optimization, this assumption also is undoubtedly convenient. But it inescapably results in an upward bias in estimated benefits.

The RIA uses the differences in BLLs before and after CCT and/or LSL replacement weighted by the number of years in each category, and this also may be a source of bias:

> [U.S. Environmental Protection Agency (2019b)] Exhibit 6-24 presents modeled SHEDS-IEUBK blood lead levels in children by year of life. The blood lead levels in this exhibit represent what children's blood lead level would be if they lived under the corresponding drinking water system scenario for their entire lives. These blood lead levels are used as inputs for the individual children in each corresponding PWS for the benefits modeling, and do not represent weighted population estimates. In the SafeWater LCR analyses of benefits, the EPA estimated lifetime blood lead levels from these values by taking the average of the blood lead levels for each year of the child's life, up to age 7, based on their drinking water system scenario status during each year. Age at implementation of the rule was taken into account when calculating lifetime average blood lead levels. If, for example, the child is age 3 at implementation of the rule, the EPA would calculate lifetime average blood lead levels by averaging 3 years of pre-rule blood lead levels and 4 years of post-rule blood lead levels. Or, if the child is age 5 at implementation of the rule, the EPA would calculate lifetime average blood lead levels by averaging 5 years of pre-rule blood lead levels and 2 years of post-rule blood lead levels (U.S. Environmental Protection Agency 2019b, p. 6-33).

The average BLL before implementation should be expected to be fairly constant, so the effect of averaging before implementation should be minor. But averaging BLLs after implementation is likely to overstate BLL reductions in the early years (where discounting has little effect) and understate BLL reductions in the later years (where discounting has its greatest effect). More importantly, BLL reductions that are modeling artifacts increase estimated IQ losses avoided.

8. Estimated IQ changes may not be clinically significant

USEPA's modeled IQ losses for 25 combinations of pre-rule lead concentration. LSL status, and CCT status. For none of the 25 combinations does the geometric mean estimate of IQ loss that would be prevented by the Proposed LCRR exceed 2 points (U.S. Environmental Protection Agency 2019b, Exhibit 6-26). For reference, note that this is just 13% of the 15-point standard deviation in IQ measures (Weiss et al. 2010). This is equivalent to assuming that Z-scores of 0.000 and 0.133 are clinically meaningful.

Changes of this magnitude are indistinguishable from random error. This is especially so for the 11 combinations in which the estimated IQ improvement is less than 1 point (i.e., Z-

score < 0.007). The fact that USEPA reports estimated IQ changes with three significant figures does not imply that any of the three figures reported are meaningful.[13]

The RIA cites approvingly advice provided in 1998 by the USEPA Science Advisory Board that purports to say that changes in IQ too small to be clinically significant in individuals are nevertheless valid and reliable for extrapolation to exposed populations. In a review of studies on lead health effects, the RIA states:

> The studies reviewed here derive statistical relationships that represent average effects at a population level. Even when studies have estimated heterogeneous effects across broad demographic subgroups, it is not appropriate to use the estimates to predict a change in earnings at the individual level. Rather, the findings can only be interpreted as representing incremental changes in earnings associated with IQ changes on average across a population. The EPA's Science Advisory Board (SAB) has previously recommended that predicting changes in IQ, including mean changes of less than a single IQ point, is appropriate for a population in economic and risk analysis but is not defensible at the individual level [citing U.S. EPA Science Advisory Board (1998)]. The SAB noted that, "small effects distributed across a large population exert large total health effects," and "the characterization of IQ point loss by the summation of fractional IQ points over the entire population of children is considered defensible and appropriate" U.S. Environmental Protection Agency (2019b, p. J-8).

The SAB is cited out of context, however, and in a way inapt for benefits estimation.

