Exhibit B

to August 9, 2023 SDWA Emergency Petition regarding
Jackson, MS

Declaration of
Elin Warn Bentanzo

I, Elin Warn Betanzo, do hereby affirm and state:

I. Introduction & Qualifications

1. I am an environmental engineer. I hold a Bachelor of Science in Environmental Science from Carnegie Mellon University (1998) and a Master of Science in Environmental Engineering and a Water Quality Management Certificate from Virginia Tech (2004). I am a Professional Engineer registered in Michigan, Maryland, and Virginia and a certified water system operator in Maryland and Michigan.

2. I have specific expertise in drinking water science, engineering, and policy issues based on over 20 years of experience. I have worked for the U.S. Environmental Protection Agency (EPA) in the Office of Ground Water and Drinking Water writing and implementing national drinking water regulations. I have also worked for the Washington Suburban Sanitary Commission, where I led water system master planning and hydraulic modeling, and for the Northeast-Midwest Institute leading their Safe Drinking Water Research and Policy Program. A true and correct copy of my resume is attached to this declaration as Exhibit A.

3. I currently serve on several federal, state, and regional government panels on drinking water quality. These include EPA's National Drinking Water Advisory Council; EPA's Microbial and Disinfection Byproducts Rule Revisions Working Group; the Southeast Michigan Council of Governments Water Infrastructure Task Force; and the Michigan Department of Environment, Great Lakes, and Energy Corrosion Control Advisory Panel. I previously served on the Federal Advisory Committee on Water Information from 2014 to 2017.

4. I am the founder of Safe Water Engineering LLC, which is a small consulting firm that works to improve access to safe drinking water through engineering and policy consulting.

5. By virtue of my engineering training, consulting, technical advisory work, and knowledge of pertinent scientific literature, I consider myself an expert on drinking water treatment, water distribution systems, communication with impacted residents about drinking water, and drinking water impacts on public health. Below are examples of my work:

a. I have provided engineering consulting services to the Detroit Water and Sewerage Department in Detroit, Michigan to establish their lead service line replacement program.

b. I completed an independent verification and validation of DC Water's Lead Service Line Removal Plan for the Council of the District of Columbia.

c. In Benton Harbor, Michigan, I provided technical assistance regarding lead in water to analyze data, improve public outreach and messaging, promote community awareness, and advance public health protective policy.

d. In Highland Park, Michigan, I provided technical assistance to the water system regarding the implementation and refinement of standard operating procedures; compliance assistance with the Safe Drinking Water Act (SDWA); water quality data analysis; lead service line replacement; Lead and Copper

Rule (LCR) compliance and outreach; and planning infrastructure renewal programs.

e. I provided technical assistance to the Michigan Environmental Council and Natural Resources Defense Council regarding water infrastructure, the Safe Drinking Water Act, and other policy issues at the state and federal level for several projects.

f. In my policy work, I have worked directly with municipal, county, state, and federal government agencies in Michigan and nationally to improve drinking water safety while ramping up asset management approaches to sustainably renew and replace our decaying water infrastructure.

g. I served as a technical expert on the University of Michigan's project supporting implementation of Michigan's Revised Lead and Copper Rule.

6. I have focused my career on the quality of water in the distribution system, i.e., the pipe system that carries drinking water from water treatment plants to consumers' taps. The distribution system is a critical portion of water system infrastructure that can maintain or compromise water quality coming from the water treatment plant based on infrastructure conditions, materials, and hydraulic and water quality management. Contaminants entering distribution systems and/or poorly managed distribution system water quality can harm public health even if the water entering the system from treatment plants is safe. 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 listed in Exhibit B. The Interim Third-Party Manager (ITPM) just issued a quarterly report covering the period of April 1-June 30, 2023. This report demonstrates important progress over this time but does not substantially change the concerns I have based on my review of the documents listed in Exhibit B. Progress will be best demonstrated through data showing improved water quality data at the water treatment plants and in the distribution system during this time period.

7. I am providing this declaration to explain the water quality challenges currently experienced in Jackson and the reasons I believe there remains a public health risk for people consuming water in Jackson.

8. This declaration is provided in support of Petitioners' People's Advocacy Institute and Mississippi Poor Peoples Campaign, Emergency Petition to EPA.

II. Concerns with Jackson's water system's compliance with Surface Water Treatment Rules

A. The City of Jackson's Surface Water Treatment Plants

9. Detailed water treatment plant schematics are not publicly available. The description that follows is what I have been able to assemble by reading the 2020 EPA National Enforcement Investigations Center inspection report ("2020 NEIC inspection"), several Mississippi State Department of Health (MSDH) sanitary survey reports, several monthly operating reports, and using my training and professional judgment. Any errors in this

description are due to a lack of transparency and clarity in publicly available documentation. Jackson's drinking water comes from two sources. First, Jackson has a surface water system that treats water from rivers or reservoirs. The surface water system serves most of Jackson. Second, Jackson also has a groundwater system that draws water from nine wells in the southern part of the City. Three of the nine wells are inactive.

10. Jackson has two surface water drinking water treatment plants: O.B. Curtis and J.H. Fewell. These two treatment plants utilize several treatment techniques to remove contaminants from the water including microorganisms.

11. The J.H. Fewell Treatment Plant treats water from the Pearl River. Based on my review of the documents provided, my understanding is that the J.H. Fewell Treatment Plant operates using conventional treatment through the following steps:

a. Alum and hydrated lime are used for the coagulation process, then a slow mix flocculator encourages particles including microorganisms in the water to clump. The particles sink to the bottom of a sedimentation basin by gravity.

b. Water then moves through rapid sand filters to further remove the coagulated materials.

c. Disinfection is achieved through UV lamps, chlorine dioxide, and chlorine and chloramine treatment. Chlorine is added at the outlet pipe from the sedimentation basin. Chlorine disinfection occurs as water travels through this pipe prior to ammonia injection, through the filters, and in the clearwell. According to disinfection calculations by MSDH, requirements are met by using a high chlorine dose and a short contact time. Ammonia is added to react with the chlorine and a chloramine residual is provided in the distribution system.

12. The O.B. Curtis Treatment Plant treats water from the Ross Barnett Reservoir. The documents that I reviewed indicate that the O.B. Curtis treatment plant consists of two treatment processes. One is a conventional system similar to J.H. Fewell's. The other is a membrane system.

13. In the O.B. Curtis conventional system, potassium permanganate is continuously fed for manganese reduction. Aluminum chlorohydrate polymer is used as the coagulant and soda ash may be used to adjust the pH. The water goes through a flocculation tank and sedimentation tank and then goes through rapid sand filters. Disinfection is also achieved through UV lamps and the use of chloramines in a clearwell. In contrast to J.H. Fewell, O.B. Curtis uses a low dose of free chlorine and with a long contact time in the clearwell.

14. In the O.B. Curtis membrane system, aluminum chlorohydrate polymer is added, then the water goes through a flocculation tank. An ultrafiltration tank with membranes is used for the primary treatment on this side. Membranes are a more advanced treatment option compared to sand filters and use water pressure differentials on each side of a membrane to force water through small pores to remove contaminants. A clearwell provides disinfection with chlorine and ammonia injection to create chloramines.

B. Mississippi's microbial certification process

15. Jackson is a subpart H system under SDWA for purposes of meeting filtration and disinfection requirements. A subpart H system serving at least 10,000 people must treat its source water consistent with certain treatment technique requirements. These requirements include 1) filtration requirements, which depend on the types of filters used, 40 C.F.R. §§141.73, 173, and 2) disinfection requirements that consist of installing and properly operating water treatment processes which reliably achieve: (a) At least 99% (2-log) removal of Cryptosporidium, (b) 99.9% (3-log) removal and/or inactivation of Giardia lamblia cysts and (c) 99.99% (4-log) removal and/or inactivation of viruses, 40 C.F.R. §§ 141.72(b)(1), 172. Each of Jackson's three treatment systems—the conventional system at J.H. Fewell, the conventional system at O.B. Curtis, and the membrane system at O.B. Curtis—must each separately meet these requirements. 40 C.F.R. §§ 141.70(b)(2), .170(b)(2). Under the Long-Term 2 Enhanced Surface Water Treatment Rule, states may assign water systems to "bins" and require additional Cryptosporidium removal/inactivation based on source water quality testing. Prior to February 2023, MSDH required Jackson to meet a greater 3.5-log removal of Cryptosporidium. In February 2023, O.B. Curtis was reclassified to bin 1, requiring only 2-log removal of Cryptosporidium.

16. Removal/inactivation processes begin at the point where the raw water enters the treatment plants and continue through the water treatment plant until the water is sent into the distribution system, where it could be recontaminated. Based on my review of the sanitary surveys, MSDH determines a treatment system's compliance with the disinfection requirement by awarding credits that add up to the total "log" removal/inactivation credits via filtration/membrane "removal" processes and disinfection "inactivation" processes.

17. The below table summarizes my understanding of MSDH's calculations of the log removal/inactivation achieved for each contaminant at each plant based on the 2021 Sanitary Survey:

Table 1:

		Giardia	Viruses	Cryptosporidium
	Requirement	**3-log removal/inactivation**	**4-log removal/inactivation**	**3.5-log* removal/inactivation**
J.H. Fewell	Filters	2.5-log	2.0-log	2.0-log
	Chlorine	0.486-log	2.0-log	
	UV	1.5-log		1.5-log
	Total	**4.486-log**	**4-log**	**3.5-log**
O.B. Curtis Conventional	Filters	2.5-log	2.0-log	2.0-log
	Chlorine	0.29-log	2.0-log	
	UV	1.5-log		1.5-log
	Total	**4.29-log**	**4-log**	**3.5-log**
O.B. Curtis Membrane	Membranes	3.0-log	2.0-log	3.5-log
	Chlorine		2.0-log	
	Total	**3.0-log**	**4.0-log**	**3.5-log**

* Requirement reflects values in 2021 Sanitary Survey. Based on the bin reclassification, the Cryptosporidium requirement is currently 2.0-log removal/inactivation for O.B. Curtis.

18. Based on my review of MSDH's sanitary surveys, each system must have all treatments (filters, disinfection, and UV; membranes and disinfection) working simultaneously at all times to meet all the requirements of the Surface Water Treatment Rules.

a. The conventional treatment systems cannot rely only on chlorine or UV disinfection alone because the filters must still meet the filtration requirements. I understand that the UV disinfection treatments for Giardia and the chlorine treatment for viruses exceed the amount of inactivation credit awarded by MSDH. However, a public water system using conventional or membrane systems must also meet turbidity-based filtration requirements to comply with the Surface Water Treatment Rule. 40 C.F.R. § 141.173(a)-(b). These requirements make sense to me from an engineering and public health perspective. Having multiple barriers to prevent contaminants from entering the distribution system ensures that even if a microorganism makes it through one treatment process, another treatment process may remove or inactivate it. Moreover, chemical and UV disinfection processes are less effective when there is high turbidity, as particles can shield microorganisms from these inactivation processes. Having a separate turbidity requirement for filters and membranes ensures that disinfectant processes work as intended.

b. The conventional systems cannot meet Giardia disinfection requirements without UV operating and cannot meet virus disinfection requirements without chlorine disinfection. Until February 2023, UV had been required to meet Cryptosporidium requirements at both treatment plants, but after the classification to bin 1, UV is required to meet Cryptosporidium requirements only at J.H Fewell.

c. The O.B. Curtis membrane system relies on the membranes to meet filtration, Giardia, and Cryptosporidium disinfection requirements and needs credit from chlorine disinfection to meet virus disinfection requirements.

19. Although the State determined that all three treatment systems were meeting requirements for each of the three microbial contaminants during its sanitary surveys, I have serious concerns about the systems' filters, membranes, chlorine disinfectant, and UV disinfection operations based on my review of monthly operating reports, sanitary surveys, and EPA inspection reports. I would need to see more information before I could conclude that the treatment systems are currently simultaneously and consistently meeting their filtration and disinfection requirements. I would need more clearly presented data that demonstrates that for each treatment plant there is always a consecutive sequence of at least one filter bed, appropriate chlorine monitors, and UV treatment fully operational at all times that meet the flow requirements at the time they are in operation.

20. As described above, the treatment systems must operate with at least one fully functional treatment train at all times. In most cases, the treatment plants cannot meet the removal/inactivation requirement for a particular microbial contaminant if just one of the treatment processes is not functioning and, therefore, not awarded the log removal credit determined by MSDH. The fact that there are problems with all three processes further increases the likelihood that the treatment systems are not meeting the filtration and disinfection requirements for some of the contaminants at least some of the time, which would increase the risk of microbial contamination in the distribution system.

C. Filters and membranes

21. For J.H. Fewell and the O.B. Curtis conventional system, the sanitary surveys indicate that filters must achieve a combined filter effluent (CFE) of 0.3 NTU or less 95% of the time and not exceed 1.0 nephelometric turbidity units (NTU) to meet the filtration requirement. 40 C.F.R. § 141.173(a)(1). For the O.B. Curtis membrane system, the sanitary surveys indicate that the membrane system must achieve 0.15 NTU or less 95% of the time and not exceed 1.0 NTU to meet the filtration requirements. If a membrane unit exceeds 0.15 NTU for two consecutive 15 minute periods, that unit must immediately undergo direct integrity testing. The system would receive a violation if immediate direct integrity testing is not completed. Insufficient information is available to determine whether consecutive 0.15 NTU readings occurred and whether direct integrity testing occurred as a result. If a conventional filter meets the filtration requirement, MSDH awards credit for 2-log removal of viruses and Cryptosporidium, and 2.5 log-removal of Giardia. If the membrane system meets the requirement, MSDH awards credit for 3-log removal for Giardia, 2-log removal for viruses, and 3.5-log removal for Cryptosporidium. There is no method for partial credits if the filters or membranes do not achieve the set turbidity standard.

22. As described below, I have concerns about the ability of the filters and membranes to meet the turbidity requirements based on documented problems with their

operations and the equipment monitoring their performance. If a system's filters or membranes do not meet the filtration requirement, they cannot comply with the Surface Water Treatment Rule regardless of the other disinfection processes. Problems with the filters and membranes would prevent the other disinfection processes from working as effectively. As a result, the filter and membrane problems cause me to be concerned about potential microbial contamination leaving the treatment plants.

Problems documented by turbidity data

23. Compliance with the filter requirements is based on measuring Combined Filter Effluent (CFE), the combined performance of all the filters in a system, and individual filter effluent (IFE), the performance of each specific filter, through monitoring equipment. EPA Region 8 (which directly implements the Safe Drinking Water Act for Wyoming) has recognized this in its Surface Water Treatment Rule Fact Sheet: "Since CFE may meet the regulatory requirements even though one filter is producing high turbidity water, the IFE must also be measured to help the operators assess individual filter performance."[1] This means that harmful microorganisms could pass through an individual filter but not exceed the turbidity limit when diluted with filter effluent from the other filters. That microorganism could still be present and can still cause disease in those consuming the water.

24. Information that I reviewed in the complaint by EPA, inspection reports, and monthly operating reports call into question whether the filters can meet the requirement of 0.3 NTU or less 95% of the time and not exceed 1.0 NTU, and whether the membranes can meet the requirement of 0.15 NTU or less 95% of the time and not exceed 1.0 NTU. There were several turbidity exceedance events in February 2021, June 2022, and July 2022 as summarized in the Department of Justice's complaint against Jackson (itemized below).

Table 2:

Date	Exceedance
February 2021	O.B. Curtis: only 75% of the turbidity measurements were less than or equal to 0.3 NTU
February 2021	At J.H. Fewell: only 93% of the turbidity measurements were less than or equal to 0.3 NTU
February 18, 2021	O.B. Curtis: 1.0 NTU exceedances with Filter 3, 4
February 22, 2021	O.B. Curtis: 1.0 NTU exceedances with Filter 3, 4
February 23, 2021	O.B. Curtis: 1.0 NTU exceedances with Filter 3, 4

[1] EPA, Surface Water Treatment (SWTR) Fact Sheet, Region 8, at 5.

June 27 and 28, 2022	O.B. Curtis exceeded 1 NTU —ranging as high as 7.5 NTU for the membrane system
July 18, 2022	O.B. Curtis exceeded 1 NTU —ranging as high as 2.5 NTU

25. CFE Turbidity measurements, taken from monthly operating reports for July 1, 2022-April 30, 2023 (the most recent monthly operating report I have access to), are summarized in Exhibits C-E. Exhibits C-E show the daily maximum turbidity value at each plant. In each graph, the green "HS1/Finished" line represents the final turbidity measurement at the plant before the water is pumped into the distribution system. This is the most similar plant turbidity measurement to water that residents receive in their homes. The blue "Filter/CFE" line represents the turbidity measurement taken at the discharge flume between the filter effluent collector tank and the clearwell (for the O.B. Curtis conventional system) and at a water line between the break tank and pH contact chamber (for the O.B. Curtis membrane system). J.H. Fewell "uses HS1/Finished" to determine compliance with filtration requirements, as did O.B. Curtis prior to August 2022. In August 2022, O.B. Curtis changed the compliance sampling point from "HS1/Finished" to "Filter/CFE" because corrosion control chemicals added after the filters were contributing to turbidity in the treatment plant. The lower red horizontal line shows the level at which the water turbidity must stay below 95% of the time. The red horizontal lines at 1 NTU shows the value that turbidity cannot exceed.

