NDWAC MDBP Rule Revisions Working Group

National Drinking Water Advisory Council (NDWAC)

January 24, 2023 Meeting 6 Summary

DRAFT EPA MANAGEMENT REVIEW

Meeting Summary

Background on the MDBP Working Group

The United States Environmental Protection Agency (EPA) has sought public input and information to inform potential regulatory revisions of eight National Primary Drinking Water Regulations (NPDWRs) included in five Microbial and Disinfection Byproducts (MDBP) rules following the third Six-Year Review. EPA hosted an initial virtual public meeting in October 2020 to solicit input on further improving public health protection from MDBPs in drinking water. Throughout 2021, EPA sought input relevant to potential rule revisions through additional public meetings focusing on topics identified through public comments and information.

EPA has now charged the National Drinking Water Advisory Council (NDWAC or Council), a Federal Advisory Committee (FAC) established under the Safe Drinking Water Act (SDWA) of 1974 to provide the agency with advice and recommendations on potential revisions to the MDBP Rules. In addition, to support the work of the Council, EPA asked the NDWAC to form a working group to explore specific issues and identify potential MDBP rule revision options for the Council to consider in making recommendations to EPA. More information on the NDWAC MDBP Rule Revisions Working Group meeting schedules and other information are available at: https://www.epa.gov/ndwac/national-drinking-water-advisory-council-ndwac-microbial-and-disinfection-byproducts-mdbp. EPA is currently providing the public with an opportunity to send written input to EPA via the public docket at www.regulations.gov, Docket ID: EPA-HQ-OW-2020-0486.

Meeting summaries and background documents on each meeting topic are available in the MDBP Rule Revisions public docket at www.regulations.gov, Docket ID: EPA-HQ-OW-2020-0486. More information on the potential rule revisions is available at: https://www.epa.gov/dwsixyearreview/potential-revisions-microbial-and-disinfection-byproducts-rules.

Meeting Purpose

The sixth Working Group (WG) meeting was held to continue problem characterization discussions on environmental justice, begin focused discussion on problems relevant to implementation and compliance challenges, and continue discussions about preliminary findings for problem characterization.

This document provides a summary of presentations and discussions from the meeting on January 24, 2023.

Reference articles, updated agendas, presentations, and responses to WG requests for information were shared with the WG ahead of the meeting. In addition to WG members, approximately 125 observers attended the meeting.

Segment 1

Agenda Review and Meeting Procedures

Elizabeth Corr, MDBP Rule Revisions Working Group Designated Federal Officer, Office of Ground Water and Drinking Water (OGWDW), Office of Water, EPA

Ms. Corr welcomed all to the fifth meeting.

Eric Burneson, Director, Standards and Risk Management Division, OGWDW, Office of Water, EPA

Mr. Burneson thanked the WG as well as the technical panel members who have been working to provide information to this WG. He also extended thanks to Ross Strategic for their facilitation of the process, as well as to the EPA staff. Mr. Burneson noted a continued transition from presentations to increased discussion amongst the WG.

Lisa Daniels, NDWAC MDBP Rules Revision Working Group Co-Chair

Ms. Daniels expressed thanks to technical advisors, EPA staff, and fellow WG members. Ms. Daniels shared how the process is on track and that Meeting #6 will allow more opportunity for discussion, looking at preliminary findings, and identifying compliance challenges.

Robert Greenwood, Principal, Ross Strategic

Mr. Greenwood discussed plans for future WG meetings. He shared that Meeting #7 is currently scheduled for March 9th, to be held virtually from 11 AM to 6 PM EST, followed by Meeting #8 on April 19th. He discussed the possibility of having an in-person WG meeting towards the end of June but noted that a decision about such a possibility was on hold pending resolution of EPA budget information. Mr. Greenwood extended thanks to the teams from EPA, Ross Strategic, as well as the Cadmus Group. He provided an overview of the agenda and noted the importance of creating a strong foundation on problem characterization before moving into solutions, as the challenges discussed so far are highly interdependent in nature.

See Appendix 1 for a roster of Working Group members and an indication of those in attendance.

Segment 2

Follow up on Problem Characterization Discussions Related to Environmental Justice

Segment 2: Follow up on Problem Characterization Discussions Related to Environmental Justice.

Mr. Greenwood opened this segment by rereading the NDWAC charge that directly points out the Environmental Justice (EJ) considerations: "EPA seeks consensus recommendations on opportunities to advance environmental justice in regulatory revisions to equitably protect consumers' health, particularly disadvantaged and historically underserved consumers." He then summarized the wide range of EJ topics the WG discussion in the previous WG meeting touched on, including lack of technical, managerial, and financial capacity, limits to recruit/train staff, weakness in utility governance, limited board understanding). Mr. Greenwood characterized the Meeting 5 discussion as a good foundation in broader EJ issues and noted that the underlying systemic EJ challenges transcend the MDBP rules and SDWA itself, with impacts across the environmental arena. Mr. Greenwood then outlined that though today's discussion advances our understanding of EJ and acknowledges the broader challenges that are present, presentations and discussion will focus on specific EJ-related challenges posed by the MDBP rules that will be carried forward in our discussions.