In context, SAB members offered their *risk management* judgment while simultaneously advising USEPA to explain its case better and not to infer clinical significance to individual IQ changes (which the Agency implicitly does in the RIA by quantifying and monetizing benefits from changes in individual IQs):

> *[Charge Question]*
>
> *The characterization of IQ point loss in the population includes the summation of fractional IQ points over the entire population of children. Have we provided a sufficient technical justification for this approach? Is this approach defensible and appropriate?*
>
> Findings and Recommendations
>
> The [SAB Environmental Health Committee] considered that the Agency report should emphasize a core principle of public health; namely, that small effects distributed across a large population exert large total health effects. Thus the characterization of IQ point loss by the summation of fractional IQ points over the entire population of children is considered defensible and appropriate.

[13] Changes are presented ± 0.005 IQ point – three ten thousandths of the standard deviation.

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> It was also considered that the technical justification needed to be explained more clearly. In developing the final rule should be very careful when referencing effects in individual children. Some readers, understandably, may be confused because they interpret the exercise as awarding fractional IQ points to individual children. The relatively large test-retest variation associated with any individual measure of IQ should be clearly presented (U.S. EPA Science Advisory Board 1998, p. 13-14 [emphasis added]).

But if individual IQ changes lack clinical significance – i.e., they are not demonstrably "real" in a clinical sense – it is far from clear that there is any distinguishable difference in lifetime earnings, or a bona fide willingness-to-pay to achieve them or prevent their loss.

Estimating population benefits by aggregating clinically insignificant individual-level effects is further justified by reference to USEPA's economic analysis guidelines [(U.S. Environmental Protection Agency 2019b, p. J-8), citing U.S. Environmental Protection Agency (2010)]. Once again, the RIA cites its presumed authority out of context. The relevant Agency guidance concerns how to value the partial achievement of a threshold that must be met for any benefits at all to exist. The logic behind this advice is that, if only achievement of the threshold yields benefits, then every unit of work toward that threshold has no economic value.

Reasonable analysists may differ with respect to how they would advise an agency concerning how to value partial achievement of a minimum threshold, but this issue is immaterial to the question at hand. USEPA asserts that there is no threshold for adverse effects from lead ingestion. Thus, the question posed here is a very different one: How should biological effects that individually have no value be counted in the aggregate?

9. IQ valuation method does not capture willingness-to-pay

The RIA values the benefits of avoided IQ losses in children using discounted present value earnings. This method is inherently unsatisfying for several reasons. First, income losses are a poor substitute for WTP because income is not the only margin on which individuals base their preferences. Second, very small changes in estimated IQ are not likely to result in meaningful differences in lifetime income, especially given the array of confounding factors with demonstrably greater income effects. Third, there is no reason to believe that IQ differences that are clinically *insignificant* at the individual level result in clinically *significant* differences in lifetime income. USEPA should be credited for working admirably with what it has available, but it has reached far beyond what the literature can justify.

There may be ways, until now unexplored, by which objective valuations could be obtained for the avoidance of biological endpoints that nonexperts do not understand or otherwise cannot value. In a recent scientific presentation, the author of this comment proposed a scheme whereby valuations of such endpoints could be obtained using contingent valuation surveys of experts, then scaled to the general population (Belzer 2019). This proposed method would solve a host of problems that arise when unappealing proxies are used because WTP cannot be directly estimated.

Note that this proposed method was devised to deal with a different class of problems in which scientists have raised concern about biological phenomena that nonexperts cannot (and cannot reasonably be expected to) value. Experts believe that these phenomena are located on a pathway to a frank health effect (such as cancer), the avoidance of which nonexperts reasonably can value. But the ability of nonexperts to value the avoidance of a frank health effect does not translate into an ability to value underlying precursor biological phenomena. And there may be substantial scientific uncertainty concerning whether these phenomena are possible, likely, or necessary waypoints on the road to a frank health effect that nonexperts can understand.

The valuation of small IQ losses in children might be amenable to the application of this proposed valuation method. Parents may be unable to rationally quantify WTP for small differences in their children's IQ, especially if these changes are clinically insignificant. However, experts in the measurement of intelligence might be able to make meaningful distinctions, and if so, the proposed method provides a way to use their expertise in WTP estimation.

