

## 2. INTRODUCTION

Local and state governments have a historic opportunity to improve the health of their residents by replacing their lead service lines with a safer pipe material that does not leach the poisonous metal into tap water. Lead-contaminated drinking water in many U.S. communities has caused widespread harm, including intellectual deficits and neurological problems, particularly in children, and cardiovascular disease and death in adults.

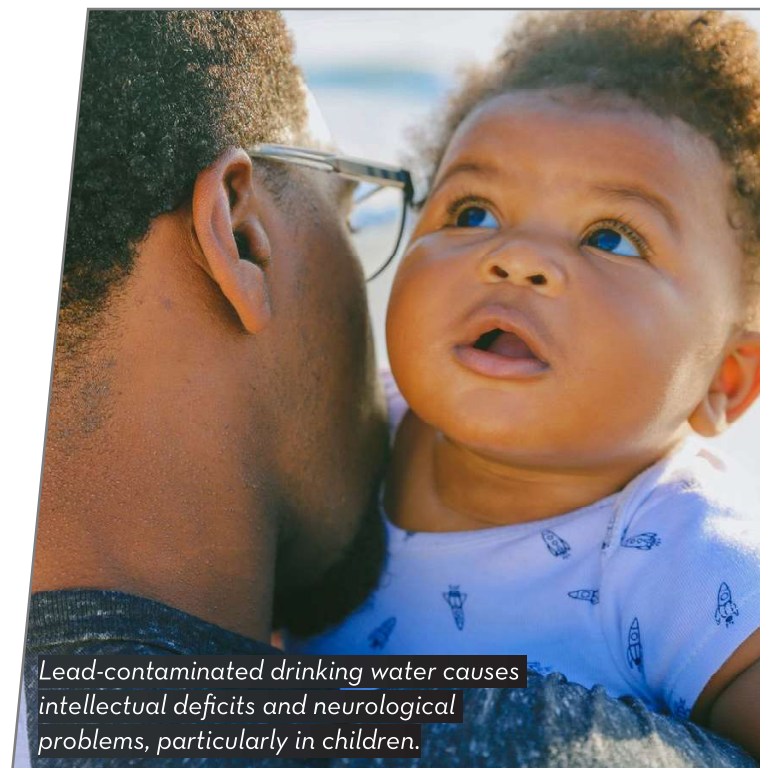
On November 15, 2021, President Joe Biden signed the Bipartisan Infrastructure Deal into law, authorizing \$1 trillion in new federal funding for infrastructure improvements. Fifteen billion of this will be used to help state and local governments pay to replace their old lead service lines, which connect underground water mains to building plumbing systems. Water systems can tap into these dedicated funds through each state's Drinking Water State Revolving Fund, a program overseen by the U.S. Environmental Protection Agency (EPA).

The EPA is not, however, providing any guidance to communities to help them select a safer piping material among the options on the market, which include metal pipes, such as copper, and plastic pipes, like polyvinyl chloride (PVC) or high-density polyethylene (HDPE).

All types of water pipes, not only lead, can release chemicals into drinking water. Plastic pipes, which are constructed from potentially dozens of different chemicals, release more contaminants into drinking water than unlined metal pipes, which are built of few materials.<sup>1</sup> Communities need to understand the potential health risks associated with different water pipe materials so that they do not end up with what's known as a "regrettable substitution," or a situation in which a selected alternative turns out to be just as bad, if not worse, as the original option.

This report delves into the potential health risks associated with drinking water from service lines made of PVC or chlorinated polyvinyl chloride (CPVC). It focuses on these pipe materials because they are one of the top plastic pipe choices for service lines. PVC is furthermore unlike all other plastic pipe choices in that it is made with vinyl chloride, which results in a slew of health and environmental problems.

