NATIONAL DRINKING WATER ADVISORY COUNCIL

Report of the Microbial and Disinfection Byproducts Rule Revisions Working Group

NOVEMBER 13, 2023

CONTENTS

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Section 1. Executive Summary

The MDBP Rule Revisions Working Group, in response to direction from the National Drinking Water Advisory Council, explored specific issues concerning how to support MDBP rule revisions and non-regulatory approaches. The Working Group (WG) has provided group recommendations to the NDWAC where consensus was reached and alternative perspectives where consensus was not reached. Provided below are focused highlights of the thirteen recommendations that appear in the main body of this report. Nine of the thirteen recommendations received full support of the WG (these are Recommendations 3, 5, 6, 7, 8, 9, 10, 11, and 12). Three recommendations (Recommendations 1, 2, and 4) received substantial support. One recommendation (Recommendation 13, Parts 1 and 2) received full support while Part 3 received substantial support.[1]

Recommendation 1: Disinfectant Residual - Address the potential for no or low disinfectant residual in surface water Public Water System (PWS) distribution systems (DS) by addressing all of the following:

Part 1: Adopt a national positive numeric minimum disinfectant residual requirement. This recommendation would change the current "detectable" disinfectant residual requirement to a numeric minimum requirement and cover the same drinking water systems. The expert input suggests EPA should raise the national minimum disinfectant residual requirement from the current value of "detectable" and include a range for consideration of setting a minimum specific value of up to 0.5 mg/L for free chlorine and 0.7 mg/L for total chlorine for chloraminating systems.

Part 2: Establish and require adoption of a disinfectant residual sampling and monitoring plan that will provide an accurate understanding of areas within the distribution system that have low or no disinfectant residual. Consider the following three options as part of establishing the new sampling and monitoring plan. WG members view Option 1 as a baseline modification to current disinfectant residual monitoring requirements, while Options 2 and 3 represent opportunities to build on Option 1 to improve public health protections, create a more integrated and comprehensive picture of distribution system water quality, and potentially streamline monitoring requirements overall.

- Option 1: Modify disinfectant residual sampling site selection criteria based on additional criteria set during the rule revision process.
- Option 2: Design multi-parameter monitoring and assessment plan to overlay RTCR, DBP, and other DS sampling provisions (essentially any new monitoring requirements coming out of the MDBP rules revisions) to provide a more complete picture of water quality conditions in the DS.
- Option 3: Establish an Integrated Monitoring Plan that brings into one plan all SDWA required DS sampling and monitoring requirements (i.e., residuals, total coliforms/E. coli, DBPs, lead and copper, state-required sampling, other related water quality parameters).

[1] See Section 2 (Background) of this report for "Process Overview" and definition of "substantial" support.

Part 3: Establish a revised disinfectant residual compliance basis that reduces the potential for areas of distribution system to experience low or no disinfectant residual on a repeat basis. The recommended approach is to allow no less than 95% of samples meeting a numeric minimum each month and a prohibition on site-specific repeat failure to maintain the numeric minimum.

Recommendation 2: Premise Plumbing - EPA should advance a national building water quality improvement initiative based on an enhanced partnership among federal agencies and state SDWA oversight agencies.

Part 1: Identify opportunities to build on the existing partnership relationship between ASDWA, CDC, and EPA with a goal of establishing an effective framework for creating and implementing an "all of government," regulatory or incentivized program applying to buildings for improving the safety of premise plumbing with respect to opportunistic pathogens. Include in this initiative Water Management Program requirements for all federally owned/operated buildings not already covered by such requirements.

Part 2: Conduct data gathering and analysis that will provide the information needed to achieve the outcome sought, including activities such as understanding gaps in current building water improvement promotion efforts, barriers to uptake of Water Management Programs (WMP), and establishing incentives for WMP uptake.

Part 3: Based on work completed in the data gathering and analysis stage, consider expanding the initial partnership to include additional members, for example, building and institution-related national associations (e.g., American Hospital Association), building service providers (e.g., water quality management companies, insurers), state and local public health agencies, and unions involved in operating and maintaining building plumbing systems.

Part 4: Build out a program that focuses on providing appropriate requirements and materials for different types of buildings with differing relative risks.

Part 5: Develop and implement a Legionella public awareness campaign targeting smaller-scale building owner/renters (e.g., single family residences) to elevate improved building water quality management practices.

Recommendation 3: DBPs of Emerging Concern - Address data and analysis gaps associated with DBPs of emerging concern.

WG members believe the potential for public health impacts from regulated and unregulated DBPs merit further research, and WG members acknowledge there are DBP concerns that require follow-up. To advance further consideration of new DBP regulatory interventions, the WG recommends that EPA and the research community address data and analysis gaps on DBPs of emerging concern by undertaking the following: Generate nationally representative occurrence, health effects, and treatment data on regulated and unregulated DBPs to better characterize national occurrence/exposure and risk baselines and to inform risk management strategies.

Recommendation 4: Multi-Benefit Precursor Control - Establish a PWS source water evaluation screening requirement and, under defined conditions, provide additional mandatory treatment to reduce DBP formation and disinfectant demand.

Part 1: Evaluate options for a source water vulnerability screening requirement to identify those systems with a higher risk of DBP formation.

Part 2: Evaluate options for an enhanced precursor control treatment technique requirement in response to elevated precursor conditions characterized through the vulnerability screening. As part of considering options:

1. Examine the role additional monitoring can (would need to) play for higher vulnerability systems to create the baseline needed for application of the treatment technique requirement.
2. Examine a range of approaches to establish the method(s) higher vulnerability systems will use to determine their performance requirement.
3. Examine and seek to include a range of options for how covered systems must operate to achieve the performance levels indicated by the treatment technique performance requirement.

Recommendation 5: Finished Water Storage Tanks - Address finished water storage tank vulnerabilities by establishing a national inspection and cleaning as needed requirement; supported by a review and update as needed of current storage tank operations and maintenance guidance.

Part 1: Institute a national finished water storage tank inspection and cleaning as needed requirement to fill the current gap left by limited state-level regulatory efforts for storage tanks. Factors that could indicate a need to clean storage tanks include continual loss of disinfectant residuals and accumulated material leaving tanks. In support of this requirement, WG members anticipate there also will be additional training and tank inspection protocols needed to address current challenges with sanitarian expertise related to structural integrity of facilities and limitations on confined-space entry and climbing of tanks.

Part 2: Review of current finished water storage tank guidance to identify gaps and update guidance accordingly, as well as provide for additional guidance in support of implementing a national inspection and cleaning as needed requirement.

Recommendation 6: Chloramination - Improve chloramination practices to promote control of microbial contamination and DBP formation potential and improve overall consistency of water quality.

Part 1: Develop national comprehensive chloramine application guidance to assist primacy agencies and chloraminating systems on properly managing chloramine disinfection, by considering the related information available from relevant existing documents and new literature.

Part 2: Develop a national comprehensive temporary chlorine conversion guidance to assist primacy agencies and chloraminating systems to minimize negative impacts on water quality in DS during conversion periods.

Part 3: Monitor regulated DBPs before, during, and after chlorine conversion. In the context of temporary chlorine conversion, to improve attentiveness to the potential for high, acute exposure to DBPs, as well as recognize the potential impact on long-term exposure, require systems conducting extended conversion (e.g., longer than one week or engaged in multiple, shorter-duration conversions throughout the year) to monitor regulated DBPs before, during, and immediately after the conversion and include the monitoring results, on a time-weighted average for the quarter, in their compliance calculation of Locational Running Annual Averages.

Part 4: Require a Nitrification Control Plan (NCP) for all chloraminating systems that incorporates practices described in guidance resulting from Parts 1 and 2. Primacy agencies, consistent with current state chloramination permitting or plan review and approval procedures, would approve the NCP for each newly chloraminating system. Existing chloraminating systems would submit an NCP to the state upon a schedule to be determined. EPA must couple this requirement with new funding for PWS and Primacy Agencies, provision of enhanced and appropriate TMF capacity, and a water affordability program included in Recommendations 9, 10, and 11 to ensure all systems will have the resources to install and safely maintain appropriate treatment to reduce MDBP health risks and would not need to limit the use of appropriate technology based on water affordability constraints.

Recommendation 7: Consecutive Systems - Improve water quality and regulatory compliance rates for consecutive systems.

Part 1: Develop a problem-based consultative requirement between wholesale and consecutive systems.

1. For all PWSs that provide water to a consecutive system, require disinfectant residual sampling at the active points of connections of the wholesale and consecutive systems or nearest water quality sampling point.
2. Examine options available under the SDWA to require a joint, root-cause analysis consultation among the wholesale system, consecutive system, and state regulators in contexts where the consecutive system experiences violations of health-based standards related to DBPs or disinfectant residual.
3. Examine options available under the SDWA for requiring DBP and disinfectant residual monitoring by the wholesale system at the active points of connection to the consecutive system as part of the response to health-based standards violations.
4. Specifically target TMF capacity support for wholesale and consecutive systems related to the required root-cause analysis consultation and establish this support, as well as DWSRF funding, as a priority to address changes needed to return to compliance.

Part 2: Prepare guidance on recommendations for consecutive system model contracts and improved communications between wholesalers and consecutive systems.

Recommendation 8: Source Control - Leverage non-SDWA authorities to:

Part 1: Prevent the introduction of potential drinking water contaminants into the water cycle. EPA should develop a policy requiring chemical or other constituent screening processes (e.g., Toxic Substances Control Act Significant New Use Review) to evaluate proactively the potential for impacts on public health risks from drinking water, on drinking water treatment, and on drinking water quality management.

Part 2: Restrict discharge into all source waters of the primary constituents that contribute to the formation of DBPs, growth potential of opportunistic pathogens, or introduction of frank pathogens. EPA should identify and prioritize anthropogenic drinking water constituents (and related predominant sources) that contribute to the formation of DBPs or to the growth potential of opportunistic pathogens and introduction of frank pathogens. These high priority constituents/sources of contaminants would be slated for action to control their entry into drinking water sources under relevant environmental and public health authorities (e.g., Clean Water Act (CWA), Clean Air Act (CAA), Resource Conservation and Recovery Act (RCRA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)).

Recommendation 9: Environmental Justice (EJ) Improvement Opportunities - Conduct analyses to characterize the current gap in MDBP rule implementation and affordability pressures faced by public water systems serving EJ, disadvantaged and historically underserved communities. Provide strategies for ensuring this gap is filled and to work toward more equitable implementation of the MDBP rules across demographic groups. Ensure that new requirements can be implemented consistently, with sufficient additional resources provided to equitably receive the benefits anticipated to result from the rule revisions.

Part 1: To ensure all communities equitably receive the benefits intended by the MDBP rule revisions, all of EPA's analyses to support rule revisions should identify and account for existing and potential disparate impacts to EJ, disadvantaged and historically underserved communities.

Part 2: To ensure the most overburdened communities and water systems are adequately evaluated for compliance and provided resources for improved water quality, structure MDBP rule revisions to enable and incentivize problem solving and proactive improvement.

Part 3: To ensure all residents have access to timely information for protecting their families and communities, improve community access to PWS performance information.

- Intervention 1: Improve Public Notification of PWS Compliance and Performance Information to Consumers.
- Intervention 2: Enhance PWS Data Management and Communications Capacity
- Intervention 3: Improve Systemic SDWA Data Access.

Recommendation 10: Public Water System (PWS) Technical, Managerial, and Financial (TMF) Capacity - Provide and align additional TMF capacity for small, rural, EJ, disadvantaged and historically underserved communities consistent with new demands placed on PWS by MDBP rules revision.

Part 1: Target additional technical and financial assistance to small, rural, EJ, disadvantaged and historically underserved communities (not limited to systems below 10K people served) to support the transition to and maintain compliance with existing and new MDBP rule revisions.

Part 2: Evaluate and improve operator certification with an emphasis on DS management to maintain disinfectant residuals through DS optimization, including storage tank operations and chloramination practice, and to reduce risks to public health from microbials and DBP formation.

Part 3: Make permanent the Low-Income Household Water Assistance, or similar, Program (LIHWAP2).

Part 4: Establish strong incentives for PWS to require training for their Board members.

Recommendation 11: Primacy Agency Capacity - Address SDWA Primacy Agency capacity needs associated with the new demands anticipated from MDBP rule revisions.

Part 1: Identify and direct ample capacity resources for primacy agencies to implement new MDBP rule requirements.

Part 2: Adjust sanitary survey implementation to reflect MDBP rule revisions.

Recommendation 12: MDBP Overall Data and Analysis Gaps - Address gaps in data and analysis related to microbial and DBP contaminants.

The WG has identified areas within the MDBP topics referred for consideration that could benefit from additional research to address data and analysis gaps. The WG recommends that EPA further develop information related to the areas listed below to inform future consideration of MDBP revisions.

Part 1: Source Water Data and Analysis Gaps.

Part 2: Treatment Data and Analysis Gaps.

Part 3: Distribution System Data and Analysis Gaps.

[2] https://www.acf.hhs.gov/ocs/programs/lihwap.

Part 4: Premise Plumbing Data and Analysis Gaps.

Part 5: Enabling Environment Data and Analysis Gaps.

Recommendation 13: Ground Water Under the Direct Influence of Surface Water (GWUDI) – EPA should revisit the definition, determination methods, and guidance for GWUDI to ascertain what changes should be made to improve the protection of public health.

Part 1: Review and revise the definition of GWUDI. Reviewing and revising the definition of GWUDI to add total aerobic spores or other indicators into the definition would provide additional example methodology to make a determination.

Part 2: Update the recommended determination method and EPA guidance for making GWUDI determinations. A goal is to make the determination simpler and more accurate.

Part 3: Require systems to periodically update GWUDI determinations.

Section 2. Background

The Safe Drinking Water Act[3] (SDWA) requires EPA to review the National Primary Drinking Water Regulations (NPDWRs) every six years and identify the NPDWRs for which new data, information, or technologies "provide a health or technical basis to support a regulatory revision that will maintain or strengthen public health protection."[4]

In January 2017 , as part of its third six-year review of NPDWRS, EPA identified eight contaminants covered by five Microbial and Disinfection (MDBP) rules as candidates for revision due to "new information on health effects, treatment technologies, analytical methods, occurrence and exposure, implementation and/or other factors."[5]These eight contaminants are included in the following five MDBP rules: Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules; Surface Water Treatment Rule (SWTR); Interim Enhanced Surface Water Treatment Rule; and Long Term 1 Enhanced Surface Water Treatment Rule. The eight contaminants are chlorite, *Cryptosporidium*, haloacetic acids (HAA5), heterotrophic bacteria, *Giardia lamblia*, *Legionella*, total trihalomethanes, and viruses.

The purpose of the SWTRs identified as candidates for revision is to reduce disease incidence associated with pathogens and viruses in drinking water.[6] The SWTRs require public water systems to filter and disinfect surface water sources to provide protection from microbial pathogens. The purpose of the Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules is to reduce drinking water exposure to disinfection byproducts which can form in water when disinfectants used to control microbial pathogens react with natural organic matter found in source water. The MDBP regulations are linked together because of the need to balance these risks."[7] For organic disinfection byproducts, the major concern is potential increased risk of cancer and short-term adverse reproductive and developmental effects.[8]

[3] Safe Drinking Water Act (SDWA), 42 U.S.C. § 300f *et seq.* (1974).
[4] EPA Fact Sheet: Announcement of Completion of EPA's Third Six-Year Review of Existing Drinking Water Standards.
[5] Six-Year Review 3 of Drinking Water Standards (85 Fed. Reg. 3518 (Jan. 11, 2017).
[6] NDWAC MDBP Rule Revisions Charge to the Council and Working Group Formation, November 2021
[7] NDWAC MDBP Rule Revisions Charge to the Council and Working Group Formation, November 2021.
[8] The Federal Register notice for the Six Year Review 3, 82 Fed.Reg. 3518, at 3533 (Jan. 11, 2017). Since then, additional studies have been completed related to the risks of repro/developmental harm. See for example:

2020 Waterkeepers Alliance Settlement

Consistent with the 2020 Waterkeepers Alliance v. EPA settlement agreement, the EPA is committed to sign for publication in the *Federal Register* a proposal to revise the NPDWRs for the MDBP contaminants, and then publish notice of final action on that proposal by September 30, 2027, unless EPA determines that the existing NPDWRs for the MDBP rules are no longer appropriate for revision and EPA announces that decision. The deadline may be extended under certain circumstances. [9]

MDBP Rule Revisions Charge to NDWAC[10]

EPA has charged the NDWAC to provide the agency with advice and recommendations that will be used to inform the development of potential revisions to the MDBP Rules. To support the work of the Council, EPA asked the NDWAC to form a working group of balanced membership including stakeholders with a variety of backgrounds and expertise – the MDBP Rule Revisions Working Group – to explore specific issues and identify potential MDBP rule revision options for the Council to consider in making recommendations to EPA.[11]

The MDBP Rule Revisions Working Group considered issues related to potential rule revisions and developed recommendations for the NDWAC's consideration.

EPA was seeking consensus recommendations from the NDWAC on the following topics:

1. Disinfectant residuals and opportunistic pathogens
2. Regulated and unregulated DBPs
3. Finished water storage facilities
4. Distribution system water quality management
5. Source water approach, including DBP precursor removal
6. Mischaracterized ground water under the direct influence of surface water (GWUDI) systems
7. Sanitary Surveys
8. Water Safety Plans
9. Consecutive and small systems

Säve-Söderbergh M, Toljander J, Donat-Vargas C, Berglund M, Åkesson A. Exposure to Drinking Water Chlorination by-Products and Fetal Growth and Prematurity: A Nationwide Register-Based Prospective Study. Environ Health Perspect. 2020 May;128(5):57006. doi: 10.1289/EHP6012. Epub 2020 May 18. PMID: 32438832; PMCID: PMC7263457.
Kaufman JA, Wright JM, Evans A, Rivera-Núñez Z, Meyer A, Reckhow DA, Narotsky MG. Risks of obstructive genitourinary birth defects in relation to trihalomethane and haloacetic acid exposures: expanding disinfection byproduct mixtures analyses using relative potency factors. J Expo Sci Environ Epidemiol. 2023 Sep 12. doi: 10.1038/s41370-023-00595-1. Epub ahead of print. PMID: 37700034.

[9] 2020 Waterkeepers Alliance v. EPA settlement agreement. 5. (a) Except as provided in subparagraphs 5(c), (d), (f), or (g), no later than July 31, 2024, the Administrator shall sign for publication in the Federal Register a proposal to revise the NPDWRs for the microbial and disinfection byproduct contaminants identified in subparagraph 1(g) and the EPA's Six-Year Review 3, published on January 11, 2017 (82 Fed. Reg. 3518). (b) Except as provided in subparagraph(s) 5(c), (d), (e), (f), or (g), no later than September 30, 2027, the Administrator shall sign for publication in the Federal Register a notice of final action on the proposal for revised NDPWRs identified in subparagraph 5(a). (c) The deadlines for signature of a proposal and final action in subparagraphs 5(a) and 5(b) will each be extended by 12 months if the EPA decides, in its sole discretion, to seek recommendations from a Federal Advisory Committee established pursuant to the Federal Advisory Committee Act, or if the EPA requests, and the National Drinking Water Advisory Council agrees, to establish a subcommittee to provide advice to EPA on the development of the proposal identified in subparagraph 5(a). The EPA will notify Plaintiffs in writing if the Agency decides to exercise this provision. (d) The deadlines for signature of a proposal and final action in subparagraphs 5(a) and 5(b) will each be extended by 18 months if the EPA, in its sole discretion, determines to conduct a rulemaking to collect information relevant to the MDBP rule revisions prior to publication of the proposal identified in paragraph 5(a). The EPA will notify Plaintiffs in writing if the Agency decides to exercise this provision. (…) (g) All potential extensions in this paragraph are cumulative.

[10] NDWAC MDBP Rule Revisions Charge to the Council and Working Group Formation, November 2021.

[11] NDWAC MDBP Rule Revisions Charge to the Council and Working Group Formation, November 2021.

The NDWAC is charged with considering and providing consensus recommendations on:

1. Advancing public health protection while balancing the risks of microbial control with managing disinfection byproduct (DBP) formation.
2. Addressing public health concerns caused by opportunistic pathogens (e.g., Legionella), DBPs (e.g., unregulated haloacetic acids), and possibly other emerging contaminants.
3. Addressing implementation challenges to reduce the burden of existing MDBP regulations while maintaining or enhancing public health protection.
4. Ensuring efficient simultaneous compliance with other drinking water regulations when implementing any proposed revisions to the MDBP rules.
5. Additional potential non-regulatory approaches that may improve public health protection from the contaminants under consideration.
6. Opportunities to advance environmental justice in regulatory revisions to equitably protect consumers' health, particularly disadvantaged and historically underserved consumers.

EPA has also provided opportunities for the public to provide input and information related to EPA's potential MDBP rule revisions, including a series of public meetings and a public docket.[12] EPA has received a significant amount of valuable information during this time, all of which will be available and could inform both the NDWAC and any subsequent rulemaking.

Process Overview

The NDWAC MDBP Rule Revisions Working Group (WG) met from May 2022 through November 2023. Consistent with the WG mission, the WG discussions explored advancing public health protection within the context and scope of the five MDBP rules designated within EPA's charge to the NDWAC, as well as additional non-regulatory approaches. Within this context, the discussion also included seeking opportunities for burden reduction, advancing environmental justice, and ensuring efficient simultaneous compliance with other drinking water regulations. Additionally, Working Group discussions included opportunities that exist for enhancing public health protection related to microbial and DBP contaminants that are related to, but not explicitly addressed, in the five MDBP rules for this effort (e.g., upstream source water protective measures and premise plumbing interventions). The WG started with problem characterization discussions, followed by development of potential interventions and implementation mechanisms, and final deliberations on recommendations to the NDWAC.

The WG strived to reach consensus, where possible. The following framework characterizes how the facilitation recorded and characterized the level of support WG members have for each of the recommendations.

- Full Support: yes from all 18 Working Group members
- Substantial Support: yes from 15 to 17 Working Group members
- Strong Support: yes from 10 to 14 Working Group members
- Limited Support: yes from 4 to 9 Working Group members
- Little Support: yes from 1 to 3 Working Group members

The WG explored specific issues concerning how to support MDBP rule revisions and non-regulatory approaches and have provided group recommendations to the NDWAC where consensus was reached and alternative

[12] October 2020-November 2021 Meeting Series Information: National Drinking Water Advisory Council (NDWAC) Microbial and Disinfection Byproducts (MDBP) Rule Revisions Working Group. https://www.epa.gov/dwsixyearreview/public-engagements-potential-revisions-microbial-and-disinfection-byproducts-rules.

perspectives where consensus was not reached. Working Group members, consistent with an invitation provided in the WG procedures, have also submitted up to three pages of individual, attributed comments. Individual comments from those WG members that chose to submit comments are appended to this report without modification (see Appendix B).

Working Group Membership and Meeting Series

The Working Group consisted of 18 members with a variety of backgrounds and expertise. Members were selected based on the expertise, experience, and perspectives needed to provide balanced recommendations to the NDWAC on issues related to potential MDBP Rule Revisions. WG members did not represent their affiliated organizations and as such, spoke based on their expertise and individual points of view.

Between 80 to 200 public observers attended each meeting. The WG's membership and operational procedures can be found in Appendix A. Meeting agendas, presentation materials, and summaries were made available to the public on the EPA web site (www.epa.gov/ndwac).

Technical Support

EPA organized and provided summary background information and responded to WG requests for information. To expand on EPA's internal and contract expertise, the WG members identified subject matter experts to provide technical assistance. These individuals provided input to EPA as it responded to some of the Working Group questions. With limited exceptions, these individuals donated their time to the working group process. Information provided by EPA was intended to help WG members better understand the historical background, technical substance, context, baseline conditions, states of science, and other relevant considerations on topics of interest to the WG. The input provided was based on individual experiences and expertise rather than targeted or iterative data analysis. Some of these individuals participated and provided input in WG meetings again in the role of a technical resource. WG members wish to express their appreciation to these subject matter experts for their technical input and for helping members understand causes of public health concerns and public health benefits of potential interventions.

Organization of Remainder of Report

The following sections include the NDWAC MDBP Rule Revisions Working Group's recommendations to the NDWAC. Each recommendation begins with an overarching recommendation statement, provides a background section focused on problem characterization, provides an "Outcomes Sought" section that includes further details about each recommendation, concludes with the level of Working Group support, and, where applicable, alternative perspectives.

Section 3. Recommendations

Overall Framing Across Recommendations

Recommendations Crosswalk with NDWAC Charge and NDWAC Direction to Working Group

The NDWAC MDBP Rules Revision Working Group has prepared 13 recommendations for full NDWAC consideration. These recommendations seek to respond fully to the EPA charge to the NDWAC and the NDWAC direction to the Working Group. Table 1 contains a cross-walk between the 13 recommendations and the six NDWAC charge areas and the nine NDWAC topic areas. For each recommendation, the table identifies the range

of topic and charge areas addressed. Additionally, bold font topic and charge areas identify the central purpose of the recommendation (e.g., for Recommendation 1, Topic 1 and Charge Area 2 reflect the central purpose of the recommendation). Table 1 makes clear that WG recommendations tend to cut across multiple topic and charge areas, and this very much reflects the highly interdependent nature of the recommendations and their relationship to the topic and charge areas.

Table 1: MDBP Working Group Recommendations Relationship to NDWAC Charge Areas and Topics

MDBP Working Group Recommendation	NDWAC Charge Areas and Topics Addressed
Recommendation 1 (Disinfectant Residual)	Topics **1**, 4; and Charge Areas 1, **2**, 6
Recommendation 2 (Premise Plumbing)	Topics **1**, 2, **8**; Charge Areas 1, **2**, 3, 4, **5**, 6
Recommendation 3 (DBP MCL Data and Analysis Gaps	Topic **2**; Charge Areas **1**, **2**, 3, 4
Recommendation 4 (Precursor Control)	Topics 1, 2, 4, **5**, 9; Charge Areas **1**, 2, 3, 4, 5
Recommendation 5 (Finished Water Storage Tanks)	Topics 1, 2, **3**, 4; Charge Areas 1, **2**, 3, 4, 5
Recommendation 6 (Chloramination Practice)	Topics 1, **2**, **4**, 9; Charge Areas **1**, 2, 3, 4
Recommendation 7 (Consecutive Systems)	Topics 1, 2, 3, **4**, **9**; Charge Areas 1, **2, 3**, 4, 5, 6
Recommendation 8 (Contaminant Source Control)	Topics 1, 2, **5**; Charge Areas 2, 3, **5**
Recommendation 9 (Environmental Justice)	Topics 1, **2**; Charge Areas 2, 5, **6**
Recommendation 10 (PWS TMF Capacity)	Topics 1, 2, 3, 4, 5, **9**; Charge Areas 2, **3**, **5**, 6
Recommendation 11 (Primacy Agency Capacity)	Topics 1, 2, **3**, 4, 5, 6, **7**, 8, **9**; Charge Areas 2, **3**, **5**, 6
Recommendation 12 (Overall MDBP Data and Analysis Gaps)	Topics and Charge Areas across the board
Recommendation 13 (GWUDI Improvements)	Topics 1, **6**, 9; Charge Areas 1, **2**, 3

Key Themes Across Recommendations

1. The WG members recognize that EPA will undertake substantial additional analysis as part of the EPA rules revision evaluation, and the WG intends that their recommendations will provide focus and support to the EPA analysis as it will be more in-depth than that available to WG members during their deliberations.
2. The recommendations emphasize delivering equitable outcomes to all communities irrespective of community and Public Water System (PWS) (note, the definition of PWS includes, among a variety of other system characteristics, publicly owned and privately owned systems) capacity or underlying vulnerabilities. The WG members recognize there is a need for EPA to address water affordability and develop a specific plan of action (e.g., Congressional budget request) to provide targeted support for small, rural, EJ, disadvantaged and historically underserved communities to ensure that no community or household gets left behind.
3. WG members understand that new requirements can place pressure on the affordability of drinking water services (especially small, rural, and EJ, disadvantaged and historically underserved communities), and the recommendations call for a strong emphasis – consistent with the commitment

to delivering equitable outcomes – on enhanced support to low-income customers. On the other hand, many small, rural, and EJ, disadvantaged and historically underserved communities cannot qualify for DWSRF funding unless upgrades are needed to comply with SDWA requirements; it is very difficult to secure funding to implement guidance or best practices.