10. Variability and uncertainty are acknowledged, but not propagated through the analysis

The estimates of benefits (and net benefits) in the RIA have substantial variability and uncertainty, and in several places the RIA is refreshingly candid about this.[14] With effort, uncertainty can be propagated through the RIA so that decision-makers and the public are better able to evaluate to extent to which benefit (and net benefit) estimates are likely to be different across alternatives. This was not done in the RIA. Thus, decision-makers and other readers are likely to misinterpret benefit (and net benefit) estimates as fixed values instead of uncertain quantities that may or may not be different.[15]

The WLL data on which benefit estimates depend are variable across water systems and uncertain at several points in their derivation (see, e.g., U.S. Environmental Protection Agency 2019b, Sec. 4.3.5). Several of these sources of variability and uncertainty are quite large:

- The number of water systems covered by the Proposed LCRR
- The distribution of WLLs in these water systems
- The extent to which LSL replacement results in short-term increases in WLLs

[14] See, e.g., U.S. Environmental Protection Agency (2019b, p. 6-2): "Ideally, to determine the potential lead tap concentrations under the various CCT and LSL scenarios, a researcher would analyze the variation of lead concentrations in tap samples nationwide across the defined scenarios. However, due to the nature of the available data, the EPA's lead concentration data were collected from different locations, with different methods, over multiple decades, and for different purposes. Therefore, the interpretation of what is driving the tap sample lead concentration variation within and across the CCT and LSL scenarios becomes complicated. A good deal of the variation in the lead concentration data may be due to the use of differing sample collection methodologies and unequal numbers of repeated samples in the same time and place."

[15] The fixed value USEPA settled on was the fifth cumulative one-liter sample drawn from a household tap after stagnation because it is representative of peak WLL and occurs after a flush of roughly 30-45 seconds (U.S. Environmental Protection Agency 2019b, Sec. 6.2).

- Human exposure to these WLLs, both in the baseline and as a result of implementation of each provision in the Proposed LCRR
- The concentration-response functions converting increased WLL into increased BLL, and increased BLL into IQ losses
- The concentration-response function converting reductions in WLL into reduced BLL, ad reduced BLL into IQ gains
- The extent to which modeled IQ changes are statistically or clinically meaningful
- The valuation of IQ changes

In addition to these uncertainties, which are real but were not propagated in the analysis, the interpretative problem is exacerbated by the RIA's routine use of excess precision. Aggregate benefits and costs were reported to the nearest $1,000 (i.e., ± $500) (U.S. Environmental Protection Agency 2019a, b), but there is no support in the analysis for that degree of precision, and excess precisions conveys the impression of accuracy because the public often misunderstands these concepts.

11. The RIA does not comply with applicable economic analysis guidance

As previously noted *en passant*, the RIA is in key places noncompliant with federal guidance documents on economic analysis (Office of Management and Budget 2003; U.S. Environmental Protection Agency 2016b). The RIA does not persuasively show that any systematic effort was made to adhere to these guidelines. Given his expressed concerns about this matter (Wheeler 2019), the Administrator would be well advised to probe more deeply and also consider nongovernmental guidelines (e.g. Dudley et al. 2017) that are targeted for RIA consumers such as himself.

D. Reasons to be Skeptical that Regulatory Provisions Other Than CCT and LSR Replacement will Produce Benefits

The Proposed LCRR includes a host of provisions. The RIA assumes, probably correctly, that several of them will not reduce WLLs. These provisions include the LSL inventory requirement, water system sampling at schools and licensed child-care facilities, and new public education requirements (U.S. Environmental Protection Agency 2019b, p. 5-20). For these regulatory provisions, any benefits that might be realized will be highly indirect, probably impossible to quantify, and in any event, small. USEPA does expect that other provisions in the Proposed LCRR will reduce WLLs – in particular, the "fix and fix" provision. The RIA does not quantify these benefits, however (U.S. Environmental Protection Agency 2019b, p. 6-40).