26. Exhibit C shows turbidity compliance sampling for J.H. Fewell. The daily maximum turbidity for J.H. Fewell crosses 0.3 NTU several times over the period July 1, 2022-April 30, 2023, specifically starting around January 1, 2023. Exhibit D shows turbidity compliance sampling for the O.B. Curtis conventional system. Several daily maximum turbidities at the Filter/CFE location exceed 0.3 NTU. The HS1/Finished measurements occasionally exceed 1 NTU, the value at which O.B. Curtis would receive a violation if this was their compliance sampling point. Exhibit E shows turbidity compliance sampling for the O.B. Curtis Membrane system. Several daily maximum turbidities at the Filter/CFE location exceed 0.15 NTU. All but 5 of the HS1/Finished measurements are above 0.15 NTU over the complete time period of July 2, 2022-April 30, 2023, and occasionally exceed 1 NTU, the value at which Jackson would receive a violation if this was their compliance sampling point.

27. The Jackson data show that turbidity values are typically close to the 0.3 NTU and 0.15 NTU limits and frequently exceed those limits even if they don't account for 5% of the data. For the filters, this indicates that they are in the final stages of effectiveness as pointed out in the sanitary surveys, and/or operations are not optimized. It is unclear whether those filters were or are currently slated for rehabilitation. Moreover, the filters and membranes have several ongoing events where they do not meet the filter targets, even if they do not technically cross the compliance threshold (complete data were not available to verify that the requirement for 95% of turbidity values <0.3 and <0.15 NTU respectively were consistently met). Well operated plants try to maintain turbidity well below this level with a safety factor and have rare excursions above this value, which are typically associated with irregular events like extreme weather. I am therefore concerned that the conventional systems' normal filter operations have the filters functioning right at the margins of compliance.

28. I am also concerned by the HS1/Finished measurements at O.B. Curtis that are above 1.0 NTU even if they are not violations based on the moved compliance sampling point. While the purpose of measuring CFE turbidity is to verify the performance of the filters, one of the purposes of low turbidity water is to ensure that disinfection processes can be effective. The new placement of the O.B. Curtis compliance monitoring location ignores this purpose and serves water to the public that may not be treated as intended by the Surface Water Treatment Rules. Exhibit D shows that the HS1/Finished measurement for the O.B. Curtis conventional system exceeds the 0.3 NTU regulatory target very frequently. During these events, there may be additional public health risk that any or all of the target contaminants (Giardia, viruses, and Cryptosporidium) could break through treatment due to particle shielding during disinfection in the clearwell.

29. I am also concerned that the CFE for the O.B. Curtis membrane system was regularly above 0.15 NTU before January 2023 and still occasionally exceeds that limit. Based on the Long-Term 2 Enhanced Surface Water Treatment Rule, treatment plants use special testing—called Membrane Integrity Testing (MIT)—to prove the fibers are achieving Cryptosporidium removal. According to EPA's Membrane Filtration Guidance, "[i]f the continuous indirect integrity monitoring results exceed the specified control limit of 0.15 NTU for any membrane unit for . . . two consecutive readings at 15-minute intervals[], direct integrity testing must be immediately conducted on that unit." Per MSDH's 2021 Sanitary Survey Jackson inspection, "membrane integrity testing (MIT) must be completed every 24 hours, per the CFR. If the train fails MIT, it must be taken offline until it passes. If train turbidities exceed 0.15 NTU, that train *must* be taken offline until it passes MIT." Exhibit E shows that prior to January 2023, CFE readings at the O.B. Curtis membrane system hovered right at 0.15 NTU for about 3 months straight. My review shows that the CFE improved starting in January 2023, with daily maximum turbidity readings regularly below 0.15 NTU. However, the HS1/Finished sampling point data show a corresponding marked increase, now with occasional values greater than 1 NTU, thus raising the same concerns raised in paragraph 28 above.

Observed problems with the filters and membranes

30. In addition to the turbidity data, my review of the monthly operating reports and other inspections indicates there are problems with the filters at J.H. Fewell and O.B. Curtis. The reported problems are consistent with the turbidity data indicating that the filters need rehabilitation and that the filters may not be operating at the level needed for the systems to meet requirements for removal of microorganisms.

31. Both plants' conventional filters are reported as being long overdue for rehabilitation, with filter media needing replacement and some underdrains and/or valving need to be repaired and/or updated. Yet, O.B. Curtis's general filter rehabilitation plan has only just been initiated. There is nothing in publicly available compliance documents demonstrating that repairs to date have captured the full scope of the concerns initially identified in EPA's 2020 NEIC inspection. As shown in Exhibit D, there are multiple days where O.B. Curtis's CFE exceeds 0.3 NTU and the finished water turbidity exceeds 1 NTU, thus calling into question whether the conventional treatment plant is meeting filtration requirements.

32. At the J.H. Fewell Treatment Plant, the April 2023 Monthly Operating Report mentioned several other maintenance concerns with the filtering system that have not been highlighted in the Interim Third-Party Manager (ITPM) reports that require rehabilitation. This is concerning because filter compliance is the foundation for complete SDWA compliance.

33. I am also concerned about the O.B. Curtis treatment plant's ability to ensure its membranes are working based on the EPA and MSDH reports that I reviewed. The MIT process was identified as unreliable from 2020 to 2021 Sanitary Survey inspection reports. The current status of the MIT system, and thus reliability of the membrane system as a whole, is unclear. JXN Water has reported that it has recovered treatment capacity in the membrane treatment plant by fixing down equipment, valves, and minor changes to operational sequencing, repairing cassette connections, and implementing membrane cleaning, but it is unclear whether JXN Water has addressed MIT reliability.

34. If MIT is not functioning and a treatment train is failing integrity testing, JXN Water cannot assure their customers and MSDH that they are properly treating the water. The 2021 Sanitary Survey stated that MIT has improved in the last year, but there are remaining issues that "cause the system to kick out". The April 2023 Monthly Operating Report includes three 24-hour periods at two different trains where there is no reported MIT value, and the report does not indicate the trains were out of service at the time. It is not clear that the Long-Term 2 Enhanced Surface Water Treatment Rule requirements were being met at these times.

Concerns about measurement accuracy

35. I am also concerned that the turbidity measurements at the treatment plants are not accurate and may not capture all the times when turbidity exceedances occur. The reports from EPA and MSDH indicate that O.B. Curtis and J.H. Fewell do not have continuous monitoring equipment for their filters regularly working, and the monitors are not always properly calibrated to meet CFE and IFE requirements. The EPA 2020 NEIC inspection found that the continuous monitoring equipment at O.B. Curtis had not provided accurate reporting for three years due to improper calibration and maintenance. The MSDH Site Visit on August 13, 2021 identifies ongoing turbidimeter and continuous monitoring issues, e.g., "At the time of the site visit, water was not feeding to the Raw turbidimeter and the High Service #1 turbidimeter." MSDH's November 2021 Sanitary Survey stated that both plants now have instrument technicians and that all analyzers/monitors are being cleaned and calibrated on a routine basis, but no specific information clarifying that the previously identified issues have been addressed and resolved.

36. I saw in the ITPM's Consolidated Report of Activities for the quarter ending March 31, 2023 report ("Q1 2023 ITPM Report") that continuous monitoring systems have been installed at O.B. Curtis. There is no mention of the continuous monitoring systems at J.H. Fewell being repaired. The installation of the continuous monitoring systems would give me more confidence that O.B. Curtis's turbidity is in compliance 95% of the time. However, the April 2023 Monthly Operating Report continues to describe problems with the continuous monitoring systems including: "Filtered turbidity data for Filters 17, 22, and 20 was replaced due to faulty sample lines"; "Disinfection data replaced with grab data during online metering issues; assessment, troubleshooting, and calibration ongoing to improve overall online metering

performance"; and "Disinfection not flow paced on membrane trains; assessment and SCADA troubleshooting ongoing to restore flow pacing capabilities."

37. The reported problems with the continuous monitoring systems make me concerned about the reliability of the data they produce. My review of the April 2023 Monthly Operating Report shows potential discrepancies between the percentage of turbidity measurements that were greater than the turbidity limit of 0.3 NTU during the month and the four-hour turbidity data presented. On page 2 of the report, J.H. Fewell reports only 0.3% of its measurements were greater than 0.3 NTU for the month of April. The four-hour data on page 4, however, shows multiple measurements over 0.3 NTU. These exceedances represent 2.8% of the turbidity measurements in the table. Similarly, 0.6% of the published four-hour values for O.B. Curtis are greater than 0.3 NTU, but the reported value on page 8 states 1.1% meet this criterion. Although there could be explanations for these discrepancies that are not related to problems with the continuous monitoring equipment, none are provided in the monthly operating report. Without an explanation, I cannot rule out the possibility that the discrepancy is due to problems with the monitors themselves and that the data are unreliable, particularly given the reported problems with the monitors' sampling, calibration, and operations.

38. SDWA requires the filters and membranes to achieve certain requirements 95% of the time. Without properly calibrated continuous monitoring equipment, we do not have sufficient information to assume the filters and membranes are meeting these requirements. Improperly calibrated equipment may underestimate turbidity and underreport the instances when turbidity is above a regulatory maximum. Infrequent grab sampling or information from continuous monitors operating only some of the time may not detect turbidity exceedances that occur outside the monitoring or sampling periods. This would also result in undercounting turbidity exceedances.

D. Disinfection processes

Chlorine Disinfection

39. The effectiveness of chemical disinfection depends on the characteristics of the water being treated, the chemical being added, the amount of chemicals added to the water, and the time the water spends in contact with those chemicals. A treatment plant implements chemical disinfection by dosing the water with chlorine or chlorine and ammonia, and calculating the time period the water is in contact with the chlorine before it exits the water treatment plant and enters the distribution system.

40. At J.H. Fewell, the chlorine level used in MSDH's 2021 Sanitary Survey contact time (CT) calculation was 3.4 mg/L. Based on my experience, and reviewing the range of values that regularly occur at the plant, this is a high level of chlorine. J.H. Fewell must maintain chlorine levels at this high level because the water spends very little time (3.2 minutes) in contact with the disinfectant before ammonia is added.

41. At O.B. Curtis, the level of free chlorine used in MSDH's 2021 Sanitary Survey CT calculation is 0.1 mg/L for the conventional system and 0.2 mg/L for the membrane system based on the free chlorine residual measured on the day of the inspection. Based on my

experience, this is a low chlorine level. To achieve disinfection at this low level of chlorine, the water at O.B. Curtis spends a long time (109 minutes) in contact with the disinfectant.

42. The chlorine levels at both treatment plants must be maintained in a specific range due to the short time (at J.H Fewell) or low amount of disinfectant (at O.B. Curtis) being used to disinfect the water. For O.B. Curtis, the 0.1 mg/L free chlorine level is within the range of instrument measurement error.

43. O.B. Curtis's ability to maintain a 0.1 mg/L free chlorine throughout the clearwell particularly concerns me given that chlorine can react with organic matter, ammonia, other chemicals, or other contaminants in the water. The wrong chlorine to ammonia ratio could easily consume the necessary 0.1 mg/L free chlorine that is needed to inactivate viruses. Moreover, challenges continue to be noted in inspections and operating reports regarding fully automated chlorine and ammonia dosages. Without automation and precision, disinfection doses can vary widely and not meet requirements.

44. Data from the treatment plants also raise questions about whether they can maintain consistent chlorine levels. The monthly operating reports do not present disinfectant data from inside the plant, but information about water leaving the treatment plants can be used as a proxy. I graphed the total chlorine disinfectant residual (the measurement of chemical disinfectant in the water after the dose is applied) data at the entry point to the distribution system for both J.H. Fewell and O.B. Curtis in Exhibits F through H for July 1, 2022 through April 30, 2023. I also included a line at 1.5 mg/L, the chloramine goal from the 2022 Area Wide Optimization Program Distribution System Evaluation ("2022 AWOP Evaluation"). The line at 4.0 mg/L represents the Maximum Residual Disinfectant Level (MRDL). My review found that both treatment plants experienced significant variability in their disinfectant residuals on a regular basis ranging from 0.1 to 6.4 mg/L over the time period analyzed. Although the disinfectant residual ranges have become tighter more recently, they still have days below the 1.5 mg/L goal, particularly at O.B. Curtis.

45. The variability in the disinfectant residual at the entry point to the distribution system indicates to me that the treatments plants likely also struggle to maintain consistent disinfectant levels in the water within the water treatment plants.

46. The large magnitude of chlorine variability coupled with the very low target chlorine level at O.B. Curtis indicates that conditions exist where there may not be sufficient chlorine left to meet microbial inactivation requirements. MSDH's CT calculation depends on several factors including the flow rate, the disinfectant residual, and the water's pH and temperature. Even though both treatment plants can meet the inactivation credits for viruses via chlorine disinfection with a large safety factor, the CT calculations would not account for the potential for the lack of free chlorine residual being in the clearwell due to dosing problems.

47. Notably, MSDH used the measurements it observed on the days of its sanitary surveys to calculate CT. MSDH's CT calculations would be more representative of the treatment plants' ability to meet microbial requirements at any given time if they used the maximum flow rate and the minimum disinfectant residual observed at the relevant control points in each plant to calculate the boundaries of normal operations. Calculating log removal under these conditions

in addition to calculations for actual day conditions would better estimate and confirm whether disinfection requirements are maintained during typical observed variability in the plants' operations. As noted above, the treatment plants have wide variability in their disinfectant residual measurements.

48. Using the maximum flow rate and minimum disinfectant residual measurement is particularly important because conditions at the treatment plants can differ significantly from those observed by MSDH on the specific day of its review. Although there is a safety factor for achieving the virus removal requirement, it would give me more confidence to see 1) CT calculations at the boundaries of normal operations, 2) evidence that chlorine and ammonia dosing equipment are performing consistently and reliably, and 3) online chlorine monitors are measuring chlorine levels consistently and reliably throughout the water treatment plant.

UV Disinfection

49. Based on my review of MSDH's calculations for UV disinfection, the UV systems appear to meet the inactivation requirements for Giardia and Cryptosporidium when they are operating.

50. The UV systems must be operating for the plants to meet the disinfection requirements for Giardia at both plants and for Cryptosporidium at J.H. Fewell. Monthly operating reports demonstrate that the UV systems often experience problems that cause their reactors to go offline. If a UV reactor is down, that stream of filtered water must be taken offline to prevent it from entering the distribution system.

51. Monthly operating reports indicate that the UV systems at both treatment plants are unreliable. UV reactors at both plants have consistently been inoperable or down over the last three years. EPA's 2020 NEIC inspection mentions the UV systems being offline. The April 2023 Operating Report shows that at J.H. Fewell, one to three UV reactors are offline on any given day. It is not clear if water from offline units is necessary to meet demand in the Jackson community. No UV data are provided for O.B. Curtis, yet UV is still necessary for O.B. Curtis to meet its disinfection requirements for Giardia.

52. I do not see in the ITPM's Q4 2022 or Q1 2023 reports that there are plans to fix the UV systems to ensure they are always online. Based on information available, without repairs to the UV systems, I do not think their reliability could be increased. The August 13, 2021 MSDH site visit report states "MSDH reminds EPA that the UV systems at JHF are in-line with the high service pumps, not the filters as at OBC. When the UVs are marked as 'Off' on WOR and MORs, the corresponding high service pump was not sending water to distribution."

53. Without evidence that the UV disinfection systems are online when necessary, the following systems are out of compliance for the following microbial contaminants: J.H. Fewell for Cryptosporidium and Giardia, and the O.B. Curtis conventional system for Giardia.

III. Concerns Related to Lead Contamination

E. Jackson's Drinking Water Storage & Distribution System

54. Water leaves the treatment plants via pumping stations and is sent through Jackson's distribution system which includes, but is not limited to, transmission mains, water mains, service lines, storage tanks, valves, and fire hydrants.

55. Large-diameter pipes called "transmission" or "distribution mains" transport the treated water throughout the City.

56. Pipes called "service lines" branch off from water mains to carry water to a house or business. Service lines are typically several feet long and run from the street under public and individuals' private property. Common service line materials include lead, galvanized steel, copper, and plastic.