4. The recommendations related to new requirements utilize a problem-based approach (i.e., in contrast to a one-size-fits-all regulatory requirement, the recommendations seek to isolate problem contexts where new requirements can be applied in a targeted and tailored manner) and seek to establish positive incentives for identifying and addressing problems proactively (e.g., tying the provision of TMF resources to PWS impacted by new requirements).
5. The recommendations are assembled to work together to advance equitable public health improvement, even as individual recommendations, in and of themselves, can act to advance public health and improved PWS performance.
6. The recommendations span from source water to tap and invoke SDWA changes, other federal authorities (e.g., Toxic Substances Control Act, Clean Water Act, Clean Air Act), and a mix of regulatory and non-regulatory interventions.

Recommendation 1: Disinfectant Residual

> Address the potential for no or low disinfectant residual in surface water Public Water System (PWS) distribution systems (DS) by addressing all of the following:
>
> 1. Adopting a national positive numeric minimum disinfectant residual requirement.
> 2. Requiring adoption of a disinfectant residual sampling and monitoring plan that will provide an accurate understanding of areas within the distribution system that have low or no disinfectant residual, while also maintaining representative coverage of the entire system.
> 3. Establishing a revised disinfectant residual compliance basis that reduces the potential for areas of distribution systems to experience low or no disinfectant residual on a repeat basis.

Background

Disinfectant residuals play a crucial role in the multi-barrier strategy to ensure that the distribution system (DS) is properly maintained and identify and limit contamination from outside the DS when it might occur; limit growth of heterotrophic bacteria and *Legionella* within the DS; and provide a quantitative limit which, if not equaled or exceeded, would trigger remedial action. The current SDWA regulatory framework that requires maintaining a "detectable" disinfection residual in the PWS DS can result in low or no disinfectant residual in portions of the DS. The current compliance basis[13] can allow for the same portions of a DS to have little or no detectable residual on a repeat basis, and residual monitoring locations[14] may not be indicative of risks and some areas of the system may never be monitored. In addition, monitoring total chlorine in systems using chloramines as a

[13] Requires that the residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, cannot be undetectable in more than 5 percent of the samples each month, for any two consecutive months that the system serves water to the public.40 CFR § 141.72. In developing the compliance basis for disinfectant residuals in the distribution system, EPA considered that systems which exceeded the criterion for one month would be given the opportunity to take remedial action so as to meet the limit in the following month. 52 Fed. Reg. 42224 (November 3, 1987).

[14] Disinfectant residual monitoring is required to be conducted at total coliform monitoring sites, which are representative of water quality in the distribution system, rather than higher risk locations (e.g., sites with potential for lower disinfectant residuals). 40 CFR §141.853(a)(1) (describing general monitoring requirements for all public water systems sample siting plans… "Systems must develop a written sample siting plan that identifies sampling sites and a sample collection schedule that are representative of water throughout the distribution system... These plans are subject to State review and revision….").

residual can be interfered with by the presence of organic chloramines in the water. These organic chloramines have little to no disinfecting power. EPA has recently approved a monitoring method for monochloramine.

Outcomes Sought

The WG has crafted a three-part implementation approach to address the potential for low or no disinfectant residual in portions of PWS DS and the implications for lower water quality and opportunistic pathogen growth. Together, these approaches seek to more consistently assure the maintenance of adequate disinfectant residual in PWS DS and thereby improve support to the three objectives for carrying an adequate disinfectant residual: acting as an effective indicator of overall distribution water quality[15]; managing microbial growth (recognizing the joint responsibility that PWS have with building owner/operators for managing public health risks from opportunistic pathogens, for example *Legionella*); and controlling biofilm growth. WG members understand instituting this requirement holds the potential to increase DBP formation and compliance challenges depending on the operational responses a system chooses for maintaining disinfectant residual. In that context, WG members believe EPA must commit to provide adequate TMF resources to address the challenges systems can be anticipated to face (see also Recommendations 10 and 11 focused on bolstering PWS and Primacy Agency capacity). Additionally, WG members believe these requirements should be supported by positive incentives for systems to identify and address DS water quality problems, including resources directly tied and readily available to addressing identified problems. When recommendation 1 is coupled with recommendations 4, 5, and 6, WG members believe PWSs will have the opportunity to identify responses that address the comprehensive water quality needs for their source water and DS.

Part 1: Adopt a national positive numeric minimum disinfectant residual requirement.[16]

This recommendation would change the current "detectable" disinfectant residual requirement to a numeric minimum requirement and cover the same drinking water systems. WG members believe that a problem-oriented approach to ensuring disinfectant residual is maintained can be supported through systems selecting from an EPA-developed toolbox[17] that PWSs could use to restore and maintain disinfectant residuals at the required levels (the toolbox would have information about techniques like flushing, find and fix actions for a specific sampling location, water age management, pressure management, and backflow prevention to help maintain residuals). Additionally, EPA should evaluate removing alternative compliance criteria (HPC) in the context of moving to a numeric minimum requirement in contrast to the current "detectable" requirement.[18]

WG members recommend EPA take into consideration when establishing the values for the national numeric minimum disinfectant residual the following background information provided, in part, by Technical Analysts contributing to the WG's deliberations.

1. Technical Analysts generally agreed on the range for what levels of numeric minimum residual should be maintained relative to the values presented under item 2 below, however, the experts' suggestions are lower at the upper end of the range. The expert input suggests EPA should raise the national minimum

[15] Maintaining an adequate disinfectant residual throughout the distribution system results from effective, overall distribution system water quality management practices including for water age; sediment and biofilm accumulation; corrosion; and infrastructure condition.
[16] A related consideration for adopting a national numeric minimum disinfectant residual requirement is the risk balancing with potential increases in DBP concentrations. A preliminary evaluation of two case study states that recently changed their minimum disinfectant residual requirements (i.e., CO and WA) showed slight decreases to no change in annual average THM4 concentrations following implementation of a numeric minimum disinfectant residual requirement, depending on system sizes and state, and annual average HAA5 levels that appeared to hold mostly steady following changes to required residual levels.
[17] https://www.epa.gov/dwreginfo/drinking-water-distribution-system-tools-and-resources.
[18] Water in the distribution system with a heterotrophic bacteria concentration less than or equal to 500/ml, measured as heterotrophic plate count (HPC), is deemed to have a detectable disinfectant residual for purposes of determining compliance with the detectable residual requirement.

disinfectant residual requirement from the current value of "detectable" and include a range for consideration of setting a minimum specific value of up to 0.5 mg/L for free chlorine and 0.7 mg/L for total chlorine for chloraminating systems.

2. Currently, approximately 50% of the states have numeric minimum disinfectant residual requirements. The remaining states require a detectable disinfectant residual under the SWTR.[19] Various numeric levels of disinfectant residuals are required among states that required systems to maintain numeric levels. These range from 0.2-1.0 mg/L for free chlorine and 0.2-2.0 mg/L for total chlorine.

Part 2: Establish and require adoption of a disinfectant residual sampling and monitoring plan that will provide an accurate understanding of areas within the distribution system that have low or no disinfectant residual.

WG members have discussed three options for EPA consideration as it undertakes the MDBP rules revisions process. WG members view Option 1 as a baseline modification to current disinfectant residual monitoring requirements, while Options 2 and 3 represent opportunities to build on Option 1 to improve public health protections, create a more integrated and comprehensive picture of distribution system water quality, and potentially streamline monitoring requirements overall.

1. *Option 1:* Modify disinfectant residual sampling site selection criteria based on additional criteria set during the rule revision process. Potential elements of an improved monitoring plan designed to understand changes in the presence of DR throughout the DS could include monitoring at or near distribution system water storage (with the intent to ensure water quality impacts from the flow of stored water into the DS is well understood and managed), historically challenging sites for maintaining residuals, near facilities such as hospitals, senior care facilities, daycare facilities, and schools, active points of connection to consecutive systems, sampling at DBP sites, and increased sampling frequency (e.g., more than required under the Revised Total Coliform Rule[20] (RTCR)). Any changes to sampling site selection criteria used would require updated approval of site sampling plans by primacy agencies. Additionally, rule revisions should include reconsideration of approved methods for testing (e.g., no color wheels) as a part of consideration of total management of data and sample integrity from point of collection to data entry; and encouraging/requiring development of a DS hydraulic model.
2. *Option 2:* Design multi-parameter monitoring and assessment plan to overlay RTCR, DBP, and other DS sampling provisions (essentially any new monitoring requirements coming out of the MDBP rules revisions) to provide a more complete picture of water quality conditions in the DS. For example, in developing such monitoring and assessment plans consider including information such as DR, water age, pipe material, and other parameters.
3. *Option 3:* Establish an Integrated Monitoring Plan that brings into one plan all SDWA required DS sampling and monitoring requirements (i.e., residuals, total coliforms/*E. coli*, DBPs, lead and copper, state-required sampling, other related water quality parameters). Water systems would compile their current DS compliance monitoring programs into a single monitoring plan that consolidates 1) existing monitoring requirements, 2) additional monitoring requirements developed as part of MDBP rule revisions, and 3) considers whether additional sampling locations or frequencies are necessary to represent all critical conditions and DS vulnerabilities. Guidance would be provided to identify a comprehensive list of critical sampling point categories and sampling purposes so that water utilities

[19] MDBP WG Meeting 2, August 17, 2022. https://www.epa.gov/system/files/documents/2022-11/MDBP-Rule-Revisions-Working-Group-Meeting-Presentation-August-17-2022_5.pdf.
[20] 78 Fed. Reg 10269 (Feb. 13, 2013) and minor corrections 79 Fed. Reg. 10665 (Feb. 26, 2014).

can cross check their sampling plan to ensure the critical areas in their own DS are covered by their sampling plan.[21]

Part 3: Establish a revised disinfectant residual compliance basis that reduces the potential for areas of distribution systems to experience low or no disinfectant residual on a repeat basis.

WG members recommend EPA amend the compliance basis for maintaining DR from the currently-required no less than 95% of samples having detectable residuals in two consecutive months. The recommended approach is to allow no less than 95% of samples meeting a numeric minimum each month and a prohibition on site-specific repeat failure to maintain the numeric minimum. Systems failing to maintain minimum levels would be required to evaluate the cause of the problem and take appropriate action. Compliance would be based on conducting the evaluation and implementing the appropriate action.

Level of Working Group Support = Substantial

Alternative Perspectives (reflects perspectives of individual(s) not supporting the recommendation)

Many drinking water systems continue to struggle to achieve the risk balancing required between microbial control and DBP control under current MDBP requirements. Recommendation 1 (Disinfectant Residual), in combination with Recommendation 4 (Precursor Control), will place further pressure on the risk balancing challenge potentially leading to increased DBP non-compliance. Additionally, Part 2 and Part 3 of this recommendation may not be possible to correctly and fairly implement without complete training and funding for every regulatory agency employee that would need to implement the rules. In addition, both the regulatory employees and every system operator would need to understand the complete hydraulic model and engineering principals of the unique system being operated.

Recommendation 2: Premise Plumbing

> EPA should advance a national building water quality improvement initiative based on an enhanced partnership among federal agencies and state SDWA oversight agencies.

Background

Opportunistic pathogens are naturally occurring, and amplification can occur in premise plumbing under favorable conditions.[22] Municipal water systems do not provide sterile water to building water systems, and where favorable conditions exist either in the municipal system or within building water systems, opportunistic pathogens may grow.[23] If conditions are suitable for growth in the service line(s) or building plumbing, even low levels of opportunistic pathogens entering from the drinking water distribution system can be problematic.[24]

[21] The DS monitoring plan would identify all planned sampling sites on a single DS map and provide a consolidated calendar of the designated, required, and/or recommended sampling schedule. Through an iterative process, water utilities would consider sample location criteria and opportunities for consolidating sampling events (e.g., sample for multiple rules at the same location on the same day or sample on different days at the same locations for ongoing information gathering) or spreading them out to better achieve spatial and temporal coverage of the distribution system.
[22] National Academies of Sciences, Engineering, and Medicine (NASEM) 2020 Management of *Legionella* in Water Systems. The National Academies Press, Washington, DC.
[23] LeChevallier, Mark W. "Managing Legionella pneumophila in Water Systems." *Journal: American Water Works Association* 112, no. 2 (2020).
[24] LeChevallier, Mark W. "Managing Legionella pneumophila in Water Systems." *Journal: American Water Works Association* 112, no. 2 (2020).

Further, some building/plumbing code-driven and certification program plumbing design conditions (e.g., Green Building codes that emphasize ultra-low flow plumbing fixtures), or hot water temperature limits can contribute to problems leading to opportunistic pathogen growth.[25]

While water utilities and building owners share responsibility for the quality of drinking water provided to consumers, in most instances, only utility owned and operated systems are subject to regulation designed to protect drinking water quality.[26] Building water quality may be affected by inadequate disinfectant residuals, potential for growth of opportunistic pathogens, infrastructure deterioration, inadequate corrosion control, increasing water age, sediment and biofilm accumulation, and backflow of contaminants through cross connections. Most outbreaks of Legionnaires' disease have been documented as associated with building water systems, with 48 percent of all reported drinking water associated outbreaks between 2003 and 2014 were from *Legionella* in premise plumbing.[27]

WG members understand that drinking water is a contributor to *Legionella*-related public health impacts and that both public water systems and building water systems have a role to play in improving public health outcomes for consumers. In the specific context of this recommendation, WG members recognize that, in addition to improving disinfectant residuals and appropriate DS management in municipal systems, largely unregulated building water quality must also be addressed to maximize the opportunity for public health improvements. WG members further understand that certain building contexts currently are explicitly required or incentivized to implement Water Management Programs[28] to improve building water quality and system operations and maintenance to reduce the potential for the amplification of opportunistic pathogens in building plumbing. These largely voluntary efforts provide a leveraging opportunity to improve building water quality in other high-risk building contexts. Working group members believe that, although the regulatory framework for premise plumbing is complex, as water professionals focused on improving public health these actions are reasonable and address emerging knowledge about opportunistic pathogens.

Outcomes Sought

WG members consider advancing a federal partnership program focusing attention on improving building water quality as critical to improving public health outcomes related to opportunistic pathogens. The primary objectives of the partnership will be to broaden the scope and rate of uptake of Water Management Programs by higher-risk building owners/operators. WG members recommend the following actions for consideration by the federal partnership effort:

[25] MDBP Meeting #3, September 20, 2022. https://www.epa.gov/system/files/documents/2022-12/MDBP-Rule-Revisions-Working-Group-Meeting-Presentation-September-20-2022.pdf.
[26] Building water quality typically falls under the authority of local health agencies and usually is only considered when there is a problem such as a confirmed case of Legionnaires' disease or other water quality problem. In some cases, buildings have been identified as PWSs.
[27] Data pulled from CDC's NORS dataset for purposes of EPA presentation to MDBP Working Group. Note, NORS is a dynamic dataset and the numbers have likely changed since the data pull. Building water systems are often considered to be premise plumbing as in NORS dataset.
[28] For example, the Centers for Medicare and Medicaid Services (CMS) expects Medicare and Medicare/Medicaid certified healthcare facilities to have water management policies and procedures to reduce the risk of growth and spread of *Legionella* and other opportunistic pathogens in building water systems. Facilities must have a water management program and documentation that, at a minimum, ensure each facility:
Conducts a facility risk assessment to identify where *Legionella* and other opportunistic waterborne pathogens (e.g., *Pseudomonas*, *Acinetobacter*, *Burkholderia*, *Stenotrophomonas*, nontuberculous mycobacteria, and fungi) could grow and spread in the facility water system;
Develops and implements a water management program that considers the ASHRAE industry standard and the CDC toolkit; Specifies testing protocols and acceptable ranges for control measures, and document the results of testing and corrective actions taken when control limits are not maintained. Centers for Medicare & Medicated Services Memorandum dated June 2, 2017 related to requirement to reduce *Legionella* risk in healthcare facility water systems, available at https://www.cms.gov/medicare/provider-enrollment-and-certification/surveycertificationgeninfo/downloads/qso17-30-hospitalcah-nh-revised-.pdf.

Part 1: Identify opportunities to build on the existing partnership relationship between ASDWA,[29] CDC, and EPA with a goal of establishing an effective framework for creating and implementing an "all of government," regulatory or incentivized program applying to buildings for improving the safety of premise plumbing with respect to opportunistic pathogens. Include in this initiative Water Management Program requirements for all federally owned/operated buildings not already covered by such requirements.

Part 2: Conduct data gathering and analysis that will provide the information needed to achieve the outcome sought.

Activities here, for example, should include:

1. More clearly establishing an understanding of:
    a. current initiatives that promote/incentivize uptake of Water Management Programs by building owners/operators,
    b. current gaps in promotion efforts relative to the overall building landscape, and
    c. current barriers to the uptake of Water Management Programs by building owners/operators.
2. Establish a criticality review method to identify building water characteristics (e.g., seasonal use, large buildings, buildings that serve sensitive subpopulations such as health care and elder services facilities, schools) that represent higher-risk contexts for building water quality problems and target water quality improvement promotion/incentive efforts accordingly.
3. Explore and develop further incentives for Water Management Program uptake by higher-risk building owners/operators, including withholding federal funds; providing federal tax incentives; establishing SRF eligibility; and influencing insurers and building certification initiatives.
4. Engage the National Institute of Standards and Technology (NIST) or similar federal institutions to conduct a cross-cutting analysis of building, energy, and plumbing codes and standards to understand potential unintended adverse water quality outcomes (this would include green building certification standards).

Part 3: Based on work completed in the data gathering and analysis stage, consider expanding the initial partnership to include additional members, for example, building and institution-related national associations (e.g., American Hospital Association), building service providers (e.g., water quality management companies, insurers), state and local public health agencies, and unions involved in operating and maintaining building plumbing systems.

Part 4: Build out a program that focuses on providing appropriate requirements and materials for different types of buildings with differing relative risks.

In program development work, seek to match up different promotional efforts, incentives, and communication methods with premise plumbing systems being managed, for example, those providing treatment and regulated under the SDWA, higher-risk building contexts such as health care facilities, large buildings/institutions such as hotels and office buildings, and student housing, large residential buildings, and buildings with significant differences in seasonality of usage.

[29] A characterization of state approaches has been developed by ASDWA - https://www.asdwa.org/wp-content/uploads/2019/09/State-Approaches-to-Building-Water-System-Regulation.pdf

Part 5: Develop and implement a Legionella public awareness campaign targeting smaller-scale building owner/renters (e.g., single family residences) to elevate improved building water quality management practices.[30]

Level of Working Group Support = Substantial

Alternative Perspectives (reflects perspectives of individual(s) not supporting the recommendation)

There is full support from Working Group members for efforts to improve building water quality management. Concerns exist, however, that this recommendation holds the potential to either drive new requirements for PWS in the absence of sufficient progress in building water management or draw PWS directly into solving building water quality problems. There is a belief that clarity must be maintained of the distinctions between PWS and building owner/operator responsibilities for ensuring safe drinking water within their respective span of control. These concerns lead to lack of support for this recommendation.

Recommendation 3: DBPs of Emerging Concern

> Address data and analysis gaps associated with DBPs of emerging concern.

Background

Disinfection with chlorine or chloramines can lead to formation of a wide range of DBPs (more than 700 DBPs have been identified).[31] The existing DBP rules include MCLs for Total Trihalomethanes (TTHM) (referred to here as THM4) and five haloacetic acids (HAA5), along with Total Organic Carbon (TOC) removal requirements, with the consideration that controlling THM4 and HAA5 (as surrogates), along with TOC, help reduce the risk from the overall DBP mixtures. Some of the unregulated DBPs have inorganic precursors that may not be controlled based on removal of TOC. Uncertainty exists regarding the comparative risks between regulated and unregulated DBPs and whether reducing concentrations of regulated DBPs also proportionally decreases concentrations of unregulated DBPs. However, some treatment approaches for regulated DBPs or their precursors will reduce exposures to unregulated DBPs.

In vitro test results on a variety of DBPs have indicated the following relative trend in DBP toxicity: iodinated DBPs greater than brominated DBPs greater than chlorinated DBPs; nitrogenous DBPs greater than carbonaceous DBPs.[32] Considering metabolism and sensitivity of human cells/organs, a higher cytotoxicity or genotoxicity of DBPs via the *in vitro* testing may not necessarily imply higher human risks, considering the levels of DBP exposure in the national drinking water supply.[33] There are several unknowns about the potential human risks

[30] Response to WG member request - What is being done regarding public awareness of *Legionella*? Provided on August 30, 2023.
[31] Richardson, Susan D., and Michael J. Plewa. "To regulate or not to regulate? What to do with more toxic disinfection by-products?" Journal of Environmental Chemical Engineering 8, no. 4 (2020): 103939.
[32] WG Meeting # 3 Presentation, Segment 4 Problem Characterization - DBPs (September 20, 2022), https://www.epa.gov/system/files/documents/2022-12/MDBP-Rule-Revisions-Working-Group-Meeting-Presentation-September-20-2022.pdf.
[33] Claxton, L.D., Pegram, R., Schenck, K.M., Simmons, J.E. and Warren, S.H., 2008. Integrated disinfection by-products research: Salmonella mutagenicity of water concentrates disinfected by chlorination and ozonation/postchlorination. Journal of Toxicology and Environmental Health, Part A, 71(17), pp.1187-1194.
Pegram, R.A., Andersen, M.E., Warren, S.H., Ross, T.M. and Claxton, L.D., 1997. GlutathioneS-Transferase-Mediated Mutagenicity of Trihalomethanes in Salmonella typhimurium: Contrasting Results with Bromodichloromethane and Chloroform. Toxicology and applied pharmacology, 144(1), pp.183-188.

associated with the DBP mixtures from different disinfection strategies under different water quality conditions and which DBPs or DBP groups are the risk drivers.[34] Current science signals that the HAA group may need specific attention. There are nine haloacetic acids in the HAA group and the current MCL for HAA5 does not include four brominated HAAs (out of six brominated HAAs). In a 2021 Report on Carcinogens, the National Toxicology Program (NTP) found that four unregulated HAAs and two regulated HAAs are reasonably anticipated to be human carcinogens.[35]

Outcomes Sought

WG members understand that research undertaken since the implementation of Stage 1 and Stage 2 D/DBPRs signal that certain unregulated DBPs (e.g., unregulated brominated HAAs) may have the potential to pose both cancerous and non-cancerous health effects. WG members believe the potential for public health impacts from regulated and unregulated DBPs merit further research, and WG members acknowledge there are DBP concerns that require follow-up. To advance further consideration of new DBP regulatory interventions, the WG recommends that EPA and the research community address data and analysis gaps on DBPs of emerging concern by undertaking the following. WG members stress that federal funding must be made available for health effects and other research and data collection and analysis to be successful. Additionally, to the extent peer-reviewed best available scientific evidence that meets EPA's criteria for establishing new or revised National Primary Drinking Water Regulations emerges as EPA undertakes further analysis in support of MDBP rules revision and addresses the data and analysis gaps identified below, WG members believe this new evidence should influence the nature of immediate and targeted near-term regulatory options EPA considers.

Part 1: Generate nationally representative occurrence, health effects, and treatment data on regulated and unregulated DBPs to better characterize national occurrence/exposure and risk baselines and to inform risk management strategies.

This includes the development of EPA-approved analytical methods for DBPs of emerging concern. The core ingredients of the additional data and analysis are the following.

1. Assessing existing exposure data and, if necessary, augmenting by generating occurrence of unregulated DBPs, where unavailable, and co-occurrence data among DBP groups to better understand the overall exposure/risks in context of DBP mixtures, the risk tradeoffs for various DBP groups, and the application of established, peer-reviewed assumptions regarding consumption.
2. Developing health effects information to better understand the human health risks due to exposure to DBPs in drinking water. Addressing gaps in this area will be helpful to further support identifying and evaluating health benefits from various potential regulatory strategies.
3. Evaluating treatment information for determining the appropriate control strategies and risk balancing for regulated and unregulated DBPs and associated impacts, including how enhanced precursor removal affects concentrations of unregulated DBPs.
4. Generating a better understanding of national baseline source water TOC, SUVA, alkalinity, and bromide conditions, along with an understanding of the current and potential future use of chlorination and chloramination, to better inform risk management strategies.

[34] Balancing and Minimizing Microbial and Chemical Risks: The Disinfection Byproduct Side of the Equation; Jane Ellen Simmons and Rex Pegram (ORD/U.S. EPA); Briefing to MDBP Stakeholder Meeting; October 2020; https://www.regulations.gov/document/EPA-HQ-OW-2020-0486-0015.
[35] NTP (National Toxicology Program)2021Report on Carcinogens, 15th ed. Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service. https://ntp.niehs.nih.gov/go/roc15 (EndNote XML). DOI: https://doi.org/10.22427/NTP-OTHER-1003.

5. Draw on existing and, as needed, new data and analysis to characterize, in support of Recommendation 4 options evaluation, the extent wastewater effluent is a contributor to DBP formation potential in drinking water systems, the specific DBP precursors contributing to this formation potential, the methods that can be used to characterize wastewater effluent influence on a drinking water system at the local level, and the potential wastewater source control and treatment options a wastewater system can use to address these conditions.

Part 2: In context of the gaps identified above, examples of the data and analysis associated with unregulated DBPs that EPA should address are highlighted below.

1. How much national-level risk remains from HAA exposure, considering the HAA5, HAA6Br, and HAA9 occurrence and population served information from UCMR4?
2. What are the comparative implications to overall risks from DBP mixtures resulting from chloramination and chlorination treatment, when considering levels of TOC and/or NOM?
3. To what extent do haloacetonitriles (HANs) occur in chlorination versus chloramination water systems, and what are the human health risks?
    a. To what extent do HANs co-occur with THMs/HAAs?
    b. What are effective control strategies for HANs? How does THM4/HAA5 control impact formation of HANs?
4. To what extent do iodinated DBPs occur in water systems and what are the public health risks?
    a. To what extent do iodinated DBPs co-occur with THMs/HAAs?
    b. What will be the effective control strategies for iodinated DBPs? How does THM4/HAA5 control impact formation of iodinated DBPs?
5. With climate change and increased source water salinization in many communities, will occurrence of iodinated and brominated DBPs increase in the future?

