IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW JERSEY

NEWARK EDUCATION WORKERS CAUCUS et al.,	
Plaintiffs,	Case No. 2:18-cv-11025
v.	**Judge Katharine S. Hayden**
CITY OF NEWARK et al.,	**Magistrate Judge Cathy L. Waldor**
Defendants.	

Declaration of Daniel E. Giammar, Ph.D., P.E.

I, Daniel E. Giammar, do hereby affirm and state:

Introduction and Qualifications

1. I am an environmental engineer. I hold a B.S. in Civil Engineering from Carnegie Mellon University (1996). I received a master's degree (1998) and doctorate (2001) in Environmental Engineering Science from the California Institute of Technology. Since 2011, I have been a licensed Professional Engineer in the State of Missouri.

2. I am the Walter E. Browne Professor of Environmental Engineering at Washington University in St. Louis.

3. My research focuses on chemical reactions that affect the behavior of metals and radionuclides in water systems. For the past twelve years, I have conducted research on the causes of lead corrosion and approaches for controlling corrosion associated with managing the replacement of lead pipes in water distribution systems. This research has involved bench-scale experiments and pilot-scale testing of corrosion control treatment alternatives.

4. I teach the graduate course *Physical and Chemical Processes for Water Treatment* and the undergraduate course *Environmental Engineering Laboratory.*

5. I have provided technical consulting services to several public drinking water systems. I currently serve as a member of the Providence Water Board's Expert Panel on Abatement of Lead Corrosivity. For this Expert

Panel, I have been closely involved in the design and interpretation of data from a pipe loop system for evaluating the potential application of orthophosphate for corrosion control. I am also providing technical consulting services to the Medford Water Commission in Oregon, the San Antonio Water System, and the Chicago Department of Water Management.

6. I serve as an Associate Editor of *Environmental Science & Technology*, and I was previously an editorial board member of *Journal—American Water Works Association*.

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

8. By virtue of my engineering training, my research, consulting, technical advisory work, and knowledge of pertinent scientific literature, I consider myself an expert on water chemistry, its effect on drinking water distribution systems, including the release of metals from infrastructure through corrosion, and methods for preventing the release of metals from drinking water infrastructure.

9. All of the information set forth in this declaration is based upon my education, personal knowledge, and experience, as well as my personal review of the documents attached as Exhibits B-F.

Corrosion of Lead Pipes and Solder in Drinking Water Systems

10. Public water systems treat their source water at treatment plants. After leaving the treatment plant, the water travels through large-diameter pipes known as "distribution mains," which typically run underneath streets. Most distribution mains are made of iron, cement-lined iron, or cement. Water flows from the distribution mains to individual homes and buildings through "service lines." Water moves from these service lines to a home or building's interior plumbing, ultimately flowing out of residents' taps.

11. Historically, service lines were made of lead. Lead service lines are particularly common in cities that have many homes that were built prior to the 1940s. Lead is commonly found in other water infrastructure components, as well. For example, the curved pipes that connect the distribution mains to service lines, known as goosenecks, are also commonly made of lead. Many older homes also have interior plumbing that contains lead components: either lead piping or copper piping with lead solder.

12. When water flows from the treatment plant through lead pipes, it can cause the interior surface of those pipes to deteriorate through a process called corrosion. The metal is broken down as a result of chemical reactions with the water environment. Although all water corrodes metal to some

degree, differences in water chemistry can affect the relative corrosivity of water sources.

13. With treatment, solid layers called scales form on the inside surface of the pipe. These scales are needed because they can protect pipes from corrosion.

14. Water's pH, a measure of how acidic or basic the water is, is the best indicator of how quickly the water will corrode metal pipes. Alkalinity (a measure of water's ability to protect itself against changes in pH) is another important factor that affects the overall corrosivity of the water. The physical characteristics of water, including temperature, flow, and velocity, also affect the rate at which water will corrode metal pipes.

15. A water system must minimize and control the corrosion of its lead infrastructure in order to avoid lead leaching into drinking water. Internal corrosion of metal water pipes can cause the release of metal ions and particles into drinking water.

16. Lead released from lead pipes after exposure to corrosive water can travel with the water into residents' taps. Lead can be released either in dissolved form or present as suspended particles. Suspended lead-containing particles can become stuck on plumbing components, including elbow joints in home plumbing or in aerators on household faucets. This is problematic

because lead lodged in plumbing can disintegrate into the water over time, as it flows through the pipes and fixtures.

17. Water systems employ various techniques to reduce the lead concentrations in water associated with the corrosion of lead pipes and solder. For example, it is common to add orthophosphate, a corrosion-inhibiting chemical, to the water. Other techniques include adding soda ash, lime, or silica to the water. Corrosion control chemicals are effective when they minimize lead in the drinking water to the maximum extent feasible.

18. Corrosion-inhibiting chemicals function by forming a protective solid scale on the inside surface of pipes. These scales are formed when the water's components combine with lead from the pipe and build up as layers on the inside of the pipe's surface. These layers prevent the water from coming into contact with the part of the pipe that is lead, which is unstable and would otherwise corrode quickly.