57. A service line connects to the plumbing inside a house or business including pipes, meters, valves, faucets, and water fittings. Water passes through interior plumbing before it comes out of a tap. Residents cannot access water from a community water system without a service line.

58. Any of the pipes in the distribution system—including the water mains and service lines—can crack or break. Cracks and breaks are more likely in pipes that are old, made out of certain materials, or corroded.

59. Pipes made of cast iron and galvanized steel are particularly susceptible to cracking and breaking through a process called corrosion. Galvanized steel can corrode from the outside and the inside. When water flows through metal pipes it can cause the interior surface of those pipes to deteriorate and corrode. Corrosion involves the breakdown of metals as a result of chemical reactions with their environment. Internal corrosion of pipes can cause metal ions and particles to enter the water and for the pipe to become weaker. Corrosion byproducts can also restrict water flow through the pipe.

60. Corroded galvanized steel pipes alter the smell, taste, and color of drinking water that passes through them. Brown, smelly, and metallic tasting drinking water are signs of corroded galvanized steel pipes. Although the metal particles from a corroded galvanized steel pipe are primarily iron, which by itself does not cause significant health effects, corroded galvanized steel pipelines increase the risk of microbial and lead contamination. Corroded iron can provide a surface for opportunistic pathogens, such as legionella bacteria, to grow.

61. Based on my review of available building materials surveys, at least some of Jackson's service lines are made of galvanized steel.[2] Lead service lines may also be present, but they have not been confirmed. Lead and galvanized steel service lines are common in older distribution systems built around the same time as Jackson's, which I think is estimated to be

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[2] EPA, *Research and Development, Plumbing Materials and Drinking Water Quality: Proceedings of a Seminar, Cincinnati, Ohio May 16-17, 1984*, at 140 (1985).

around 1922 based on the age of the J.H. Fewell treatment plant. I have also read news articles with statements from Jackson residents describing their water as brown, smelly, and foul-tasting. Knowing that Jackson has galvanized steel service lines and may have lead lines, I am concerned those pipes have corroded. The presence of corroded galvanized steel service lines exacerbates the concerns that I have about microbial and lead contamination.

F. Sources of Lead Contamination & Regulation

62. The EPA has set the Maximum Contaminant Level Goal (MCLG) for lead at 0 parts per billion (ppb), indicating that there is no safe level of lead exposure. EPA has clearly stated that the lead action level of 15 ppb is not a measure of public health protection.[3]

63. Water leaving a surface water treatment plant typically does not contain lead. The main sources of lead contamination are through the distribution system and plumbing materials inside buildings.

64. Where present, a lead service line is the largest source of lead in water[4], but it is not the only potential source.

65. Some water systems have a short (around one foot long) pipe called a "gooseneck" to connect a service line to a water main. Goosenecks are common with galvanized steel service lines because galvanized steel is rigid, which can make it difficult to connect to a water main. A gooseneck is typically made of a material that is flexible, including lead, copper, or plastic. From my experience, it is common to see the combination of a galvanized steel service line and lead gooseneck.

66. Under EPA's Lead and Copper Rule definition of a "lead service line," a lead service line includes a non-lead service line connected to a lead gooseneck. 40 C.F.R. § 141.2 ("lead service line"). Under EPA's Lead and Copper Rule Revisions (effective October 2024), a "lead service line" does not include a lead gooseneck. 86 Fed. Reg. 4198, 4281 (Jan. 15, 2021). Given the confusion among definitions, a water system could categorize a house as not having a lead service line even if it has a lead gooseneck. Even though it is not the service line, a lead gooseneck can still corrode and cause lead particles to enter tap water. In fact, galvanized steel service lines can soak up lead from a gooseneck and then release the lead over time. Rerelease of lead from galvanized pipe can result from changes in flow, water quality, and corrosion conditions. Galvanized steel service lines themselves can be sources of lead, even independent of soaking up lead from a gooseneck. Galvanized steel manufactured for drinking water applications prior to 2014 could have between 0.5 and 1.4% lead content by weight, which can be a considerable amount of lead given the length of service lines.

67. Before water comes out of taps, it flows from the service line though the interior plumbing of a house or business. These pipes, fittings, and fixtures inside the building can also be a source of lead. Older interior fixtures and fittings may be made of lead. Additionally,

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[3] EPA, Lead and Copper Rule Revisions White Paper, Office of Water (2016).

[4] Anne Sandvig et al., Contribution of Service Line and Plumbing Fixtures to Lead and Copper Rule Compliance Issues, Awwa Research Foundation, (2008).

plumbers use metal solder to connect and fuse together plumbing, typically copper, components. Solder can also have high lead content. EPA prohibited lead solder for use in potable plumbing in 1986. 42 U.S.C. § 300g-6(a)(1)(A). However, lead solder may be present in older homes, and lead solder itself is still available for purchase to use in non-drinking water types of construction. As a result, even newer construction can contain lead solder.

68. Until 2014, compliance with SDWA's definition of lead-free plumbing allowed plumbing to contain up to 8% lead.[5] This means that plumbing made of other materials including brass fittings or galvanized steel can also contain lead. In 2014, the lead-free definition was revised such that plumbing containing up to 0.25% lead by weight would be considered "lead-free." 42 U.S.C. § 300g-6(d)(1)(B). Materials meeting both "lead-free" definitions can leach lead at levels of concern.[6]

69. Lead enters tap water through corrosion of lead-containing pipes, fittings and fixtures that may be present in the distribution system, and most frequently in buildings. Any of the lead-containing parts described above may corrode and be a source of lead contamination in drinking water. Even if a water system's records indicate that a house does not have a lead service line, lead may still contaminate a house's water if the house has a lead gooseneck, a service line containing some percentage of lead (including galvanized steel), or lead-containing interior plumbing.

70. EPA requires community water systems to collect lead and copper compliance samples at homes meeting specific risk criteria for having higher lead in drinking water. Water systems with lead service lines must collect half of their compliance samples at sites with lead service lines and half at sites with copper pipes and lead solder. Jackson is currently required to collect 100 lead and copper samples every 6 months because they serve more than 100,000 people and they have water quality parameter violations. 40 C.F.R. §§ 141.80(c), .86(c), 90(a)(1)(iv). If 10% or more of these samples contain more than 15 ppb of lead, the water system has exceeded EPA's "lead action level." 40 C.F.R. § 141.80(c)(2). The lead action level is not a health-based standard, but it is a trigger for water systems to take additional action including corrosion control treatment, increased sampling, and public education.

71. EPA also regulates lead by requiring water systems to treat their water in certain ways to minimize the risk of lead entering drinking water through its distribution system through corrosion. Water systems serving 50,000 or more must employ "corrosion control" techniques to lower, but not prevent, the risk of corrosion from lead-containing pipes, fittings, and fixtures. 40 C.F.R. § 141.81(a), (d). Commonly, water systems will add chemicals to drinking water before it enters the distribution system to adjust its pH (the measure of how acidic or basic the water is), alkalinity (a measure of water's ability to protect itself against changes in pH), and/or they add a corrosion inhibitor.

72. Corrosion control treatments for lead promotes chemical conditions that form low solubility mineral protective "scales" on the inside surfaces of pipes, fixtures, and fittings to

[5] Reduction of Lead in Drinking Water Act, Pub. L. No. 111-380, § 2(a)-(b), 124 Stat. 4131 (2011).
[6] Jeffrey Parks et al., "Potential Challenges Meeting the American Academy of Pediatrics' Lead in School Drinking Water Goal of 1 Mg/L." 8 *Corrosion* 74 (2018).

prevent the water from coming into contact with soluble lead. Instead, the water comes into contact with the protective scale on the pipe's surface that reduces the quantity of lead that dissolves in water as it passes through the materials. The scale forms when the lead or other minerals combine with other chemicals in the water. Chemicals that promote scale formation can occur naturally, but they can also be added by water systems. There is an expectation that the low solubility scales form uniformly on pipe, fitting, and fixture surfaces for consistent and reliable reduction of lead in water. However, in reality, the scales formed vary in uniformity, resulting in varying levels of protection especially on already corroded surfaces that are frequently found on galvanized steel pipe. Further, scales can vary throughout a distribution system based on locational differences in water quality.

73. Protective scales do not form immediately when a water system adds corrosion control chemicals into its water. Rather, they build up over time to create a thick or sufficiently consistent layer to reduce water contact with lead in the pipe. The specific mineral layer and its relative strength depends on conditions including the water's chemistry, temperature, frequency of water use, flow, and velocity. As water treatment, water distribution, water use, and water quality change over time and space, scales can form, dissolve, and reform with a different complex that may be more or less soluble in the predominant water quality.

74. Protective scales can also become dislodged from inside a pipe under certain conditions, including instantaneous or long-term changes in flow and pressure, changes in water quality, and physical disturbance due to exterior construction or interior plumbing work.

75. To allow scales to build up and reduce the risk of scales from breaking off, consistent water quality conditions must be maintained—i.e., consistent pH and alkalinity and regular addition of the same corrosion control chemicals with dosing to maintain consistent levels in the distribution system.

76. For homes known or suspected to be connected to a lead service line or have lead-containing plumbing, regular sampling is needed to ensure corrosion control techniques are working. There is always a risk of lead in water when leaded materials are present. Consistent, appropriate lead sampling that generates repeat non-detects would confirm corrosion control is working in water systems with many leaded components. There are no effective surrogates or indicators of lead in water.

77. Lead and Copper Rule sampling requires the collection of the first liter of water from a tap that has not been used for a minimum of six hours. The purpose of this sampling protocol is to measure the highest risk water a resident might drink after waking up or returning to the house after work since lead can continue to leach into water as the water sits still in the lead containing materials. The first liter of water typically pulls from the faucet itself and proximate plumbing. First liter samples rarely include water that was stagnant in the highest risk sections of a lead service line, galvanized service, or a lead gooseneck. As a result, water systems

with lead and/or galvanized steel services lines can experience higher lead in water results than found in first liter samples.[7]

78. Lead sampling can show a wide range of results, especially when particulate lead loosens from plumbing.[8] Disturbances, like replacing a water meter, or construction and excavation activities, increase the risk of particulate lead release because the work can shake particulates free from pipes and plumbing. Particulate lead is a concern because the lead content can be very high. A lead particulate could end up in a single glass of water, but not in water sampled just before or after. Lead and Copper Rule sampling is not designed to detect particulate lead. Particulate lead can result in acute lead exposure with more immediate health effects compared to the chronic health effects often associated with prolonged low-level exposures to lead in drinking water.

79. A single first liter lead sample is not a good representation of the overall risk of lead in water at an individual home, even though it is the measure EPA established for compliance with the Lead and Copper Rule. EPA has updated the sampling requirement in the Lead and Copper Rule Revisions.

G. Jackson's Corrosion Control

80. My review of the information provided to me identified several concerns with Jackson's corrosion control process. Without adequate corrosion control, protective scales will not form to reduce lead from leeching into tap water. Inappropriate or inconsistent corrosion control can increase the release of lead in water.

Protective scale may not form due to unintended water quality mixing in the distribution system at the boundary between Jackson's surface water and groundwater systems

81. I am concerned that the corrosion control at the treatment plants is inconsistent. Monthly operating reports and recent violations indicate that Jackson is not meeting its mandatory optimal water quality parameters. Daily extreme fluctuations in chloramines and water quality parameters indicate a lack of process control, a lack of consistency in water quality at the entry point to the distribution system and in the distribution system, and therefore a lack of reliable corrosion control scale to reduce the risk of exposure to lead in water.

82. Based on my review of the 2022 AWOP Evaluation and Q1 2023 ITPM Report, Jackson did not properly close all the valves at the boundary of its groundwater and surface water systems prior to the reporting period. An open boundary would allow groundwater and surface water to improperly mix in the distribution system, creating major fluctuations in water quality and corrosion control.

83. The 2022 AWOP Evaluation raises concerns about an open boundary based on observing large differences between the total chlorine and free chlorine residuals near the

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[7] Elin Betanzo et al., Lessons from the first year of compliance sampling under Michigan's revised Lead and Copper Rule and national Lead and Copper Rule implications, AWWA Water Science, e1261 (2021).
[8] Brandi Clark et al., Profile Sampling to Characterize Particulate Lead Risks in Potable Water, 12 *Environmental Science & Technology* 48 (2014).

groundwater and surface water system boundaries: The 2022 AWOP Evaluation stated that the groundwater system would be expected to have similar levels of total and free chlorine residual. The evaluation concludes that "[b]ecause the surface water carries a chloramine residual and the groundwater system carries a free chlorine residual, the discrepancy between total chlorine and free chlorine residuals may indicate that surface water is entering the area of the system supplied by groundwater, due to leaking or inadvertently open valves."

84. Water mixing from the different systems would frequently alter the prevailing chemistry conditions, preventing corrosion control treatment from forming a protective scale on pipe and plumbing materials. According to publicly available documents, the groundwater system does not use formal corrosion control treatment. The water in the groundwater and surface water systems are treated to different disinfectant, pH, alkalinity, and temperature conditions and are expected to form fundamentally different corrosion control scales. Without consistent water quality, neither the surface water nor ground water scale can form and can even cause existing scale to be stripped from plumbing materials.

85. My review of available documents indicates that Jackson closed its valves forming the boundary between the groundwater system and the surface water system sometime during the first quarter of 2023. The Q1 2023 ITPM Report describes using standard industry practices to identify the appropriate operating state of critical valves throughout the distribution system. The report describes water pressure improvements that resulted from isolating the surface water system from the groundwater system.

86. Although the closed system boundary would allow for each service area to receive the intended corrosion control formula, it is unclear whether enough time has passed for the protective scale to form on pipes on each side of the closed surface water/groundwater system boundary. Due to the sporadic nature of lead release, I would like to see at least two rounds of 6-month lead compliance samples that meet all Lead and Copper Rule sampling requirements, collected on both sides of the system boundary before determining whether lead levels have sufficiently stabilized on both sides of the boundary.

Jackson's corrosion control may not be optimized for its system

87. Jackson may not be using appropriate studies to determine which corrosion control treatment to use for its water. I reviewed the June 7, 2017 Optimal Corrosion Control Treatment Report for the O.B. Curtis and J.H. Fewell Treatment Plants prepared by Trilogy Engineering Services ("2017 Corrosion Control Study"). None of the appendices presenting data collected via this study were available. This analysis relies on descriptions of the data collected that were provided in the body of the report.

88. The 2017 Corrosion Control Study recommended an optimal corrosion control treatment for Jackson by assessing the amount of lead and copper dissolved from three pieces of new metal exposed to three different corrosion control treatments. This technique is called a "coupon study."

89. For O.B. Curtis, the study evaluated: current water treatment from filter No. 6 with chlorine, ammonium hydroxide, and hydrofluosilicic acid to mimic finished water plus: 1) soda ash for pH adjustment to 9.2 +/- 0.2, 2) soda ash for pH adjustment to 8.8 +/- 0.2, and 3)

phosphoric acid for PO4 addition, and added soda ash for pH adjustment to 7.5 +/- 0.2. Lime, the pH adjustment chemical used at the plant just prior to initiation of the study, was not evaluated.

90. For J.H. Fewell, the study evaluated current treatment and 1) plant finished water, 2) hydrofluorosilicic acid, phosphoric acid, and soda ash for final pH adjustment to 7.5+/- 0.2, and 3) hydrofluosilicic acid for fluoride addition at a 0.60 mg/1 dose, added soda ash for final pH adjustment to 8.8+/- 0.2 for 10 batches and 9.2+/- for 12 batches.

91. The 2017 Corrosion Control Study concluded that the optimal corrosion control was soda ash at a pH target of 9.2 to 9.3 for the first three months and pH will be raised to 9.3 to 9.4 at the beginning of the fourth month for the O.B. Curtis treatment plant ("2017 optimal corrosion control treatment"). Targets for pH, CaCO3, and alkalinity are provided, and soda ash is the only substance to be used to achieve the target values for all three parameters. The study recommended a minimum distribution system pH based on one-half the 15-ppb lead action level in the demonstration unit. There did not appear to be an evaluation to determine what treatment was necessary to minimize, or achieve the lowest possible, lead release.