Level of Working Group Support = Full

Recommendation 4: Multi-Benefit Precursor Control

> Establish a PWS source water evaluation screening requirement and, under defined conditions, provide additional mandatory treatment to reduce DBP formation and disinfectant demand.

Background

Source water quality parameters such as TOC, bromide, and wastewater effluent discharge contribution are important when considering DBP formation. Researchers have identified over 700 DBPs and generally consider brominated (Br-DBPs), nitrogenous DBPs (N-DBPs), and iodinated (I-DBPs) to have greater toxicity than their chlorinated analogs.[36,37] Many Br-, N-, and I-DBPs (e.g., haloacetonitriles (HANs)) have been associated with drinking water systems receiving elevated levels of wastewater effluent discharge in their source waters, i.e., *de*

[36] Liberatore, H.K., Daiber, E.J., Ravuri, S.A., Schmid, J.E., Richardson, S.D., and DeMarini, D.M. (2022). Disinfection Byproducts in Chlorinated or Brominated Swimming Pools and Spas: Role of Brominated DBPs and Association with Mutagenicity. Journal of Environmental Sciences. 117 (253-263).
[37] Muellner, M. G., E. D. Wagner, K. McCalla, S. D. Richardson, Y. Woo, AND M. J. Plewa. Haloacetonitriles vs Regulated Haloacetic Acids: Are Nitrogen Containing DBPs more Toxic? Environmental Science & Technology. American Chemical Society, Washington, DC, 41(2):645-651, (2007).

facto reuse, as treated wastewater effluent is a source of TOC, nitrogenous organic matter, bromide, and iodide.[38]

Removal of organic matter (i.e., precursor control) was included in the Stage 1 D/DBPR to supplement the use of MCLs to control DBP formation. In the Stage 1 rule, EPA included a 3x3 matrix[39] based on source water TOC and alkalinity that specifies the percent TOC removal to be achieved for surface water or Ground Water Under the Influence of Surface Water (GWUDI) systems (collectively referred to as Subpart H systems) that use conventional filtration treatment (i.e., coagulation, flocculation, sedimentation, and filtration). Precursor removal was considered to reduce the formation of, and related health effects associated with, most DBPs, diminish the incentive to shift toward alternative disinfectants, and reduce disinfectant demand.[40] EPA also provided alternative compliance criteria for PWSs. Current removal levels of organic matter leave potential for regulated and unregulated DBP formation and disinfectant demand. Finished water TOC from plants meeting the 3x3 matrix can be relatively high (e.g., 31% and 10% of 3x3 matrix-compliant plants had TOC > 2 and > 3 mg/L in finished water, respectively).[41] Additionally, the D/DBPRs do not include a requirement for TOC removal from treatment plants other than conventional surface water plants (e.g., direct filtration plants, slow sand filtration plants, or membrane filtration plants), or from ground water sources, which could have high source water and finished water TOC and DBP concentrations. There are also implications for simultaneous compliance with the PFAS MCLs which will likely drive many PWSs to install advanced treatment (e.g., activated carbon, reverse osmosis).

Outcomes Sought

WG members seek to improve drinking water quality by achieving the multiple benefits associated with providing enhanced precursor control, including the potential to reduce DBP formation, which will have the significant health benefits of reducing exposure to both regulated and unregulated DBPs. Additional precursor control could also reduce disinfectant demand providing for more stable distribution system disinfectant residual and potentially producing water that has greater biostability, thus reducing exposure to opportunistic pathogens.

To achieve the benefits of precursor control, the WG has discussed an approach that is rooted in a problem-based, treatment technique requirement. This requirement would address source water quality conditions known to be conducive to DBP formation, such as elevated levels of TOC, bromide, iodide, or wastewater effluent discharge contribution. The approach the WG has discussed and recommends to EPA for further consideration involves a framework for utilities to enhance the control of precursors thought to form regulated and unregulated Br-DBPs, and unregulated N-DBPs and I-DBPs in the DS without the use of MCLs. There is a higher level of health concern associated with these groups of DBPs, relative to the regulated TTHM and HAA5 groups[42]. This approach will also improve overall water quality conditions in the DS, including lower disinfectant demand to better support the improvements being pursued under Recommendation 1.

The recommended framework for further consideration is an enhanced, problem-based precursor control approach comprised of two parts.

[38] Joshua M. Allen, Michael J. Plewa, Elizabeth D. Wagner, Xiao Wei, Katherine Bokenkamp, Kyu Hur, Ai Jia, Hannah K. Liberatore, Chih-Fen T. Lee, Raha Shirkhani, Stuart W. Krasner, and Susan D. Richardson. Drivers of Disinfection Byproduct Cytotoxicity in U.S. Drinking Water: Should Other DBPs Be Considered for Regulation? Environmental Science & Technology 2022 56 (1), 392-402DOI: 10.1021/acs.est.1c07998
[39] 40 CFR § 141.135 Treatment technique for control of DBP precursors.
[40] Stage 1 D/DBPR Federal Register Notice of Proposed Rule, 59 Fed Reg. 38754, (July 29, 1994).
[41] UCMR4, 81 Fed. Reg. 92666 (December 20, 2016).
[42] Joshua M. Allen, Michael J. Plewa, Elizabeth D. Wagner, Xiao Wei, Katherine Bokenkamp, Kyu Hur, Ai Jia, Hannah K. Liberatore, Chih-Fen T. Lee, Raha Shirkhani, Stuart W. Krasner, and Susan D. Richardson. Drivers of Disinfection Byproduct Cytotoxicity in U.S. Drinking Water: Should Other DBPs Be Considered for Regulation? Environmental Science & Technology 2022 56 (1), 392-402DOI: 10.1021/acs.est.1c07998.

Part 1: Evaluate options for a source water vulnerability screening requirement to identify those systems with a higher risk of DBP formation.

As part of considering options:

1. Assess and prepare a rationale for the inclusion in the source water screening requirement all Subpart H PWS and groundwater systems that disinfect, taking into account that distinct differences between surface water and true groundwater systems will likely lead to different approaches between the two. This requirement is not intended to apply to consecutive water systems unless the consecutive system has its own source(s) of supply in addition to receiving finished water from one or more wholesale systems.
2. Examine a range of data sources to be part of the vulnerability assessment screening process. Options to consider include: PWS history of SWTR or D/DBPR violations or challenging local source water quality conditions (e.g., 303(d) impaired waters, upstream fracking operations, coal fired power plant discharges, saltwater intrusion, or relatively high source water cyanobacteria, nitrogen, and/or phosphorus).
3. Examine available source water monitoring data for bromide and TOC (e.g., previously generated UCMR-related TOC and bromide monitoring data) and the contribution of wastewater effluent (or nonpoint source) discharge to the utility's drinking water source[43] for the role they can play in the screening requirement.
4. Examine under what operational or other conditions (e.g., advanced treatment is already being utilized, demonstrated high performance of system relative to microbial and DBP control, high quality sources) a PWS can opt out of the vulnerability screening requirement. It is recommended that EPA establish a timeframe for re-evaluation to ensure the operational or other conditions have not changed (e.g., every three to five years).

Part 2: Evaluate options for an enhanced precursor control treatment technique requirement in response to elevated precursor conditions characterized through the vulnerability screening.

As part of considering options:

1. Examine the role additional monitoring can (would need to) play for higher vulnerability systems to create the baseline needed for application of the treatment technique requirement. Monitoring areas to consider include the following:
    a. Source water monitoring for bromide.
    b. Reporting of current distribution system THM4 monitoring data, breaking out individual THMs such that brominated THMs can be quantified.
    c. Expand HAA method to evaluate nine HAA species and report those HAA species individually such that brominated HAAs in the distribution system can be quantified.
    d. Depending on results of the data and analysis conducted under Recommendation 3, the contribution of wastewater (or nonpoint source) discharge to the utility's drinking water source, as well as when the contribution of wastewater effluent discharge is thought to be of concern, the reporting of HAN-4 (i.e., individual species and the sum of dichloroacetonitrile,

[43] Note, wastewater effluent is also addressed under Recommendations 3 and 8. Additional data and analysis is suggested as needed for wastewater effluent screening and characterization under Recommendation 3, and focused efforts to control problematic wastewater discharge are suggested under Recommendation 8.

dibromoacetonitrile, trichloroacetonitrile, and bromochloroacetonitrile)[44], that represent N-DBPs, through an extension of the existing EPA-approved methods (i.e., Method 551)[45].

2. Examine a range of approaches to establish the method(s) higher vulnerability systems will use to determine their performance requirement including the following (individually or in combination): modify the stringency of the Stage 1 3x3 matrix; limit the use of alternative compliance criteria applicable to the 3x3 matrix; establish a numeric maximum for TOC entering the distribution system; develop a level of response framework based on source water Br and TOC (to further control brominated DBPs such as for THM3Br and/or HAA6Br); and develop a new basis for factoring wastewater effluent contribution into the requirement.
3. Examine and seek to include a range of options for how covered systems must operate to achieve the performance levels indicated by the treatment technique performance requirement (see item 2 above) including:
    a. Better management of DBP formation in distribution systems such as with reducing water age, improved storage management, and controlling disinfectant residual (see Recommendations 1, 5, and 6).
    b. The use of alternative source waters (recognizing the likely limited applicability of this option) and/or methods to reduce upstream contamination levels (see Recommendation 8).
    c. Adjusting or adopting new treatment practices (e.g., enhanced coagulation, biofiltration, activated carbon).

The WG understands that the evaluation of any specific precursor control requirements will be conducted in accordance with requirements for EPA including a Health Risk Reduction and Cost Analysis (HRRCA). Potential challenges for conducting a HRRCA include the availability of data to fully characterize baseline conditions nationally for DBP precursors and to evaluate benefits and costs of potential future control strategies especially in some of the more precursor-challenged portions of the country. As discussed in Recommendation #3, generating a better understanding of source water TOC, SUVA, alkalinity, and bromide, along with current and potential future use of chlorination and chloramination will be helpful to better understand national-level baselines and inform risk management strategies.

Level of Working Group Support = Substantial

Alternative Perspectives (reflects perspectives of individual(s) not supporting the recommendation)

Many drinking water systems continue to struggle to achieve the risk balancing required between microbial control and DBP control under current MDBP requirements. Recommendation 1 (Disinfectant Residual), in combination with this Recommendation 4 (Precursor Control), will place further pressure on the risk balancing challenge potentially leading to increased DBP non-compliance. Additionally, local water systems usually only have one source of water available, and the water is treated based on the supply. Therefore, possible improved source water protection is a better option than the precursor control proposed under Recommendation 4. Treatment methods might be changed but sources are usually not possible to change. Controlling the supply availability could severely discriminate against certain groups.

[44] EPA method 551 (used for THM4) could be modified to include the four HANs. No additional sampling would be needed for measuring HAN-4.
[45] Revisions to Unregulated Contaminant Monitoring Rule (UCMR5), 86 Fed. Reg. 13846 (March 11, 2021).

Recommendation 5: Finished Water Storage Tanks

> Address finished water storage tank vulnerabilities by establishing a national inspection and cleaning as needed requirement; supported by a review and update as needed of current storage tank operations and maintenance guidance.

Background

Because finished water storage facilities contain large volumes of water that is meant for human consumption, they have the potential to impact the health of many people. Finished water storage facilities can have significant impacts on finished water quality in the DS. The impacts on water quality can be linked to the development of corrosion products, biofilms, sediments, and structural breaches that allow for contaminant entry.[46] If improperly managed, finished water storage facilities can create high water age situations which can lead to the growth of opportunistic pathogens and the formation of DBPs. For instance, opportunistic pathogens such as *Legionella* occur naturally in supply sources and can thrive in finished water storage facilities in the presence of corrosion products, biofilms, and/or sediments, especially where high water age exists.[47] A lack of water quality monitoring at or near storage facilities can allow these contaminants to go unnoticed and therefore persist and accumulate, prolonging the problem. This lack of monitoring can also be problematic because the utility may be unaware of potential water age problems within the facilities. Monitoring of residuals at or near storage may not be straightforward for some systems and should consider locations (e.g., inlet/outlet) and fill and draw cycles.

Storage inspection and cleaning requirements:

Currently, there is a lack of standardized national requirements for finished water storage tank inspection and cleaning. A limited number of states have moved to institute such requirements. For instance, Colorado developed storage tank requirements following a salmonellosis outbreak due to finished water storage tank contamination.[48] However, some states cannot do this because of state-level restrictions on adopting more stringent regulations than those prescribed at the national level.[49]

Finished water storage facilities are examined during sanitary surveys and storage-related significant deficiencies are among the most prevalent of all deficiencies. Of over 40,000 reviewed surveys, significant deficiencies were reported in 11.1% of the surveys.[50] Of these, some of the most common deficiencies pertained to finished water storage. Even with this relatively high proportion of significant deficiencies being related to storage, some problems with storage can be missed during sanitary surveys. Sanitarians may lack expertise to

[46] National Research Council. *Drinking water distribution systems: Assessing and reducing risks*. National Academies Press, 2007.
[47] Gleason, J. A., & Cohn, P. D. (2022). A review of legionnaires' disease and public water systems–Scientific considerations, uncertainties, and recommendations. *International Journal of Hygiene and Environmental Health*, *240*, 113906.
[48] Colorado's Primary Drinking Water Regulations include 5 Colo. Code Regs § 1002-11.28(3)(b)(2014), which states that "comprehensive inspections of each finished water storage tank must be scheduled and performed at least every five calendar years, or on an alternative schedule". In addition, Section 11.28(3)(d) states how suppliers must perform 'comprehensive inspections' of each finished water storage tank. 'Comprehensive inspection' is defined in regulation 11.28(1)(b) as "an internal and external storage tank inspection to identify sanitary defects that covers all aspects of the condition of the storage tank including but not limited to sanitary, structural, and coating system conditions, as well as security and safety concerns."
[49] Association of State Drinking Water Administrators (ASDWA) Primacy Agency/Stringency informal survey results. Is your primacy agency allowed to be more stringent than EPA? Responses from 28 states: Yes – Georgia, Texas, Alabama, New Hampshire, California, Tennessee, Arkansas, Louisiana, Missouri, Nebraska, Pennsylvania, Colorado, Rhode Island, Northern Mariana Islands, Washington, Massachusetts, Iowa. No – Montana, South Dakota, Arizona, Oklahoma, Utah, Indiana, Alaska, Maryland. Some situations – Kansas. Only with legislative approval – South Carolina. Not under most circumstances – Idaho.
[50] Heinrich, Austin, Deborah Vacs Renwick, Richard J. Weisman, Ashley Greene, Stig Regli, Kevin Roland, and Kenneth Rotert. "Using Sanitary Survey Findings to Identify Risk Management Challenges." *Journal AWWA 114, no. 5 (2022): 34–45. https://doi.org/10.1002/awwa.1920*.

properly assess the structural integrity of the facilities, and limitations on confined-space entry and climbing of tanks may allow for some internal and external integrity and water quality issues to go undetected.

Storage operation and maintenance guidance:

High water age in storage can create a variety of water quality problems. Water turnover varies due to changes in operation, demand, season, temperature, extent of mixing, and other site-specific factors. Small temperature differences in the water change the buoyancy, leading to the creation of layers or zones that do not mix (i.e., stratification). The extent of mixing is dependent on the inlet flow rate, outlet flow rate, temperature of the tank water versus the incoming flow, configuration of the piping within the tank, and geometry of the tank. Furthermore, equalization that is used to meet peak demands typically makes up only about 30% of the stored volume. The other 70% is typically for fire storage (30%), emergency storage (30%), and unusable (dead) volume (10%). Only the equalization volume will typically be turned over daily. Water exchange often happens from a small zone and the remaining water is stagnant, operating like two separate tanks. If the tank is not fully mixed, the stagnant volume (potentially 60-75% of the volume) could be sent out into the system during emergency incidents such as main breaks or fires. This was documented as the cause of outbreaks in several cases such as in Gideon, MO.[51] Stagnant water, with low residuals, sediments, and the presence of opportunistic pathogens in a storage tank was also tied to two community outbreaks of legionellosis.[52] In the years following the outbreaks, the storage tank was drained, washed, and disinfected, and free chlorine levels returned to an acceptable level, again highlighting effective intervention measures.

Outcomes Sought

WG members understand that sediments and biofilms can accumulate in finished water storage tanks and provide a habitat for opportunistic pathogen growth,[53] while storage tank breaches can allow contaminants to enter from outside of tanks.[54] Additionally, increased water age and accumulation of sediments and biofilms can contribute to elevated DBP levels in storage tanks as the disinfectant residual levels are decreased.[55] WG members further recognize that storage tank operation and management conditions can contribute to high water age and stagnation in some situations, and these conditions are associated with opportunistic pathogen growth and DBP formation.[56] Overall, WG discussions signaled a need to approach improved storage tank conditions holistically, covering physical/structural integrity (roof, walls, vents) and operational conditions. Members also recognize that water quality objectives and water quantity objectives (for fire flow, peak demand, and emergency situations) can represent competing priorities. It was also noted that some storage tank challenges fall under the more general challenge of technical, managerial, and financial (TMF) capacity constraints that, if addressed, could solve multiple problems (see also Recommendation 10 TMF Capacity). In this context, WG members recommend a two-part approach to address finished water storage tank vulnerabilities:

[51] Clark, R. M., E. E. Geldreich, K. R. Fox, E. W. Rice, C. H. Johnson, J. A. Goodrich, J. A. Barnick, F. Abdesaken, J. E. Hill, and F. J. Angulo. "A waterborne Salmonella typhimurium outbreak in Gideon, Missouri: results from a field investigation." *International Journal of Environmental Health Research* 6, no. 3 (1996): 187-193.
[52] Cohn, P. D., J. A. Gleason, E. Rudowski, S. M. Tsai, C. A. Genese, and J. A. Fagliano. "Community outbreak of legionellosis and an environmental investigation into a community water system." *Epidemiology & Infection* 143, no. 6 (2015): 1322-1331.
[53] Gleason, Jessie A., and Perry D. Cohn. "A review of legionnaires' disease and public water systems–Scientific considerations, uncertainties and recommendations." *International Journal of Hygiene and Environmental Health* 240 (2022): 113906.
[54] National Research Council, 2006, *Drinking Water Distribution Systems: Assessing and Reducing Risks (chapter 8).* Washington, DC: The National Academies Pres, available at: https://nap.nationalacademies.org/catalog/11728/drinking-water-distribution-systems-assessing-and-reducing-risks.
[55] National Research Council, 2006, *Drinking Water Distribution Systems: Assessing and Reducing Risks (chapter 8).* Washington, DC: The National Academies Pres, available at: https://nap.nationalacademies.org/catalog/11728/drinking-water-distribution-systems-assessing-and-reducing-risks.
[56] Cohn, P. D., Gleason, J. A., Rudowski, E., Tsai, S. M., Genese, C. A., & Fagliano, J. A. (2015). Community outbreak of legionellosis and an environmental investigation into a community water system. Epidemiology & Infection, 143(6), 1322-1331.

Part 1: Institute a national finished water storage tank inspection and cleaning as needed requirement to fill the current gap left by limited state-level regulatory efforts for storage tanks.

Factors that could indicate a need to clean storage tanks include continual loss of disinfectant residuals and accumulated material leaving tanks. Exterior inspections of storage facilities on a regular basis can identify signs of compromised security, signs of vandalism or storm damage, signs of bird or animal entry, and issues affecting the facility's physical integrity. Inspections often also include an assessment of the overall tank condition, a review of relief devices and venting, and hatch and manhole inspections. Interior inspections performed on a regular basis can be used to monitor the presence of corrosion and corrosion products, biofilms, sediment levels, check the integrity of internal facility structures, missing vents, and check the status of internal and external coatings. WG members suggest that EPA look to existing standards (e.g., AWWA D101 currently being updated, and AWWA M42 (2013) for steel water tanks) and state storage tank inspection requirements (e.g., Colorado) for models related to inspection frequency and needed follow-up actions regarding cleaning. Storage facility cleaning can include removing sediment, corrosion products, biofilm, and other debris, which could lead to benefits across reductions of multiple contaminants. In support of this requirement, WG members anticipate there also will be additional training and tank inspection protocols needed to address current challenges with sanitarian expertise related to structural integrity of facilities and limitations on confined-space entry and climbing of tanks.

Part 2: Review of current finished water storage tank guidance to identify gaps and update guidance accordingly, as well as provide for additional guidance in support of implementing a national inspection and cleaning as needed requirement.

EPA can look to the existing 10 States Standards as one model and others for developing this guidance.[57] The 10 States Standards include recommendations relevant to storage inspection and cleaning, such as prevention of contamination, preventing adherence of materials in storage tanks, preventing of water age concerns through proper design, operations, and disinfection. Measures are also noted to prevent intrusion of water or infiltration of contamination from external sources, address safety concerns, and to prevent freezing. An additional source for consideration is a Colorado Department of Public Health and Environment operator training program designed to increase understanding of storage facilities.[58]

Level of Working Group Support = Full

Recommendation 6: Chloramination

> Improve chloramination practices to promote control of microbial contamination and DBP formation potential and improve overall consistency of water quality.

Background

The use of chloramines for disinfection purposes provides benefits for both opportunistic pathogen and DBP control when managed effectively in both surface and groundwater DSs, however the chloramination process can pose operational and management challenges such as controlling chlorine to ammonia ratios, nitrification, and formation of unregulated DBPs. These challenges can be more prevalent in small, rural, and EJ, disadvantaged

[57] Available at: https://www.health.state.mn.us/communities/environment/water/tenstates/standards.html.
[58] https://cdphe.colorado.gov/wq-facility-operator

and historically underserved communities.[59] Systems using chloramines for secondary disinfection may experience nitrification when the system has high source water ammonia levels and/or when the system adds too much ammonia. The breakdown of chloramines, releasing free ammonia, can also contribute to nitrification.[60] A temporary switch from chloramine to chlorine (sometimes referred to as a chlorine burn but hereafter referred to as a temporary chlorine conversion) is used periodically in many chloraminating systems to break the cycle of nitrification and improve water quality throughout the DS. The duration of a temporary conversion can be site-specific (a few days to many weeks). If not properly managed or during some times of the year (such as in warmer weather when DBP formation increases), temporary chlorine conversion can create short term increases in regulated DBP concentrations, depending on site-specific conditions (e.g., levels of DBP precursors in the water entering DS, temperature, pH, chlorine residual level, and water age in DS). In some cases, these DBP increases can be substantial. Huerta et al. (2015) reported that THM4 and HAA5 concentrations during temporary chlorine conversion could jump to a range of 200-300 ug/L[61] (compared to MCLs of 80 and 60 ug/L, respectively). DBP monitoring during this conversion period is not currently required by EPA to be included in compliance calculations for regulated DBPs.

Outcomes Sought[62]

WG members understand that chloramination as an alternative distribution system disinfection practice has several well-documented challenges, can be associated with the formation of DBPs with emerging evidence signaling potential concerns, and can contribute to nitrification and the need for periodic chlorine conversion practices (that can produce high, short-term levels of DBPs). Improving chloramination practice will be beneficial for control of nitrification, microbial contamination and DBP formation potential, as well as maintenance of consistent water quality within DS. WG members understand that the requirements proposed in this recommendation hold the potential, depending on how individual utility systems choose or need to implement them, to limit chloramination use by some systems. In this context, WG members encourage EPA to research new practical alternatives that can replace chloramination as a means for systems to meet DBP compliance. To address these challenges and improve overall DS water quality, Working Group members recommend the following actions:

Part 1: Develop national comprehensive chloramine application guidance to assist primacy agencies and chloraminating systems on properly managing chloramine disinfection, by considering the related information available from relevant existing documents and new literature.

Preliminary considerations for guidance would include outcomes from free chlorine contact time, blending chlorinated water with chloraminated water, corrosion control when chloramine is applied, preoxidation with chlorine dioxide, free chlorine, or ozone, TOC removal prior to chlorine addition, careful control of the chlorine-to-ammonia ratio, targeting the concentration of chloramine at the entry points to the DS (dictated by the

[59] National Research Council, 2006, *Drinking Water Distribution Systems: Assessing and Reducing Risks (chapter 8).* Washington, DC: The National Academies Press, available at: https://nap.nationalacademies.org/catalog/11728/drinking-water-distribution-systems-assessing-and-reducing-risks.
[60] Chloramines can degrade throughout the DS and result in increased microbial activity (including nitrification). This can lead to an increase in microbiologically produced organic matter. These organics can react with chlorine or chloramines, leading to more reduction of chloramine residual levels. Excess ammonia (naturally-occurring or added for chloramine formation) can accelerate this process by promoting nitrification and more microbial activity.
[61] Huerta, J., K. Smith, and J. Zambrano. 2015. Evaluating the Effectiveness of Controls for Unintended Consequences Associated with a Temporary Disinfectant Switch: A Case Study. American Water Works Association Annual Conference, ACE15
[62] Recommendations 10 (PWS TMF capacity) and 11 (Primacy Agency capacity) act in close concert with this recommendation to identify and provide the resources needed to ensure equitable access to, and the affordability of, the intended benefits of all MDBP rule revisions.

concentrations at the far ends of the distribution system), and active points of connection[63] to consecutive systems, and optimizing treatment to lower TOC levels and nutrient levels in water entering the DS.

Part 2: Develop a national comprehensive temporary chlorine conversion guidance to assist primacy agencies and chloraminating systems to minimize negative impacts on water quality in DS during conversion periods.

Topics addressed in the guidance would include careful consideration of the time of year the practice is undertaken, reducing TOC levels, flushing pipes beforehand and during, and considering the duration of the practice. Additionally, better management of chloramination practices and nitrification control may reduce the need to conduct chlorine conversions. The duration of the practice can vary from not being necessary at all, to several weeks two or more times per year, depending on site-specific conditions and system operational practices.

Part 3: Monitor regulated DBPs before, during, and after chlorine conversion.

In the context of temporary chlorine conversion, to improve attentiveness to the potential for high, acute exposure to DBPs, as well as recognize the potential impact on long-term exposure, require systems conducting extended conversion (e.g., longer than one week or engaged in multiple, shorter-duration conversions throughout the year) to monitor regulated DBPs before, during, and immediately after the conversion and include the monitoring results, on a time-weighted average for the quarter, in their compliance calculation of Locational Running Annual Averages.

Part 4: Require a Nitrification Control Plan (NCP) for all chloraminating systems that incorporates practices described in guidance resulting from Parts 1 and 2.