1. Reasons to be skeptical of new public education requirements

For decades, federal guidance on economic analysis has promoted information disclosure as a presumptively superior alternative to command-and-control regulation when information asymmetries are present (Office of Management and Budget 1990, 1996, 2003; U.S. Environmental Protection Agency 1983, 2000, 2014, 2016b) This preference appears to

have been grounded more on theory than evidence. Experience gained with informational strategies suggests consumers may not give them he attention advocates had expected. Ben-Shahar and Schneider (2014), for example, show that mandated information disclosure has not been successful in financial and health-care regulation. More disturbingly, they make a strong case that these strategies likely cannot succeed because, among other things, people already experience informational overload.

Experience in other regulatory areas also invite skepticism. Examples include privacy polices (such as those mandated by the European Union's General Data Protection Regulation), nutritional labeling mandated by the Food and Drug Administration, and fuel-economy performance. Indeed, the fuel economy example should be quite familiar to USEPA. The Agency has recently asserted that, despite the prominence of information disclosures already required by regulation, firms ignore it when purchasing heavy-duty trucks (U.S. Environmental Protection Agency and National Highway Traffic Safety Administration 2016a, b) and consumers ignore it when purchasing light-duty personal vehicles (U.S. Environmental Protection Agency and National Highway Traffic Safety Administration 2010, 2012). If the so-called "energy paradox" is true, even the prominent disclosure of fuel economy information is not achieving its intended purpose. It is therefore uncertain at best whether new information disclosure requirements will succeed when previous mandates have failed.

While it is possible that *these* new public education requirements will be effective, there is only limited evidence that prior efforts have accomplished anything. For example, SDWA 1996 directed USEPA to mandate the distribution of consumer confidence reports (CCRs), apparently based on the conventional wisdom (widely shared by regulation mavens, including this author) that useful information would be easy to disseminate and consumers would have no difficulty understanding it.[16] A recent study by Evans and Carpenter (2019) dumps cold water on this conceit, highlighting the difficulty of crafting CCRs that are both effective and truthful, and summarizing a painfully extensive history of well-meaning failure. They cite numerous studies and reports suggesting that the very act of disseminating CCRs *regardless of content* may cause alarm, making them counterproductive as tools for ensuring their statutory purpose – i.e., ensuring consumer confidence in drinking water.[17] To the extent that CCRs cause alarm even if they contain no objectively alarming information, it may be better if consumers ignore them. Meanwhile, new public education requirements are mandated by the America's Water Infrastructure Act of 2018 (AWIA), and USEPA is required to issue implementing regulations by October 2020. While it is possible that – *this time* – Congress and USEPA will have finally cut this particular Gordian Knot, there is reason for optimism.

[16] The absence of a decision-making context is an inherent weakness of the CCR mandate that may be impossible to overcome no matter how much care is devoted to making them accessible and "user friendly." Given that water is supplied by a public or private monopoly, it is not clear how consumers are expected to use CCRs for decision-making. A more plausible (if not often admitted) purpose is that the primary beneficiaries of CCRs are advocacy groups.

[17] This may be one explanation for the observations of Family et al. (2019), who found *lower* confidence in fluoridated tap water among low-income households in Los Angeles County.

2. *Reasons to be skeptical of the benefits of new requirements for water systems to implement lead in drinking water sampling programs at schools, licensed child care facilities, and local health agencies*

These proposed new requirements are a mix of expanded monitoring and public education efforts. They are peculiar insofar as they are probably too weak to accomplish much *even if public education could be successful*, but they are unlikely to produce net benefits *even if they were much stronger*. The number of WLL samples required to be taken is too small to characterize the distribution, and small sample sizes are inherently susceptible to interpretative error and misuse. Because the Proposed LCRR also requires water systems to report test results to schools and child-care facilities, neither of which has special capacity to understand them, these reports seem so likely to cause undue alarm that it raises the question whether alarm is an intended consequence.

Intuitively, the school and child-care facility provisions appear to impose costs on water systems (and their customers) without any serious prospect of benefits. A more worrisome result would occur if this provision diverted scarce resources by leading schools and child-care facilities (and maybe the water systems that supply them) to chase ephemeral risks at high opportunity cost.