92. There are several problems with the design of the 2017 Corrosion Control Study.

93. First, coupon studies are suboptimal tools for evaluating corrosion control treatments, especially in water systems with older materials and corroded galvanized steel service lines. The 2017 Corrosion Control Study only describes testing new metal coupons and no materials taken from the distribution system. New pieces of metal have different properties than the metals found in an actual distribution system. As the 2017 Corrosion Control Study recognizes, "the coupon method of corrosion study gives an idea of general corrosiveness of the water but does not predict the specific effect on lead containing plumbing or fittings." EPA does not recommend relying only upon coupon studies to determine corrosion control optimization, and I agree with the agency's recommendation. According to EPA's 2016 corrosion control guidance manual, "It is important to note that coupon studies can be useful in determining the corrosion rate, but may have limited use in predicting the concentrations of lead or copper in the water."[9] The 2017 study gave no consideration for the impacts of corrosion control treatment on corrosion control scales that may have existed at the time in the distribution system and plumbing materials.

94. Second, based on the information that I have available, the 2017 Corrosion Control Study did not follow typical scientific study design by ensuring its results were reliable and reproducible. The 2017 Corrosion Control Study does not identify whether more than one replicate of each study condition was used, but no replicates are described. Given the sporadic nature of lead release, it is even more important to ensure that replicates are used in a corrosion control study. It appears this did not happen in the 2017 Corrosion Control Study, although I did not have access to the study's appendices.

95. Third, the 2017 Corrosion Control Study for O.B. Curtis did not have a study iteration using "current" water because the plant already switched to soda ash for final pH

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[9] EPA, Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems, at F-2 (2016).

adjustment at the time the study began. The study did not consider at all the potential lower lead that might result from liquid lime compared to the results they collected for soda ash. This concept was further examined in the 2021 Amendment.

96. Fourth, the 2017 Corrosion Control Study did not consider simultaneous compliance implications of the corrosion control treatments assessed for either water treatment plant. There may be other fundamental treatment and corrosion control strategies that work better together to enhance compliance with all requirements.

97. Fifth, the recommendations for optimized corrosion control did not evaluate corrosion control to minimize lead release as required by EPA's regulations. The Lead and Copper Rule defines an optimized corrosion control treatment as "the corrosion control treatment that minimizes the lead and copper concentrations at the users' taps while insuring that the treatment does not cause the water system to violate any national primary drinking water regulations." 40 C.F.R. § 141.2. Instead, the 2017 Corrosion Control Study states "The minimum distribution system pH was determined by the lowest pH that yielded lead concentrations of one-half of the 15 ppb action level in the demonstration unit."

98. Without optimal study design, I am concerned that the 2017 Corrosion Control Study recommends a corrosion control treatment that will not minimize lead release in Jackson's water system. Implementing a corrosion control treatment that does not minimize lead release in water leaves residents at risk of consuming lead-contaminated water, especially given the documented limitations of Lead and Copper Rule compliance sampling. The worst case is a corrosion control recommendation that changes the pipe chemistry such that existing corrosion control scales dissolve, releasing increased lead in the drinking water, before forming a new scale. Given the ongoing fluctuations in water quality at both treatment plants and in the distribution system it is possible that this is an ongoing challenge throughout the distribution system.

99. For the O.B. Curtis treatment plant, I also question the effectiveness of the recommended corrosion control treatment based on the data included with the Water Treatment Plant Optimal Corrosion Control Study Amendment Project of 2021 ("2021 Amendment") completed by Cornerstone Engineering, LLC. Based on the analysis presented in the 2021 Amendment, the O.B. Curtis treatment plant had installed the optimal soda ash corrosion control treatment as identified by the 2017 Corrosion Control Study by 2021. However, data presented in the 2021 Amendment indicate the 2017 optimal corrosion control treatment may result in higher lead release than the original treatment scheme using lime. The 2021 Amendment observes the lowest lead levels in the O.B. Curtis zone of the distribution system in 2019 during the temporary use of lime feed. The 2021 Amendment uses the lower lead levels with lime at O.B. Curtis to justify not changing to soda ash at the J.H. Fewell water treatment plant, but does nothing to address the documented elevated lead levels in the O.B. Curtis service area that result during use of the 2017 optimal corrosion control treatment. Because the data are not provided in the study itself, and the adequacy of sampling sites for reflecting the risk of lead release is not available, I was unable to independently evaluate this conclusion.

100. I am concerned about statements made in the 2021 Amendment that reflect medical recommendations made by the engineering firm with respect to treatment decisions for

Jackson. First, the 2021 Amendment emphasizes that the city needs to limit the use of soda ash in the J.H. Fewell service area because of its majority African American customer base, that "is typically more susceptible to Hypertension". Meanwhile, they made no modification to soda ash recommendations at the O.B. Curtis Treatment Plant. The engineering firm presents no evidence for this finding, nor lists the medical or public health community that was consulted on the occurrence of elevated hypertension in the community and the potential epidemiological implications of water treatment.

101. Second, the 2021 Amendment recommends the utility of CO2 treatment to achieve calcium bicarbonate hardness that would theoretically protect humans against lead exposure. Calcium to protect humans against lead exposure is an interesting hypothesis, but it has not been proven. While lead and calcium compete for the same locations within the body and are stored in the bone, there are no data to substantiate that calcium in water confers a level of protection. Before any recommendation of this nature is implemented, there must be adequate study demonstrating that the manipulation for increased calcium bicarbonate hardness results in a confirmed decrease in lead release in the distribution system rather than the potential increase indicated in the literature.[10] A recommendation for experimentation on the population of Jackson because there may be a beneficial outcome without any relevant data to support the recommendation is inappropriate.

102. Medical determinations are not the area of expertise of the engineering firm, and it is not appropriate for an engineering firm to make treatment recommendations based on medical hypotheses. An engineering firm should not be making judgments or decisions based on the demographics of a population that could put the population at risk of exposure to one or more drinking water contaminants. Race-based measures in medicine are frequently based on inappropriate data. Recommendations of this nature should only be implemented with full consultation with the public health community to ensure that appropriately designed and recent studies support the findings, and that medical doctors believe this is an appropriate function of the public water system.

103. For the J.H. Fewell Treatment Plant, I am concerned that the 2021 Amendment recommends a corrosion control treatment that it did not study and could potentially increase lead release.

104. The 2021 Amendment recommended installation of liquid lime and carbon dioxide (CO2) to achieve optimal corrosion control at the J.H. Fewell water treatment plant. Only liquid lime was evaluated as part of the study. No implementation or analysis of CO2 treatment is presented.

105. The 2021 Amendment states "enhanced coagulation with CO2 would allow for increasing alkalinity in the winter without increasing pH and scaling potential." But EPA's corrosion control guidance manual states that CO2 will lower pH and not change alkalinity.[11] An increase in alkalinity may increase lead release. Given the conflicting information, it is critical

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[10] Optimal Corrosion Control Treatment Evaluation Technical Recommendations 22.
[11] *Id.* at 24.

for Jackson to evaluate the impact of actual CO_2 addition on lead release before treating water and distributing it to the public.

106. The 2021 Amendment finds that J.H. Fewell has consistently ten times better lead control compared to O.B. Curtis, but J.H. Fewell accounts for all the Water Quality Parameter (WQP) excursions. The 2021 Amendment recommends adjusting alkalinity and increasing pH in the finished water for the purpose of meeting the optimal WQPs, but not for the purpose of lead control. Based on corrosion control literature summarized in EPA's corrosion control guidance manual, there is a chance that increasing alkalinity could destabilize scale and increase lead in the J.H. Fewell service area.[12] The 2021 Amendment recommends a treatment change that could potentially increase lead release even when the study does not identify a current concern about lead in the water compared to the O.B. Curtis water treatment plant.

107. It is essential to achieve and maintain consistency in water quality leaving the treatment plant to ensure consistent corrosion control and water quality in the distribution system. Fundamental adjustments at the treatment plant that are made for the purpose of consistency in water quality parameters but have an unstudied impact on lead release from current distribution system materials in Jackson may have the unintended consequence of increasing lead solubility. Considering the engineer's conclusion that J.H. Fewell corrosion control is more effective than corrosion control at O.B. Curtis, it would appear that better process control and distribution system water quality management are the appropriate remedies for achieving WQP compliance, rather than the recommended change in water treatment. If the treatment plant cannot maintain consistent water quality at the entry point to the distribution system in the present treatment process, they will still be unable to maintain consistency after changing the treatment process. Exhibit I shows that, despite clearly set pH targets at the entry point to the distribution system, pH values regularly vary above and below these targets with a pH range of 6.5-10.3. Guidance from the American Water Works Association recommends that pH stay within +/- 0.2 pH units of the target pH.

108. The 2021 Amendment recommends changing the corrosion control films in the pipes via chemistry but includes no pipe scale analysis to determine whether the hypothesized films are actually present. The 2021 Amendment only hypothesizes about the corrosion control mechanism happening in the study materials. Since only one replicate of the study materials reflects current materials in the distribution system, it is impossible to understand the cumulative impact of the change from one scale to another.

109. No analysis is presented to confirm the cause of elevated lead in the O.B. Curtis service area or to explore opportunities to reduce lead release to become more in line with lead release in the J.H. Fewell service area.

110. Additional corrosion control studies that could be done include: 1) a true assessment of orthophosphate inhibitors on current Jackson lead containing materials, 2) evaluating a switch to alum as a coagulant at the O.B. Curtis treatment plant to match the treatment at J.H. Fewell and the hypothesized stronger corrosion scales produced as a result of the sulfate containing coagulant, or 3) identifying what total organic carbon removal would be

[12] *Id.* at 46.

required to allow for chlorine disinfectant in the distribution system while maintaining compliance with disinfection byproduct Maximum Contaminant Levels (MCLs) and whether orthophosphate might be more effective with chlorine than with chloramines. These last two options represent a simultaneous compliance evaluation of Jackson's water quality, ensuring that whole water quality and consequently, public health protection, are considered rather than compliance on a rule-by-rule basis.

111. I understand that Jackson has updated its corrosion control at the O.B. Curtis treatment plant based on the 2017 study. I understand that the J.H. Fewell treatment plant has yet to complete installing the recommended corrosion control treatment although the ITPM predicts that there could be substantial completion by the end of June 2023 based on the Q1 2023 Report. As stated in my analysis above, I am concerned about potential, unresearched outcomes from application of the new treatment. I am concerned that application of the new treatment will not result in the lead risk reduction implied by the corrosion control studies.

112. Based on my concerns about the corrosion control studies, I think there is a significant risk that: lead corrosion is occurring; lead corrosion might increase as a result of implementing the recommendations; corrosion control is unstable due to ongoing water quality fluctuations at the treatment plant and throughout the distribution system; and potential lead contamination will not be detected by Lead and Copper Rule compliance sampling. Even if the recommended corrosion control treatment is currently being implemented, I do not have confidence that it is consistently reducing and minimizing the risk of exposure to lead in drinking water for the entire Jackson community.

H. Existing Sampling Would Not Necessarily Detect Unsafe Lead Levels

113. Based on my review of the data, I have concluded that there is a significant risk that there are lead-containing pipes, fittings, and fixtures throughout the distribution system in Jackson and surveys have not yet identified because neither the required 1991 materials inventory nor the inventory recommended by EPA guidance in 2017 have been completed.

114. Jackson exceeded the lead action level in 2015 and 2016. I also reviewed Jackson's Lead and Copper Rule data for July 1, 2020 through June 30, 2023, and found that lead was detected, even though the 90th percentile for lead was below the action level. These test results indicate to me that multiple sources of lead in plumbing are present in some parts of Jackson's distribution system. Any detectable level of lead in water is a concern for public health.

115. I am aware that the City of Jackson reports that it does not have lead service lines. However, Jackson has not published a service line inventory and has not provided transparent information supporting its claims. As a result, I am concerned that lead service lines may be present but undetected. Lead service lines, when present, are the largest potential source of lead in drinking water.

116. Even if Jackson does not have lead service lines, I am concerned that Jackson's galvanized steel service lines could be a significant source of lead through either lead goosenecks or lead in the pipes themselves.

117. I am aware that Jackson has service lines made of galvanized steel, which, as discussed earlier, can be a significant source of lead on their own.

118. Given the risk of significant sources of lead contamination in Jackson's service lines and building plumbing systems, it is important for Jackson to have effective corrosion control treatment. Based on the above concerns—the mixing of Jackson's ground and surface water systems, the questionable methodology of the 2017 and 2021 Corrosion Control Studies, and variable water quality—I do not think Jackson has optimal corrosion control treatment for minimizing the risk of lead exposure.

119. I do not interpret the lack of lead action level exceedances since 2016 as an indication that Jackson's corrosion control treatment is effective given that Jackson does not appear to fully comply with the Lead and Copper Rule's sampling requirements and my experience that Lead and Copper Rule sampling does not represent the full risk of lead exposure in systems with similar problems as Jackson's.

120. I have reviewed Jackson's Lead and Copper Sampling from July 1, 2020 through June 30, 2023. Sufficient data to ascertain whether data are in full compliance with the Lead and Copper Rule's sampling and monitoring requirements are not publicly available. Jackson's sampling results do not contain information to determine whether the samples were taken in compliance with the Lead and Copper Rule, such as: the sampling tier of each sampling site; the sampling protocol implemented at each home; whether multiple samples were collected at a single home during a single compliance sampling period; whether samples are collected at the same locations during successive compliance sampling periods; whether sample sites are biased toward newer regions of the distribution system with lower lead risk; and whether sample sites are distributed throughout the Jackson service area.

121. The lack of information about Jackson's sample collection is troubling given that the EPA National Enforcement Investigations Report in 2020 identifies a variety of additional sampling irregularities. The evidence from the EPA National Enforcement Investigations Report indicates that insufficient and noncompliant Lead and Copper Rule sampling has been occurring in Jackson for many years. There is potential that unidentified elevated lead in Jackson water could be occurring and may have occurred for a very long time. There is not sufficient information in publicly available documentation to determine whether the issues raised in the 2020 Report have been resolved.

122. My analysis of data that are publicly available raises concerns about whether Jackson is underestimating lead levels by failing to sample in places with high lead risk. Although there are additional Jackson Lead and Copper Rule compliance sampling data available on the MSDH Drinking Water Watch website for 2021-2023, very few addresses or block-level data are available for sampling sites. Information about Jackson's 2015 sample sites is also

available on news websites. The few sites for which location information is available are shown in Exhibit J.[13]

123. Exhibit J also contains information on median housing age. Older homes and buildings are more likely to contain more and larger sources of lead containing plumbing since regulations have prohibited use of lead containing materials and reduced the amount of lead allowed in lead containing plumbing over the years as discussed earlier. The homes at greatest risk of lead in plumbing are more likely to be found in older sections of the distribution system.

124. Based on my review of Exhibit J, I am concerned that the identified sampling sites are not located in the oldest sections of Jackson and do not represent locations with the highest risk of lead in plumbing materials. The lack of recent and consistent data regarding sampling locations raises many questions about whether Lead and Copper Rule compliance sampling locations in Jackson represent the highest risk of lead in water in Jackson. The fact that the lead action level was exceeded in 2015 when sampling at most of these apparently low-risk sites makes me even more concerned about the potential for even larger lead release at homes in older sections of the city.

125. Even if Jackson's sampling complied with the Lead and Copper Rule, I am concerned that sampling may underestimate lead exposure due to the prevalence of galvanized steel service lines in Jackson, which may be connected to lead goosenecks. In my experience, samples collected under the Lead and Copper Rule sometimes do not capture the significant source of lead from lead service lines, galvanized service lines, or lead goosenecks if they are present. Lead and Copper Rule sampling requires the collection of the first liter of water from a tap that has not been used for a minimum of six hours. This water would not have recently passed through the gooseneck given that the gooseneck is typically five or more liters upstream from a typical kitchen faucet.

126. Revised lead sampling protocols in Michigan demonstrate how fifth liter samples better represent the range of potential lead exposure in locations with lead service lines compared to first liter only. For water systems with lead service lines, fifth liter samples are more likely to capture the range of lead coming from the lead service lines as described in Betanzo et al., 2021.