Primacy agencies, consistent with current state chloramination permitting or plan review and approval procedures, would approve the NCP for each newly chloraminating system. Existing chloraminating systems would submit an NCP to the state upon a schedule to be determined. This approval would include ensuring the operational parameters central to effective chloramination practice (e.g., free chlorine contact time prior to ammonia addition taking into consideration reducing the formation of regulated and nitrosamine DBPs, chlorine-to-ammonia dose ratio, ammonia in plant effluent, maintaining pH, minimum chloramine residual based on nitrification risk, regular nitrate/nitrite monitoring in the distribution system to support nitrification management) are explicitly addressed, appropriately tailored with monitoring requirements and system specific operating ranges, and sufficiently supported by the technical capacity available to the system.[64] To support this requirement, the WG recommends that EPA develop a national comprehensive NCP Guidance by incorporating successful state and industry practices.[65] EPA must couple this requirement with new funding for PWS and

[63] The term "active points of connection" as used in this document is designed to cover the physical areas of connection where wholesale systems transfer water to consecutive systems and where one consecutive system transfers water to another consecutive system.
[64] Two examples are the NCP Guidance from the State of Louisiana, and the AWWA M56 Guidance: Nitrification Prevention and Control in Drinking Water.
[65] Several case studies of successfully controlling nitrification exist, which could be included in this document. For instance, the Metropolitan Water District of Southern California, which targeted a high enough residual (e.g., 2.0 to 3.0 mg/L) at the EPDS reduces nitrification in the distribution system by maintaining residuals at the far end of the system. They found that such a residual and weekly monitoring for nitrite and free NH3 allowed for the control of nitrification without needing to go to a temporary chlorine conversion in the transmission system. The Newport News Waterworks, converted from free chlorine to monochloramine in January 1998, and has not used temporary chlorine conversions since. Success factors include minimizing the amount of free ammonia leaving the plant, maintaining a good residual at all points in the distribution system, the use of automatic and manual flushing as needed, minimizing tank storage, and implementing a Nitrification plan. The City of Tampa, FL ran monthly HPCs (250 samples) and 400 coliform samples, assembled a small team to sample and respond to customer complaints, flushed routes daily, and targeted 0.1 mg/L free ammonia and 4.2 mg/L of total chlorine at the entry point. Information provided by email personal conversation with MDBP WG Members and Technical Analysts.

Primacy Agencies, provision of enhanced and appropriate TMF capacity, and a water affordability program included in Recommendations 9, 10, and 11 to ensure all systems will have the resources to install and safely maintain appropriate treatment to reduce MDBP health risks and would not need to limit the use of appropriate technology based on water affordability constraints.

Level of Working Group Support = Full

Recommendation 7: Consecutive Systems

> Improve water quality and regulatory compliance rates for consecutive systems.

Background

Consecutive systems come in a wide variety of water supply arrangements. Some consecutive systems receive water from multiple wholesale systems.[66] Some may obtain water near the beginning of the wholesale supply with a potentially low water age when the consecutive systems receive the water. Some consecutive water systems receive water from the far end of a wholesale supply and may face challenges such as potentially experiencing higher water age that can impact their ability to maintain disinfectant residuals and control DBPs. In some cases, the wholesaler may be out of compliance while the consecutive system is not. Ultimately, the water supply arrangements can have an influence on the final water quality received by consumers. A recent EPA in-depth analysis indicated that the Stage 2 D/DBPR health-based violation rate for consecutive community water systems (CWSs) is 3.5 times greater than non-consecutive CWSs, indicating greater compliance challenges faced by consecutive systems.[67] These challenges include meeting detectable disinfectant residuals, particularly in water provided to recipients of wholesalers. Additional challenges include managing taste and odor issues, and long residence times, with associated bacteria growth and nitrification problems.[68] Many consecutive systems have little control over the quality of water they receive from wholesale systems, and in some cases, may be unaware of the water quality they receive. In some instances, they may know little beyond whether the water received is compliant with NPDWRs. The Stage 2 D/DBPR does not require either wholesaler or consecutive systems to take water samples as part of routine compliance monitoring at the interconnection of wholesaler and consecutive system.[69] This can limit understanding the potential causes of Stage 2 D/DBPR violations for consecutive systems, and where return to compliance strategies can be applied. A technical analyst evaluated wholesaler-consecutive system pairs based on the maximum quarterly THM4 LRAA and grouped results into 4 quadrants based on levels of DBPs. For systems identified as “1 Seller 1 Buyer Purchasing 100%” pairs, results showed that consecutive systems are more dependent on their wholesaler’s DBP levels and that there is a higher percent of consecutive systems with higher DBP levels than their wholesaler. The available

[66] 40 CFR §141.2 (2022). Wholesale system is a public water system that treats source water as necessary to produce finished water and then delivers some or all of that finished water to another public water system. Delivery may be through a direct connection or through the distribution system of one or more consecutive systems. Consecutive system is a public water system that receives some or all of its finished water from one or more wholesale systems. Delivery may be through a direct connection or through the distribution system of one or more consecutive systems.
[67] https://www.epa.gov/dwreginfo/diving-regulations
[68] National Research Council, 2006, *Drinking Water Distribution Systems: Assessing and Reducing Risks (chapter 8).* Washington, DC: The National Academies Pres, available at: https://nap.nationalacademies.org/catalog/11728/drinking-water-distribution-systems-assessing-and-reducing-risks.
[69] https://www.epa.gov/dwreginfo/diving-regulations

data was insufficient to explain why a consecutive system may have higher or lower DBP levels than its wholesaler.[70]

Furthermore, many consecutive systems are small and may have that status because they have TMF capacity challenges to ensure their finished water is of sufficient quality and meets regulatory thresholds (see also Recommendation 10 – TMF Capacity). Communication limitations and contractual frameworks may also present challenges for some consecutive systems to ensure compliance and the provision of safe drinking water. Contractual frameworks tend to focus on water quantity provisions, not water quality.[71] Having listed these challenges, WG members also recognize that as water professionals, it is important to identify potential solutions to these issues so as to protect public health and the equitable provision of safe drinking water for everyone.

Outcomes Sought

The WG recommends taking action to improve water quality and regulatory compliance rates for consecutive systems. Specifically, the WG recommends a two-part approach:

Part 1: Develop a problem-based consultative requirement between wholesale and consecutive systems.

1. For all PWSs that provide water to a consecutive system, require disinfectant residual sampling at the active points of connection of the wholesale and consecutive systems or nearest water quality sampling point. For any chloraminating system that provides water to a consecutive system, the active points of connections of the wholesale and consecutive systems or nearest water quality sampling point must be a mandatory sampling location as part of the Nitrification Control Plan (NCP) and the wholesale system must maintain compliance with water quality ranges established as part of the NCP at the point of entry to the consecutive system. The sampling envisioned in this context is intended to be in alignment with the existing regulatory framework for total coliforms under the RTCR and to be consistent with any modifications to monitoring plans under Recommendation 1, Part 2.
2. Examine options available under the SDWA to require a joint, root-cause analysis consultation among the wholesale system, consecutive system, and state regulators in contexts where the consecutive system experiences violations of health-based standards related to DBPs or disinfectant residual. Consider, as part of the options, the role Operational Evaluation Level (OEL) determinations could play as an early warning trigger for such consultation. Also consider the role an EPA Toolbox of best practices can play in elevating water quality management practices for both the wholesale and retail systems.
3. Examine options available under the SDWA for requiring DBP and disinfectant residual monitoring by the wholesale system at the active points of connection to the consecutive system as part of the response to health-based standards violations (e.g., monitoring becomes part of the response to the root-cause analysis consultation or in combination with the distribution sampling plan included in Recommendation

[70] The 4 quadrants are (1) both wholesaler and consecutive system have low levels of DBPs (about 70% pairs examined); (2) the wholesaler has low levels of DBPs but the consecutive system has high levels of DBPs (about 10%); (3) the wholesaler has high levels of DBPs and the consecutive system has low levels of DBPs (about 9%); and (4) both the wholesaler and consecutive system have high levels of DBPs (about 11%). Source: Samson and Seidel. 2019. Identifying Factors Impacting Consecutive System Disinfection Byproduct Compliance. 16th Annual EPA Drinking Water Workshop: Small Systems Challenges and Solutions. Cincinnati, Ohio.

[71] MDBP WG Meeting 7 Summary: https://www.epa.gov/system/files/documents/2023-07/MDBP-Rule-Revisions-Working-Group-Meeting-Summary-March-9-2023.pdf. Meeting 7: Slide 25: https://www.epa.gov/system/files/documents/2023-04/MDBP-Rule-Revisions-Working-Group-Meeting-Presentation-March-9-2023.pdf.

1). Monitoring could inform whether water being received by consecutive systems is of sufficient quality and in compliance with NPDWRs. Monitoring results could lead to increased problem-solving collaboration between the wholesaler and consecutive systems. To the extent there is a restriction under the SDWA to require monitoring by the wholesale system in specific response to the root-cause analysis consultation, examine options for a new wholesale system monitoring requirement at the active points of connection. Options should include recognizing/accommodating the complex hydraulic relationships existing within the wholesale-consecutive system context (e.g., multiple connection points, connection points with different levels of water age, bi-directional flow between systems).

4. Specifically target TMF capacity support for wholesale and consecutive systems related to the required root-cause analysis consultation and establish this support, as well as DWSRF funding, as a priority to address changes needed to return to compliance.

Part 2: Prepare guidance on recommendations for consecutive system model contracts and improved communications between wholesalers and consecutive systems.

Development of guidance could provide a mechanism for consecutive systems to obtain better assurances of water quality from wholesale systems that also complies with NPDWRs. It could include improved communication mechanisms and follow-up water quality testing. This could help facilitate mentorship between large systems and consecutive systems for better technical capacity, monitoring, and operator capacity to manage residuals, DBPs, and other water quality parameters. One Technical Analyst provided three examples of water quality provisions in water supply contracts. While each of these differed in their approaches, some of the basic elements in one or more of these contracts include activities by the wholesaler, such as monitoring, operational changes, recordkeeping, increased data analysis, notification to the consecutive system, and public notification. Two of these also include tiered levels of responses based on levels of parameters detected.

Level of Working Group Support = Full

Recommendation 8: Source Control

Leverage non-SDWA authorities to:

1. Prevent the introduction of potential drinking water contaminants into the water cycle.
2. Restrict discharge into all source waters[72] of constituents that contribute to the formation of DBPs, introduction or increase in growth potential for opportunistic pathogens, or frank pathogens.

Background

Source water conditions[73] have a substantial influence on PWS water treatment requirements, distribution system management practices, overall water system water quality, and operating costs. Some source waters are vulnerable to potential water quality impacts including those from wastewater effluents, industrial discharges,

[72] Source water refers to sources of water (such as rivers, streams, lakes, reservoirs, springs, and groundwater) that provide water to public drinking water supplies and private wells (https://www.epa.gov/sourcewaterprotection/basic-information-about-source-water-protection). Surface water is defined in EPA's regulations at 40 C.F.R. §141.2: Surface water means all water which is open to the atmosphere and subject to surface runoff.
[73] Source water conditions of particular interest in the MDBP context include organic matter, nitrogenous matter, algal matter, nutrient levels (including from municipal and industrial wastewaters, and agricultural and septic tank non-point sources), microbial contaminants, and bromide and iodide from naturally occurring and anthropogenic sources.

saltwater, and algal blooms.[74] Organic-rich source waters can increase disinfectant demand, reduce disinfectant residuals, result in relatively high organic levels in treated water, introduce opportunistic and frank pathogens, and increase biological activity (including increasing the growth potential of opportunistic and frank pathogens within the distribution system and premise plumbing) and increase DBP formation potential within the treatment train and distribution system. Wastewater effluent organic and nitrogenous matter is related to the formation of nitrogenated DBPs.[75] High source water bromide may be naturally occurring (such as from saltwater intrusion in some areas of the country) or anthropogenic (such as from industrial wastewater discharges from oil field brines and coal-fired power plants). High bromide in source water can be difficult to remove and may increase formation of brominated DBPs[76] or, if ozone treatment is used, bromate.[77] Source water iodide (e.g., from some wastewaters) is of concern for the formation of iodinated DBPs. PWSs may have limited information related to water pollution sources and often have limited or no control over upstream conditions (point and non-point water pollution sources) that may introduce microbial contaminants and DBP precursors, such as TOC, iodide, or bromide into source waters. Additionally, there is limited authority to characterize and protect source water under the SDWA.

Outcomes Sought

WG members understand the substantial influence anthropogenic source water conditions can have on drinking water system operations and recognize the opportunity source water contaminant control measures represent to improve drinking water quality and affordability of drinking water services. WG members believe it is important for drinking water stakeholders "to be at the table" whenever and wherever decisions are made that will impact drinking water source water quality. In response, WG members have identified a two-pronged approach to improving source water quality conditions for drinking water source waters. WG members acknowledge that these measures reside outside of the authority of the SDWA (and they do not reside directly under MDBP rule revisions) while supporting their consideration by EPA as contributing to an overall holistic approach to equitably, reliably, and affordably addressing public health concerns related to opportunistic pathogens and DBPs, leading to multiple benefits. The WG recommends:

Part 1: Prevent the introduction of potential drinking water contaminants into the water cycle.

EPA should develop a policy requiring chemical or other constituent screening processes (e.g., Toxic Substances Control Act Significant New Use Review) to evaluate proactively the potential for impacts on public health risks from drinking water, on drinking water treatment, and on drinking water quality management. This could control the introduction of difficult to treat and potentially harmful substances that would otherwise impose risks, costs, and responsibilities on drinking water utilities and consumers.

[74] Drinking Water Disinfection Byproducts (DBPs) and Human Health Effects: Multidisciplinary Challenges and Opportunities Xing-Fang Li and William A. Mitch Environmental Science & Technology 2018 52 (4), 1681-1689
DOI: 10.1021/acs.est.7b05440.
[75] S. W. Krasner, The formation and control of emerging disinfection by- products of health concern, Philos. Trans. R. Soc., A, 2009, 367, 4077–4095. WRF 4711, which also investigated iodide occurrence in source water.
[76] Estimating Potential Increased Bladder Cancer Risk Due to Increased Bromide Concentrations in Sources of Disinfected Drinking Waters Stig Regli, Jimmy Chen, Michael Messner, Michael S. Elovitz, Frank J. Letkiewicz, Rex A. Pegram, T.J. Pepping, Susan D. Richardson, and J. Michael Wright. Environ. Sci. Technol. 2015, 49, 22, 13094–13102. https://doi.org/10.1021/acs.est.5b03547.
https://www.epa.gov/dwreginfo/stage-1-and-stage-2-disinfectants-and-disinfection-byproducts-rules.

Part 2: Restrict discharge into all source waters of the primary constituents that contribute to the formation of DBPs, growth potential of opportunistic pathogens, or introduction of frank pathogens.

EPA should identify and prioritize anthropogenic drinking water constituents (and related predominant sources) that contribute to the formation of DBPs or to the growth potential of opportunistic pathogens and introduction of frank pathogens. Working Group members have identified wastewater effluent influence on drinking water system source water as a specific, high priority area for near-term source water vulnerability analysis and precursor control efforts. Many Br-, N-, and I-DBPs (e.g., haloacetonitriles [HANs]) have been associated with drinking water systems receiving elevated levels of wastewater effluent discharge in their source waters, i.e., de facto reuse, as treated wastewater effluent is a source of TOC, nitrogenous organic matter, bromide, and iodide. These high priority constituents/sources of contaminants would be slated for action to control their entry into drinking water sources under relevant environmental and public health authorities (e.g., Clean Water Act (CWA), Clean Air Act (CAA), Resource Conservation and Recovery Act (RCRA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)). Multiple CWA programs could be helpful in achieving the desired outcome.[78] Also, in light of the limited authority provided under the SDWA to control source water quality, EPA would document and promote existing policies and procedures that state and local agencies can adopt under non-SDWA environmental and public health authorities to control the quality of source water (e.g., industrial, wastewater discharge pre-treatment, Combined Sewer Overflow (CSO) control, contaminated site practices, using drinking water endpoints in developing CWA impaired water listings and NPDES permitting).

Level of Working Group Support = Full

Recommendation 9: Environmental Justice Improvement Opportunities

> Conduct analyses to characterize the current gap in MDBP rule implementation and affordability pressures faced by public water systems serving small, rural, EJ, disadvantaged and historically underserved communities. Provide strategies for ensuring this gap is filled and to work toward more equitable implementation of the MDBP rules across demographic groups. Ensure that new requirements can be implemented consistently, with sufficient additional resources provided to equitably receive the benefits anticipated to result from the rule revisions.

Background

The MDBP rules are intended to protect public health by simultaneously reducing the risk of exposure to microbial and disinfection byproduct contaminants. Historically, public health protection has been inconsistent and inadequate in many low-income and Black, Hispanic, and Native American populations. These populations can have underlying public health issues (e.g., poor food quality, lack of healthcare access, adequate housing concerns), while not having access to the necessary resources to address these issues effectively. Consistent

[78] The CWA 303(d) list is a state's list of impaired and threatened waters (e.g., stream/river segments, lakes). For each water on the list, the state identifies the pollutant causing the impairment, when known. In addition, the state assigns a priority for development of Total Maximum Daily Loads (TMDLs) based on the severity of the pollution and the sensitivity of the uses to be made of the waters, among other factors. A TMDL establishes the maximum amount of a pollutant allowed in a waterbody and serves as the starting point or planning tool for restoring water quality. (https://www.epa.gov/tmdl). NPDES permits contain limits on what can be discharged, monitoring and reporting requirements, and other provisions to ensure that the discharge does not hurt water quality or people's health (https://www.epa.gov/npdes/npdes-permit-basics). The general pretreatment regulations at 40 CFR Part 403.8(a) require certain Publicly-Owned Treatment Works to establish a local pretreatment program to control discharges from nondomestic sources and to prevent pass through and interference at the treatment plant. Under CWA Section 319, states, territories and tribes receive grant money that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects.

with Executive Order 12898 and EO 14096 requirements, EPA will consider while adopting new MDBP rules whether population groups of concern (e.g., minority and low-income populations) are disproportionately exposed to microbial contaminants and DBPs in drinking water. EPA also evaluates whether these groups will be disproportionately affected by potential regulatory options under the MDBP rule revisions. Cost-benefit and affordability analyses are conducted separately as part of EPA's regulatory process, as per distinct SDWA statutory requirements.[79]

The prospect of MDBP rule revision disparities reside in both MDBP-specific challenges as well as broader, systemic challenges. MDBP-specific challenges include, for neighborhood and built environments, the finding that certain housing and facility conditions may create environments conducive to *Legionella* growth. This was shown in a study undertaken in New Jersey where the incidence of Legionnaires' disease showed increases associated with a higher percentage of vacant homes, rented homes, and older homes. Water age and storage, pipe material, water quality, and drinking water sources may influence the growth of *Legionella* and other opportunistic pathogens in these environments. Additionally, the scope and timing of opportunistic pathogen and DBP-related public notification can be inadequate where insufficient capacity and communication channels to EJ, disadvantaged and historically underserved communities can contribute to the lack of timely notification hindering the ability of community members to take needed actions.[80] Compliance provisions that allow for DR to be undetectable in 5% or less of samples each month (for any two consecutive months) can create conditions where certain locations in a distribution system lack disinfectant residual over an extended period of time.[81]

In a systemic context, systems serving EJ, disadvantaged and historically underserved communities may not have access to financial resources to make capital improvements and hire additional staff and have the potential to face substantial affordability challenges. As a result, they may not be able to meet regulatory requirements and make proactive decisions based on compliance sampling data to ensure water quality across the system. Specific challenges include lack of access to adequate funding through the local rate base, lack of access to technical knowledge (e.g., salary and recruiting limitations), location and size of systems (e.g., rural, small systems with low density customer base, complicated source water), lack of access to basic TMF capacity to implement regulations, and barriers to apply for and administer federal and state funding. Additionally, residents in such communities may have fragile public trust in the system based on previous experiences and carry disproportionate burdens (e.g., cumulative health impacts, lack of or poor-quality health care) that create underlying health disparities across demographic groups.

Outcomes Sought

WG members seek to ensure equitable access across all communities to the intended outcomes of any MDBP rule revisions. WG members understand that disparities currently exist across, and at times within, communities regarding access to the resources needed (funding, technical and managerial capacity, timely access to information) to realize fully the intended benefits of SDWA requirements generally, and current and future MDBP rules specifically. WG members recognize that certain of the recommended actions in this section will generate additional resource demands on TMF challenged water utilities and drinking water primacy agencies. Recommendations 10 and 11 specifically acknowledge the substantial financial support needed related to these

[79] MDBP WG Meeting #6, January 24, 2023. https://www.epa.gov/system/files/documents/2023-04/MDBP-Rule-Revisions-Working-Group-Meeting-Presentation-January-24-2023.pdf.
[80] MDBP WG Meeting #5, December 13, 2022. https://www.epa.gov/system/files/documents/2023-03/MDBP-Rule-Revisions-Working-Group-Meeting-Presentation-December-13-2022.pdf.
[81] 40 CFR §151.72(b)(3)(i); MDBP Meeting #5 presentation https://www.epa.gov/system/files/documents/2023-03/MDBP-Rule-Revisions-Working-Group-Meeting-Presentation-December-13-2022.pdf.

additional demands and propose actions designed to address them. With the above in mind, Working Group members recommend the following actions:

Part 1: To ensure all communities equitably receive the benefits intended by the MDBP rule revisions, all of EPA's analyses to support rule revisions should identify and account for existing and potential disparate impacts to Environmental Justice, disadvantaged and historically underserved communities.

In doing so, EPA should look for every opportunity to identify and eliminate any disparities related to the challenges of MDBP-related public health protection, compliance, affordability, and implementation. All rule supporting analyses should explicitly recognize the implications of the challenging circumstances in which EJ, disadvantaged and historically underserved communities operate (e.g., low economic base, etc.) and identify and account for the fact that such communities can also be exposed to systemic, underlying vulnerabilities (e.g., poorer underlying health conditions) that can amplify public health risks. These analyses include the health risk reduction and cost analysis, affordability analysis, small system compliance technologies, identification of variances, and others.

When completing a cost-benefit analysis it is critical to conduct an assessment that quantifies all health benefits; incomplete benefits assessments can result in biased decision-making when compared to easily quantifiable costs, which magnifies negative consequences for EJ, disadvantaged and historically underserved communities. Rule analyses must quantify the cost of all communities receiving equitable public health protection regardless of where people live and their incomes. Likewise, there is a need to evaluate and assess the ratepayer dependent model that sets the expectation that every community must be self-sustaining and depend only on rate payers. This expectation does not honor the structural disadvantages faced by EJ, disadvantaged and historically underserved communities or their higher level of need. Rule supporting analyses must ensure that public health protection is not limited by the incomes of the residents of the impacted community.

Part 2: To ensure the most overburdened communities and water systems are adequately evaluated for compliance and provided resources for improved water quality, structure MDBP rule revisions to enable and incentivize problem solving and proactive improvement.

PWSs operating in constrained TMF capacity contexts will have limits on their ability to plan ahead, proactively investigate and address problems, with the potential added disincentive that these activities will identify needs the PWS may lack resources to address. Across the Working Group's MDBP rule revision recommendations, it is important to establish requirements within a framework that rewards problem identification with ready and timely access to the needed resources and while providing affordability programs for those that struggle to afford their water bills. This is particularly important given the role the recommendations can play in addressing current EJ challenges. In particular, Recommendation 1 (disinfectant residual), Recommendation 4 (multi-benefit precursor control), Recommendation 5 (finished water storage tanks), Recommendation 6 (chloramination), and Recommendation 7 (consecutive systems) can be anticipated to 1) improve water quality conditions in EJ, disadvantaged and historically underserved communities (as the water quality challenges these recommendations address are associated with the type of PWS infrastructure and operating conditions that can exist and persist in TMF constrained communities), and 2) while also imposing new TMF demands. Recommendations 10 (PWS TMF capacity) and 11 (Primacy Agency capacity) act in close concert with this recommendation to identify and provide the resources needed to ensure equitable access to, and the

affordability of, the intended benefits of all MDBP rule revisions (e.g., Recommendation 10 identifies the need for a federal, permanent, low income household assistance program).

Part 3: To ensure all residents have access to timely information for protecting their families and communities, improve community access to PWS performance information.

Getting access to up-to-date water quality information is especially important in situations where water quality may be degraded, and public health may be at risk. If a community with chronic water quality and compliance challenges is not provided relevant information, members of the community are unable to protect themselves or take action to change chronic circumstances. Chronic water quality and compliance challenges are more likely to occur in EJ, disadvantaged and historically underserved communities.[82] Especially in times of crisis, PWSs in such communities may lack the capacity to meet reporting requirements and disseminate information in a timely and accessible fashion. These recommendations will improve PWS transparency, make public data more available, and foster trust with EJ, disadvantaged and historically underserved communities. Accordingly, Working Group members recommend that EPA:

Intervention 1: Improve Public Notification of PWS Compliance and Performance Information to Consumers.

1. The Public Notification (PN) Rule was last revised in 2000.[83] EPA should commit to revising the entire PN Rule as soon as possible to provide effective, understandable, meaningful, timely, and accessible public notice for all SDWA regulations (at a minimum, to be consistent with improvements being made to the CCR Rule) and enable the use of modern means of delivery and communications.[84]
2. Because revision of the PN Rule will take time, EPA should commit to the following analyses that are specific to PN under the MDBP regulations to support improving community awareness of needed responses to microbial and DBP public health concerns and building on-going community awareness of the investments needed to address chronic non-compliance and other water system challenges[85]: a) consult with representative impacted communities to identify opportunities to enhance transparency and make PN more effective; b) review and reflect in any new or revised MDBP PN requirements available science on effective methods for public communications; and c) consult with CDC and consider how the CDC Drinking Water Advisories continuum framework could contribute to improving public communications.
3. Upon consideration of Part 2 analysis, revise MDBP public notice requirements with a focus on ensuring public notice is effective, understandable, meaningful, timely, and accessible (e.g., carefully consider the purpose and approach of the PN tier assignment and requisite requirements for each MDBP violation to ensure effective notification and protection of public health for both microbial and DBP conditions), revise mandatory language to improve understanding of risk and the recommended response (e.g., describing SWTR violations with an explanation of the violation, the implications for public health, and the recommended responses), and, for complex SWTR violations, consider requiring PN communications to include additional details to explain the purpose and meaning of the requirement, the specific cause of the violation, and the status of resolution of the incident.

[82] NRDC Watered Down Justice; September 2019 reported that the rate of drinking water violations increased in: communities of color; low-income communities; areas with more non-native English speakers; areas with more people living under crowded housing conditions; areas with more people with sparse access to transportation.
[83] 65 Fed. Reg. 25982 (May 4, 2000).
[84] The CDC Drinking Water Communication Toolbox Is a model. The needs for the MDBP rule could become another module https://www.cdc.gov/healthywater/emergency/dwa-comm-toolbox/index.html.
[85] Note that Environmental Justice principles establish that EJ communities should have the right to determine for themselves, in consultation with appropriate experts, what their needs are. In this context, the intent for this analysis described here will need to evolve in consultation with the impacted communities.

4. Consistent with findings from items 2 a, b, and c, establish new or revised requirements for clear and consistent public notice and provision of safe water supplies during drinking water emergencies and waterborne disease events.

Intervention 2: Enhance PWS Data Management and Communications Capacity.