3. *Reasons to be skeptical of the benefits of potential new requirements for water systems to remediate lead service lines within private residences*

The Proposed LCRR includes a new "find and fix" provision that appears to be crafted so that water systems become USEPA's agent in persuading (pressuring?) householders and others to conduct remedial actions on their own property. This includes original and follow-up sampling and the provision of sampling results to residents and property owners in as little as 24 hours. Such urgency might be justified in extraordinary circumstances where extremely high lead concentrations had been found. However, by forcing water systems to act urgently in response to non-urgent WLLs, this provision appears likely to instill fear and panic rather than informed decision-making. Are fear and panic intended?

A reasonable response by a frightened resident or property owner is to demand that the water system fix the problem, even if the likely source is the property owner's water pipes, solder, or fixtures. The proposed rule appears to allow water system personnel to walk away if property owners decline to remediate, but this seems naïve. Water system managers could expect extraordinarily adverse reaction if they do not fix what they find, facing pressure from primacy agencies and the media to go far beyond what the Proposed LCRR requires. This outcome is sufficiently predictable that the costs of repairs to private property wherever "high" WLLs are found, should be counted as a quantified cost of the Proposed LCRR, not excluded on the ground that it is either a matter of state discretion or not technically required.

E. Reasons to be Skeptical of USEPA's Non-monetized Benefits

The RIA claims six categories of additional health effects that "were not quantified" (U.S. Environmental Protection Agency 2019b, p. 7-4). Causality is inferred based on subjective criteria ("reasonableness") that are more accepted in law than science. Indeed, none of these claims of causality can be refuted, the essential feature of scientific method.[18] Appendix D summarizes some of the literature, focusing on a pair of external reports (National Toxicology Program 2012; U.S. Environmental Protection Agency 2013). No new analyses were performed, and no dose-response relationships are discussed.

More to the point, the RIA makes no claim that the information summarized in Appendix D is relevant to the changes in lead exposure expected to be realized as a result of the Proposed LCRR. Yet these non-quantified benefits purported to result from small WLL changes are key to the Administrator's determination that benefits justify costs.

IV. Regulatory Reform and Equity

In the preamble to the NPRM, USEPA asserts, apparently without reservation or irony, that the benefits of the Proposed LCRR justify the costs (U.S. Environmental Protection Agency 2019a, p. 61734). But the preamble and RIA fail to make a persuasive case. The Agency appeals to net benefit calculations that it acknowledges could well be negative. And, as shown in Section III.B above, the Agency relies on a misleading method for characterizing marginal benefits and costs. In reality, the Agency's case relies on speculative, non-quantified benefits to make up the difference.

A. The Proposed LCRR is a missed opportunity for regulatory reform

This disturbing practice has been observed in several post-SDWA 1996 rulemakings, where net benefits, conventionally calculated, were substantially negative, as they are here (Belzer 2020). Indeed, the record of post-SDWA 1996 rulemakings reveals no example in which USEPA exercised its discretion under SDWA 1996 not to propose or promulgate regulations where benefits do not justify costs. This history, read as context for the Proposed LCRR, raises serious doubt as to whether USEPA is willing or able to exercise the common sense authorized by Congress over 20 years ago.

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[18] USEPA relies on causality determinations made by the authors of the external sources on which it relies (National Toxicology Program 2012; U.S. Environmental Protection Agency 2013). In both cases, causality is inferred when "chance, bias, and confounding could be ruled out with *reasonable* confidence." *Likely causality* is inferred when "chance and bias can be ruled out with *reasonable* confidence but potential issues remain" (emphasis added). See U.S. Environmental Protection Agency (2019b, p. D-1).

A dispassionate review of the RIA shows that, on its own terms, the case for the Proposed LCRR is very weak. Enormous effort was devoted to the analytic task, and for that commitment the Agency should be praised. But reading the RIA and its many ancillary parts conveys the impression that the proposed rule is the inevitable byproduct of the scale of Agency resources expended on both analysis and consultation with stakeholders and rentseekers. The analysts' job appears to have been to provide a legal justification for the Proposed LCRR, but despite leaving no stone unturned in this endeavor, they came up short.