Vinyl chloride exposure is linked to increased risk of liver, brain, and lung cancers, as well as lymphoma and leukemia, according to the National Institute of Health.<sup>2</sup> The International Agency for Research on Cancer first declared the chemical to be a carcinogen in 1974.<sup>3</sup> In response, the



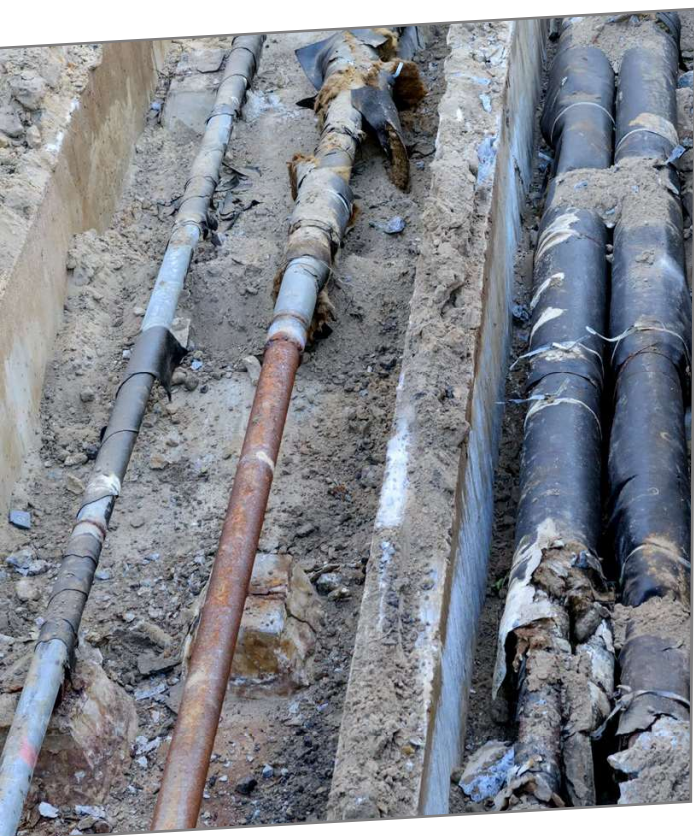
*Lead-contaminated drinking water causes intellectual deficits and neurological problems, particularly in children.*

Consumer Product Safety Commission banned its use as an aerosol in consumer products,<sup>4</sup> while the Food and Drug Administration banned its use in cosmetics.<sup>5</sup>

While touted as an inexpensive, durable choice for communities seeking to replace their lead service lines, research shows that dozens of harmful chemicals, including many for which there are no drinking water standards, can leach into tap water from PVC and CPVC pipe walls, fittings, gaskets, and the cements used for installation.

In their review of the research<sup>6</sup> on chemical release from plastic pipes, Dr. Bonnie Ransom Stern, an independent consultant at BRStern and Associates LLC, and Dr. Gustavo Lagos, a professor at Pontificia Universidad Católica de Chile, warned that, “The health effects of the leachate chemicals that have been evaluated toxicologically are significant, ranging from liver and kidney effects to adverse health outcomes on the reproductive, developmental, immune and nervous systems, endocrine

disruption and/or carcinogenicity.” They said that further study was needed to characterize the human exposures to these many dangerous chemicals, both regulated and unregulated, that leach from plastic pipes.



Beyond the health risks to consumers, the production of PVC and CPVC water pipes can release harmful chemicals into the air and water at each stage of the product’s life cycle, from manufacturing to installation to use to end of life. The February 3, 2023, Norfolk Southern train derailment and explosion that released a toxic mushroom cloud of vinyl chloride and other pollutants in East Palestine, Ohio, is the latest in a string of environmental disasters associated with PVC manufacturing or transport. The train was carrying five tanker cars of vinyl chloride, the fundamental building block of PVC and CPVC, as well as four hopper cars of PVC plastic resin material, likely in the form of pellets.<sup>7</sup> The contents of all nine cars burned — either during the course of the derailment and its immediate aftermath, or intentionally three days later to avert an explosion.<sup>8</sup> When vinyl chloride is burned, it can release hazardous chemicals including hydrogen chloride, phosgene, and potentially dioxins.