1. Provide targeted support to PWSs that have demonstrated a lack of capacity to notify consumers of water quality problems in a meaningful, timely, and accessible manner (e.g., providing support to Primacy Agencies to supplement PWS communications capacity, or by assigning a Technical Assistance/communications provider to the water system to help it fulfill requirements).[86]
2. To build trust and provide opportunities for community members to engage with and learn about their water system, provide and promote resources for implementing community engagement best practices to develop strong relationships between PWSs and those they serve. Identifying community engagement best practices and working with community organizations to promote and engage in these practices can help EJ, disadvantaged and historically underserved communities support their PWS while honoring local experience and expertise to support the PWS as a community anchor institution.
3. To ensure necessary information is available to fill the MDBP implementation gap and improve technical resources for effective decision making in EJ, disadvantaged, and historically underserved communities, advance the utilization of data management software and electronic reporting.
    a. Provide water systems with EJ concerns with access to high quality software and analytical tools.
    b. Develop new strategies to address limits of technology availability in some communities, especially for operations at PWSs.
4. All communities deserve and require clear and relatable information about their water system. To improve transparency and provide more complete and relevant information and data that empowers both consumers and decision-makers to take action to solve problems, EPA should provide guidance and encourage water systems to improve various forms of communications. This could include best management practices (BMPs) for more effective use of Consumer Confidence Reports (CCRs), or the development, as a companion to the CCR, of a State of the Water System Report. The report, for example, could describe the water system's efforts and challenges to produce and deliver high quality water, identify problems and the resources required to address those problems, and identify and address system and supply reliability issues to increase resiliency. This information could enable consumers and water systems to more effectively advocate for the resources that are needed.
5. To improve the quality of advice delivered to residents during MDBP water quality challenges, provide public health guided public communications templates for use in PNs and CCRs during emergencies and persistent compliance challenges. This would cover issues including but not limited to 1) templates for providing water quality and compliance data in readily available and in easily accessible format, 2) clear explanations of the public health significance of persistent and recurring MDBP and other SDWA violations, and 3) a public health protective response regarding water consumption during persistent/chronic water quality issues.

[86] According to EPA's compliance analysis for this workgroup, 5,098 unique community water systems, serving a total of approximately 13 million people, reported a Code 75 violation of the Public Notification Rule (i.e., Public Notification Violation for NPDWR Violation) in the four-year period examined (i.e., 2018-2021), indicating that at least 5,098 community water systems could have benefited from this type of support.

Intervention 3: Improve Systemic SDWA Data Access.

1. EPA should provide the necessary funding and resources and complete the necessary upgrades to the federal reporting system, Safe Drinking Water Information System (SDWIS), as soon as possible to improve the availability and transparency of data to consumers.
2. Increase electronic and trackable reporting of sanitary surveys to make information more readily available for compliance analysis, public availability, and building transparency around drinking water quality.
3. Establish requirements for national consistency in tracking and reporting of water supply warnings - Boil Water Advisories and Do Not Use Advisories.
4. Develop requirements that allow for the use of electronic reporting and automated compliance calculations to improve consistency of implementation, enforceability, and automation of new and existing requirements to ensure that the public health protection sought by new requirements is ensured and achieved consistently regardless of jurisdiction.
5. Publish in easily accessible format timely significant deficiencies and violations reports on a state and/or water system basis. Everyone should be able to easily look up which water systems in their own state currently have a significant deficiency or drinking water violation.
6. Create a national database of water system service area boundaries to support spatial/demographic analyses of PWSs and PWS relationships, as well as water quality analyses.

Level of Working Group Support = Full

Recommendation 10: Public Water System Technical, Managerial, And Financial (TMF) Capacity

> Provide and align additional TMF capacity for small, rural, EJ, disadvantaged and historically underserved communities consistent with new demands placed on PWS by MDBP rules revision.

Background

Inadequate TMF capacity can be a significant challenge for some public water systems, with those in small, rural, EJ, disadvantaged and historically underserved communities particularly vulnerable. Such communities can face a variety of challenges including: lack of access to adequate funding through the local customer rate base (e.g., low number and density of customers) and technical expertise (e.g., challenges recruiting and retaining Certified Operators and other local workforce limitations), barriers to apply for and administer federal or state funding, and disproportionate burdens (e.g., cumulative health impacts, lack of or poor-quality health care) that create underlying health disparities across demographic groups. The economic capacity of the community is almost always a key factor underlying water quality or supply reliability challenges. Systems lacking the financial resources to reinvest in water system facilities will often choose to defer taking action to address identified and understood issues because they can't identify a way to fund the work. This approach is certainly understandable in the context in which it is made, but will also, inevitably, contribute to dealing with the consequences of the problem on an ongoing basis over time. When those consequences result in or contribute to negative health consequences for consumers, however, lack of action is not only unacceptable it is unethical.

The TMF capacity challenges can create conditions for opportunistic pathogen growth and DBP formation including prolonged water ages, deteriorating infrastructure creating increased susceptibility to breakage or

leakage, intrusion, disinfectant demand, general O&M deficiencies, and sampling and reporting deficiencies, while disproportionate burdens can increase the susceptibility of exposed individuals to greater risk of negative public health outcomes. Overall, TMF capacity limitations can lead to more difficulty in achieving and maintaining water quality and regulatory compliance, as well as managing drinking water infrastructure sustainably.

Outcomes Sought

WG members recognize that some PWS, particularly small, rural, EJ, disadvantaged and historically underserved communities (including low income of all sizes) systems, currently operate in a capacity constrained context and that changes made to MDBP rule requirements may impose additional pressure on these systems' ability to achieve and maintain compliance with SDWA requirements as well as meet desired financial sustainability and system resiliency objectives. WG members further recognize that, to the extent existing PWS capacity challenges contribute to an inequitable gap in the delivery of safe drinking water within or across communities, this gap may only increase under the demands of further requirements, unless means are undertaken to lessen this gap. The current costs associated with addressing water quality and supply reliability issues, as well as the recognition of how poor water quality and unreliable supply contribute to the ongoing and cumulative disadvantages experienced in EJ communities calls for a substantially increased commitment of resources to these efforts. In response, WG members believe new MDBP rule requirements must come with additional resources targeted specifically to support the PWS implementation demands associated with MDBP rule revisions. To this end, the WG makes the following recommendations:

Part 1: Target additional technical and financial assistance to small, rural, and EJ, and disadvantaged and historically underserved communities (not limited to systems below 10K people served) to support the transition to and maintain compliance with new MDBP rule revisions.

WG members believe it is important that EPA explicitly characterize both the transitional and ongoing TMF capacity demands that new or revised MDBP rules will place on these communities and work to secure and make ready access to the resources needed to address these demands. Given the complex nature of the operational demands to meet risk balancing under the MDBP rules, WG members foresee, in addition to existing unmet needs, new needs related to staffing, training, sampling, and monitoring (e.g., improve technical capacity for monitoring for chlorine residual), initial implementation (including capital needs) and ongoing O&M funding, and Operator Certification updates. In support of meeting these needs, EPA should consider additional grants to support local training for Operator Certification (e.g., providing training for individuals already in the community), and sustained funding and technical assistance along with support to access those resources. In support of making the determination of additional TMF needs, WG members suggest EPA assess how many systems in each EPA region have TMF needs that are currently unmet and to address the issue of the miss-match between program resources (and the potential miss-match of how program funds are prioritized for spending) and priority needs with an action plan on which states and EPA agree to identify how (e.g., Congressional budget request) to fund the program at necessary levels over the term needed to substantially address the needs.

Part 2: Evaluate and improve operator certification with an emphasis on DS management to maintain disinfectant residuals through DS optimization, including storage tank operations and chloramination practice, and to reduce risks to public health from microbials and DBP formation.

WG members suggest EPA look to review existing operator certification training and certification in the context of new requirements and fill gaps to ensure adequate competencies, evaluate how/if Area Wide Optimization

Program (AWOP) principles and tools can be used or expanded to bolster operator certification training in the distribution management area, and create more local training opportunities for individuals that have roots in the local community. Regarding chloramination practice, WG members recommend improvements in operator training and certification to better ensure chloraminating systems have access to the technical capacity needed to effectively convert to, operate, and maintain the practice. Additionally, additional new funding with the PWSS and DWSRF set-aside grant funding will be needed to support adding new requirements to state operator certification programs.

Part 3: Make permanent the Low-Income Household Water Assistance, or similar, Program (LIHWAP87).

The LIHWAP, set to sunset on December 31, 2023, assists low-income households that pay a high proportion of household income for drinking water and wastewater services by paying water and wastewater utilities to reduce arrearages and rates charged to households. It is modeled on the Low-Income Household Energy Assistance Program (LIHEAP). WG members view such a program as foundational to addressing TMF capacity because it allows utility managers to raise local water rates to meet capital and O&M funding needs while addressing the impact on affordability for the most economically vulnerable customers. It is also foundational from an Environmental Justice standpoint as it addresses the potentially catastrophic impact on a family of a shutoff of water and wastewater services. The current LIHWAP program also addresses the limited or complete lack of capacity that some PWS may have to administer such a program locally by administering the program from the grantee level (e.g., State or Tribal authority) and making payments directly to the utility. The program also makes provisions to cover certain local utility administrative costs, and WG members encourage that any continued program emphasizes streamlined administration to limit the burden for both utility systems and utility customers. Additionally, EPA should work with stakeholders on measures to encourage PWSs to adopt water affordability programs, where legally feasible, such as water rate reforms that address water affordability for low-income consumers.

Part 4: Establish strong incentives for PWS to require training for their Board members.

WG members believe Board training is foundational to establishing and maintaining sound, sustainable TMF capacity. Board members require a sufficient understanding of the business of operating a water utility to provide effective support and guidance to utility staff and ensure sustainable and reliable delivery of safe drinking water to customers. Board training modules are available from established water sector technical assistance providers and can be readily leveraged to meet this objective. Incentives for Board training for EPA to consider include making Board training an eligibility requirement for receipt of EPA or USDA grant and loan funding; or providing bonus points for applicants for federal funding when there is a demonstration of Board member training.

Level of Working Group Support = Full Support, One Abstention

One Working Member indicated full support for additional resources for PWS, but this member abstained from the voting due to concerns about the appearance of conflict of interest.

[87] https://www.acf.hhs.gov/ocs/programs/lihwap.

Recommendation 11: Primacy Agency Capacity

> Address SDWA Primacy Agency capacity needs associated with the new demands anticipated from MDBP rule revisions.

Background

SDWA primacy agencies undertake a broad range of functions in support of implementing and overseeing safe drinking water requirements. These functions include: permitting and plan review; all hazards emergency planning, response, and recovery; compliance inspections and sanitary surveys; enforcement; technical assistance to PWS; training for state staff and PWS; public communications; design and construction standards; operational review; internal SOP development; operator certification program support; lab accreditation; State Revolving Fund (SRF) implementation; simultaneous compliance determination and optimization; and recordkeeping and reporting. Many, if not most, primacy agencies consistently operate in a resource constrained environment while supporting these functions and have the added challenge of keeping pace with the cumulative demands of implementing new regulations. While demands have increased, state Public Water System Supervision (PWSS) grants have remained static, some primacy agencies operate under authorities that limit budgeting or hiring flexibility, and SRF monies can come under pressure from the federal level. State sanitary survey programs, a foundational requirement for the delegation of primary enforcement responsibility from EPA, also experience vulnerabilities. These include inspector time and resource constraints that limit their ability to provide guidance or work through issues with water utilities (which can lessen the value of the sanitary survey inspection); differences in training and certification of surveyors; differences in the designation of deficiencies across states; and differences across states in the priority placed on the eight core sanitary survey elements. These pressures on primacy agency programs can result in a constrained ability to deliver the desired level of oversight and resources (e.g., funding, technical assistance) to some PWSs to ensure they provide high quality water that meets regulatory requirements through well-maintained infrastructure while operating in a sustainable manner.

Outcomes Sought

WG members recognize that SDWA Primacy Agency programs currently operate in a capacity constrained context and that changes made to MDBP rule requirements may impose additional pressure on primacy agency ability to support effectively the new implementation demands. WG members further recognize that, to the extent existing primacy agency capacity constraints contribute to an inequitable gap in the delivery of safe drinking water across communities, this gap may only increase under the demands of further requirements, unless means are undertaken to lessen this gap. In response, WG members believe new MDBP rule requirements must come with additional resources targeted to support the fulfillment of the primacy agency mission to provide the technical assistance and oversight needed to ensure communities deliver drinking water quality and related services in compliance with the new requirements. To this end, the WG recommends:

Part 1: Identify and direct ample capacity resources for primacy agencies to implement new MDBP rule requirements.

1. Training: provide resources and materials to support training primacy agency personnel and PWSs in the new requirements including technical training (e.g., precursor removal, distribution system optimization, simultaneous compliance, chloramination). A combination of classroom and hands-on training is necessary to meet these needs. There is a need to quantify the current needs, determine whether they

are being met, then quantify the incremental needs to meet the revised MDBP requirements. There is a need to address the current deficit (if it exists) before adding to it.

2. Funding: Quantify and support increased funding to the Public Water System Supervision (PWSS) Grant consistent with anticipated primacy agency workload demands. This would include utilization of existing primacy agency workload estimation models during rule development, explicit acknowledgement in any new rulemaking of the anticipated primacy agency workload demands, and identification of the amount and source of funding needed to support these workload demands. In addition to quantifying the incremental increase needed to support revised MDBP requirements, a current quantification of the base needs for implementing and enforcing the entire suite of current SDWA requirements is necessary to set an appropriate funding baseline for maintaining safe drinking water across the entire country.
3. Guidance: publish primacy agency implementation guidance with the revised rules. Include within this effort guidance on approving permits that better match water system design with the community capacity available to support it. Also, make a connection to, and update as necessary, AWOP.
4. Peer Support: enable primacy agency sharing of best practices for implementing new requirements. This could take the form of sponsoring quarterly, virtual, peer sharing opportunities.
5. Public Notice: prepare guidance specific to public notice expectations and risk communication related to the new requirements. (See also Recommendation 9)
6. PWS TMF Capacity: provide additional, targeted support to the TMF capacity needs anticipated for small, rural, EJ, disadvantaged and historically underserved drinking water systems (see also Recommendation 10) (as this assistance will have direct, positive benefits in support of a primacy agency's mission to provide effective technical assistance and compliance oversight).

Part 2: Adjust sanitary survey implementation to reflect MDBP rule revisions.

1. Provide a clear articulation of needed changes to sanitary survey procedures and practices to support new MDBP requirement implementation.
2. Make timely updates to sanitary survey guidance related to the new requirements.
3. Increase the availability and frequency of EPA-delivered surveyor trainings.

Level of Working Group Support = Full

Recommendation 12: MDBP Overall Data and Analysis Gaps

> Address gaps in data and analysis related to microbial and DBP contaminants.

Background

Substantial amounts of research, data collection and analysis, and compilation of relevant materials were undertaken by the EPA, Technical Analysts, CDC, utility associations, community groups, and others to support the MDBP Working Group meetings. This effort provided the MDBP WG with essential information that included many perspectives on topics relevant to the MDBP rules. (The responses to WG questions prepared by EPA and Technical Analysts are provided as a compendium on the MDBP WG website.)

The WG understands that there are gaps in data on MDBP contaminants and that actions to address these gaps would be helpful to further inform EPA's and NDWAC's consideration of the WG recommendations.

Outcomes Sought

The WG has identified areas within the MDBP topics referred for consideration that could benefit from additional research to address data and analysis gaps. The WG recommends that EPA further develop information on the items listed below to inform future consideration of MDBP revisions.[88] Of particular note, and cutting across these data and analysis areas, it would be helpful to address gaps related to health effects research needed to identify and evaluate health benefits from various potential regulatory strategies.

Part 1: Source Water Data and Analysis Gaps

1. **DBP indicator parameters.** Need further work on indicator parameters that address the range of DBPs of concern and that provide the level of sensitivity needed to inform decisions related to protecting public health.[89]
2. **Costs of source water treatment.** Need better information about the costs to utilities from recurring pollution events and the long-term impacts on their source water quality. Comparison of cost to utilities for removal of pollutants versus protecting source water from pollution.
3. **Impacts of point and non-point source pollution on source water quality.** Review research on impacts of point and non-point source pollution including the impact of upstream wastewater discharge on regulated and unregulated DBPs.[90]
4. **Algal blooms.** Need to better understand the impacts to distribution system chlorine demand from source water impacted by algal blooms.[91]

Part 2: Treatment Data and Analysis Gaps

1. **Use of analytical method for monochloramine.** Determine total nationwide use of EPA Method 127 (specific to analysis of monochloramine) and potential use in new DS DR monitoring requirements.[92]

[88] EPA has recently awarded several research grants the results of which may relate to subject areas described below. National Priorities: Research on Disinfectants, Disinfection By-products (DBPs), and Opportunistic Pathogens in Drinking Water Distribution System Grants. Grants awarded for research August 1, 2023 through July 31, 2026: Grant R840604 Winning the Race Against Competing Risks: Optimizing Drinking Water Disinfection to Minimize Opportunistic Pathogen & DBP Risk; Grant R840606 Integrated Water Microbiome and Disinfection Byproducts Monitoring and Management to Advance Drinking Water Quality; Grant R840607 Consortium On Disinfection by-products and Opportunistic pathogens in Water Networks (CO-DOWN).

[89] Recently completed EPA research that may be relevant to this area includes: Schaaper, J., R. Hertzberg, J. Simmons, M. Mumtaz, and G. Rice. Chemical mixtures: toxicologic interactions and risk assessment. Information Resources in Toxicology, Fifth Edition. Academic Press Incorporated, Orlando, FL, USA, 1: 401-414, (2020). https://doi.org/10.1016/B978-0-12-813724-6.00037-2; Kenyon, E. Physiologically Based Pharmacokinetic (PBPK) Modeling Contaminants of Concern in Drinking Water. Presented at American College of Toxicology, Phoenix, AZ, USA, 11/17/2019 - 11/20/2019; https://epa.figshare.com/articles/presentation/Physiologically_Based_Pharmacokinetic_PBPK_Modeling_Contaminants_of_Concern_in_Drinking_Water/22572697; The roles of glutathione s-transferase theta 1-1 and cytochrome P450 2E1 in the metabolism and genotoxicity of the water disinfection byproduct bromodichloromethane in human urothelial cells. Presented at NC SOT, Research Triangle Park, NC, USA, https://doi.org/10.23645/epacomptox.22572613.

[90] Recently completed EPA research that may be relevant to this area includes: Kamrath, B., and Y. Yuan. Streamflow duration curve to explain nutrient export in Midwestern USA watersheds: Implication for water quality achievements. JOURNAL OF ENVIRONMENTAL MANAGEMENT. Elsevier Science Ltd, New York, NY, USA, 336: 117598, (2023) https://doi.org/10.1016/j.jenvman.2023.117598; Compton, J. Non-point source nutrient pollution in the US: Navigating from drivers to solutions. Presented at Arizona State University, Ira Fulton School of Engineering, Environmental Engineering Seminar Series, Virtual presentation, AZ, USA, Presented at Arizona State University, Ira Fulton School of Engineering, Environmental Engineering Seminar Series, Virtual presentation, AZ, USA; Sabo, R., B. Sullivan, C. Wu, E. Trentacoste, Q. Zhang, G. Shenk, G. Bhatt, and L. Linker. Major sources of point and nonpoint source nutrient pollution to surface water have declined throughout the Chesapeake Bay watershed. Presented at American Geophysical Union (AGU) Fall Meeting, Washington, DC, DC, USA, 12/13/2021 - 12/17/2021.

[91] Recently completed EPA research that may be relevant to this area includes: Handler, A. Cyanobacteria Assessment Network: Bloom Monitoring in US Lakes. Presented at Idaho Department of Environmental Quality, NA, ID, USA.

[92] Recently completed EPA research that may be relevant to this area includes: Wahman, D. Investigation of Chloramines, Disinfection Byproducts, and Nitrification in Chloraminated Drinking Water Distribution Systems, Cincinnati. Presented at 2023 FSTRAC Spring Webinar, Cincinnati, OH, USA, 04/20/2023 -04/20/2023; A Water Research Foundation Project that is yet to be completed but may be relevant to this area includes: #5215 A Simple and Cost-Effective Alternative Analytical Method for Monitoring and Optimizing Chloramine Chemistry in a Distribution System (to be completed 2025).

2. **Life-cycle evaluation of various DBP control strategies.** Assess the life cycle costs of treatment for precursor removal vs. need for continuous DBP control through distribution system operations and maintenance management, such as water use for flushing and booster disinfection.[93]
3. **Reducing precursor removal costs.** Develop methods for reducing cost of precursor removal methods and technology. Develop more efficient and less expensive ways to remove NOM (TOC) at the treatment plant to reduce the concentration of DBPs in the distribution system.[94]
4. **Impacts of PFAS requirements on MDBP precursor control.** Assess the extent to which new PFAS requirements would impact microbial and DBP precursor levels and co-occurrence of PFAS with contaminants or indicators such as arsenic, TOC, and bromide.[95]
5. **Co-benefit of improved filtration.** Assess the extent to which improved filtration control (individual filter effluent and combined filter effluent) has co-benefit of addressing DBP precursors.
6. **Online monitoring methods for disinfectant residuals.** Develop online monitoring methods for disinfectant residuals that would be helpful to use at small utilities and would not have resource-intensive QA/QC requirements for use.
7. **Characterize simultaneous compliance issues with newly adopted, proposed, and potential regulations.** Evaluate related risk of unintended consequences from rules such as PFAS and LCRI (e.g., arsenic contamination of carbon filters used for PFAS control limiting filter performance and ability to regenerate filter media).

Part 3: Distribution System Data and Analysis Gaps

1. **National occurrence data for opportunistic pathogens (e.g., *Legionella*) in drinking water distribution systems (including storage tanks).** This includes information about amoeba co-occurrence and protection of *Legionella* relationship. Additional data are needed to better understand the occurrence of the factors that support the occurrence and growth of *Legionella* and other opportunistic pathogens in the distribution system. Further, this could provide greater insight into the relationship between distribution systems and building water systems.[96]

[93] Water Research Foundation Projects that may be relevant to this area include: Project #5053 Precursors and Control of Halogenated Acetonitriles (to be completed 2024); Project # 5140 The Impact of Pre-Chlorination and GAC Treatment on DBP Formation and Overall Toxicity in Drinking Water (to be completed 2024).
[94] Recently completed EPA research that may be relevant to this area includes: James, P., and M. Heberling. Drinking Water Treatment Costs and Source Water Quality: A Cost Function Analysis of Municipal Water Systems in Wisconsin. Presented at Annual Meeting of the Wisconsin Section of the American Water Resources Association, Wisconsin Dells, WI, USA.
[95] Background information about estimated benefits for DBP reduction associated with the use of GAC for PFAS is provided in the Federal Register Notice[95] for the proposed PFAS NPDWR: systems estimated to be impacted by the proposed regulation serve 70-94 million people, showing that advanced treatment (e.g., GAC or RO) would have a large impact.88 Fed. Reg. 18638 (March 29, 2023); Recently completed EPA research that may be relevant to this area includes: Speth, T., J. Burkhardt, N. Dugan, L. Haupert, P. Jordan, R. Khera, M. Krause, T. Lee, M. Mills, M. Nadagouda, P. Potter, P. Ransom, and E. Sahle-Demessie. Removing PFAS from Drinking Water: Performance, Cost, and Management of Residual Streams - MI. Presented at MTU Lecture Series, Houghton, MI, USA; Burkhardt, J., L. Haupert, and T. Speth. PFAS Basics and EPA Tools for Drinking Water Treatment.Presented at What You Wish You Could Know About PFAS, Virtual, OH, USA; Speth, T., N. Dugan, L. Haupert, P. Jordan, R. Khera, T. Lee, M. Mills, M. Nadagouda, P. Potter, J. Pressman, T. Waters, J. Perez, and P. Ransom. Treatment of PFAS and other Emerging Contaminants. Presented at 14th CECIA-IAUPR Simposio Bienal sobre Temas de Agua Potable en Puerto Rico: Ciencia, Tecnología y Regulación, San Juan, PR, USA.
[96] Recently completed EPA research that may be relevant to this area includes: Gomez-Alvarez, V. Challenges of Studying Water Storage Tanks in Distribution Systems - decoding a complex ecosystem. Presented at Pathogens: Small Drinking Water Systems Webinar Series, Cincinnati, OH, USA; Ryu, H. Microbial water quality of the built environment and Development of an UV-LEDs POU device for water disinfection. Presented at USKOREA Water Innovation Seminar 2023, Seoul, SOUTH KOREA; Water Research Foundation projects that are underway and may be relevant to this area include: Project #5151 Impact of UV Treatment on Microbial Communities in a Full-Scale Drinking Water Distribution System (to be completed 2025); Project # 4911: Sampling and Monitoring Strategies for Opportunistic Pathogens in Drinking Water Distribution Systems; Project # 4983: Evaluating Legionella Detection Rates and Occurrence by Distribution System Characteristics in a Community Water System (to be completed 2023).

2. **Relationship between disinfectant residual and *Legionella*.** Need to better understand the relationship between disinfectant residual and *Legionella* in distribution systems and storage including the variability of disinfectant residual measurements.[97]
3. **Methods for measuring biostability.** Identify methods suitable for measuring biostability in distribution systems.[98]
4. **Efficacy of DBP control options.** Better understand the efficacy of DBP control options (such as mixing in storage tanks) related to percent reduction in DBP concentrations and reductions in DBP risk (recognizing that mixing may not lead to reductions of the more toxic brominated DBP compounds).[99]
5. **Relationship between biofilm and distribution system characteristics.** Need to better understand the relationships between biofilms and distribution system characteristics (e.g., pipe material and age). This includes better understanding of improvements and best practices that have less likelihood of unintended consequences (e.g., releasing red water if biofilms scoured).
6. **Regional differences in *Legionella* outbreaks.** Need a better understanding of the characteristics of water systems in the Northeast where there have been *Legionella* outbreaks.[100]

Part 4: Premise Plumbing Data and Analysis Gaps

1. **Role of distribution system water quality in influencing building water quality.** Better understanding the relationship between distribution system water quality and building water quality, especially as related to opportunistic pathogens and factors related to their occurrence and growth.[101]
2. **Water scalding.** Need a better understanding of water scalding. Consider leveraging existing information and ICD codes – seek to obtain quantitative data from hospitals and community organizations that advocate for the elderly.

Part 5: Enabling Environment Data and Analysis Gaps

1. **Gaps in available data on regulatory compliance.** Additional information is needed to inform a more complete understanding of what percentage of violations were missed to get a sense of underreporting (EPA previously has done primacy agency program reviews of PWS oversight records to determine whether violations were properly issued, entered into SDWIS State, and/or transferred to SDWIS Fed).
2. **Sanitary survey improvements for hard-to-reach places.** Need support for technologies and approaches to inspect 'hard to reach' aspects, such as water sources, sub-surface infrastructure, and high-level water tanks that are very hard to inspect.

[97]Water Research Foundation Projects that may be relevant to this area include: Project #5033 Demonstrating the Effectiveness of Flushing for Reducing the Levels of Legionella in Service Lines and Premise Plumbing (to be completed: 2023); Project #5118 Understanding the Mechanisms of Chlorine and Chloramine Impact on Opportunistic Pathogens in Distribution Systems (to be completed 2025); Project #5218 Inactivation of Amoeba-Internalized Legionella pneumophila by UV-LED and Multi-Barrier Approaches (to be completed 2026).
[98] A Water Research Foundation Project that may be relevant to this area includes Project # 5100 Rapid Detection and Quantitation of Active Microorganisms (to be completed 2024).
[99] A Water Research Foundation Project that may be relevant to this area includes Project #5122 Technologies and Approaches to Minimize Brominated and Iodinated DBPs in Distribution Systems (to be completed 2024).
[100]A Water Research Foundation Project that may be relevant to this area includes Project # 5156 Occurrence of Legionella spp. in Drinking Water Distribution Systems (to be completed 2024).
[101] A Water Research Foundation Project that may be relevant to this area includes Project # 4721: Methods for Detecting and Differentiating Opportunistic Premise Plumbing Pathogens (OPPPs) to Determine Efficacy of Control and Treatment Technologies (completed 2022); WRF Project 4664: Customer Messaging on Opportunistic Pathogens in Plumbing Systems (completed 2019).