127. EPA's research has found that the third through eighth liter of water collected from the tap typically contains higher levels of lead than the first liter when there is a lead service line, galvanized service line and/or lead gooseneck. EPA's recent sequential sampling study in Benton Harbor, Michigan demonstrates the extent to which first liter sampling can underestimate peak lead in homes. Out of 26 homes where sequential samples were collected, 22 homes found their peak lead value not in the first liter sample; only 4 homes detected the highest lead result in the first liter.[14] Many of the sequential samples collected in Benton Harbor demonstrate that although the first liter sample may be well below the action level, lead levels

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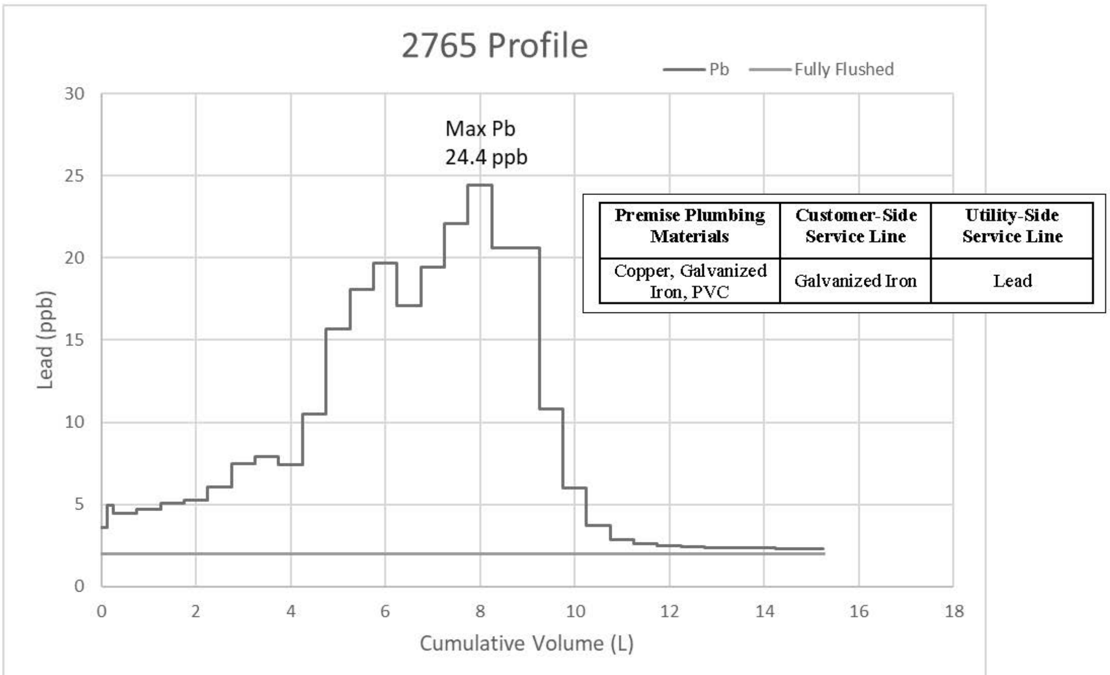
[13] I received this map from the Natural Resources Defense Council. I understand that Dr. Matthew Mackenzie, Senior Director, Data & Policy Analysis, Science Office created these maps by overlaying the addresses available from the MSDH Drinking Water Watch website for 2021-2023 and 2015 news story with U.S. Census data on median housing age.

greater than the action level of 15 ppb are present in the household water as shown in Figure 1, which shows the lead sampling results for one of the houses in the study:

Figure 1:



128. This specific plumbing profile consists of copper, galvanized iron, and PVC household plumbing; galvanized iron service on the household side; and lead service line on the water main side. Lead levels increase in the 4th liter, where, based on my experience, the household side service line typically begins influencing sequential sample results.

129. Because at least some of Jackson's service lines are made of galvanized steel, I am concerned that sampling may underestimate lead exposure even if the sampling follows Lead and Copper Rule procedures.

130. In addition, each of the 6 compliance sampling periods analyzed for Jackson includes several sample sites with first liter lead results above the lead action level. These samples represent potential exposure in the entire community, not just for the individual sampled homes. In a sampling period like July 1-December 31, 2022, where 5% of sample results are above the lead action level of 15 ppb, this indicates that 5% of Jackson residents, or about 7,500 people (using a current population of 150,000), may be receiving water with lead greater than 15 ppb in the first liter on a regular basis. The sequential sampling results shown in Figure 1 indicate that even more than 7,500 may be receiving water with greater than 15 ppb of lead from water consumed after the first liter. As previously noted, 15 ppb is not a measure of public health protection.

131. Based on my understanding of the distribution system and water conditions in Jackson, I am concerned about the potential for ongoing exposure to concerning levels of lead in

drinking water throughout Jackson. Incomplete information about Jackson's distribution system means there could be lead goosenecks connected to galvanized steel service lines. Reports of brown, foul-smelling tap water from Jackson residents indicate to me that there is a high probability that Jackson's galvanized steel service lines are corroding. The corroded galvanized steel service lines can absorb lead coming from the lead gooseneck upstream and then sporadically release lead.

132. Moreover, once lead particles enter drinking water, they can become lodged in plumbing materials, such as aerators on household faucets. Lead trapped in aerators can present a prolonged risk of elevated lead levels in tap water, because the lead can dissolve or break through over time as water continues to flow through the plumbing.

133. The release of lead into drinking water can be sporadic due to changes in water quality, the breaking off of protective scales, or the release of lead trapped in faucet aerators. Further, changes in household water use can cause short term and long-term changes in lead release. Low water use typically results in weaker scales and higher lead in water. As a result, a nondetect lead sample test from a tap does not necessarily rule out the possibility that the house is connected to a lead gooseneck, lead service line, or has lead present in household plumbing. Repeat nondetect or very low lead samples taken at high-risk homes with an appropriate sampling protocol would be necessary to confirm that lead is being minimized via optimized corrosion control treatment.

134. As discussed here, 1) Jackson has an unidentified inventory of potential lead service lines and lead goosenecks; 2) EPA has cited Jackson for not complying with lead sampling and monitoring requirements; 3) available but limited sample site location information indicate that the highest risk areas in Jackson are not being sampled; 4) Lead and Copper Rule compliance samples are insufficient for representing the potential range of exposure to lead in water; 5) my concern that Jackson has implemented potentially inappropriate and inconsistent corrosion control treatment; 6) water quality entering the distribution system is highly inconsistent; and 7) insufficient information is publicly available to determine whether Jackson is currently complying with all Lead and Copper Rule requirements. These 7 factors coupled with publicly available data indicate there is a very real risk of ongoing lead exposure in Jackson. As a result, I am concerned that corrosion is occurring and that lead is entering Jackson residents' drinking water on a regular basis. The overall magnitude of risk cannot be identified without transparent information on the occurrence of lead service lines, galvanized service lines and lead goosenecks; full compliance with lead sampling monitoring requirements; and additional study to determine the impact of leaded materials commonly found in Jackson plumbing.

135. Lead is a potent neurotoxin and its health effects cannot be reversed once discovered. In the absence of complete data it is appropriate to take a preventative approach to ensure the risk of lead exposure is prevented, especially because effective alternatives are readily available.[15]

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[15] Emily A. Benfer, Contaminated Childhood: How the United States Failed to Prevent the Chronic Lead Poisoning of Low-Income Children and Communities of Color, 491 Harv. L. Rev. 493, (2017).

136. Lead exposure, even at levels below the lead action level, is particularly concerning in water systems that have previously exceeded lead action levels because lead accumulates in the body. Disparate health impacts of lead exposure for African American communities are well documented.[16] Once people, especially vulnerable populations, are exposed to lead it becomes even more important to prevent ongoing and future exposures to lead.

IV. Concerns related to the Distribution System

137. I am also concerned that reactions between materials in the distribution system and the water leaving the treatment plants could exacerbate both microbial and lead contamination problems.

138. Jackson uses chloramines as its disinfectant residual in the distribution system to meet its requirements for preventing microbial contamination. The Surface Water Treatment Rules require Subpart H water systems to maintain a minimum disinfectant residual concentration at the entry point to the distribution system and detectable disinfectant residuals throughout the distribution system at 95% of monitoring sites. Disinfectant residuals act as an indicator of overall water quality conditions, provide protection from contaminants entering the distribution system, and provide for biofilm control.

139. Chloraminating systems in warm climates are particularly susceptible to a process called "nitrification." According to EPA's 2016 corrosion control guidance manual, "Nitrification occurs when nitrifying bacteria convert ammonia into nitrite and nitrate, which may lower the pH and alkalinity of the water. This can accelerate brass corrosion and cause problems with lead release . . . Ammonia may also form compounds with lead and copper, which can interfere with the effectiveness of CCT."[17]

140. Nitrification causes taste and odor, color and turbidity problems. It also results in microbial growth, disinfectant byproduct formation, and changes in water quality that can increase lead solubility. The 2022 AWOP Evaluation identified the following: "The plant staff target a free ammonia goal of 0.1 — 0.3 mg/L at both plants, but data reviewed for the previous 12 months indicated some periods when free ammonia was > 0.55 mg/L as N, which is the maximum detection limit of the method used for analysis. Free ammonia above the optimization goal of <0.10 mg/L as N may contribute to nitrification in the distribution system." Data are presented in the appendix of the report.

141. There is no indication that there is any regular monitoring in the distribution system to identify whether nitrification is occurring, and it is not clear that Jackson has a nitrification action plan in the case that they find nitrification is occurring in the distribution system.

142. Given the concerns raised in the 2022 AWOP evaluation and the clear potential for nitrification, it is reasonable to be concerned that nitrification is occurring unchecked in the

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[16] Deniz Yeter et al., 17, Int. J. Enviorn. Res. Public Health, Disparity in Risk Factor Severity for Early Childhood Blood Lead among Predominantly African-American Black Children: The 1999 to 2010 US NHANES, 1552 (2020).
[17] Optimal Corrosion Control Treatment Evaluation Technical Recommendations 17-18.

distribution system. Unchecked nitrification increases my concerns about lead release, microbial water quality, the presence of nitrate and nitrite which are both regulated via MCLs but not measured in the distribution system, and public health protection in general.

143. It is important that Jackson demonstrate full compliance with all SDWA regulations, but more importantly, given the long history of inadequate water quality, it is critical for the remedies to focus on comprehensive public health protection for all Jackson residents.

V. Remedies

144. If EPA has information available to demonstrate that any of the concerns raised here are not applicable, that complete information should be published immediately to demonstrate EPA's current knowledge of water safety throughout the entire city of Jackson. I have provided as an Appendix to this declaration a list of information that is pertinent to determining the safety of Jackson's water.

145. I am concerned about both lead and microbial contamination in Jackson and think any at-home treatments Jackson residents use should remove both.

146. When microbial contamination is a concern, I do not recommend people use carbon filters like those in pitcher and faucet-mounted filters that reduce lead. The microbes can become trapped in the filters and the carbon provides food for additional microbial growth, increasing the risk of exposure. People can use a carbon filter to address lead contamination and then boil the water to address microbial contamination, but that process is time-consuming and difficult to implement consistently and reliably. Additionally, relying on a filter and boiling process would require clear instructions about the order of operations. Residents should not boil water and then filter because hot water damages carbon filters.

147. There are some at-home treatments that remove microbial contaminants and lead. These treatments include certain types of refrigerator filters, undersink filters, or reverse osmosis systems. Unlike carbon filters, these systems would require professional installation. I only recommend point of use units for this application. Point of entry treatment units that would treat water as it enters a home may remove corrosion control treatment as the water passes through lead containing plumbing within the home and allow higher levels of lead to leach into the water. Although I think the installation of these at-home devices would benefit Jackson residents, they cannot address immediate public health needs at the community scale because of the time they take to install. Installation of these filters could be a medium-term method to address both lead and microbial contamination for Jackson residents. It is possible that when compared to total lifecycle costs of a longer term bottled water program including bottled water delivery, logistics, and disposal this may be a cost-effective strategy with greater public health benefit.

148. When both microbial and lead contamination are a concern, as is true here, providing residents with bottled water can be an appropriate short-term intervention to protect public health. Bottled water can be distributed quickly and requires fewer instructions than a process that requires residents to take multiple precautionary steps.

149. I have concerns about the safety of some bottled water because bottled water is regulated by a different set of requirements, and many bottled water companies are not required

to meet SDWA requirements. Although regulated bottled water is allowed to have up to 5 ppb of lead in it, water for bottling typically does not sit in contact with leaded materials for extended periods like water in household plumbing. As a result, I recommend that bottled water come from a company that bottles water from a regulated community water system, that is fully compliant with all SDWA requirements so that it simultaneously meets both sets of requirements, with or without additional treatment prior to bottling. Plastics from bottles can leach into water, especially when stored in warm climates. There are many reasons why bottled water should not be considered as a long-term intervention.

150. Lead contamination can be a long-term problem. Because there is no safe level of lead exposure and health impacts are permanent, it is appropriate to use filters certified to NSF/ANSI standard 53 for the reduction of lead until the lead service line can be removed, and for some period of time after lead service line removal, even in scenarios with reliable corrosion control. The Lead and Copper Rule Revisions require the provision of a 6-month filter supply following a lead service line replacement. Replacing lead service lines in Jackson could take a long time given that the City does not have an inventory of where lead service lines are located. Filter distribution could be appropriate once issues with microbial contamination are resolved or if community members are educated about how to sequence filtering and boiling.

151. Prioritizing a lead service line inventory and lead service line and lead gooseneck replacement program is necessary to address lead contamination in Jackson. Removing lead service lines and lead goosenecks would eliminate the biggest sources of potential lead contamination. Given that Jackson does not currently know where lead service lines are located, inventorying where lead service lines have a high probability of being located is an important first step. In addition to a complete records and code review as described in EPA guidance for service line inventories, such an inventory should also include a statistically significant, randomized excavation and verification study consisting of about 400 service line excavations with 4-point inspections as described in guidance for complying with the Michigan Lead and Copper Rule. In the absence of good historical documentation, this is a cost-effective way to survey service lines to estimate and predict probable materials system wide. Further, when undergoing the effort to develop a service line inventory, all service line materials confirmed should be recorded, rather than categorized by lead and non-lead. This effort will pay back in the future as condition assessments and asset management plans are developed and implemented for the City of Jackson.

152. Given the complexity and potential tradeoffs from the solutions to address lead and microbial contamination, I think community input and transparency is important for ensuring acceptance, effective implementation, and thorough adoption of alternative water sources. Communities should provide feedback on solutions that are feasible and sustainable. They should provide their evaluation of the risk tradeoffs they experience in their own homes and communities, supported by full transparency of water quality data, compliance data, and risk analysis in the community by appropriate experts.

153. I would like to see more regular reporting from Jackson's water system to help residents and others evaluate water quality. The lack of public information makes it nearly impossible to evaluate statements about Jackson's water quality. All statements about water quality in Jackson should be accompanied by data, an explanation of compliance requirements,

and an explanation of how the data demonstrate that requirements are being met to support the claims. The public should have every opportunity to evaluate and verify all statements about water quality in Jackson.

154. Home testing can be appropriate for individuals to help authorities and water systems monitor water quality. Home tests can also provide individuals and water systems with information, which there is currently a lack of in Jackson. Given concerns about lead and galvanized service lines in Jackson, any sampling program implemented should collect more than the first liter of water at the tap. I would therefore recommend that any home testing adopted in Jackson be tailored to collect both the first liter of water and water that is representative of the building's service line.

155. Until an appropriate home testing program is set up, any other forms of home testing should have appropriate instructions explaining how community members should interpret the results. Home testing results that detect lead or microbial contamination would be concerning to me. However, I do not think inferences should be drawn from low or non-detect lead or microbial results collected in households. One-time non-detect home test results do not support a conclusion that water is consistently safe because contamination can vary over time. Lead release is sporadic based on water treatment, water quality, water use, and outside disturbances. Therefore, community education about the limitations of non-detect results from home testing kits is important.

156. Jackson should prioritize improving corrosion control to protect the public from lead contamination. Optimizing corrosion control quickly is important because of the time it takes corrosion control scales to form. Any new corrosion control study must comply with requirements of the Lead and Copper Rule Revisions and consider all aspects of simultaneous compliance to ensure that treatment is implemented at the water treatment plant that ensure consistent and reliable water that meets all requirements of the Safe Drinking Water Act.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed in Beverly Hills, MI on August 9, 2023.

Elin Warn Betanzo.