Section III.B above shows that the RIA does not support a conclusion that benefits justify costs. Annualized net benefits are positive only if 3% is used for the discount rate, and only if the sunsetting option is ignored. Meanwhile, the RIA shows that sunsetting the Current LCR would produce annualized net benefits of $364 million (3%) to $357 million (7%) for the low-cost scenario, and $209 million (3%) to $390 million (7%) for the high-cost scenario. What vindication of the Proposed LCRR the RIA achieves is accomplished by ignoring the net benefits of sunsetting the Current LCR to stop the perpetual stream of social welfare losses it imposes.

B. The Proposed LCRR is likely to have devastating effects on the poor

If USEPA were to perform an objective assessment of distributional impacts, it is highly likely that both the Current LCR and the Proposed LCRR would be revealed to have unacceptable effects on the poor. That makes it a missed opportunity to avoid exacerbating a regressive policy that punishes the poor for being poor.

USEPA's affordability doctrine allows the Agency to compel the expenditure of up to 2.5% of the U.S. median household's income on drinking water (U.S. Environmental Protection Agency 1998), and the Agency may extract these resources irrespective of the benefits households receive. Obviously, half of all households have income less than the median in their respective jurisdictions, and in many jurisdictions a substantial majority of households have income below the national median. This means they must pay disproportionately more for the same private good. About 60% of Mississippi households earned $50,000 or less in 2016, a year when the national median household income was $58,820. All 82 counties in Mississippi had median incomes below the national median. In 20% of these counties, median household income was less than half of the national median. USEPA's affordability doctrine thus requires these household to pay 5% of their income – or more – on drinking water (Belzer 2020).

C. Leaving the Current LCR in place would make families poorer

An equally disturbing insight from the RIA is that leaving the Current LCR in place imposes hundreds of millions of dollars in negative annualized net benefits, with predictably disproportionate costs imposed on the poor.

To the extent that regulatory costs are borne by households – a very likely circumstance given that drinking water is a private good – low-income households are likely to bear disproportionate regulatory costs (Belzer 2020). In a paper currently under review, Cardoso and Wichman (2019) estimate that 13.6% of households have water and sewer expenditures

greater than 4.5% of annual household income, and those in the lowest income decile pay on average 8.1% of their annual income on water and sewer service. These estimates reflect, among other things, the Current LCR. Leaving the Current LCR in place would almost certainly harm the poor more than it would benefit them. Sunsetting the Current LCR would stop the continued drain of scarce resources from the budgets of low-income households. Maintaining the Current LCR, on the other hand, keeps this resource drain in place without relief.

Under Executive Order 12,866, a regulation such as the Current LCR would be an obvious candidate for regulatory reform,[19] and this is even more so in context of Executive Orders 13,771 and 13,777 (Trump 2017b, a).[20] Further, implementing guidance for Executive Order 13,777 strongly suggests that the Current LCR warrants inclusion in the Agency's list of rules deserving "repeal, replacement, or modification" (Office of Management and Budget 2017a, p. 1). The Current LCR is inexplicably missing from USEPA's list of potential regulatory reform opportunities (U.S. Environmental Protection Agency 2017), and the Agency's intent is to make matters worse.

D. The Proposed LCRR would make families even poorer than the Current LCR

As noted in Section III above, the Proposed LCRR is likely to impose substantial negative net benefits. These welfare losses would be borne by households because drinking water, even when supplied by a public utility, is a private good delivered without need-based subsidies (UNC Environmental Finance Center 2017). The costs of the Proposed LCRR would be reflected in household water bills, so their burdens will be disproportionately felt by low-income communities, and low-income families generally.

The opportunity cost of reducing lead in drinking water at the margin could be justified if household-level health benefits exceeded these costs, but the RIA indicates they are very unlikely to do so. This conclusion is reinforced by the fact that the claimed benefits are obtained by aggregating across the population individual-level effects that are clinically insignificant. Therefore, the practical consequence of the Proposed LCRR, were USEPA to finalize it, is that American families generally will be made worse off, and low-income families will be made worse off by the greatest amount.