3. **Improved understanding about concerns relevant to underserved communities.** Additional information is needed about resource needs and opportunities for consolidation or shared services to bridge resource gaps; further there is a need to develop a repository of information available to utilities.[102]

Level of Working Group Support = Full

Recommendation 13: Ground Water Under the Direct Influence of Surface Water (GWUDI)

EPA should revisit the definition, determination methods, and guidance for GWUDI to ascertain what changes should be made to improve the protection of public health.

1. Review and revise the definition of GWUDI.
2. Update the method and EPA guidance for making GWUDI determinations.
3. Require systems to periodically update GWUDI determinations.

Background

Ground water under the direct influence of surface water (GWUDI) is ground water that does not obtain adequate reduction of pathogens such as *Giardia* or *Cryptosporidium* as the subsurface water passes from the surface water body (e.g., river, lake, stream) to the point of ground water extraction. Distance to surface water, subsurface water travel time, and hydrogeologic conditions of the aquifer contribute to the natural filtration obtained. GWUDI sources are subject to the same requirements as surface water sources under the full suite of the Surface Water Treatment Rules. Viruses and bacterial pathogens in ground water that is not under the direct influence of surface water are addressed through the Ground Water Rule.

Because of the sporadic occurrence of *Giardia* and *Cryptosporidium* in surface water and their analytical method limitations, GWUDI determinations use indicator parameters in addition to analytical results for these pathogens. As reflected in the definition of GWUDI in 40 CFR 141.2, determination of direct surface water influence may include identifying the presence of other large particulates of surface water origin and/or water characteristics that correlate to surface water.

> *"Ground water under the direct influence of surface water (GWUDI) means any water beneath the surface of the ground with significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as Giardia lamblia or Cryptosporidium, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. Direct influence must be determined for individual sources in accordance with criteria established by the State. The State determination of direct influence may be based on site-specific measurements of water quality and/or documentation of well construction characteristics and geology with field evaluation."* [Source 40 CFR 141.2]

[102] Recently completed EPA research that may be relevant to this area include: Tully, J., S. Shilling, V. Bosscher, M. Schock, and D. Lytle. Benton Harbor Drinking Water Study. U.S. Environmental Protection Agency, Washington, DC, USA, 2023.

State programs establish their procedures and requirements for determining which ground water sources are GWUDI. A description of the state's program must be provided for EPA approval, including GWUDI program revisions.[103] There are no EPA-approved methods for GWUDI determination.

There is a need for improved science on making the distinction between ground water and surface water. Advances have been made in the applicable science. In addition, the first GWUDI determinations were required to be made more than 20 years ago and there is no federal requirement for re-evaluation of determinations or for on-going monitoring of source water quality.[104] Since the implementation of the LT2 Rule, outbreaks due to *Giardia*, *Cryptosporidium,* and viruses are rare and related to systems not intended as potable supplies or not compliant with existing regulations.[105]

Outcomes Sought

Considerations compiled for addressing possible mischaracterization of GWUDI as ground water sources include three parts: reviewing and revising the definition of GWUDI to incorporate new information, updating the recommended determination method and EPA guidance to simplify the process and improve accuracy, and requiring systems to periodically update GWUDI determinations.

Part 1: Review and revise the definition of GWUDI

Contributing factors to mischaracterized GWUDI determinations include outdated guidance and lack of good surrogates or surface water indicators, among others. Reviewing and revising the definition of GWUDI to add total aerobic spores or other indicators into the definition would provide additional example methodology to make a determination.

Level of Working Group Support = Full

Part 2: Update the recommended determination method and EPA guidance for making GWUDI determinations.

There are no EPA-approved methods for GWUDI determination. Guidance includes considerations for hydrogeologic assessments, water quality characteristics, and Microscopic Particulate Analyses. A goal is to make the determination simpler and more accurate. Most states utilize, in whole or part, the 1992 EPA guidance[106] produced to assist states in making GWUDI decisions. Suggestions include incorporating into EPA guidance monitoring parameters such as total aerobic spores to assist identifying ground water systems that are GWUDI. An additional suggestion is source water testing to assess DBP, nitrification, and OP issues at time of source development, and use of this testing as a basis for routine monitoring.

Level of Working Group Support = Full

[103] Source: National Primary Drinking Water Regulations Implementation, Special Primacy Requirements 40 CFR 142.16(b)(2)(i)(B)
[104] Source: Six-Year Review 3 Technical Support Document for Microbial Contaminant Regulations, and Post-Meeting 8 Initial Intervention Ideas Compiled 05-11-23
[105] Technical Analyst Input.
[106] Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA), https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100C58D.txt.

Part 3: Require systems to periodically update GWUDI determinations.

As guidance is updated, previous mischaracterizations could be identified through application of the new guidance to re-evaluate sources where determinations are already completed. There is no existing requirement for systems to periodically update GWUDI determinations or re-evaluate the determinations after events that have potential impacts to subsurface filtration of the underground sources.

Level of Working Group Support = Substantial

Alternative Perspectives (reflects perspectives of individual(s) not supporting the recommendation)

Alternative perspectives indicated lack of support for an EPA requirement to periodically update GWUDI determinations and suggested that it should be a state decision given that conditions are different across the country and a requirement cannot accommodate a tailored versus a one-size-fits-all approach. EPA information or guidance was offered as an alternative proposal.

Appendix A: Working Group Member Roster and Operational Procedures

First Name		Last Name	Affiliation	NDWAC/NEJAC Members
1.	Andy	Kricun	US Water Alliance	WG Co-Chair, NEJAC Member
2.	Lisa	Daniels	Pennsylvania Department of Environmental Protection	WG Co-Chair, NDWAC Member
3.	Alex	Rodriguez	Diversity Consulting Group	NDWAC Member
4.	Benjamin	Pauli	Kettering University, Department of Liberal Studies	NEJAC Member
5.	Bill	Moody	Mississippi State Department of Health	
6.	Elin	Betanzo	Safe Water Engineering	NDWAC Member
7.	Erik	Olson	Natural Resources Defense Council	
8.	Gary	Williams	Florida Rural Water Association	
9.	Jeffrey	Griffiths	Tufts University School of Medicine	
10.	John	Choate	Tri County Regional Water Distribution District	
11.	Jolyn	Leslie	Washington State Department of Health	
12.	Kay	Coffey	Oklahoma Department of Environmental Quality	
13.	Lynn	Thorp	Clean Water Action	
14.	Lisa	Ragain	Metropolitan Washington Council of Governments	
15.	Michael	Hotaling	Newport News Waterworks	
16.	Nancy	Quirk	Green Bay Water Utility	NDWAC Member
17.	Rosemary	Menard	City of Santa Cruz, California	
18.	Scott	Borman	Benton Washington Regional Public Water Authority	NDWAC Member

Working Group Member Operational Procedures

Mission

The purpose of the National Drinking Water Advisory Council (NDWAC) Microbial and Disinfection Byproducts (MDBP) Rule Revisions Working Group is to provide advice to the NDWAC as the Council develops recommendations for the U.S. Environmental Protection Agency (EPA) on key issues related to potential revisions to the following Microbial and Disinfection Byproducts (MDBP) rules under the Safe Drinking Water Act (SDWA): Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules, Surface Water Treatment Rule, Interim Enhanced Surface Water Treatment Rule, and Long-Term 1 Enhanced Surface Water Treatment Rule.

EPA's goal for the MDBP Rule Revisions is to improve public health protection provided by the regulations, better assure the regulations equitably protect consumers' health, particularly for disadvantaged communities, and be implementable. The NDWAC is charged with considering and providing consensus recommendations on:

- Advancing public health protection while balancing the risks of microbial control with managing disinfection byproduct (DBP) formation.
- Addressing public health concerns caused by opportunistic pathogens (e.g., *Legionella*), DBPs (e.g., unregulated haloacetic acids), and possibly other emerging contaminants.
- Addressing implementation challenges to reduce the burden of existing MDBP regulations while maintaining or enhancing public health protection.
- Ensuring efficient simultaneous compliance with other drinking water regulations when implementing any proposed revisions to the MDBP rules.
- Additional potential non-regulatory approaches that may improve public health protection from the contaminants under consideration.
- Opportunities to advance environmental justice in regulatory revisions to equitably protect consumers' health, particularly disadvantaged and historically underserved consumers.

The MDBP Rule Revisions Working Group will consider issues related to potential rule revisions and will develop recommendations for the NDWAC's consideration.

Participants

- **Member Selection.** Working Group members were selected based on the expertise, experience, and perspectives needed to provide balanced recommendations to the NDWAC on issues related to potential MDBP Rule Revisions.
- **Expectation.** Working Group members are expected to participate in all meetings to the greatest extent possible.
- **Replacement of Members.** In the event a Working Group member can no longer serve, they should communicate their resignation as soon as possible in writing to EPA. EPA may consider his or her replacement, in consultation with the NDWAC chair.
- **Perspective.** Working Group members are considered representatives of a particular point of view. The exception is members of the NDWAC, who serve as Special Government Employees based on their individual expertise and do not represent a point of view.

Decision Making

- **Consensus.** The Working Group, consistent with EPA's charge to the NDWAC, will strive to reach consensus, where possible. The nature of the subject matter that will be discussed by the Working Group is complex and it is recognized that the Working Group may not reach consensus on all topics. The Working Group should explore specific issues concerning how to implement the goals for MDBP rule revisions, provide information, conduct relevant analyses, suggest options for the Council to consider in making its recommendations to EPA, and provide group recommendations to the NDWAC where consensus is reached and alternatives where consensus is not reached in the time available. Alternatives will be captured in the final Working Group product. Working Group members also will have an opportunity to submit up to three pages of individual, attributed comments. Individual comments will be appended to the Working Group document without modification.
- **Agreement and Product(s).** Agreement of the Working Group on any written document or other product(s) of the Working Group intended for delivery to the NDWAC will be considered products of the Working Group. Content in the products will not be attributed to individual Working Group members. Pre-consensus draft materials should not be considered nor characterized as products of the Working Group.

Procedures

- **FACA.** The Working Group is established by the NDWAC, a Federal Advisory Committee established under the Safe Drinking Water Act of 1974 and complying with the requirements of the Federal Advisory Committee Act (FACA).
- **Designated Federal Officer (DFO).** A DFO or employee of the federal government will sit in attendance of each Working Group meeting and is so designated and authorized, whenever she/he determines it to be in the public interest, to adjourn any such meeting.
- **Open Meetings.** Meetings of the NDWAC Working Group are open to the public as observers.
- **Scope of Discussions.** Consistent with the Working Group Mission, the scope of Working Group discussions is limited to exploration of advancing public health protection within the context and scope of the five MDBP rules designated within EPA's charge to the NDWAC, as well as additional non-regulatory approaches. Within this context, the scope of discussion will also include seeking opportunities for burden reduction, advancing environmental justice, and ensuring efficient simultaneous compliance with other drinking water regulations. Additionally, Working Group discussions can include opportunities that exist for enhancing public health protection related to microbial and DBP contaminants that are related to, but not explicitly addressed, in the five MDBP rules for this effort (e.g., upstream source water protective measures and premise plumbing interventions).
- **Meeting Summaries.** Meeting summaries will include general descriptions of discussions. Members' input and differences of opinion captured in Working Group documents will not be attributed to individuals or interests. Draft summaries of the Working Group meetings will be developed by the facilitator in collaboration with the Working Group Co-Chairs for review by Working Group members. Meeting summaries will be made available to the public only after approval by the Working Group Co-Chairs. Completed meeting summaries will be posted on the EPA web site (www.epa.gov/ndwac).
- **Agendas.** Meeting agendas will be drafted by the facilitator in collaboration with the NDWAC Working Group Co-Chairs and in consultation with EPA. Agenda items will be tentatively identified at each meeting for the subsequent meeting. A draft agenda will be distributed in advance of each meeting for

review and consideration by Working Group members. The Co-Chairs in collaboration with the facilitator and consultation with EPA will finalize the agendas prior to each meeting.

- **Relationship to NDWAC.** This Working Group has been formed to address specific issues (see mission statement) and to make recommendations to the NDWAC (not to EPA). The Working Group is not authorized to make decisions for the NDWAC.
- **NDWAC Receipt of Working Group Products.** The NDWAC will consider the Working Group's full report in developing the Council's advice and recommendations to EPA.
- **Facilitator.** A neutral, third-party facilitator will, in collaboration with the Co-Chairs, convene and manage the Working Group meetings. The role of the facilitator, in close collaboration with the Working Group Co-Chairs, typically includes developing draft agendas, focusing meeting discussions, working to resolve any impasses that may arise, preparing meeting summaries, supporting, in close collaboration with Working Group members and EPA, identification of subject matter experts (SMEs) to present on designated topics, and coordinating with the Working Group Co-Chairs and EPA staff in locating and circulating background materials as needed to support meeting discussions.
- **Observers.** Working Group meetings are open to observation by the public. Observers are any non-Working Group attendees at meetings. Only the Working Group members and EPA representatives will be direct participants (e.g., full virtual meeting audio and video controls, seated at the table) in discussions. Any person who wishes to file a written statement can do so by sending it to MDBPRevisions@epa.gov. Any statement received will become part of the permanent file and will be shared with the Working Group members for their information.
- **Co-Chairs:** The Working Group will be served by Co-Chairs. At least one of the Co-Chairs will be a member of the Working Group who is also a member of NDWAC. EPA, in consultation with the NDWAC chair, will identify the Co-Chairs. The role of the Co-Chairs is to act as a sounding board for the facilitation team between meetings, help to finalize the agendas prior to each meeting, open and close the meetings, assist the facilitation team in running the meetings, and approve meeting summaries after the facilitation team has addressed comments by members. The Co-Chairs also participate in deliberations and decision making as full members of the Working Group. The Co-Chairs do not determine the Working Group recommendations any more or less than any other member.
- **Changes to Procedural Protocols.** These Procedural Protocols may be revised in coordination with the Working Group and with approval by the DFO.

Safeguards For Working Group Members

- **Mutual respect.** Collaborative problem-solving depends on mutual respect and careful listening among members. Meetings and conference calls will be structured to support a respectful atmosphere, encourage the development of trust and understanding, and provide for participation of all Working Group members.
- **Good Faith.** All Working Group members agree to act in good faith in all aspects of the Working Group deliberations and consensus-building. To encourage the free and open exchange of ideas, members agree not to use specific perspectives, statements, or offers made by another member for any purpose other than this process. It is the hope that other attendees at Working Group meetings also voluntarily comply with this provision. Personal attacks and prejudiced statements will not be tolerated.
- **Others' Positions.** Members agree not to characterize the views of any other Working Group member in public statements or in discussions with the media (even if that member resigns from the Working

Group). To the extent feasible, members will refer others to approved meeting summaries for information about the Working Group's discussions.

- **Interactions with the Press.** Recognizing that the way in which Working Group discussions or the statements or perspectives of Working Group members are publicly characterized may affect the optimal functioning of the Working Group, wherever possible Working Group members should consider referring inquiries from the press regarding the overall process of the Working Group to approved meeting summaries. If a Working Group member does engage in discussion with the press, members should be clear that their views do not reflect those of other Working Group members or of the NDWAC or EPA.

Schedule & Travel

EPA anticipates the Working Group would be active approximately from Spring 2022 through Summer 2023. Meetings will be held on a monthly or bi-monthly basis, and it is anticipated that most or all meetings of the Working Group will be held virtually. A total of 8-15 meetings are expected to be held.

Appendix B: Individual Working Group Member Attributed Comments

Comments in alphabetical order:

Elin Betanzo

Scott Borman

Jeff Griffiths

Mike Hotaling

Andy Kricun

Jolyn Leslie

Rosemary Menard

Erik Olson

Ben Pauli

Lisa Ragain

Lynn Thorp

Gary Williams

MDBP WG ATTRIBUTED COMMENTS
From Elin Betanzo
Safe Water Engineering, LLC
Detroit, Michigan

November 13, 2023

It has been a pleasure to be a part of the MDBP WG and spend the last 18 months with this dedicated group of public health professionals working together to improve drinking water safety. I am pleased with the recommendations produced by the MDBP WG. I believe that if EPA examines all of the recommendations and incorporates each of the concepts into rulemakings and policy priorities, the result will be improved public health protection; reliable, implementable, and enforceable requirements that simplify compliance while improving water quality at the tap; and improved equity via targeted resources and water affordability programs for small, rural, EJ, disadvantaged and historically underserved communities and Public Water System Supervision Programs.

Through my participation in the MDBP WG I learned that several members share the same priorities as I do, and these priorities are reflected in our respective comments. Please refer to the comments of Jeff Griffiths, Erik Olson, Ben Pauli, and Lynn Thorp for additional discussion of our shared priorities. Andy Kricun also shares these priorities.

Identification of Technical Analysts

Subject matter experts were engaged throughout the MDBP Working Group process to help WG members better understand the historical background, technical substance, context, baseline conditions, states of science, and other relevant considerations on topics of interest to the WG. As stated in the final report, “The input provided was based on individual experiences and expertise rather than targeted or iterative data analysis.” The technical analysts provided valuable information throughout the WG process as evidenced by references to their input throughout the recommendations.

For transparency and understanding for those who will read this report who were not active participants in the MDBP WG process, it is essential for the complete list of technical analysts to be provided along with the other citations and participants in the final report. I am concerned that the lack of this list undermines the transparency and credibility of this important report.

Recommendation 1: Disinfectant Residual

Working Group (WG) recommendation 1 represents a huge opportunity to improve distribution system (DS) water quality management and encourage proactive strategies for ensuring high quality drinking water for all consumers within a public water system (PWS) regardless of their location in the DS. In addition to setting a numeric minimum and prohibiting site-specific repeat failure to maintain that numeric minimum, we enthusiastically recommend establishing and

adopting disinfectant residual (DR) sampling and monitoring plans via Part 2. We encourage EPA to seriously consider the opportunities and multiple benefits of option 3: “Establish an Integrated Monitoring Plan that brings into one plan all SDWA required DS sampling and monitoring requirements.” This recommendation would bring all DS sampling into a single monitoring plan that would allow PWS to simultaneously evaluate compliance with all DS National Primary Drinking Water Regulations (NPDWRs) in the same space to minimize simultaneous compliance concerns while better understanding water quality as it moves to consumers' water taps. After the upfront effort to develop a comprehensive sampling plan, we believe this recommendation will result in more streamlined, efficient strategies for monitoring compliance and proactively identifying water quality issues before they become compliance and public health challenges.

Recommendation 7: Consecutive Systems

Many water systems across the United States have dependency relationships where a wholesale system treats water, in most cases to Safe Drinking Water Act (SDWA) standards, then sells the water to one or more consecutive systems that distribute the water to customers. The treating water system may or may not have its own customers. The consecutive systems may or may not have their own treatment.

Generally, treatment is designed to address source water contaminants; water quality changes as it moves through distribution systems due to chemical and microbial reactions, and the potential for contamination to enter the distribution system. In this case, the treating water system determines the fundamental water quality in the combined wholesale/consecutive systems, but the purchasing system is responsible for compliance with distribution system drinking water standards (Lead and Copper Rule, Total Coliform Rule, Disinfectants and Disinfection Byproducts Rules). Splitting a physically interconnected water system into different parts and dividing compliance responsibility according to ownership complicates the implementation of and compliance with drinking water regulations. The lack of requirements and triggers to assess source water treatment can limit the public health protection available to residents in the purchased water system.

Many consecutive, non-treating, water systems are small and may have that status due to TMF capacity challenges that have prevented them from operating a water treatment plant, forcing them to purchase water from a neighboring PWS. The number of these systems may grow as a result of new requirements and/or federal incentives for consolidation. The compliance disconnect between treating and purchasing PWSs means that purchasing PWSs are not guaranteed the same tools to achieve compliance and safe drinking water that treating PWSs have access to. The WG emphasized the importance of delivering equitable outcomes to all communities irrespective of community and Public Water System (PWS) capacity or underlying vulnerabilities. As such, EPA should explore revisions to the MDBP rules that establish new requirements for wholesale and consecutive systems to better clarify the obligation of wholesale systems to provide water that meets SDWA requirements at active points of connection and ensures water at the consumer’s tap meets SDWA requirements, in combination with proper

water quality management from the consecutive system. The WG recommendations are an important starting point for providing clarity of compliance obligations.

EPA should consider expanding beyond these recommendations to ensure that consumers in purchasing systems have the same opportunities for public health protection as consumers in treating systems. Currently, contractual frameworks tend to focus on water quantity provisions, not water quality. It is important for public health protection to change this focus and ensure more consistent protections for consecutive systems across all SDWA regulations.

Recommendation 10: Public Water System TMF Capacity

The WG emphasized the importance of delivering equitable outcomes to all communities irrespective of community and Public Water System (PWS) capacity or underlying vulnerabilities. To accomplish this goal, revisions to the MDBP rules and supporting programs must systematically and efficiently recognize and address the disparities in Environmental Justice, disadvantaged and historically underserved communities. We strongly emphasize the need for quantifying technical assistance needs, availability, and mechanism for closing this gap in assistance and financial resources. It is not entirely clear whether currently available resources are being used effectively for PWSs with the greatest TMF need.

Developing new requirements that serve as incentives for identifying and addressing water quality challenges rather than punishment via violations will benefit these communities in need, as well as ensuring that they have access to all the implementation tools and software that well-resourced PWSs have. Access to well trained, certified operators is critical for the proactive provision of safe drinking water. As highlighted throughout these recommendations, there are many opportunities to review certification program requirements and ongoing training to ensure proactive water quality management for all PWSs and all communities. In addition, EPA should be an important leader in initiating significant new recruiting efforts targeting all demographics including women and people of color while ensuring competitive wages for these essential public health protective careers. EPA should ensure that the operator certifications programs continue to deliver the public health outcomes intended in the 1996 SDWA amendments.

Future Workforce

As EPA considers revisions to the MDBP rules in response to these recommendations, it is important for EPA to consider the needs of and listen to the changing water workforce. Upcoming water operators and regulators are increasingly diverse and comfortable adopting the newest technology. There may be opportunities to modify the MDBP rules to better meet the needs of those moving into leadership positions in this field. We highly recommend that EPA specifically consult with younger workforce leaders to identify innovative approaches and ensure that new requirements do not place outdated limitations on the new generation who will implement the MDBP revisions.

Providing the Highest Quality Water for NW Arkansas and Eastern Oklahoma

MDBP Rule Revision Workgroup Attributed Comments from Scott Borman, GM Benton Washington Regional Public Water Authority and current member of the NDWAC and MDBP Rule Revision Workgroup

First, I would like to thank USEPA for the opportunity to participate in this MDBP Rule Revision process as a representative of both the Utility side of this equation as regional wholesale utility and as a member of the NDWAC. I would also like to thank Ross Strategic staff and Cadmus staff for all their tireless efforts in this process and trying to keep us as a group on track and on time.

I am going to offer my comments from a Utility perspective regarding some of the recommendations that will be made through the final report from the Workgroup to the NDWAC, and then ultimately on to USEPA. I am focusing on those recommendations that I believe will have the greatest impact regarding the protection of public health and still allow public water systems of all sizes to remain in compliance with any new regulatory requirements that ultimately come out of this process.

Disinfection Residual:

From my perspective, this issue has needed to be codified by USEPA for quite a while now. The problem is that while half of the States have determined what a minimum free or total disinfectant range should be, the other half of the States have not. The term “detectable” is not sufficient to ensure that adequate disinfection is occurring within a given distribution and/or transmission system and any residual below 0.1 mg/L is dubious at best with the current portable residual testing kits currently available. By codifying a minimum residual for free chlorine and total chlorine, for chloraminating systems, to be maintained in the system at all times would go a long way in terms of public health protection and dealing with emerging microbials, and be minimal in cost impact to the majority of individual systems. What that minimum level of disinfectant residual should be is up to USEPA and their process to determine what level is deemed to be effective.

With this minimum disinfectant requirement, it is very clear that there will need to be monitoring and testing requirements that also come with any compliance activity with a minimum disinfectant residual. Every public water system has key areas that are “problem areas” for disinfectant residuals, be it storage facilities, dead ends, low usage, or other reasons. Any monitoring plan should be flexible enough to allow a system of any size the ability to address these areas within their own system. I agree that monitoring is key to compliance with this issue, but it is very important that one-size fits all for all systems and for all situations not be used in the development of monitoring plan requirements. This also goes with testing equipment. I also agree USEPA should update accepted testing methods and come current with the available testing technology that is out there.

As I stated previously, this one recommendation can do a lot in the realm of public health protection. Based on what we heard from the technical experts, this can help dramatically with emerging microbials such as

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Legionella and does not necessarily mean that there will be higher DBP issues if the residuals within the system are managed correctly when also combined with adequate precursor removal.

Current and Emerging DBPs

From a Utility perspective, I do believe that compliance with current and future DBP regulations will be directly dependent on a multifaceted approach that allows Utilities a significant amount of flexibility. This flexibility must be made available in any future regulations when looking at adequately doing precursor removal or adding additional treatment procedures to deal specifically with DBP removal. If a single process approach works for some systems, then they should be allowed to pursue that solution, even if it appears to be unconventional to some. Managing the DBPs must be completed on a system-by-system basis and based on their source water characteristics and the subsequent inherent season variabilities or quality changes. Any future regulations regarding DBPs will have to have a multiple option compliance component built into them if they are going to be successful. It is imperative that EPA take this approach when developing any new regulations and avoid the one-size-fits-all systems.

In addition, based on what we heard from the technical experts, I do not believe that there is enough information at this time to expand the DBP testing requirements at this time. Most of the information we received appeared to me to be anecdotal and speculative at best. If a DBP proves to be an actual issue based on current toxicity, risk, and occurrence data, then that contaminate should be regulated. However, based on the current data and information shared with the Workgroup, there is currently not enough information to make that determination. I would encourage EPA to continue to look at those contaminates that are thought to present the greatest risk through future UCMR testing, but not to regulate those contaminates right now.

There also appears to me that there is a current option regarding current DBP regulations that will provide public health protections and increase compliance with current DBP regulations. That option would be to look at the chloroform issue. Based on what I have been able to ascertain from discussions with Utilities, State Regulatory staff, and physicians, it appears to me, that if Chloroform can be separated out of the THMs as a standalone contaminate with its own MCL then a couple of results could potentially happen. We know that with chlorinated systems, most of the THM violations occur due to high levels of chloroform. However, based on the information I have been able to obtain, aqueous chloroform represents a much lower risk to users than do the other 3 components of the THM family. While most of these risk assessments I have seen are relatively old, I do believe that it would be in the best interest of Utilities and the public to take a new look at if and how a new standard could be set regarding chloroform. I do believe that if this could achieved, we would still be providing acceptable health protections based on current toxicity and risk data for chloroform, potentially lower the standard for the other more toxic THMs relative to their risk and toxicity data, and thereby providing greater health protection and bring more systems back into compliance by allowing them to adopt different removal techniques specific to chloroform. In the end, I do feel that that when done, this action could provide stronger health protections to consumers and bring PWSs into more compliance with existing regulations.