<u>Appendix</u>

Information request for an EPA presentation on the current conditions in the Jackson, MS water system

- Please identify the JXN Water core team members who have the training, experience, and expertise in drinking water and SDWA compliance to verify that they are receiving appropriate advice from their consultants.
- Please describe how Mississippi is implementing the Surface Water Treatment Rule, the Interim Enhanced Surface Water Treatment Rule, and the Long-Term 2 Enhanced Surface Water Treatment Rule, specifically any specific state specific requirements Mississippi may have adopted that differ from the federal requirements. This includes its requirements for membrane filtration and other relevant means of determining filtration and disinfection compliance.
- Water Treatment Plant:
  - Present the data and photos from the 2020 inspection of the Jackson water treatment plants that demonstrated compliance challenges and public health concerns. Use graphs, tables, and figures to explain, describe, and demonstrate 2020 conditions.
  - Present data from the most recent 12-month period. Use graphs, tables, photos, and figures to demonstrate how conditions have changed and provide your current conclusions on reliability of compliance at the water treatment plant.
  - In August of 2022, MSDH approved Jackson moving its O.B. Curtis turbidity compliance monitoring site from its finished water to a point upstream in the treatment process because they had repeat turbidity exceedances at the finished water sampling point. How common is this compliance monitoring approach at surface water treatment plants nationwide? How common is it for surface water treatment plants to deliver water to the public with turbidity that regularly exceeds 0.3 and 1 NTU?
  - Have the water treatment plants met all compliance requirements every day of the past 6 months? What are your biggest public health concerns at the Jackson water treatment plants right now?
    - If compliance has not been consistent for 6 months, what requirements have they missed? What violations have been issued? What public notice has been issued?
    - If you identify compliance issues that you don’t consider current public health concerns, please describe why not.
- Distribution System:

- Present a summary of distribution system water quality data, including maps that indicate sampling locations, schedule, tanks, pressure monitors and treatment plant service areas.
- For the past 12 months, present heat maps showing average, max, and min disinfectant residual throughout the distribution system; average, max, and min pH throughout the distribution system; average, max and min pressures throughout the distribution system.
- Does distribution system water quality sampling (Total Coliform Rule, Lead and Copper Rule (Lead, Copper, and Water Quality Parameter data), Disinfection Byproducts Rules) adequately represent the entire distribution system, treatment plant service areas, and entire month – both weekdays and weekends? Use maps and calendars to demonstrate answer.
- Does your data analysis (and the AWOP Distribution system analysis from 2022) indicate distinct geographic areas with persistent water quality problems? Show where they are on the map and what the specific concerns are.
    - Water quality problems include compliance with disinfectant residual max and min, disinfection byproducts, total coliform and e coli, lead and copper, water quality parameters, nitrification, iron and manganese, biofilms, and opportunistic pathogens.
- Does your data analysis demonstrate intermittent distribution system water quality problems depending on factors that vary over time including season, treatment plant operations (including pumping and pressure), distribution system operations (including tanks), and chlorine burnouts?

- Lead and Copper Rule Compliance
    - How do the Jackson corrosion control study and amendment compare to the LCR requirements for a corrosion control study? Do the studies follow the EPA Corrosion Control Treatment guidance manual? What are the differences and water quality implications of those differences?
        - What additional corrosion control treatments would you recommend that Jackson consider?
        - Did the studies include a sufficient evaluation of the potential for orthophosphate to minimize lead release in Jackson?
        - The studies say that J.H. Fewell water is less corrosive, results in lower lead levels, but is responsible for most water quality parameter excursions. How might the treatment changes to maintain WQP consistency affect potential lead levels?

        - The studies recommend soda ash at O.B. Curtis, but simultaneously state that hydrated lime results in lower lead levels in the O.B. Curtis service area. Given the information in the corrosion control treatment studies, do you believe that the optimal corrosion control treatment selected is minimizing lead levels at customers taps? What changes or additional studies would you recommend?

    - Does EPA have any information about service line materials in Jackson? How many lead service lines? Galvanized services? Copper services? How does EPA know?

    - What changes has Jackson made in its LCR sampling plan, protocol, and data analysis since 2020? Has Jackson addressed all the issues raised in the 2020 inspection? Provide evidence of your findings.

Exhibit A

Elin Warn Betanzo, PE

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Detroit, MI 48201

Elin created Safe Water Engineering, LLC in 2017 to improve access to safe drinking water through engineering and policy consulting after helping uncover the Flint Water Crisis. Elin has over 20 years of experience in the water industry, working for the U.S. Environmental Protection Agency, water utilities, think tanks, and as a private consultant.

She was appointed to the U.S. Environmental Protection Agency's National Drinking Water Advisory Council and the Michigan Corrosion Control Panel in 2021, and she has been recognized by the Senate Environment and Public Works Committee as a national expert in drinking water policy.

Education
- Great Lakes Leadership Academy, Emerging Leaders Program, 2021
- MS, Environmental Engineering, Virginia Polytechnic Institute and State University, 2004
- BS, Environmental Science, Carnegie Mellon University, 1999
- BFA, Piano Performance, Carnegie Mellon University, 1998

Certifications

Professional Engineer in Michigan, Virginia, and Maryland

Certified Water Distribution Operator in Maryland, S-3 Operator in Michigan

SKILL SUMMARY

- National and state science and policy leader in the water industry.
- Recognized expert for explaining water issues in local, state, national, and international media.
- Trust builder skilled in education, transparency, and engagement within communities and the water utility sector.
- Consensus building and collaboration team leader for multidisciplinary and intergovernmental workgroups.
- Technical expert on drinking water regulatory compliance for public water systems, government agencies, and community groups at the city, county, state, and federal levels.
- Experienced engineer with asset management, plan review, infrastructure and regional planning skills.

EXPERIENCE

Safe Water Engineering, LLC; Detroit, MI
2017 – present

President and Founder. Most relevant clients and projects follow.

- **The Joyce Foundation.** Third-party monitoring and evaluation of the Benton Harbor, MI lead service line replacement program. Trained community members to observe lead service line replacement to ensure public health protection and compliance with contract provisions. Reviewed monthly operating reports and public notification documents to ensure compliance with the Safe Drinking Water Act.
- **Council of the District of Columbia.** Completed a third-party assessment of DC Water's Lead Free DC Lead Service Line Replacement Plan to ensure that the plan will remove and

replace all lead water service lines by 2030, while prioritizing vulnerable populations in any prioritization model, and maintaining fiscal responsibility.

- **Michigan Environmental Council and Natural Resources Defense Council.** Provide technical assistance regarding water infrastructure, Safe Drinking Water Act, and other policy issues at the state and federal level.
- **University of Michigan.** Project supporting implementation of Michigan's Revised Lead and Copper Rule. Scope included outreach and webinars for diverse audiences, and support of the Michigan Department of Environment, Great Lakes and Energy in their implementation and oversight of the new Rule.
- **Metro Consulting Associates/City of Highland Park.** Provide technical assistance to Highland Park regarding implementation and refinement of standard operating procedures; compliance assistance with the Safe Drinking Water Act; water quality sampling and data analysis; and planning infrastructure renewal programs.
- **Detroit Water and Sewerage Department.** Designed and initiated a proactive lead service line replacement program for minimizing lead in drinking water that serves as a national model for protecting public health. Scope included oversight and refinement of full lead service line replacement standard operating procedures; compliance assistance with the federal and Michigan Lead and Copper Rules; water quality data analysis; development of a GIS collector application and comprehensive service line inventory; public education; and coordination with the Great Lakes Water Authority Water Quality Workgroup.
- Other clients include Michigan State University, Birmingham Public Schools, and Ohio Environmental Council.

Northeast-Midwest Institute (NEMWI); Washington, DC
2012-2017

Director of the Safe Drinking Water Research and Policy Program. Completed research and policy analysis while building a regional and national awareness of drinking water policy issues. Through scientific, non-partisan, and independent data analysis, provided technical assistance and education to policy-makers and the U.S. Environmental Protection Agency to support local and regional drinking water policy improvements. Principal investigator and project manager for Toward Sustainable Water Information, a collaboration between the NEMWI and USGS investigating the ability of the NEMW region's water monitoring systems to support decision making. Presented at numerous successful congressional briefings.

Washington Suburban Sanitary Commission; Water Planning; Laurel, Maryland
2008-2012

Water Planning Unit Coordinator. Led creation of a master water modeling platform for the two-county water utility, coordinating across diverse departments. Developed cross department protocols for model data management, integration, and data sharing. Assessed and communicated water system hydraulic performance for a complex water system with multiple municipal customers in a utility consisting of over 5,000 miles of distribution mains. Responsible for master planning and day to day operations, interpretation of hydraulic, GIS, metering, billing, and SCADA data to solve problems. Project Manager for consultant services as well as project team advisor for elevated tank, pipeline, and valve/vault design, and construction contracts. Forecasted water demands and sustainable growth based on water use trends, population growth, land use, and unit consumption with regional governments.

United States Environmental Protection Agency; Office of Ground Water and Drinking Water; Washington, DC

2002-2008

National Tribal Drinking Water Coordinator. Oversaw implementation of the Safe Drinking Water Act (SDWA), including National Primary Drinking Water Regulations, for EPA's national Tribal drinking water program. Identified and addressed infrastructure funding and technical challenges affecting Tribal public water systems. Developed Tribal Water Operator Certification Program. Led interagency workgroup with USDA, HHS, DOI, HUD, and tribal representatives to improve access to safe drinking water on Tribal lands.

Environmental Engineer. Technical Lead for the Stage 2 Disinfectant and Disinfection Byproducts Rule, including stakeholder review process. Led national workgroup of EPA regions and state regulators to plan implementation of the Stage 2 Disinfection Byproducts Rule. Supported simultaneous compliance concerns with the Lead and Copper Rule during the Washington, DC Lead Crisis. Team leader for Distribution System Water Quality project. Coordinated multiple contractor research projects, compiled data for regulatory decision making, and managed multi-department expert workshops.

United States Environmental Protection Agency; Office of the Chief Financial Officer; Washington, DC

2000-2002

Environmental Protection Specialist
Developed performance-based goals for Agency planning and reviewed and edited EPA Annual Reports.

United States Patent and Trademark Office; Arlington, VA

1999-2000

Patent Examiner
Analyzed patent applications to determine patentability of inventions. Researched international scientific literature in hazardous waste destruction, gas scrubbers, nuclear waste disposal, and fertilizers for patent examination.

RECENT PUBLICATIONS

- E. Betanzo, C. Rhyan, and M. Hanna-Attisha. 2021. AWWA Water Science, e1261. Lessons from the first year of compliance sampling under Michigan's revised Lead and Copper Rule and national Lead and Copper Rule implications. ***Winner of the 2021 AWWA Water Quality & Technology Division Best Paper Award & 2021 AWWA Publications Award***

- Read, J., Attal, N., Betanzo, E., Harrison, R., Stoltenberg, A. (2022, January). Water Service Affordability in Michigan: A Statewide Assessment University of Michigan Water Center, Graham Sustainability Institute.
- Deconstructing the Cost of Lead Service Line Replacement; 2021
- Betanzo, E. 2020. "How Can I Find Out if I Have a Lead Service Line?" https://www.nrdc.org/experts/erik-d-olson/how-can-i-find-out-if-i-have-lead-service-line
- Betanzo, E. 2018. "Opportunities for Addressing Lead in Drinking Water." https://safewaterengineering.com/news/addressingleadindrinkingwater

MEDIA

- Coalition pushes for transparency over Benton Harbor water Petitioners concerned for city water, bacteria contaminants; The Herald Palladium; April 19, 2022
- Activists, expert question whether Benton Harbor is preventing bacteria contamination; The Detroit News; April 18, 2022
- Benton Harbor activists: We need more proof city's drinking water is safe; Bridge Michigan; April 18, 2022
- Petitioners worry there's a lack of transparency in new Benton Harbor water inspection report; Michigan Radio, April 18, 2022
- EPA study produces relief, concerns among Benton Harbor community; Herald Palladium; March 4, 2022
- Some lead water pipes in Michigan homes can be replaced for free; Detroit Free Press; February 12, 2022
- Efforts to Replace Michigan's Lead Water Lines Could Get Big Boost; WDET Detroit Today; December 14, 2021
- Water becomes more unaffordable for Michigan's poor, report finds; The Detroit News; December 2, 2021
- New lead testing method could reveal higher levels in water; AP News; November 30, 2021
- Why are so many Michigan water systems finding lead? They're looking harder; Bridge Michigan; October 27, 2021
- Michigan acts on lead crisis; critics urge EPA to 'jump in'; E&E News; October 15, 2021
- How the Flint water crisis has impacted US lead-pipe removal efforts; Civil Engineering Magazine, ASCE; August 4, 2021
- Lead Water Service Lines Belong in the History Books; Crain's Chicago Business; April 1, 2021
- As schools reopen, stagnant water pipes pose a health risk; Detroit Free Press; February 21, 2021
- Following Flint, increase drinking water transparency; Detroit News; December 8, 2019
- Michigan Should Revise Its Lead and Copper Rule to Protect Public Health; Bridge Magazine; June 7, 2018

COMMITTEES

- Environmental Protection Agency (EPA) National Drinking Water Advisory Council (NDWAC) 2022
- EPA Microbial and Disinfection Byproducts (MDBP) Rule Revisions Working Group 2022
- Southeast Michigan Council of Governments Water Infrastructure Task Force, appointed 2022
- Michigan Department of Environment, Great Lakes, and Energy (EGLE) Corrosion Control Advisory Panel, appointed 2021
- Federal Advisory Committee on Water Information 2014 - 2017

Exhibit B

Documents Referenced

In addition to the below documents, I reviewed documents obtained from the Jackson-specific webpage maintained by the Mississippi State Department of Health (MSDH)[1], documents obtained from a Public Records Act request to MSDH received in June 2023, the first two quarterly reports from the Interim Third-Party Manager, and documents attached to the Department of Justice's complaint against the City of Jackson. These documents included EPA and MSDH reports, historical violation and compliance sampling data, Lead and Copper rule sampling reports, enforcement orders, monthly operating reports (through April 2023), annual water quality reports (through 2021), and sanitary surveys (through 2021).

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Elin Betanzo et al., *Lessons from the first year of compliance sampling under Michigan's revised Lead and Copper Rule and national Lead and Copper Rule implications*. AWWA Water Science, e1261 (2021), https://doi.org/10.1002/aws2.1261

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[1] https://msdh.ms.gov/page/30,0,76,720.html

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EPA, Membrane Filtration Guidance Manual Overview and Summary Factsheet 2006, Office of Water, EPA 815-R-009 (2005)

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EPA, Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems, Office of Water, EPA 816-B-16-003 (2016)

EPA, *Research and Development, Plumbing Materials and Drinking Water Quality: Proceedings of a Seminar, Cincinnati, Ohio May 16-17, 1984*, (1985)

EPA, Suggested Directions for Homeowner Tap Sample Collection Procedures, Revised Version: May 2019

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Sheldon V. Masters et al., *Comparison of coupon and pipe rack studies for selecting corrosion control treatment*. AWWA Water Science, e1293 (2022), https://doi.org/10.1002/aws2.1293

Mich. Dep't of Health & Human Servs., Sample Bottle Selection When Testing Water for Lead, Version 2, (2022)

Michigan Department of Environment, Great Lakes, and Energy Drinking Water and Environmental Health Division, *Minimum Service Line Material Verification Requirements*, Revised (2021) https://www.michigan.gov/egle/-/media/Project/Websites/egle/Documents/Programs/DWEHD/Community-Water-Supply/Lead-Copper/Minimum-Service-Line-Material-Verification-Requirements.pdf

Miss. State Dep't of Health Report of Inspection of Drinking Water Supply, Sanitary Survey (Nov. 8, 2021)

Miss. State Dep't of Health, CERP Site Visit for EPA and MSDH, August 13, 2021

Miss. State Dep't of Health, Report of Inspection of Drinking Water Supply, Nov. 8, 2021

Miss. State Dep't of Health, Report of Inspection of Drinking Water Supply, Nov. 9, 2020

Miss. State Dep't of Health, Site Visit Notes, CERP Site Visit for EPA & MSDH (Aug. 13, 2021)

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Jeffrey Parks, et al., *Potential Challenges Meeting the American Academy of Pediatrics' Lead in School Drinking Water Goal of 1 Mg/L*, 75 CorrisonJournal.org Issue 8 (2018)

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A. Whelton et al., Customer Feedback a Tool for Distribution System Network Monitoring for Improved Drinking Water Surveillance, 8th Ann. Water Distrib. Sys. Analysis Symp. 1, (Aug. 27-30, 2006)