19. In water systems that use orthophosphate to control corrosion, lead concentrations at residents' taps will not be minimized unless a chemically and physically stable lead-phosphate scale has formed throughout the lead pipes in the system. For the corrosion control treatment to be effective, the system must also maintain stability across other water quality parameters, including pH and alkalinity.

20. Even after the scale has formed, water systems must continue to treat the water for corrosion control in order to control lead at residents' taps.

21. Changes in water chemistry can make the protective scale less stable, and can destroy it altogether.

22. Sustained elevated lead levels are an indicator that that the water system is not optimizing corrosion control.

Effectiveness of One-Time Drinking Water Testing at a Single Source

23. A single non-detect or low-lead-level test at a home does not mean that individuals are not exposed to lead as a result of drinking the water in that home. While initial sampling results may not detect lead, a sample at the same faucet the very next week may show much higher levels.

24. Lead levels in drinking water samples can be variable because they are affected by the time of stagnation before use and by the actual parcel of water that is sampled. The first liter of water collected following a period of stagnation will often not have the highest lead concentration to which a resident might be exposed. This is because that water had been in contact with the plumbing materials of the faucet and immediately upstream of the faucet, and not with the lead service line. As additional water is used, the water that had been stagnant in the lead service line reaches the tap, and that water often has substantially higher lead concentrations.

25. Variable lead concentrations are also influenced by the detachment of lead-rich particles from lead service lines or premise plumbing. The detachment of particles is episodic and cannot be predicted. Even the presence of lead-containing particles that are too small to be visible can result in lead concentrations that are an order of magnitude higher than the lead action level.

26. For these reasons, when a water system has not optimized corrosion control treatment, any home or building that is connected to the water main via a lead service line, or any home that has lead plumbing or copper plumbing with lead solder, is at risk of experiencing elevated lead levels.

Lead in Newark's Drinking Water

27. Based on a review of Newark's partial lead service line inventory and a recent Compliance Agreement and Order between the City of Newark and the New Jersey Department of Environmental Protection, I understand that Newark has between 18,000 and 22,000 lead service lines within the City.

28. Based on the sampling results reported on the New Jersey Drinking Water Watch website, I understand that Newark's water system has

exceeded the U.S. Environmental Protection Agency's lead action level of 15 parts per billion for the last three six-month monitoring periods.[1]

29. The most recent levels of lead reported by Newark's water system are extremely high, with more than half of the samples reported in the last seven weeks exceeding the action level.[2] The New Jersey Drinking Water Watch website shows that samples taken since the beginning of the current monitoring period have tested at 53.1 parts per billion at the 90th percentile. This means that 10 percent of the City's samples during the current monitoring period tested at 53.1 parts per billion or greater. While the current monitoring period will not be over until December 31, 2018, the City's reported levels are very high.

30. The monitoring data do not show a downward trend in the 90th percentile lead level. Overall, the residential tap water monitoring data collected between January 2017 and the present do not indicate that lead concentrations in Newark's drinking water are low and trending downward.

---

[1] Ex. B, New Jersey Drinking Water Watch, Newark Water System, PS ID# 0714001, available at https://www9.state.nj.us/DEP_WaterWatch_public/JSP/PBCUSummary.jsp?tinwsys=127.

[2] Ex. C, New Jersey Drinking Water Watch, Newark Water System, PS ID# 0714001, available at https://www9.state.nj.us/DEP_WaterWatch_public/JSP/PBCUSamples.jsp?tinwsys=127&tmnmprd=1093.

These data show that Newark's water system is not currently effectively controlling the release of lead from pipes and solder.

31. Additionally, while Newark has conducted only limited sampling over the last 18 months, several of the residential tap water samples had lead concentrations above 100 parts per billion. These very high lead levels are concerning. Lead concentrations above 100 parts per billion suggest the presence of particulate lead in the water, because dissolved lead concentrations that occur in water in pipes with well-established scale layers are usually lower than 100 ppb.

32. A system experiencing lead concentrations as high as Newark's water system has not optimized its corrosion control treatment. Newark has reported that it started adding orthophosphate and increased the silica dose to its water. However, based on the reported sampling, it appears that the most stable and least soluble scale has not yet developed on the pipes and plumbing materials. This is consistent with the New Jersey Department of Environmental Protection's repeated findings that the City of Newark is not currently optimizing corrosion control treatment.[3]

[3] Ex. D, Letter from Felicia Fieo, Section Chief, Bureau of Safe Drinking Water, N.J. Dep't Envtl. Prot., to Newark Water Dep't (July 11, 2017); Ex. E, Letter from Felicia Fieo, Section Chief, Bureau of Safe Drinking Water, N.J. Dep't Envtl. Prot., to Newark Water Dep't (Jan. 23, 2018); Ex. F, Compliance

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

[signature] 8/23/2018

Daniel E. Giammar, Ph.D., P.E. Date

Agreement and Order, NEA 180001-0714001, N.J. Dep't Envtl. Prot. 10 (July 2018).