EJ and Disadvantaged Systems and Capacity Development

I want to preface this section by stating that I truly believe that all Public Water Systems have a responsibility to provide high quality water to everyone of their customers. However, with that said, Public Water Systems are also a business and need to be run as such. In terms of disadvantaged and overburdened systems, it appears to me that without a clear understanding of how these systems got into their situation, finding an equitable solution to address the situation is next to impossible. Many of these systems in my experience have been victims of decisions made by uninformed Boards, Councils, or other governing bodies that have no discernable knowledge of what it means to own and operate a Public Water Utility. This is why I fully believe that EPA needs to address and update the current Capacity Development requirements to include mandatory and on-going Board Training for all PWS governing bodies. If EPA wants to truly begin addressing the problem of EJ and disadvantaged systems, then the work must begin at the top in discerning how the system got into their current situation, and then begin working its way down with solutions.

Often the we hear the proposed solution to this issue is just provide the PWS more money, but this does nothing to solve the root cause of how and why the system got into the situation that it is in. From governing

body decisions down to operational decisions, making the wrong decisions often digs a very large hole that is next to impossible to dig out of. This is why a review and expansion of the Capacity development regulations is so important to addressing these issues. Operator Certification is another area that needs to be looked at. Currently, it has been my experience that Operators are being taught to pass a test to reach a certain operational level, but we are not teaching them how to operate a system. It may be time to establish a national testing criteria and implement an endorsement system regarding state specific regulations or complex treatment techniques. But the bottom line is, we as an industry, need to do a better job training our governing bodies and operators. This can be done with better partnerships with Universities and Colleges, recognized internship and apprentice programs, expansion of training opportunities, and multiple other avenues if we as an industry want to truly address EJ and disadvantaged system issues.

Now with that said, at the end of the day, a public water system is still a business, and as a business it still must generate enough revenue to cover their operating costs and debt. Providing grants and low interest lows to the small and truly disadvantaged systems for capital improvements is a good thing and needs to continue and probably be expanded, but at the same time, when you see where these funds are going currently and who is requesting them,, it seems to me that the more politically connected larger systems appear to be receiving more of the funds than the small disadvantaged systems that actually need the assistance. However, while I agree that funds should be available for Capital Improvements for qualified systems with actual needs, they should not be available for ongoing O&M costs. If EPA begins subsidizing O&M costs it would be logical to assume that the Utility would become dependent on this subsidy, hold rates artificially low, and then become no longer sustainable unless artificially maintained. All Utilities should have the ability to work with low-income ratepayers within the structure of their rate schedules. Other utilities such as electric and gas companies already do this. If this cannot be done, then the reality becomes that they need to look towards other alternatives such as consolidation or regionalization.

If the goal is to make the PWSs sustainable, and produce the highest quality water possible, then a review and expansion of Capacity Development is imperative in my mind. This also means that additional funding will be needed for the State Primacy Agencies so that they in turn can implement these changes and provide even more robust Technical Assistance to the water suppliers that need it. As I stated before, this would include competent trainers that can teach governing bodies the responsibility of owning and operating a public water supply and provide training and assistance to those small and medium size systems that need to utilize more complex treatment methods to meet compliance requirements. All these comments are based on my 35 years of experience in operating, regulating, and managing PWSs ranging in size from small systems to very large systems. It has been my experience that if we unless define the scope of what caused a problem, then it is almost impossible to discern a realistic long-term solution to that problem. Capacity Development review and expansion in my mind is a good place to start addressing all these issues.

Again, I very much appreciate the opportunity to provide attributed comments for the final report to the NDWAC and ultimately the EPA. It has been a pleasure working with this group of individuals and seeing all the different perspectives brought to the table. There are a lot of existing regulations all tied in together that encompass everything literally from source to tap when looking at these regulations. There are some things that can be done to make these regulations better in terms of public health protection and in water supply operations. It is complex, intricate, and there is no one fix for all systems. I hope that the NDWAC and EPA keep that fact in mind while looking at changes to the regulations. Maintaining flexibility with multiple options to meet and maintain compliance is key for systems of all sizes and considerations of changes to the Capacity Development requirements are necessary to ensure the long tern viability of all PWSs.

MDBP WG ATTRIBUTED COMMENTS
From Jeffrey K. Griffiths
November 2023

I very much appreciated the opportunity to participate in the Microbial and Disinfection Byproducts stakeholder discussions. Below are two issues that I wanted to emphasize. The first relates to disturbing new evidence suggesting that disinfection byproducts (DBPs) cause birth defects and poor fetal growth. (Small babies are at higher risk of death and other bad outcomes). The second relates to the need to be forward-thinking about creative solutions to deal with unanticipated gaps in regulatory frameworks for premise plumbing and consecutive systems.

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Disinfection By-Products (DBPs) and Congenital Malformations and Poor Gestational Growth - Recent Studies

Recently, a number of studies have been published that greatly elevate the scientific basis for concern about the adverse health effects of disinfection byproducts (DBPs). As it stands, the current regulations and guidance around DBPs are focused on preventing cancer. These new studies address *non-cancer* adverse outcomes. They suggest that the US EPA will need to revise its basket of tools to address these risks. In my view, this set of tools will likely include additional MCLGs, MCLs, or treatment technologies. The studies from Sweden and MA also raise the specter of birth defects being related to short-term exposures to DBPs during the first trimester of pregnancy. This is very different from the DBP paradigm of adult cancer risks related to chronic exposures.

One study is from Massachusetts, and two are from Sweden. These studies were published after the EPA's review in 2017 and its prior 2006 findings. The two studies from Sweden included more than half a million birth events in their analyses, assisting with power and generalizability; and the study using data from Massachusetts used the innovative approach of weighting the exposures by toxicological data from animal studies. They studies have merit.

The authors of these studies found that exposures to chloramination DBPs led to a series of birth defects including those of the nervous and urinary systems, genitalia, and limbs. These point to first-trimester exposure risks. **Exposures to hypochlorite-derived DBPs led to small ("small for gestational age") babies at birth.** Fetal growth retardants typically harm growth during the second and third trimesters. **Lastly, exposures to brominated DBPs were linked to genitourinary tract birth defects in Massachusetts children.** Worryingly, THM4 and HAA5 levels were high for only 3.3% and 1.3% of studied children, suggesting that these adverse effects occur below current MCLs. These studies add substantial weight to this committee's focus on brominated DBPs and the reduction of precursor compounds that promote brominated DBP formation. They suggest that shorter term exposures to DBPs - e.g. during the first trimester of pregnancy - can lead to disabling birth defects.

In aggregate, the studies described below would indicate to any reasonable person that short-term exposures to elevated DBP levels can lead to birth defects and poor fetal growth. During our discussions we heard evidence of very elevated DBP levels during "chlorine burn" events as well, which are not currently monitored in any systematic fashion. It takes no great leap of imagination to see how these circumstances should be of concern to NDWAC and the US EPA.

Save-Soderbergh, et al. 2021.[1] This was a nation-wide registry study conducted in Sweden. Mothers who reported the same address 10-months before birth, and then at birth were included. Study included 623,468 births and focused on birth defects, usually associated with first trimester of pregnancy exposures. Water system TTHM levels were linked to residential information. Exposures were categorized as being categorized into no chlorination, <5, 5–15, and >15 µg TTHM/L. We quote: "…we observed associations between TTHM exposure in areas using chloramine and malformations of the nervous system (**OR=1:82**; 95% CI: 1.07, 3.12), urinary system (**OR=2:06**; 95% CI: 1.53, 2.78), genitals (**OR=1:77**; 95% CI: 1.38,2.26), and limbs (**OR=1:34;** 95%CI: 1.10, 1.64), comparing the highest exposed category with the unexposed..." This study is one of the first to show significant adverse birth effects – in this case birth defects - in babies whose mothers had chloraminated home water supplies.

Save-Soderbergh, et al. 2020.[2] This was a paired nation-wide registry study related to the 2021 study cited above. Again, mothers who reported the same address 10-months before birth, and then at birth were included. In this study, the authors of the study above focused on fetal growth outcomes such as Small for Gestational Age (SGA). SGA is usually associated with exposures in the second and third trimesters of pregnancy. Small babies are at risk of many adverse outcomes including death. SGA was defined as being < -2 standard deviations below the sex- and gestational age-specific average weights at birth, or the lowest 2.3rd percentile. We quote: "Based on approximately 500,000 births, we observed a TTHM dose-dependent association with increased risk of SGA, confined to treatment with hypochlorite, corresponding to a multivariable-adjusted **OR=1.20** (95% CI: 1.08, 1.33) comparing drinking water TTHM >15µg to the unexposed. Similar results were obtained when, instead of unexposed, the lowest exposure category (<5µg/L TTHM) was used as reference…"

Kaufman, et al. 2023.[3] This was a Massachusetts birth registry case-control study of 210 babies with obstructive genito-urinary tract birth defects (OGD), paired with 2,100 control MA babies without OGD. In lay-person's language, these are infants whose kidneys, bladders, or genitalia are malformed, and they are unable to urinate. If untreated this can be fatal. The study looked at towns with complete routine quarterly DBP measurements of 4 THMs and 5 HAAs during 1999 – 2004. The THMs and HAAs were 'weighted' on the basis of potency studies from the animal toxicology literature. We quote: "We detected elevated aORs for OGDs for the highest of bromodichloromethane (**aOR = 1.75**; 95% CI:1.15–2.65), dibromochloro-methane (**aOR = 1.71**; 95% CI: 1.15–2.54), bromodichloroacetic acid (**aOR = 1.56**; 95%CI: 0.97–2.51), chlorodibromoacetic acid (**aOR = 1.97**, 95% CI: 1.23–3.15), and tribromoacetic acid (**aOR = 1.90**; 95%CI: 1.20–3.03). Across unweighted mixture sums, the highest aORs were for the sum of three brominated THMs (**aOR = 1.74**; 95% CI: 1.15–2.64), the sum of six brominated HAAs (**aOR = 1.43**; 95% CI: 0.89–2.31), and the sum of nine brominated DBPs (**aOR = 1.80**; 95% CI: 1.05–3.10). Comparing eight RPF-weighted to unweighted mixtures, the largest aOR differences were for two HAA metrics, which both were other metrics had reduced or minimally

[1] Säve-Söderbergh M, Toljander J, Donat-Vargas C, Åkesson A. Drinking Water Disinfection by-Products and Congenital Malformations: A Nationwide Register-Based Prospective Study. Environ Health Perspect. 2021;129(9):97012. doi:10.1289/EHP9122

[2] Säve-Söderbergh M, Toljander J, Donat-Vargas C, Berglund M, Åkesson A. Exposure to Drinking Water Chlorination by-Products and Fetal Growth and Prematurity: A Nationwide Register-Based Prospective Study. Environ Health Perspect. 2020;128(5):57006. doi:10.1289/EHP6012

[3] Kaufman JA, Wright JM, Evans A, et al. Risks of obstructive genitourinary birth defects in relation to trihalomethane and haloacetic acid exposures: expanding disinfection byproduct mixtures analyses using relative potency factors [published online ahead of print, 2023 Sep 12]. J Expo Sci Environ Epidemiol. 2023;10.1038/s41370-023-00595-1. doi:10.1038/s41370-023-00595-1

changed ORs in RPF-weighted models." The authors also noted that: "Within our sample population of 2310, exposure levels were above the US EPA maximum contaminant levels of 80 ppb for THM4 and 60 ppb for HAA5 for 3.3% and 1.3% of participants, respectively." This study "supports the concept that brominated DBPs are more potent teratogens than their chlorinated analogs, including brominated HAAs…"

Common Sense and Public Health: Premise Plumbing and Consecutive Systems

The Working Group worked with several issues where lacunae exist in the regulatory and legal landscape. The first issue is the premise plumbing issue where legal ownership of the water delivery system is (typically) split between a municipality or similar authority, and a building owner. While most readers of this document might associate this issue with that of lead service lines and lead exposures, it also is relevant to opportunistic premise plumbing pathogens.[4] This includes *Legionella* bacteria, now a leading cause of water-associated illness in the United States. Indeed, the US Centers for Diseases Control (CDC) has stated that 9 out of 10 Legionnaire's disease outbreaks have been caused by problems that could have been prevented with better water systems management.[5] The second and similarly difficult issue is the landscape for consecutive systems, where the treatment and distribution system compliance issues for the originating system and the receiving system(s) are legally disconnected …. but obviously directly connected in a real-world and physical sense. Many purchasers of consecutive system water are challenged by inadequate physical, financial, and human resources. In both circumstances the split legal ownership of the infrastructure could bedevil the use of classic solutions. In both circumstances significant environmental justice issues exist.

These gaps are real and undoubtedly have real adverse public health consequences. Common sense would suggest that we must think ahead about strategies to address these gaps or disconnects. In the recommendations the Working Group (WG) has put forward for consideration by NDWAC, the WG has made it clear that as water professionals we believe it is best to propose creative solutions that may not completely rest *solely* on the authority of the EPA to resolve. Our current regulatory and legal frameworks for dealing with drinking water issues are derived from what was understood decades ago, before these gaps were understood. The absence of comprehensive legal or regulatory frameworks does not absolve us from the responsibility to identify and address the risks inherent in these situations. We are hopeful that an "all of government" approach may contribute to better outcomes around these issues. We pray that our NDWAC colleagues will accept these forward-looking recommendations.

Over time, it became clear that many WG members share the same concerns and priorities that I do. Please refer to the comments of Elin Betanzo, Andy Kricun, Erik Olson, Ben Pauli, and Lynn Thorp – as well as the other members of the WG - for additional discussion of these shared priorities.

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[4] Naumova EN, Liss A, Jagai JS, Behlau I, Griffiths JK. Hospitalizations due to selected infections caused by opportunistic premise plumbing pathogens (OPPP) and reported drug resistance in the United States older adult population in 1991-2006. Journal of Public Health Policy (2016). Doi:10.1057/S41271-016-0038-8.

[5] Clopper BR, Kunz JM, Salandy SW, Smith JC, Hubbard BC, Sarisky JP. A Methodology for Classifying Root Causes of Outbreaks of Legionnaires' Disease: Deficiencies in Environmental Control and Water Management. *Microorganisms*. 2021; 9(1):89. https://doi.org/10.3390/microorganisms9010089

Attributed Comments from Mike Hotaling

Recommendation 1: Consideration should be given to a minimum level of monochloramine residual disinfectant for chloramination systems. The total chlorine test is prone to positive interferences and a positive result is not a guarantee of monochloramine, the effective disinfectant, being present. A range comparable to free chlorine is suggested for monochloramine.

Recommendation 5: Tanks should be cleaned out at the same frequency and time as the comprehensive tank inspections.

Recommendation 6: A properly designed and implemented Nitrification Control Plan (NCP) should be able to eliminate the need for a temporary chlorine conversion. Thus, measurement of DBPs during the temporary chlorine conversion should not be necessary and should not be a barrier to chloramine use.

Individual Comments from Andy Kricun:

1. There ought to be a 50 state review for opportunities for regionalization, consolidation and shared services in order to reduce the number of communities/utilities which lack resources to implement these MDBP recommendations as well as the other services associated with operations, maintenance and management of a drinking water system. This could involve connecting smaller, under resourced, communities to larger systems and/or consolidating multiple under resourced communities in order to realize economies of scale. Or, at a minimum, looking for opportunities for peer to peer assistance from other, more well resourced, utilities and shared services. EPA should implement a **"No community left behind"** approach to ensure that every community/utility in the country either has sufficient operations, maintenance and management resources of its own, or is connected to a utility that does have those resources.

2. In addition, and in parallel, there ought to be Federal and/or State oversight for such regionalization and consolidation actions to make sure that these public-public partnerships are fairly arranged and implemented since environmental justice communities with less resources could, otherwise, be taken advantage of. Similarly, there ought to be Federal and/or State oversight for privatization processes to make sure that public-private partnerships do not result in environmental justice communities being taken advantage of as well.

These two comments are overarching comments which not only impact the efficacy of the MDBP recommendations, with respect to their applicability and protection of every community and every household, but also every aspect of a community/utility's ability to provide safe drinking water at an affordable price.

Jolyn Leslie, PE
Statewide Surface Water Program Manager
Engineering & Technical Services, Office of Drinking Water
Washington State Department of Health
November 6, 2023

Updates to the MDBP regulations should emphasize/focus on removing natural organic matter (NOM) as it is the primary driver for regulated (and unregulated) DBP formation and can also contribute to microbial regrowth and opportunistic pathogens in the distribution system. Other common remedial approaches, such as removing DBPs after they form, adding ammonia to form chloramines, or trying to manage water age by flushing, are all actions that are an indirect way to resolve the problem, rather than addressing the issue at its source. The MDBP Working Group report states "The purpose of the Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules is to reduce drinking water exposure to disinfection byproducts which can form in water when disinfectants used to control microbial pathogens **react with natural organic matter found in source water**", emphasis added. If you have less organic matter in the source water, you have the chance to create less DBPs.

All water systems (surface water and groundwater) should be required to do a minimum of baseline monitoring for NOM that also captures any seasonal fluctuations. The timing of DBP compliance samples should consider not only warmest water temperature but also NOM monitoring/results. To have a complete picture of disinfection and DBPs water systems must also collect disinfectant residual samples at the same time and location of DBP compliance samples.

Total organic carbon (TOC) is not the best indicator for the types of NOM that will react with disinfectants to form DBPs. Current research shows that using specific UV absorbance (SUVA) and/or dissolved organic carbon (DOC) is a better measure of the types of NOM that react with disinfectants and should be used. The State of Washington (WA), while having a comparatively lower rate of DBP MCL violations than many other states, has had more groundwater systems than surface water systems with MCL violations. This prompted the Washington Department of Health (WADOH) to conduct a multi-year DBP Formation study that was published in Environmental Science Water Research and Technology, https://doi.org/10.1039/D0EW00663G. The study reinforced that NOM/DOC is a critical parameter for DBP formation, but also revealed that NOM/DOC can vary seasonally in groundwater (as well as surface water), that maximum formation potentials for TTHM and HAA5 can vary significantly by season, and that water system disinfection practices (and thus disinfectant residuals) are highly variable.

Large seasonal variation in DBP formation potentials (sometimes 6-8 times above DBP MCLs) and seasonal variation in DOC were observed in some groundwater sources in the study; DOC levels in one small groundwater system ranged from 0.9 to 7.9 mg/L throughout the year. All of this suggests that in the future, implementation of the DBPRs (groundwater utilities in WA in particular and possibly in other states) should include emphasis on regular monitoring of key formation indicators (e.g., [Bromide], [DOC]), and on chlorination best practices rather than relying solely on limited TTHM/HAA5 distribution compliance sampling to characterize DBP levels. Basing reduced monitoring for small systems on one single annual or triannual sample without considering mitigating factors that may not capture the worst-case scenario is not protective of public health.

Reducing NOM will also likely improve 1) disinfectant residual stability, and 2) reduce an energy source for distribution microbial growth. More stable disinfectant residuals and reduced organic substrate, while not eliminating microbial growth in distribution and plumbing systems, would likely provide help in reducing opportunistic pathogen growth. This issue of reducing NOM becomes even more critical as we focus more and more efforts on controlling Legionella and other opportunistic pathogens in building plumbing systems.

Small water systems that are shown to have consistently low levels of NOM (or other surrogate such as SUVA or DOC) measured throughout the year could benefit from additional opportunities for reduced monitoring. Rather than using low levels of DBPs to determine reduced monitoring, using low levels of measured NOM would reduce the potential bias from variable disinfection practices, incorrect timing of compliance samples, and temporarily lowered DBPs due to activities like flushing. For example, a small system that has historically collected DBP compliance samples during the warmest time of the year may have low DBP levels due to low levels of NOM during that time. They could have much higher levels of DBPs during the winter months if NOM is higher during that time.

Many working group members have stated that organics removal is too expensive and is not feasible. We have small surface water systems in Washington State that are economically and effectively reducing the DBP health risk by using GAC for organics removal. One small surface water system charges customers $1.68 per 1,000 gallons sold for GAC and they have been in compliance with the DBP MCLs since installation, https://awwa.onlinelibrary.wiley.com/doi/10.1002/awwa.1903. However, at the same time, flushing is many times offered as the best 'treatment' solution to reduce DBPs. What is often missing in this discussion around affordability is the cost associated with trying to utilize distribution flushing to mitigate DBPs. The flushing cost includes not only treatment chemicals and pumping costs, but also operator time spent running extra treatment and then time spent flushing water. GAC has had the added benefit of reducing taste and odor complaints in these systems.

Future regulations should include the requirement that chlorine residual must be measured at the same time andlocation that the DBP sample is collected. Free and total chlorine should be measured regardless of whether a system is adding chlorine or chloramines. Our studies on DBP formation clearly showed that a primary reason for high variability in DBP compliance results was the high variability in distribution chlorine residuals. Low DBP results appear to have occurred when no chlorine residual was maintained during the sampling periond.

Some groundwater systems can have high enough levels of ammonia present that the system is effectively chloraminating without knowing it. This can lead to inconsistent free and total chlorine residual levels and may lead to unintended (and unmitigated) nitrification in the distribution system and as a result, reduced public health protection. In addition to ammonia, other things, like presence of manganese, can interfere with the accurate measurement of chlorine. Through our data integrity studies here at WADOH, we have found that we, as an industry, can and must do better. Operators are not adequately trained in ensuring that they have accurate and precise chlorine residual measurements. And once a measured value is written down, it becomes a trusted data point, even if it's inaccurate. Color wheels and chlorine test strips should not be approved analytical devices or methods for measuring chlorine residuals.

The updated rules should revise or eliminate the Operational Evaluation Level (OEL). The schedule for getting the sample result and the system having up to 90 days to submit the OEL report to the state is not timely or effective in making the needed changes/system modifications as it was designed to do. Analytical hold times range from 7-28 days, depending on the analysis, from the time of sample collection to analysis. Labs may or may not report these results to the water system and/or State program in a timely manner. In many cases, we do not receive sample results until 6 weeks or more after the sample is collected. Add the 90 days that the water system has to get the report to the state primacy agency and this timing usually leads to the water system accruing an MCL violation even before the OEL

report is due. Water systems should not be waiting until they are on the verge of an MCL violation before they take action to address the issue.

Aeration can be an effective and affordable treatment option for small systems that struggle with only elevated TTHMs (especially the lighter chlorinated TTHMs). This could be added/emphasized as an alternative best management practice for reducing some TTHM levels.

EPA should develop/provide additional guidance for small systems, other types of surface water systems, and groundwater systems; current guidance is directed more towards surface water and more specifically conventional surface water treatment. Surface water plants with other types of treatment than just conventional treatment (slow sand, membrane, direct filtration) can also have high levels of DBPs. Water systems with these other types of treatment are not able to use advanced coagulation or softening to address high DBPs. Furthermore, the alternative minimum TOC may not be low enough to prevent high DBP levels. Our study showed that TOC/DOC levels as low as 1.2 mg/L can lead to TTHMs above the MCL for some small systems.

Flushing alone is typically not a viable, sustainable method for controlling distribution DBP levels in public water systems. Flushing for DBP control can create periods where the DBP formation is lower than normal. Timing of flushing with DBP compliance sampling becomes paramount. Since sporadic or uncontrolled flushing can result in unrepresentative samples and lead to elevated DBPs between flushing periods, it is not supported or allowed by WADOH. Flushing does not address the two primary drivers leading to DBP formation: NOM in the source water and chlorine concentration. Flushing only addresses the time component of the DBP reaction by trying to reduce water age. DBPs can begin forming within hours and can reach maximum levels in a day or days. To be effective, a water system implementing engineered or controlled flushing to reduce DBPs must:

- know how long (hours/days) it takes for both TTHMs and HAAs to form in the water system.
- maintain all distribution system water age less than the formation time.
- know water volumes used daily and volume of storage tanks and distribution pipes.
- measure and record all data associated with flushing.

Collecting DBP compliance samples immediately after flushing can result in artificially low DBP results that may be highly variable as water age increases between flushing events. Flushing is also not an option in regions that must use water efficiently due to limited source water capacity.

The numerous limitations of flushing as a mitigation action for DBPs also has the potential for significant concerns surrounding equity for all customer classes. Because DBP levels in the distribution system begin increasing as soon as flushing is complete, customers are exposed to variable levels of DBPs while water systems assert that DBPs are low.

In addition to these operational challenges associated with flushing, the cost of flushing is also not adequately recognized, as mentioned above.

Thank you for the opportunity to present my comments to the MDBP Working Group.

Jolyn Leslie

Attributed Comments
Rosemary Menard

I appreciate this opportunity to provide comments on the recently completed work of the National Drinking Water Advisory Committee Microbial and Disinfectant Byproducts (MDBP) Working Group's work. I have two basic types of comments: the first group is related to the process, and the second is related to the recommendations.

Process Comments

Having been a close observer of and active participant in the earlier rounds of the development of the MDBP rules, it is impossible not to compare the work completed during those efforts and this one and conclude that the process we have just completed was inferior in many ways. So many of the critical questions that were asked by various Working Group (WG) representatives in this recent work were unanswered/unanswerable without the kind of analytical support, level of technical detail and focus on fully understanding the feasibility and consequence of ideas and proposals before supporting their inclusion in the proposed regulation.

For me specifically, I viewed my role in the process as needing to consider not only the impact or potential impact of various proposals on the utility I am responsible for but also, along with my large utility colleagues, Mike Hotaling and Nancy Quirk, looking out for the interests and needs of all utilities. The lack of a reasonable level of analytical and technical support in this recently completed process made it virtually impossible for me to understand and assess the implications of proposals, many of which are literally little more than potentially good ideas, on the utilities I viewed myself as representatives of. I will address this issue further in the recommendations section of these comments.

A second major process issue is the lack of transparency and accessibility of WG materials and meetings to outside parties. The use of a closed SharePoint site made meeting materials inaccessible to individuals and parties with legitimate interest in the work of this group. The limitation of meeting access to listen only mode not only relegated individuals and parties with legitimate interest to a virtual "peanut gallery," giving them absolutely no access even to the slides and presentations provided during the meeting that give the audio context and provide critical additional information. The decision to limit access of those individuals and parties with legitimate interest also placed them in the untenable position of trying to overcome the inevitable boredom that comes with attempting to pay attention to content where only one human sense (hearing) is being engaged. I challenge anyone reading these comments to try to provide a coherent content summary for a 7-hour Zoom meeting where you could only listen. I doubt you could. It was difficult enough for me to follow along as a fully engaged participant, given the virtual meeting format, and I had full access to the information.

While these comments so far have been somewhat critical, I want to end my process comments on a positive note. Throughout the WG process, the Ross Strategic team, particularly Rob Greenwood, have bent over backwards to work with WG members to understand their perspectives and interests. He and his team have made the best of a difficult (largely) "virtual only" meeting format. As I've experienced with the earlier regulatory negotiations processes, and in multiple other multi-party negotiations, the skill and the tenacity of the facilitator is the secret ingredient that has an incredible impact on the potential for a successful outcome. I've worked with some of the best facilitators working in the public sector multi-party facilitation field including Gail Bingham, Abby Arnold, Deb Nudelman, and Carrie Fox, during my 40+ years as a water sector leader both as a participant in processes convened by others and as the convener of processes I was responsible for. Rob Greenwood is in this group of individuals whose skills and experience produce unexpected but desired consensus results that truly make a difference. He and his team, but especially Rob,

need to be acknowledged for the skill and commitment they brought to this process. The quality of the product that has emerged is greatly due to his effective work with the WG members throughout the process. Any process or product limitations are not attributable to the Ross Strategic team.