Exhibit C

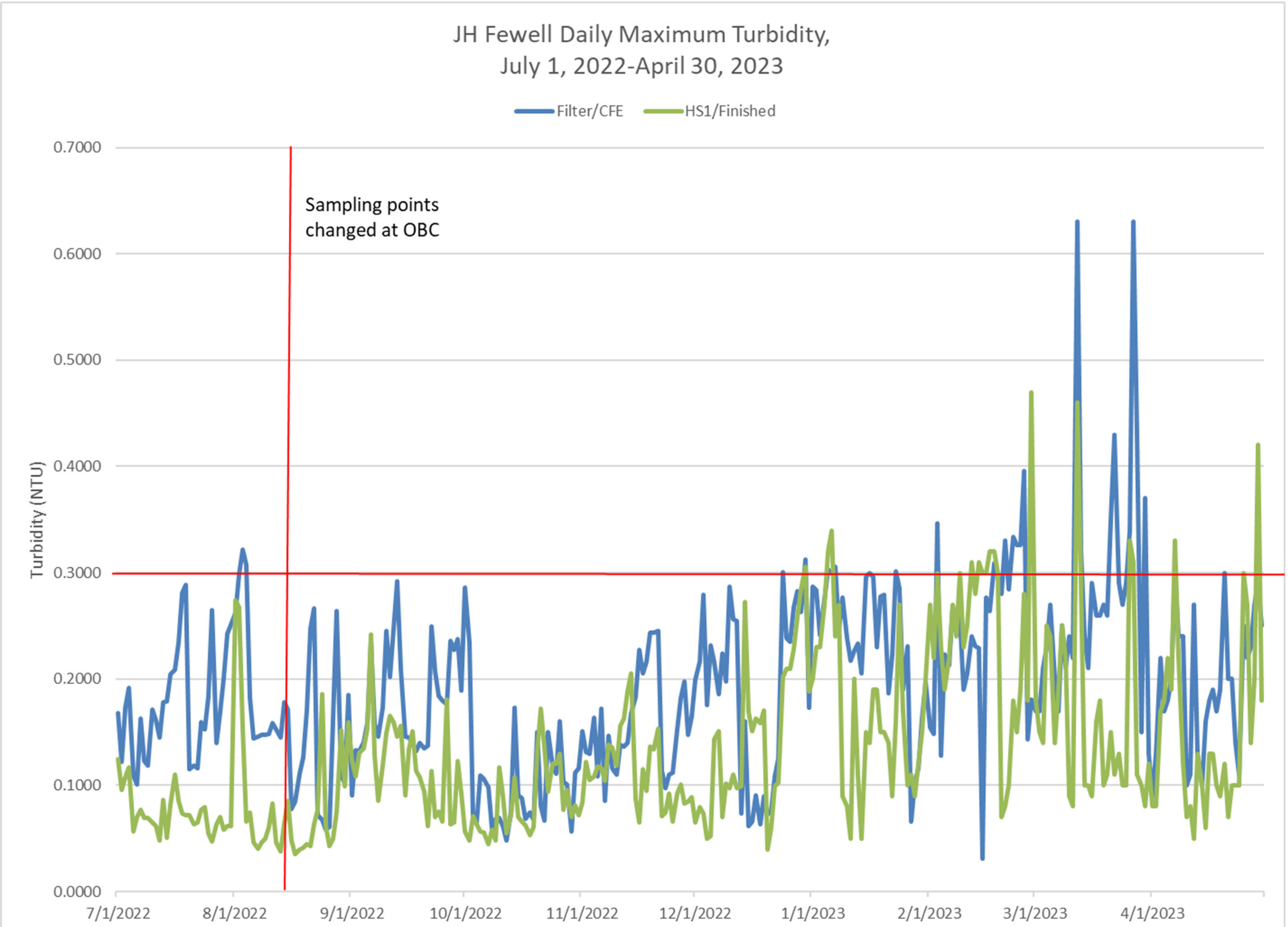

JH Fewell Daily Maximum Turbidity,
July 1, 2022-April 30, 2023
Filter/CFE
HS1/Finished
Sampling points
changed at OBC
Turbidity (NTU)
0.7000
0.6000
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
7/1/2022
8/1/2022
9/1/2022
10/1/2022
11/1/2022
12/1/2022
1/1/2023
2/1/2023
3/1/2023
4/1/2023

Exhibit D

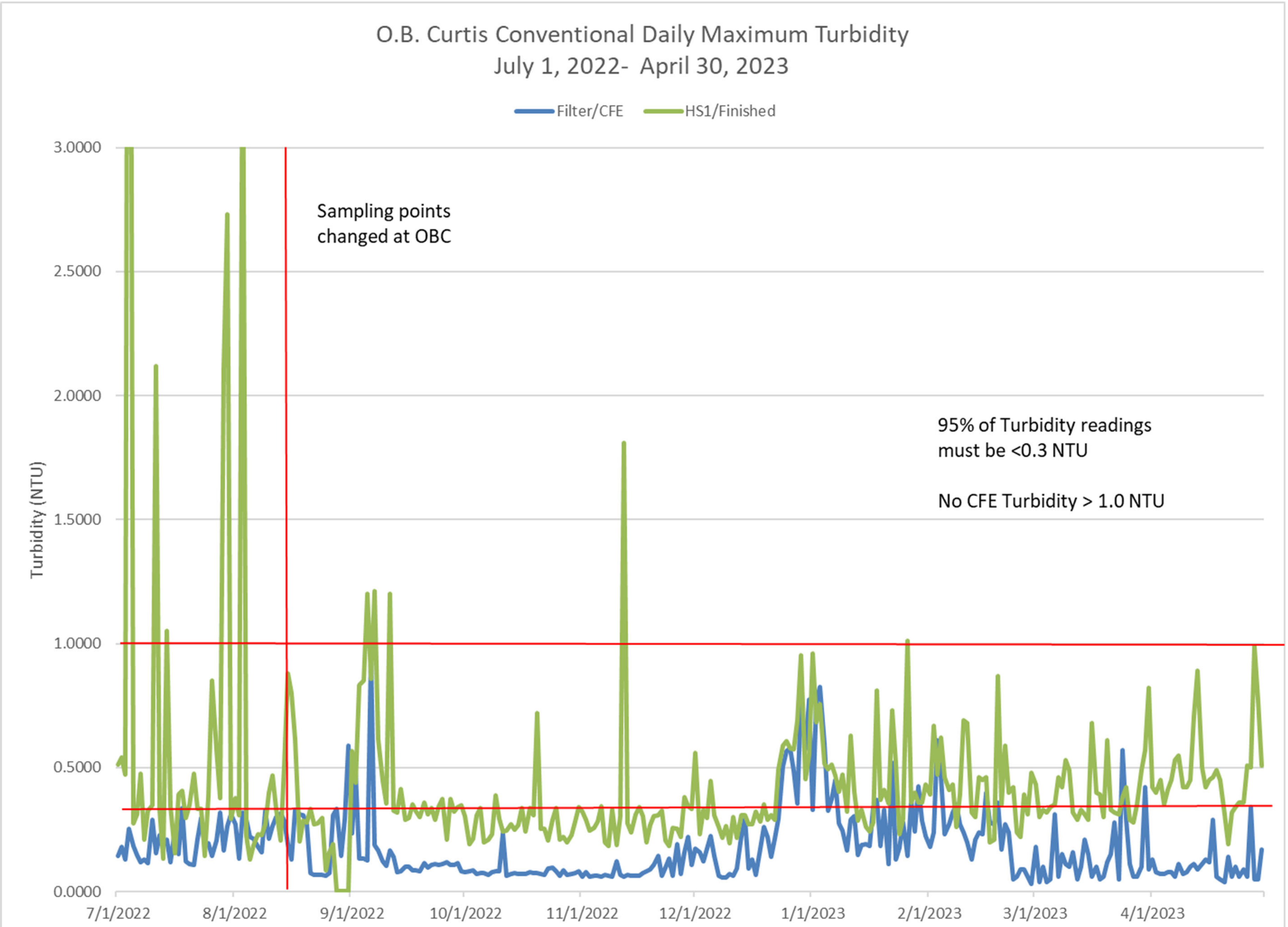
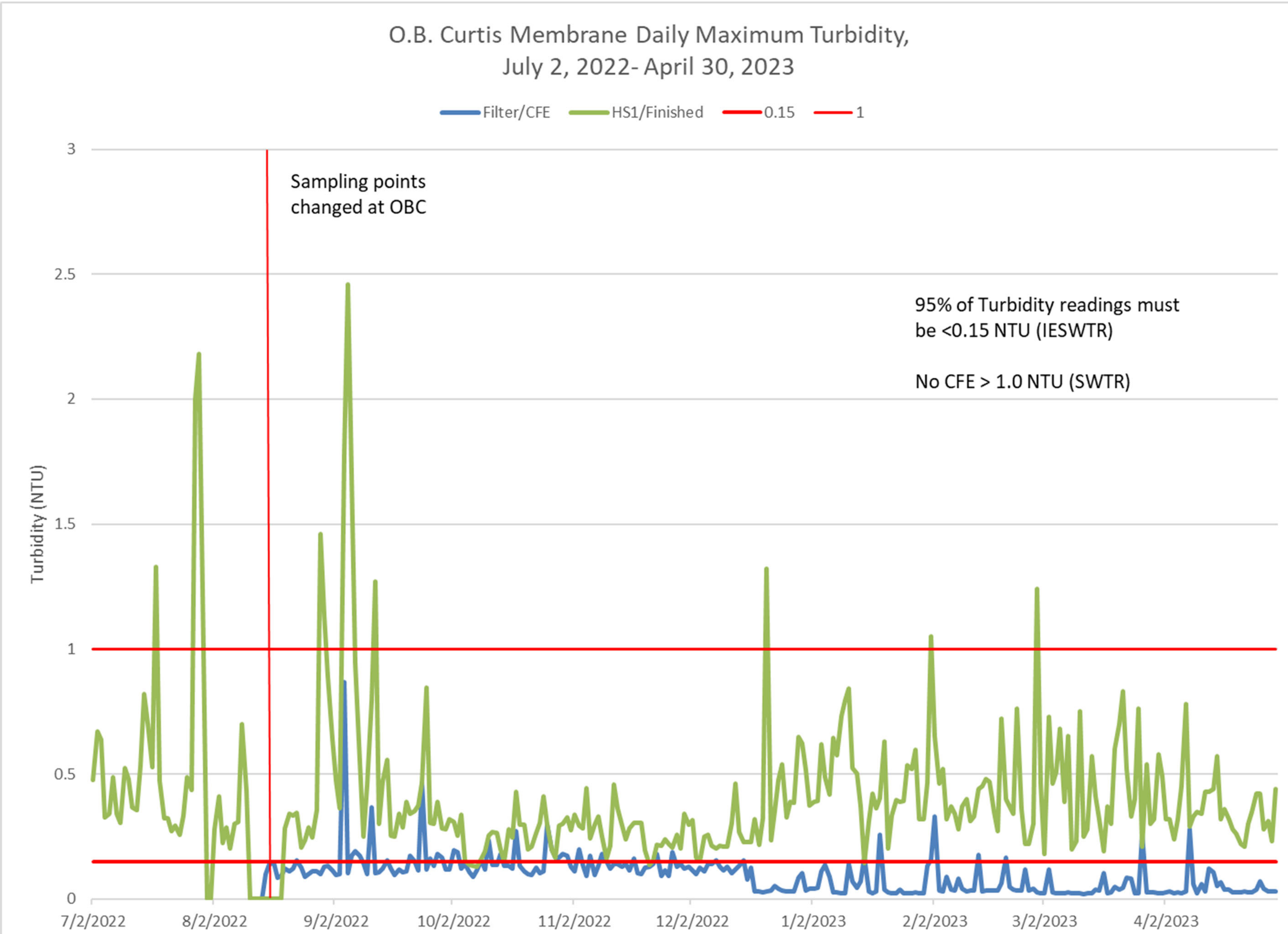
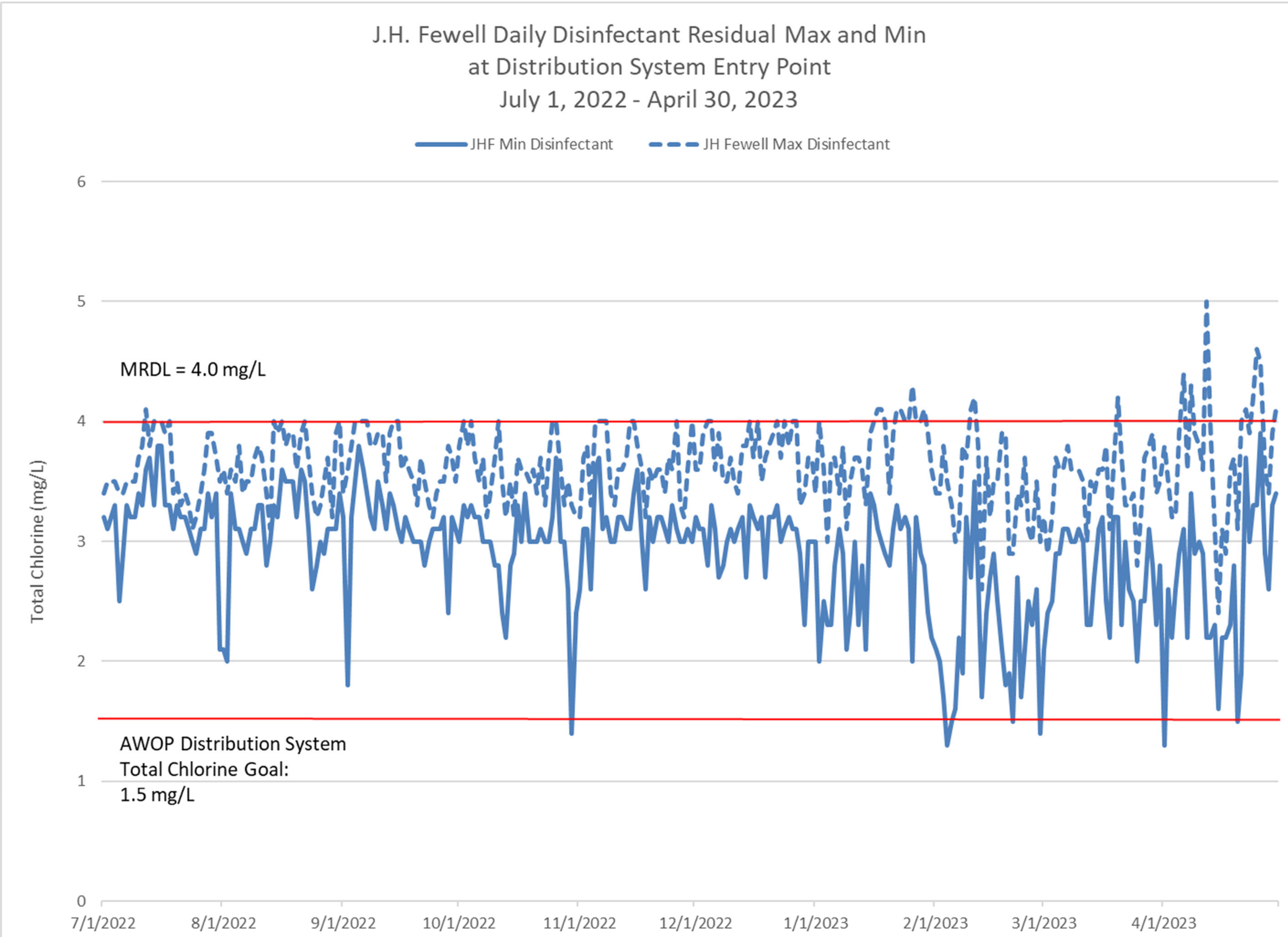

O.B. Curtis Conventional Daily Maximum Turbidity
July 1, 2022- April 30, 2023
Filter/CFE
HS1/Finished
Turbidity (NTU)
3.0000
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
7/1/2022
8/1/2022
9/1/2022
10/1/2022
11/1/2022
12/1/2022
1/1/2023
2/1/2023
3/1/2023
4/1/2023
Sampling points
changed at OBC
95% of Turbidity readings
must be <0.3 NTU
No CFE Turbidity > 1.0 NTU

Exhibit E



O.B. Curtis Membrane Daily Maximum Turbidity,
July 2, 2022- April 30, 2023
Filter/CFE
HS1/Finished
0.15
1
Turbidity (NTU)
3
2.5
2
1.5
1
0.5
0
7/2/2022
8/2/2022
9/2/2022
10/2/2022
11/2/2022
12/2/2022
1/2/2023
2/2/2023
3/2/2023
4/2/2023
Sampling points changed at OBC
95% of Turbidity readings must be <0.15 NTU (IESWTR)
No CFE > 1.0 NTU (SWTR)

Exhibit F



J.H. Fewell Daily Disinfectant Residual Max and Min
at Distribution System Entry Point
July 1, 2022 - April 30, 2023
JHF Min Disinfectant
JH Fewell Max Disinfectant
Total Chlorine (mg/L)
MRDL = 4.0 mg/L
AWOP Distribution System
Total Chlorine Goal:
1.5 mg/L
0
1
2
3
4
5
6
7/1/2022
8/1/2022
9/1/2022
10/1/2022
11/1/2022
12/1/2022
1/1/2023
2/1/2023
3/1/2023
4/1/2023