[19] See Clinton (1993, Sec. 1(b)(2) [pp. 51735-51736]): "Each agency shall examine whether existing regulations (or other law) have created, or contributed to, the problem that a new regulation is intended to correct and whether those regulations (or other law) should be modified to achieve the intended goal of regulation more effectively."

[20] Sec. 3(d)(ii) of Executive Order 13777 directs federal agencies (including USEPA) to "identify regulations that … impose costs that exceed benefits."

E. The Proposed LCRR would impose a new environmental injustice on the poor

USEPA has prepared a supplemental environmental justice report for the Proposed LCRR. Three questions are posed (U.S. Environmental Protection Agency 2019c, p. iii):

- Are there potential environmental justice concerns associated with environmental stressors affected by the regulatory action for population groups of concern in the baseline?
- Are there potential environmental justice concerns associated with environmental stressors affected by the regulatory action for population groups of concern for each regulatory option under consideration?
- For each regulatory option under consideration, are potential environmental justice concerns created or mitigated compared to the baseline?

To the extent that these questions are addressed to the proposed rule, the report skirts them or contributes no relevant insights. "Higher blood lead levels [may be] observed among minority populations," but the Proposed LCRR does not target minority populations and the RIA includes no analysis showing disproportionate impacts. A "[h]igher proportion of low-income children [may reside] in older housing [that is] likely to have lead service lines," but nothing in the Proposed Rule targets older housing and the benefits assessment does not account for housing age. "System-wide changes that benefit all customers will also benefit minority and low-income populations," but low-income residents will bear disproportionate costs (U.S. Environmental Protection Agency 2019c, Exhibit ES-1).

The environmental justice report repackages information reported in the RIA. It includes no distributional analysis of regulatory impacts:

> EPA's economic analysis of the proposed LCRR provides limited information to assess whether there are disproportionate impacts on populations of concern. It does not contain sufficient spatial information to evaluate whether reductions in lead exposure occur in areas with disproportionate numbers of populations of concern. Benefits estimates reflect the assumption that risks at the entry point level are uniform throughout a service area, which may not be the case if only part of the service area has LSLs and/or more prevalent lead-bearing materials. The quantitative analysis suggests that IQ impacts of CCT addition or re-optimization will be greater for customers with LSLs compared to those with partial or no LSLs (U.S. Environmental Protection Agency 2019c, p. 20).

As noted above, the extent to which the Proposed LCRR would impose disproportionate *costs* on minority and low-income populations – a key environmental justice question – is not addressed in the environmental justice report. The imposition of disproportionate costs on poor and minority communities apparently is not an environmental justice concern.

The authors defend USEPA's longstanding policy preference for quantity-based equity and object to price-based equity on the ground that it would "leave low-income households

with disproportionately higher health risks." [21] The authors apparently do not consider it inequitable for low-income households to pay disproportionately higher prices for the same level of risk reduction, nor do they explain how such disproportionate costs are consistent with USEPA's environmental justice policy.[22]

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[21] *Quantity-based* equity equal protection at the cost of unequal prices. *Price-based* equity seeks equal prices for risk reduction at the cost of unequal quantities of risk reduction. *Price-based* equity is characteristic of private goods like drinking water. For a more thorough discussion, see Belzer (2020, Sec. (2)(c)(3)(d) ["USEPA's policy of ensuring equal ex post health risk from drinking water imposes highly unequal ex post risk elsewhere"]).

[22] "EPA defines environmental justice as 'the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies'" (U.S. Environmental Protection Agency 2019c, p. 1), citing (U.S. Environmental Protection Agency 2016a, p. 1). Further, "The EPA further defines the term *fair treatment* to mean that 'no group of people should bear a disproportionate burden of environmental harms and risks, including those resulting from the negative environmental consequences of industrial, governmental, and commercial operations or programs and policies'." A reasonable inference is that *fair treatment* does not rule out imposing disproportionate regulatory costs.

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