Recommendation:

The MDBP WG process involved multiple meetings over roughly a year and half, a time frame similar to both the mid-1990s and the late 1990s regulatory negotiations (reg-neg) processes that produced most of the MDBP rules that are now in effect. Each of these earlier processes, along with the initial early 1990s process, produced fully vetted proposed rules supported by all the parties involved.

Participants in those earlier reg-neg processes asked and received answers about a full range of regulatory issues under consideration, for example, which utilities would most likely be impacted and in what way, likely cumulative costs of implementation, and what health benefits would be produced by the proposed regulatory changes being evaluated. Regulatory options considered were assessed for their technical and administrative feasibility, they weren't just initial ideas for further consideration. There are multiple examples in the recently completed work of approaches and outcomes that might produce public health benefits if the basic (unvetted) assumptions and thought processes underlying them turn out not to have unanticipated limitations or flaws. Below are some comments and questions related to several of the recommendations that I feel it is important to point out.

- Recommendation 4 — Multi-Benefit Precursor Control — This recommendation uses a source water vulnerability assessment approach to identify water systems that could be required to implement additional precursor control treatment techniques. It is an interesting idea but lacks any but the most general analysis about what parameters might trigger additional treatment or anything beyond the most general consideration about what additional treatment might be required. The good news about this recommendation is that it avoids a "one-size-fits-all" approach to potential requirements for treatment improvements. On the other hand, some of the parameters that might trigger additional monitoring and potential treatment are poorly defined. A primary example of this is wastewater effluent influence.

  The topic of the influence of wastewater effluent as a potential source of precursors associated with more toxic DBP is interesting. We heard a presentation that seemed to indicate that if the source water was 15% or more wastewater, it was more vulnerable. Okay, interesting. But what does it really mean? How is the 15% calculated — instantaneous flow? Average flow? Seasonal low flow? Flood flows? What if your wastewater influence is from distributed sources (i.e., septic tanks) versus one or more point sources (i.e., wastewater treatment plant discharges)? With so many unthought-through questions about just this one parameter, it is difficult to imagine how this idea is anywhere close to ready for development into a regulation in which all utilities would be affected by the requirement to assess this parameter as part of at least an initial source water vulnerability screening process.

  And, here's another question, if we know (or have an indication) that wastewater discharges are an important source (perhaps <u>the</u> important source) of precursors associated with the more toxic DBPs, why are water utilities rather than wastewater dischargers being tasked with testing for them and take steps to address their presence in drinking water sources? At the very least, allowing wastewater dischargers to contaminate drinking water sources as is contemplated in Recommendation 4 is misaligned with Recommendation 8 that focuses on Source Water Protection.

- Before concluding with some comments on the Recommendation 9 – Environmental Justice, I want to make a few comments about Recommendations 10 and 11, which cover Technical, Managerial, and Financial (TMF) Capacity, and State Primacy Agency Capacity, respectively. Our conversations throughout the recently completed MDBP WG process consistently included issues related to systems struggling to comply with existing regulations. The causes of the problems were varied, but common themes for small, rural, medium, and larger systems emerged: TMF Capacity, especially including a community's economic capacity to make the investments needed to be able to reliably produce and deliver high quality water. In the largely distributed system of Safe Drinking Water Act (SDWA) implementation, the states are partners with EPA in taking action to identify, assist and, when needed, enforce drinking water system regulations and requirements. When the states don't have the resources they need to do their job, including adequate TMF resources to provide necessary assistance to utilities, the actions needed to make progress are constrained. Recognizing that much good work has been done over time to provide those systems in need with TMF resources, it is also important to acknowledge that current TMF and State Capacity resources are inadequate to meet the needs that so clearly exist, and perhaps worse, that lack of progress in these areas is contributing to the complex system of conditions that Environmental Justice (EJ) communities are experiencing.

- The MDBP WG spent considerable time and energy working on issues related to Environmental Justice and found, among other things, that one of the challenges of working with this topic is definitional. Ultimately the WG adopted and used in relevant recommendations inclusive language that reflected all the various characteristics of communities that may be experiencing issues with water service. In some cases, the system's water issues may be specifically related to local conditions such as vacant homes or a high percentage of rentals that may be associated with larger community economic or social conditions that result in general disinvestment. In other situations, utility actions to reinvest in water system facilities and supplies to provide resiliency and reliability in the face of challenges associated with aging infrastructure or climate change are causing water rates to rise rapidly resulting in affordability challenges for low-income customers. The variability of circumstances creating challenges for small, rural, and EJ, and disadvantaged and overburdened communities (not limited to systems below 10K people served) demands that we think broadly about allocating resources to establish and maintain equitable access to water and sanitation services for all.

In closing these comments, I want to acknowledge that I do support the recommendations that have been developed even as I recognize that there is considerable additional analytical and developmental work that needs to be done to create regulatory proposals from these recommendations that effectively target actions that provide public health benefits. These recommendations recognize that drinking water isn't produced or delivered in a vacuum, and two of them, Recommendation 2 – Premise Plumbing and Recommendation 8 – Source Control, specifically include ideas that will require EPA SDWA program staff to collaborate and coordinate with other EPA program staff, State Primacy Agencies, the Centers for Disease Control along with building managers and others to achieve public health benefits for water consumers. Working across programmatic, organizational, and institutional boundaries clearly introduces significant challenges for those working to develop effective regulatory programs, but this, along with identifying and addressing large and unaddressed needs for TMF Capacity and State Capacity efforts, is what needs to happen to ensure that progress is made in providing safe, reliable drinking water to anyone receiving water service from our nation's utilities.

Attributed Comments of Erik D. Olson, Senior Strategic Director for Health, Natural Resources Defense Council, November 2023

I appreciated the opportunity to participate in the Microbial and Disinfection Byproducts Working Group (MDBP WG) in 2022 and 2023. This was a continuation of the ongoing discussion of these important issues that I have participated in on behalf of NRDC since 1992, which has resulted in numerous rules addressing both microbial risks and the health threats from disinfection byproducts. While NRDC and many other participants including water utility representatives had urged that EPA convene a formal regulatory negotiation prior to the initiation of this process, I still believe that the MDBP WG was a valuable effort engaging many key players, was professionally facilitated, and resulted in useful recommendations.

If EPA examines all of the recommendations and incorporates each of the concepts into rulemakings and policy priorities, the result will be improved public health protection; reliable, implementable, and enforceable requirements that simplify compliance while improving water quality at the tap; and improved equity via targeted resources and water affordability programs for small, rural, EJ, disadvantaged and historically underserved communities and Public Water System Supervision Programs. NRDC of course reserves the right to review, comment and support or, if necessary, challenge any final rule that EPA may issue at the end of the MDBP rulemaking process.

Through my participation in the MDBP WG I learned that several members share the same priorities as I do, and these priorities are reflected in our respective comments. Please refer to the comments of Elin Betanzo, Jeff Griffiths, Ben Pauli, and Lynn Thorp for additional discussion of our shared priorities. Andy Kricun also shares these priorities.

Recommendations 3 & 4: DBPs of Emerging Concern and Multi-Benefit Precursor Control

The evidence that many unregulated disinfection byproducts (DBPs), and particularly brominated and iodinated byproducts, are highly toxic has continued to accumulate in recent years. The good news is that the risks of both DBPs and microbes can be substantially reduced by removing precursors such as total organic carbon (TOC) or dissolved organic carbon (DOC). Removal of TOC reduces the amount of organic matter that reacts with chlorine and thus reduces both regulated and unregulated DBPs. TOC removal also has the benefit of removing organic matter that can serve as "food" for microbes in the distribution system and that can react with and reduce chlorine residual (thus increasing microbial risks). Thus, TOC removal is a "win-win" that enables a reduction in both DBPs and microbial risks, without the need for risk-risk tradeoffs.

The agreement states that EPA should evaluate options for an enhanced precursor control treatment technique requirement in response to elevated precursor conditions characterized through the vulnerability screening. Systems with relatively high levels of precursors such as wastewater-affected systems, those with higher TOC, or systems with bromine or iodine (including saltwater-affected systems) should be specifically addressed. Climate change may increasingly affect many systems (note, for example, the current situation in Louisiana with saltwater reaching many previously unaffected systems). EPA should require periodic reviews of its determinations, and additional monitoring for higher vulnerability systems to create the baseline needed for application of the treatment technique

requirement. The agency also should require granular activated carbon (GAC) or equivalent-level precursor removal particularly for higher vulnerability systems and require such systems to achieve the performance levels indicated by the GAC-based treatment technique performance requirement in the Safe Drinking Water Act (SDWA). See SDWA §1412(b)(4)(D).

As the agreement notes, there are over 700 identified DBPs; only 9 are currently regulated (4 trihalomethanes and 5 haloacetic acids). It is important that as the evidence continues to mount, EPA should consider establishing additional Maximum Contaminant Level Goals (MCLGs) and Maximum Contaminant Levels (MCLs) or more robust treatment technique requirements to address additional DBPs. As noted in Rec. 3, "to the extent peer-reviewed best available scientific evidence that meets EPA's criteria for establishing new or revised National Primary Drinking Water Regulations emerges as EPA undertakes further analysis in support of MDBP rules revision and addresses the data and analysis gaps identified below, WG members believe this new evidence should influence the nature of immediate and targeted near-term regulatory options EPA considers." Specifically, for example, as evidence develops that DBPs may have adverse developmental, reproductive, or other health effects after relatively short-term exposure (such as during pregnancy or early infancy), it is important that EPA use its authority under section 1412 of the SDWA, including by making a regulatory determination and issuing an MCL or strengthening a treatment technique, or by using its authority to regulate urgent threats to health under SDWA section 1412(b)(1)(D). We note that since EPA has established some MCLGs of zero for DBPs and may establish additional MCLGs of zero or substantially below current MCLs, the SDWA specifically requires the agency to set its standard based on what can be achieved by GAC. Of course, the Act says GAC is "feasible" for purposes of setting drinking water standards. See SDWA §1412(b)(4)(D). GAC is highly effective at removing TOC as are certain other advanced treatment technologies, and EPA should establish strict MCLs and/or rigorous precursor removal treatment techniques in light of evidence of significant health harms from short-term exposure and the GAC mandate in the SDWA.

The agreement notes, taking language directly from EPA's six-year review, that "For organic disinfection byproducts, the concern is potential increased risk of cancer and short-term adverse reproductive and developmental effects." 82 Fed.Reg. 3518, at 3533 (Jan. 11, 2017). As discussed during our negotiations, there are numerous published peer-reviewed studies indicating that some DBPs pose reproductive and developmental risks from shorter-term exposure, particularly during pregnancy. As EPA said in the Stage 2 Rule, "Some recent studies on both human epidemiology and animal toxicology have shown possible associations between chlorinated drinking water and reproductive and developmental endpoints such as spontaneous abortion, stillbirth, neural tube and other birth defects, intrauterine growth retardation, and low birth weight. While results of these studies have been mixed, EPA believes they support a potential hazard concern." 71 Fed. Reg. 388, at 391 (Jan. 4, 2006). As the agreement notes (at footnote 7), numerous studies since 2006 confirm and expand upon these findings of reproductive and developmental risks. These and any additional studies should be considered by EPA in evaluating whether to issue additional MCLs or treatment techniques.

Professor Jeffrey Griffiths' attributed comments discuss three recent studies that address non-cancer health effects of DBP exposures. They strongly support our concerns outlined above. One is from Massachusetts, and two are from Sweden. These studies were published after the EPA's review in 2017 and its 2006 finding. The two studies from Sweden included more than half a million birth events in their

analysis, assisting with power and generalizability; and the study using data from Massachusetts used the innovative approach of weighting the exposures by toxicological data from animal studies.

The authors of these studies found that exposures to chloramination DBPs led to a series of birth defects including those of the nervous and urinary systems, genitalia, and limbs. Exposures to hypochlorite-derived DBPs led to small ("small for gestational age") babies at birth. Lastly, exposures to brominated DBPs led to genitourinary tract birth defects in Massachusetts children. These studies add weight to this committee's focus on brominated DBPs and the reduction of precursor compounds that promote brominated DBP formation. In addition, the Swedish data suggests that shorter term exposures to DBPs - e.g. during the first trimester of pregnancy - can lead to disabling birth defects.

Simultaneous Compliance

This set of recommendations set forth by the WG represent a solid approach for revisiting the MDBP regulations to improve public health protection for both microbial and disinfection byproduct risks while improving water quality management and managing the implementation burden. The WG did not have adequate time to consider or explore simultaneous compliance concerns outside of the MDBP family. It will be important for EPA to evaluate how changes in treatment resulting from this set of recommendations could impact water quality delivered to consumers, especially corrosion processes addressed under the Lead and Copper Rule and related revisions. Ideally, the DS water quality recommendations included in this report will provide more predictable and stable DS water quality conditions that will also achieve benefits in corrosion reduction, but this must be confirmed through EPA evaluation.

MDBP WG ATTRIBUTED COMMENTS
From Ben Pauli
Kettering University
Flint, Michigan

November 13, 2023

I very much appreciated the opportunity to serve on the Microbial and Disinfection Byproducts Rule Revisions (MDBP) Working Group over the past 18 months. This was my second time serving on a working group under the National Drinking Water Advisory Council, and on both occasions, I found the process to be collegial, constructive, and expertly facilitated. As my fellow residents of Flint, Michigan know all too well, the stringency, efficacy, and enforcement of rules and regulations around water quality are matters of life and death, especially for marginalized and vulnerable populations. My hope is that the recommendations contained in this document will result in stronger public health protections, more effective communication between water providers and water users, and enhanced operational capacity and efficiency for regulated water systems.

Please note that several members of the MDBP Working Group share the same priorities as I do, and these priorities are reflected in our respective comments. Please refer to the comments of Jeff Griffiths, Erik Olson, Ben Pauli, and Lynn Thorp for additional discussion of our shared priorities. Andy Kricun also shares these priorities.

The MDBP Working Group's recommendations come at a time when EPA is directing renewed attention to matters of environmental justice. Part of EPA's charge to the group is to look for "opportunities to advance environmental justice in regulatory revisions to equitably protect consumers' health, particularly disadvantaged and historically underserved consumers." Any effort EPA makes to address environmental justice will depend upon having high-quality, actionable information about the ways in which microbial and DBP threats can disproportionately and cumulatively impact vulnerable populations, particularly those dealing with underlying issues of poverty, structural racism, infrastructural degradation, and preexisting health conditions. Information about disproportionate and cumulative impacts not only offers a fuller and more accurate picture of the problems at hand, but can help to shape intervention strategies and priorities.

During its deliberations, the MDBP Working Group heard troubling evidence from technical experts that African Americans are significantly more likely than other racial groups to contract Legionnaires' Disease. EPA should investigate the causes of this disparity, such as pathways of *Legionella* exposure in different building types (including private residences), any potential connection to areas with persistently low chlorine residuals, and the intersection of Legionnaires' with prior health vulnerabilities in the African American community. Available information on the environmental justice implications of other contaminants, particularly DBPs, was very limited. More research is needed, for example, on any possible disproportionate impacts of chronic and acute DBP exposure, both for regulated DBPs and emerging DBPs of concern. Furthermore, EPA must develop more robust and meaningful ways of incorporating experiential knowledge around disproportionate impact into its analyses and deliberative processes. Despite recommendations from multiple working group members that the group consider the testimony of those with relevant lived experience, none of the group's twelve meetings included designated time for such consideration. Seeking to advance the interests of impacted people without impacted people at the table is not only logically contradictory, but contrary to the principle of environmental justice.

Among the environmental justice improvement opportunities identified by the MDBP Working Group are multiple recommendations around communication between water providers and community members. While these recommendations apply to all water systems, I wish to stress the special importance of strong communication in environmental justice communities. Such communities are especially likely to suffer from communication deficits due to limited resources and distrust between utilities and residents. Given their proneness to acute contamination events, water systems in environmental justice communities are more likely to need to convey public health warnings urgently and efficiently. It is critical that MDBP revisions ensure that mandatory and effective public notice is issued for every violation reported in SDWIS. Additionally, in their efforts to demonstrate trustworthiness to those they serve, these systems stand to benefit disproportionately from sustained, proactive, and transparent communication, even when communicating about past water quality issues that are not connected to active public health concerns. A water system's overall emphasis, I believe, should be on providing information in as comprehensive, accessible, and timely a manner as possible, not only in the interest of immediate public health interventions, but in the interest of positioning water consumers to be meaningfully involved in matters of water management and governance.

I share the concern expressed by many fellow MDBP Working Group members that new rules resulting from these recommendations will create costs for water systems that are then passed on to consumers, thereby potentially exacerbating affordability challenges in environmental justice communities. However, members of these communities have been very clear in insisting that stringent environmental and public health protection not be sacrificed to considerations of cost. Rather, public health and affordability must be addressed simultaneously. As we strengthen protections, we must also insist that new demands on water systems are accompanied by efforts on EPA's part to expand the technical, managerial, and financial (TMF) capacity of under-resourced utilities in ways that reduce the overall cost of operation. New requirements from EPA, as opposed to mere guidance, can put utilities in a stronger position to demand and expect this kind of support. Furthermore, I wish to reiterate the working group's recommendation that a Low-Income Household Water Assistance Program be made a permanent federal resource for low-income households. The structure that assumes that everyone must pay the same rate brings PWS to the lowest level of public health protection, rather than ensuring that all consumers receive the same level of public health protection regardless of address or ability to pay. It should be noted that many tools are available to help governments and water systems structure rates and take other steps to assist low-income consumers to afford their water bills. See, for example, the *Water Affordability Toolkit*[1] which includes numerous measures available to assist water systems, state and local officials, and consumer advocates to address water affordability issues. Beyond this, EPA must also provide more resources to low-income homeowners and renters seeking to address water quality issues at the premise level.

Revisions to the MDBP rules should place particular attention on the PWSs that currently struggle to maintain compliance with the current regulations and ensure that revisions will provide more reliable remedies and opportunities for sustainable safe drinking water for these communities. When considering new regulatory approaches, it will be useful for EPA to consider MDBP drinking water emergencies (e.g., Benton Harbor, MI; Jackson, MS) and what might have transpired if the proposed requirements had been in place at the time of these emergencies. It is important to consider whether revisions under consideration would have had any impact in the PWS, state, or federal response in these circumstances to provide public notice or safer water sooner in these communities with well

[1] https://www.nrdc.org/resources/water-affordability-advocacy-toolkit

documented, chronic compliance challenges. If revisions under consideration would generate no perceivable change in course of action or outcome in these previous emergencies, this would indicate that the revisions are not sufficient for addressing critical EJ challenges.

Individual Comments from Lisa Ragain

The following citations are provided to inform implementation of Recommendation 9, particularly the Public Notice topic.

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National Drinking Water Advisory Council
Microbial and Disinfection Byproducts Rule Revisions Working Group Report
Attributed Comments
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Washington DC
November 2023

I appreciated the opportunity to participate in the Microbial and Disinfection Byproducts Rule Revisions Working Group. The Working Group members devoted considerable time and energy to developing recommendations on critical, wide-ranging, and highly technical Safe Drinking Water Act regulations and related activities.

I found all Working Group members open to learning about each other's perspectives and striving to find common ground. I note comments from several other Working Group members with whom I identified specific shared priorities: Jeff Griffiths, Erik Olson, Ben Pauli, and Elin Betanzo.

My comments focus on recommendation 8 – "Source Control." While these recommendations fall outside the scope of Safe Drinking Water Act regulations, the activities discussed could have dramatic positive impacts on successful control of microbial and disinfection byproduct risks in water distributed by regulated Public Water Systems.

Recommendation 8: Source Control

As noted in the Report, source water conditions have a substantial influence on drinking water treatment requirements, distribution system management practices, overall water system water quality, and operating costs. Constituents and contaminants in drinking water sources can increase public health risks from the opportunistic pathogens and disinfection by-products at issue in the Working Group's deliberations. Source water conditions that impact treatment and drinking water system operation not only contribute to public health risks but to increased costs for water system customers and consumers.

The Working Group recommended that EPA use every resource at its disposal to keep relevant contaminants and constituents out of drinking water sources. While not pertinent to revisions of Safe Drinking Water Act regulations, these activities are not superfluous. The recommendations go to the heart of activities that EPA has prioritized for decades, but around which aggressive attention is needed. For example, "integration" of the Clean Water Act and the Safe Drinking Water Act to better protect drinking water has been part of EPA Strategic Plans. Harnessing other statutory programs, including the Toxic Substances Control Act, the Clean Water Act, and others was a primary objective of EPA's 2010 "Drinking Water Strategy."

The Working Group's deliberations confirmed the importance of reducing risks from opportunistic pathogens and of preventing development of disinfection byproducts in drinking water provided by regulated public water systems. The Report recommends that EPA recognize

and act on the opportunity to support the much-needed and ambitious revisions of National Primary Drinking Water Regulations with concrete agency-wide action to address source water conditions that contribute to the public health risks being addressed.

Gary Williams comments on M/DBP working group activities.

Upon joining the Working Group for M/DBP I was hoping to address undue burdens placed on Water Utilities, especially Small Water Systems, from Stage 1 and Stage 2 D/DBP rules, but those subjects and concerns never gained traction or strong consideration with the Working Group.

Below is a list of subjects submitted early in the process related to request for problem identification. Although many may have been touched on or mentioned they didn't receive a proposal to address or any resolution.

Simultaneous compliance—implementing DBP solutions (chronic health issues) many times causes Microbial, Nitrate, lead/copper, biofilms, and other issues (many acute health issues). Resulting in elevated public health risks.

Water age reduction/flushing/batch operations cause water utilities to be in violation with consumptive use. Water use/water scarcity permits—this causes water quality vs water quantity issues and problems.

Many vast, large, consecutive systems/distribution systems even if the POE sample is zero for DBP are unable to achieve compliance using traditional disinfection. Organics, biofilms, encrustation on distribution lines, sediments, etc. alone; along with very long water age cause levels over the MCL's. Even if alternative disinfectants are used, a residual is not maintained for public health protection without chlorine—can't make MCL—or total-chloramines used to meet MCL and exceed other parameters.

The chemistry of treatment solutions doesn't exist to predict which treatment would be most effective. This causes multiple treatment solutions to have to be jar tested, pilot tested and researched at each location. Hydrogen Peroxide, Chlorine Dioxide, Miex, activated carbon, other media, etc. are effective with certain waters but ineffective with other waters. A determination of which water chemistries work best with each available treatment would help to narrow the considerations, how chemistry would have to be changed for solutions to work and other Best Available Technology determinations/assistance.

Continued assessment of the risk/risk trade-off between microbial pathogens and DBPs. No real acknowledgement of these impacts that are placed on water systems.

If adsorption media/Precursor Control is used for treatment, the systems have disposal issues with contaminated media that is hard to control, costly to dispose of and normally a logistics problem for suitable site to receive. Upcoming PFAS removal with these treatment techniques will complicate and affect M/DBP treatment usefulness and a Best Available Technology option.

Reduction of treated drinking water stored in the Distribution systems which can reduce storage for emergencies including fire mitigation.

Mandating compliance cost without commensurate public health benefits can be harmful to economically disadvantaged (environmental justice) communities because they can force the community to sacrifice more important public health actions.

Increased water flushing of distribution systems resulting in a waste of treated drinking water and increased cost on consumers.

Distribution of very alarming direct Tier 2 public notices to all consumers for maximum contaminant level (MCL) violations regardless of the relative risk of the violation or the temporary nature of the violation causing the public to distrust their drinking water and local government.

Best Available Technology determined by EPA is in many cases not affordable in low customer-based water systems.

The deteriorating infrastructure of water systems is leading to water quality issues that contribute to disinfection residual demand, M/DBP issues and SDWA rule compliance.

It is very difficult for smaller systems to employ a qualified operator with advanced knowledge and treatment background. It is a major effort for many to collect samples, do minimal reporting and operations. Operations and maintenance are often neglected and ignored, keeping up with other things.

Treatment techniques to minimize DBP's cause water quality issues. It is difficult to hold sufficient residuals that prevent microorganism growth and can nitrify in premise plumbing depressing pH and causing corrosion.

Disinfection when ammonia and organic matter are in ground waters can cause complex operational issues that seem insurmountable to small systems operators. Simple disinfection if a well is not so simple and can cause water quality issues.

Many small systems are perplexed and question a "one size fits all" M/DBP approach and are not convinced that their system compliance needs are the same as large systems.

As far as the final report and 13 recommendations being brought forward by the Working Group to the NDWAC I was wishing for different recommendations—mentioned above- and a few different outcomes.

On Disinfectant Residual-- I couldn't support recommendation and proposal to adopt a national positive numeric disinfection residual requirement. Not only am I not sure some waters (cooler climates, etc.) require this residual beyond a trace for public health protection I'm also deeply concerned a number of 0.2 free chlorine/total residual or above will exacerbate DBP compliance issues. Without a simultaneous compliance protocol-Acute concerns over Chronic concerns--we are putting water systems in a catch 22 dilemma that will not allow compliance with competing public health issues.

I strongly support increased water quality in Premise Plumbing but was unable to support the Working Group recommendation related to private property rights matched with the goals of the recommendation. EPA would only have authority and tools over the public water systems that supply these buildings and any of those used would burden water systems. So, in context of this issue, I see only costly improvements by water systems with bringing this issue forward to the NDWAC and EPA. I could support requirements within other judicial agencies, if any, related to premise plumbing but that falls outside of EPA authorities.

I was unable to support the recommendation for required precursor control as it is the most expensive and prescriptive option for M/DBP control. It circumvents options and study of the different treatment controls of both Microbial and Disinfection By-Products. The Working Group seemed singularly focused on this being the only treatment option and trying to justify by saying it would also benefit PFAS control which wasn't an issue, NDWAC or EPA point/mission or topic for this Working Group. It discounts and eliminates tools within a water system toolbox that may be more effective, better available technology and affordable. Some of those tools are mentioned above and were brought forward for Working Group consideration without acknowledgement or brought forward as alternatives. I think this position does a disservice to continued lessons learned, increased technologies and advancement in water treatment in public health protection.

I was further unable to support the GWUDI recommendation as it proposes requiring EPA to develop additional rules in this area. I can support the review and update proposals but not the requirement to tell states they must revise their rules. I don't see this as a "one size fits all" requirement as conditions in each state vary widely and these geologic and similar conditions are best to be left to each states review and considerations.

I think I was the only Working Group member to vote against any of the recommendations for reasons stated above and staying out of prescriptive requirement recommendations to the NDWAC and EPA, but I was unable to obtain that flexibility and consideration from others.

In the end I apologize to water systems, especially small systems, that I wasn't successful enough in securing flexibility, corrections/awareness of current rule burdens and effectively expressing and securing support for your concerns and issues with this M/DBP effort.

NATIONAL DRINKING WATER ADVISORY COUNCIL

Report of the Microbial and Disinfection Byproducts Rule Revisions Working Group