Exhibit G

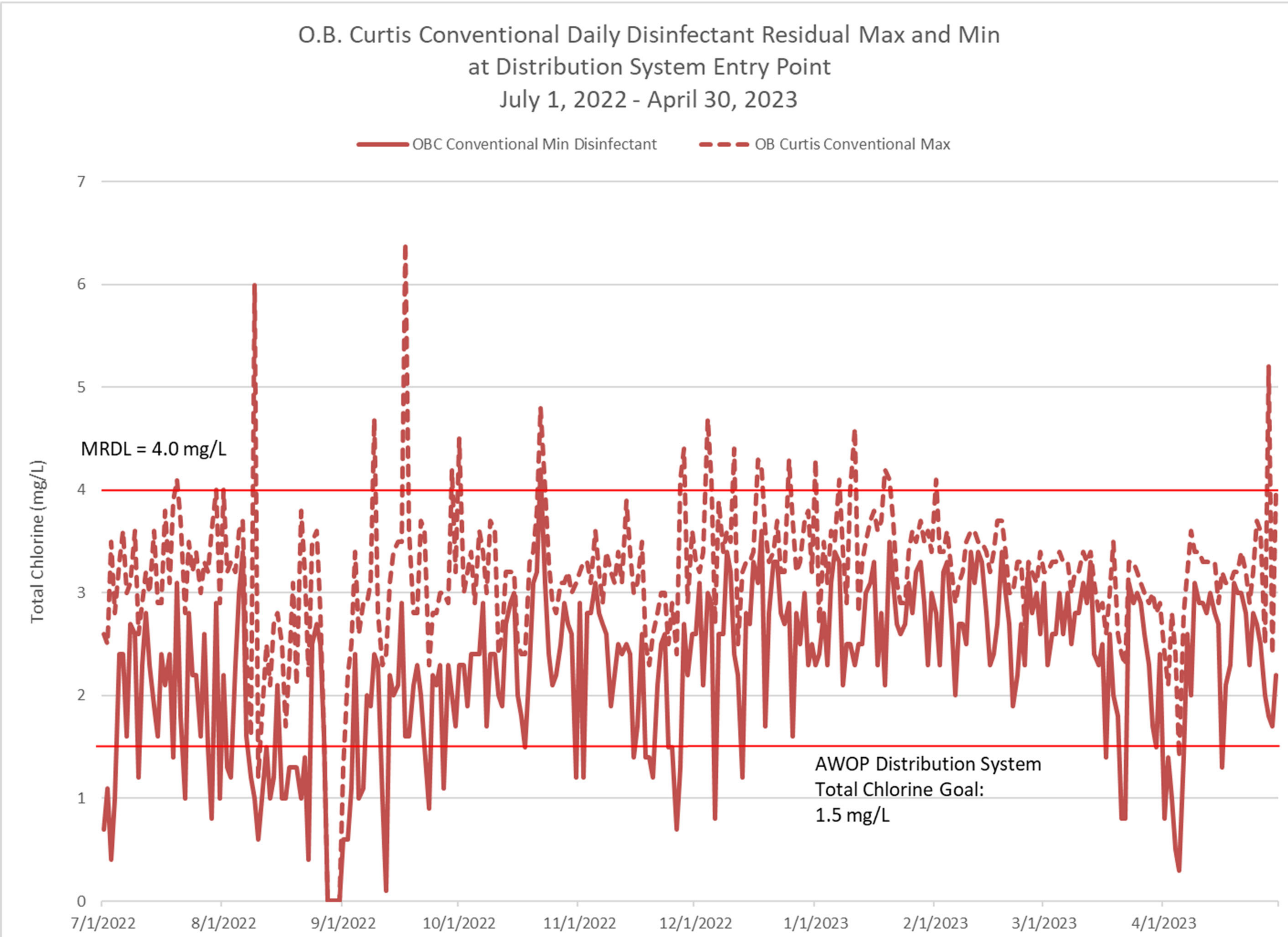

O.B. Curtis Conventional Daily Disinfectant Residual Max and Min
at Distribution System Entry Point
July 1, 2022 - April 30, 2023
OBC Conventional Min Disinfectant
OB Curtis Conventional Max
Total Chlorine (mg/L)
7
6
5
4
3
2
1
0
MRDL = 4.0 mg/L
AWOP Distribution System
Total Chlorine Goal:
1.5 mg/L
7/1/2022
8/1/2022
9/1/2022
10/1/2022
11/1/2022
12/1/2022
1/1/2023
2/1/2023
3/1/2023
4/1/2023

Exhibit H

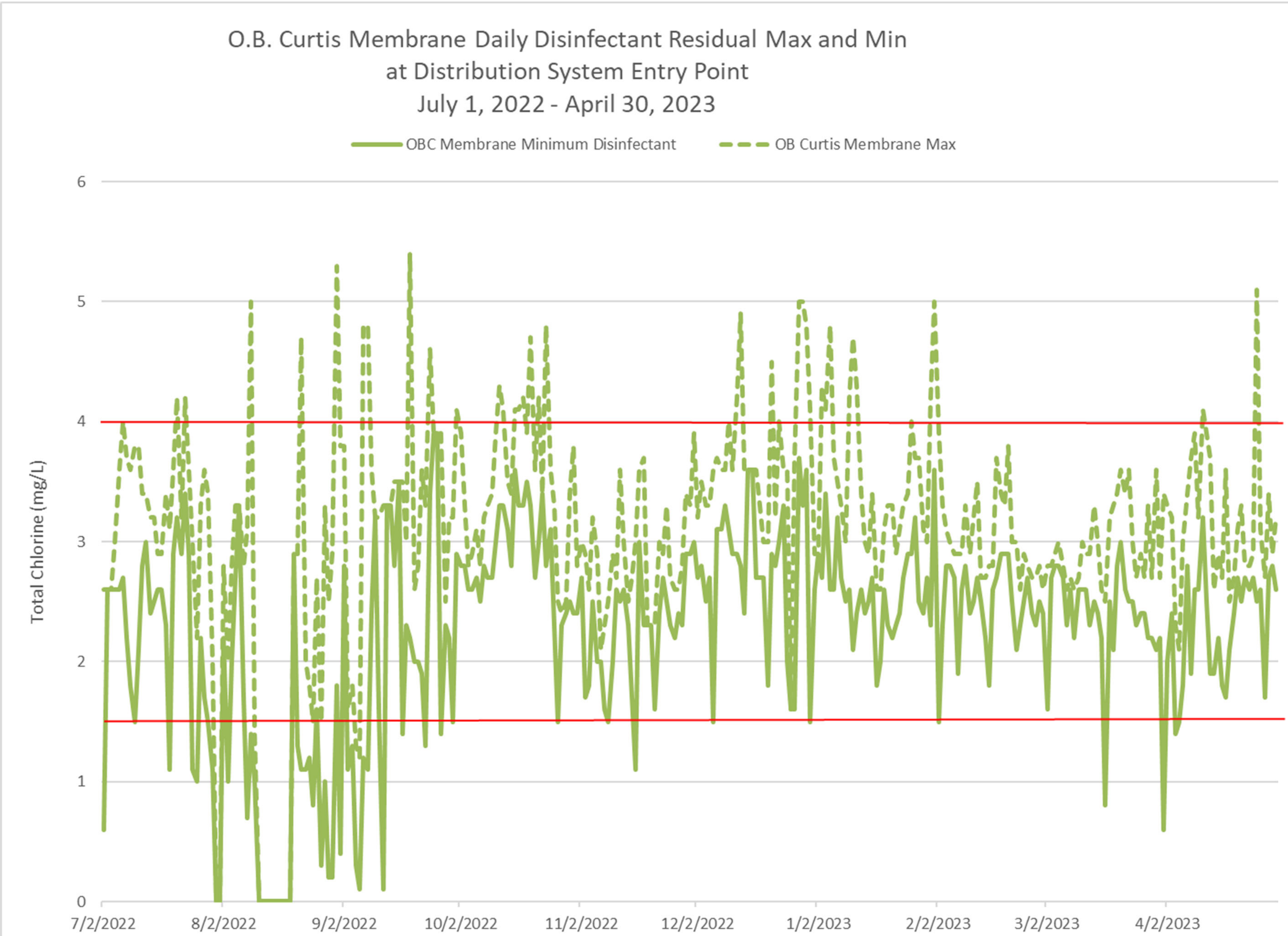
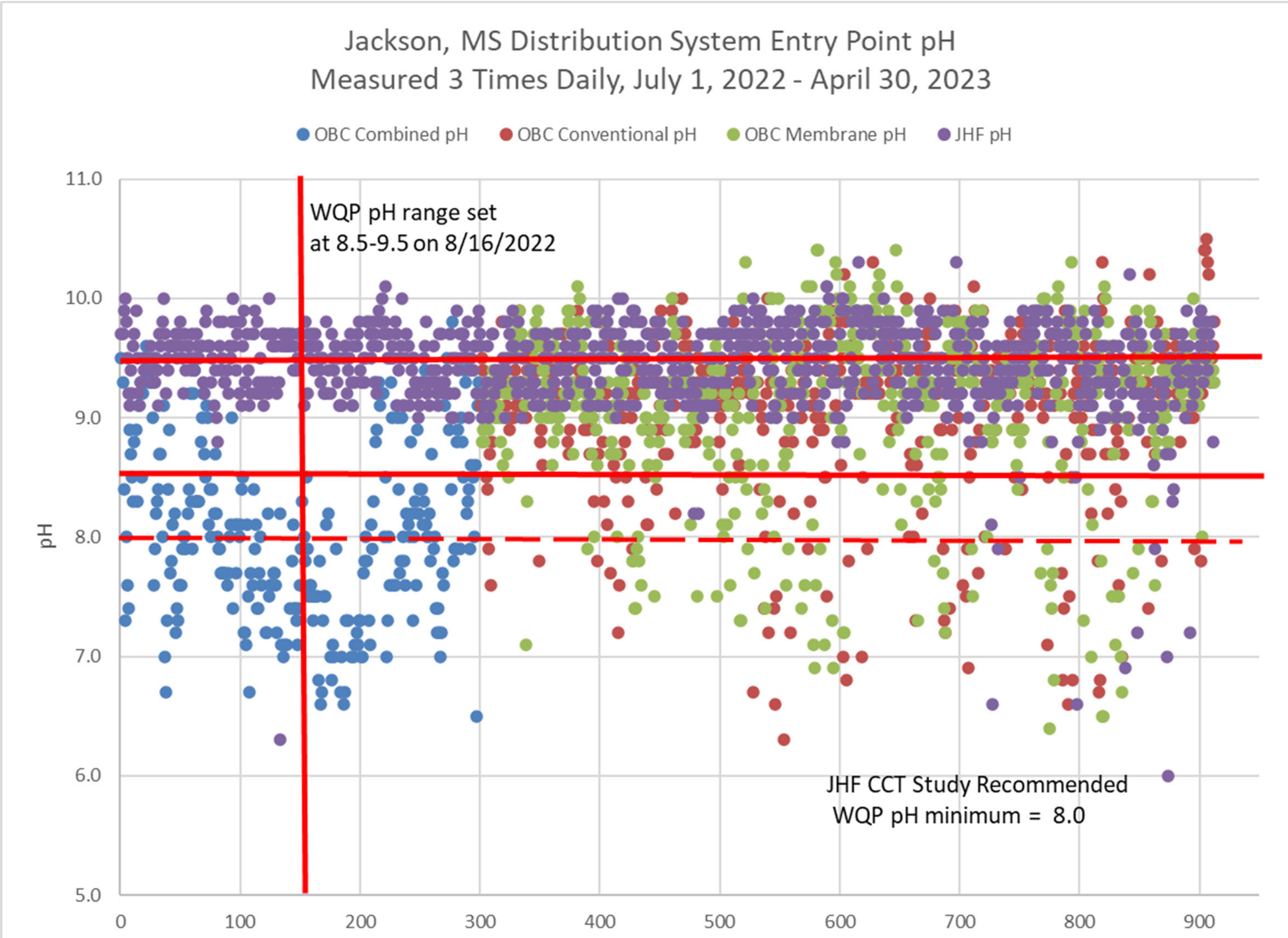

O.B. Curtis Membrane Daily Disinfectant Residual Max and Min
at Distribution System Entry Point
July 1, 2022 - April 30, 2023
OBC Membrane Minimum Disinfectant
OB Curtis Membrane Max
Total Chlorine (mg/L)
0
1
2
3
4
5
6
7/2/2022
8/2/2022
9/2/2022
10/2/2022
11/2/2022
12/2/2022
1/2/2023
2/2/2023
3/2/2023
4/2/2023

Exhibit I

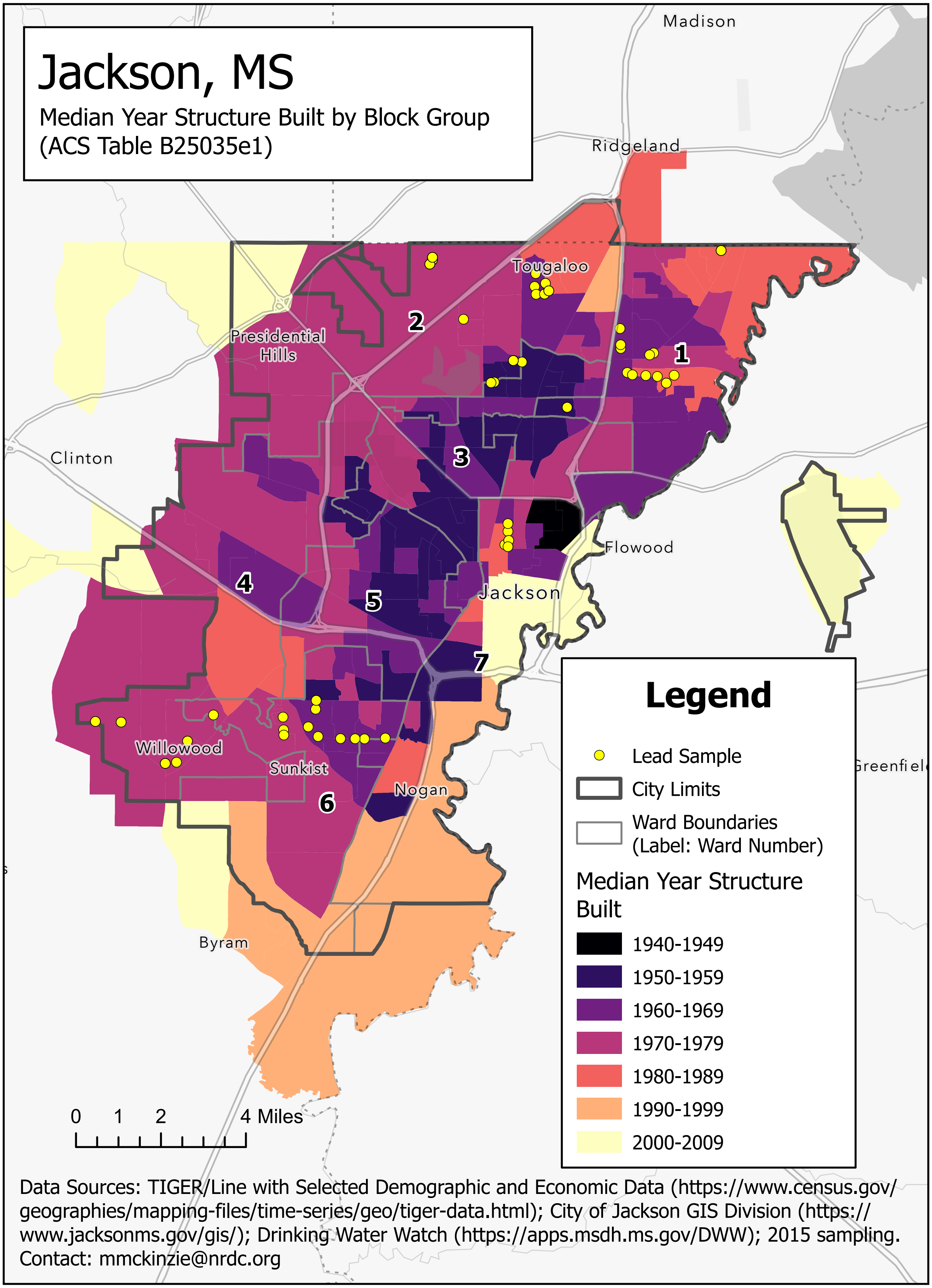


Jackson, MS Distribution System Entry Point pH
Measured 3 Times Daily, July 1, 2022 - April 30, 2023
OBC Combined pH
OBC Conventional pH
OBC Membrane pH
JHF pH
WQP pH range set
at 8.5-9.5 on 8/16/2022
JHF CCT Study Recommended
WQP pH minimum = 8.0
pH
11.0
10.0
9.0
8.0
7.0
6.0
5.0
0
100
200
300
400
500
600
700
800
900

Exhibit J

Jackson, MS

Median Year Structure Built by Block Group
(ACS Table B25035e1)



Data Sources: TIGER/Line with Selected Demographic and Economic Data (https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-data.html); City of Jackson GIS Division (https://www.jacksonms.gov/gis/); Drinking Water Watch (https://apps.msdh.ms.gov/DWW); 2015 sampling.
Contact: mmckinzie@nrdc.org