While this report focuses on the health risks to consumers whose water is delivered by PVC or CPVC pipes, it touches on the dangerous release of chemicals that can occur at other stages of the product’s life, such as during manufacturing and transport. It addresses service lines, which are different from the pipes that are used to transport water inside buildings. The report does not survey or comprehensively compare the different pipe materials that communities may choose to replace their lead service lines. Healthy Building Network provides succinct guidance to help water communities choose safe water pipe products.<sup>9</sup>

Dr. Terry Collins, Teresa Heinz Professor of Green Chemistry and director of the Institute for Green Science at Carnegie Mellon University, gets to the heart of what’s at stake, noting, “The current massive investment in the replumbing of numerous American cities should never be allowed to become an ‘out of the frying pan and into the fire’ process, and contaminant leaching from PVC, or any kind of plastic piping, has the potential to produce exactly this terrible result.”

# Key Findings

- 1. Independent researchers have documented as many as 50 different toxic chemicals released by PVC and CPVC pipes into drinking water.**

It is difficult to state with certainty the precise number of chemicals that are released because different product formulations and pipe brands release different chemicals, and at different levels. Moreover, research on this topic is thin. The government does not research chemical release from plastic pipes. Nor does it require pipe manufacturers or the third-party organization that tests and certifies the pipes to provide the public with information on their release of chemicals into drinking water. That leaves it up to independent researchers, who are few and far between, to find the funding to carry out this important work.

- 2. There is a lack of data on chemical releases from PVC and CPVC pipes in a real-world setting and a critical need for more research.**

Most studies on chemical release by PVC and CPVC pipes have been conducted in laboratory settings; it is difficult to relate their findings to in-service water pipes because many factors in a water distribution system influence the release of chemicals from PVC pipes and fittings. Studies are needed on the nature of all liberated chemicals, the dynamics of the liberation processes, the stability of the pipes under assault from microbes or chlorination, and the importance of water variables on the processes.

- 3. PVC and CPVC pipes release hormone-disrupting chemicals, including organotins and potentially phthalates, that can cause myriad health problems particularly in children and developing fetuses.**

Scientists say that exposure to these chemicals alone is enough to raise alarms about the safety of water delivered by pipes built from PVC or CPVC. Moreover, the EPA has not set a legal drinking water exposure limit for organotins.

- 4. Vinyl chloride may be released into drinking water from PVC and CPVC pipes at levels below EPA's legal safe drinking water limit, but at levels of potential health concern.**

Researchers have documented vinyl chloride in tap water at low, but not insignificant, levels. The chemical may accumulate in tap water, particularly in water that has stagnated in pipes. It may not only be released by the pipe material, but be created as a secondary byproduct of disinfection. Vinyl chloride is not routinely tested for in tap water because EPA drinking water standards do not require testing at the tap.



**5. Existing drinking water quality standards are insufficient to protect the public's health.**

Drinking water standards for synthetic chemicals, like those that plastic pipes can release, apply at the point the water enters the distribution system (i.e., at the water treatment plant), not at the tap. EPA standards therefore offer no protection from chemicals that may be released from plastic service lines. In fact, the safety of our drinking water from chemical release by plastic pipes hinges on standards set by a private organization that is not accountable to the public. Moreover, no drinking water standards factor in the cumulative burden of exposure to mixtures of chemicals in drinking water, or in the environment. There are also no full, publicly available toxicological profiles for many of the chemicals that have been found to leach from PVC and CPVC pipes.

**6. When PVC and CPVC pipes burn, they can release even more hazardous chemicals into public water supplies.**

Thermal degradation, such as from wildfires, can cause PVC and CPVC pipes to release volatile organic compounds, including cancer-causing benzene and styrene at levels above EPA's health-risk based guidelines. Communities can lose access to safe drinking water for months, or more, after a wildfire when their PVC and CPVC service lines melt or burn.

**7. PVC manufacturing and transport release toxic chemicals, including cancer-causing vinyl chloride and dioxins, into nearby communities.**

Low-income communities and communities of color bear the brunt of this pollution. Other hazardous chemicals used in the PVC production life cycle include chlorine gas and ethylene dichloride and often asbestos, PFAS, or mercury.



*Workers prepare to replace older water pipes with new copper ones in Newark, New Jersey, in October 2021. Photo by Seth Wenig courtesy of AP.*