Ken Rotert, EPA OGWDW presented on the responses from technical analysts to WG member questions related to EJ considerations. The responses were derived from input provided by the technical analysts, which included Mark LeChevallier (Dr. Water Consulting LLC; formerly with American Water), Shawn McElmurry (Wayne State University), Andrew Jacque (Water Quality Investigations), Chad Seidel (Corona Environmental Consulting), Zaid Chowdhury (Garver), Scott Summers (University of Colorado, Boulder), and Chris Owen (Hazen and Sawyer). The views shared by the technical experts included some examples from their experience and are not the only EJ challenges that may be related to the MDBP rules and potential revisions. Mr. Rotert also noted that the technical analysts were not experts in EJ issues specifically.

'How are monitoring sites selected?': Mr. Rotert noted that disinfectant residual monitoring sites are linked to Revised Total Coliform Rule (RTCR) monitoring sites. For RTCR sites, they should be representative of the distribution system (DS) and the number of samples depends on the population (about 1 sample site for every 1,000 people). RTCR monitoring sites need to be accessible to the sampler, so typically sample locations are from buildings that are open during business hours. Monitoring in buildings may not represent water quality in a DS under utility control if proper sampling procedures are not followed and if sampled buildings are not capturing all parts of a community served. Some systems use hydraulic models to help identify monitoring sites, but this may not be feasible for systems with limited resources. For DBPs, sample sites are based on population served and what's known about the relative water age (as described in the Stage 2 D/DBPR). For residential areas and other areas of the system where gaining access to public buildings may present challenges, some systems will install dedicated sampling stations that are plumbed directly to the DS mains. Site selection may be skewed toward familiar sample site locations. The final sampling plan must be reviewed and approved by the primacy agency; however, maps may not be commonly shared between systems and regulators.

'What are some of the implementation challenges for disadvantaged communities?': Many challenges exist and can vary depending on the community, and different challenges may exist for situations where the entire system serves disadvantaged populations versus a system where a relatively small proportion of the system serves a disadvantaged community. A few of the challenges that were highlighted included encountering limited resources needed to maintain the system or retain qualified personnel and experiencing significant economic changes which can alter the water demand and change system hydraulics and/or water quality. In areas experiencing significant economic changes and/or where community trust in their public water systems may be lacking, it can be difficult to

find reliable access to monitoring sites. Sample locations with a high perceived potential for a water quality violation may be avoided by some utilities.

'What capacity limitations exist for disadvantaged communities?': Many capacity limitations may exist and often relate to technical, managerial, and financial capacity. Some disadvantaged communities may be in proximity to sources of pollution without options to switch their source water, and these issues of impaired source waters likely compound existing issues of regulatory noncompliance. Some disadvantaged communities (disadvantaged at system level rather than localities within a system) may lack financial resources to make capital improvements and hire additional staff. As a result, systems serving disadvantaged communities may not be able to meet the regulatory requirements and locate sample sites as well as collect samples that appropriately represent the full distribution system.

Panel Discussion

Mr. Greenwood introduced the panelists to further discuss EJ issues for a focused discussion on how they may apply to the potential MDBP rule revisions. The technical panelists included Dr. Mark LeChevallier, Dr. Shawn McElmurry, and Chris Owen. Mr. Greenwood noted that these three panelists were speaking from their experience in working for and with utilities but noted that they were not experts in EJ issues specifically.

Dr. LeChevallier began by citing his past experience as the chief environmental officer at American Water that oversaw 300 utilities and his current work with utilities on water quality, particularly *Legionella*. He acknowledged that utilities are very concerned with quality of service and water that they provide to their customers. Constraints come from financial pressures, particularly for systems that serve disadvantaged populations. Utilities are limited in what they can do and most issues are related to the aging infrastructure (e.g., aging pipes that corrode and provide opportunities for opportunistic pathogens (OPs) to grow). As far as the monitoring that is dictated by the RTCR and the detectable residual, Dr. LeChevallier noted that monitoring selection is not a scientific process of selection and utilities often randomly distribute sampling sites across the system. The sampling location needs to be in an accessible place for the primary sample and utilities will also need two more access points within five service connections above and below that connection. The unintended consequence is that this requirement limits the utilities in where they can sample. Utilities may not be able to access those sampling points with the frequency they need and outside taps are not ideal for sampling for microbial contaminants. Dr. LeChevallier went on to explain that some utilities use dedicated sampling sites, which limits the contamination risk and grants access at any time. An additional concern for sampling in commercial businesses may also increase the potential for cross contamination or mixing of cold and hot water such that the sample may not be representative of the system. Dr. LeChevallier also mentioned that possible perceived bias from utilities toward certain disadvantaged communities may result in inequitable representation of water quality served to those communities with respect to the selection of monitoring sites in the DS. In concluding his remarks, Dr. LeChevallier highlighted the threat evaluation and vulnerability analysis that EPA developed with the U.S. Department of Homeland Security. From that threat analysis, additional research on continuous monitoring 24/7 of the DS rather than intermittent water quality monitoring may be warranted.

Dr. McElmurry described ways of identifying sampling plans and the need for updates and periodic evaluations of these plans. The communities that Dr. McElmurry has worked with have a high level of distrust of the water systems, even when local members of the community are employed. The consumer confidence reports (CCRs) can be a "black box" and include superficial responses to public concerns. Dr. McElmurry expressed a need to engage communities more but also called for releasing data and information for public consumption. There is an opportunity to open the "black box" and engage communities in the collection of the data. Dr. McElmurry went on to explain that new work is being done to promote real-time sensing and all these pieces help bring information directly to the communities. Although well intentioned, utilities, particularly those with limited financial capacity, are going

to collect only the minimum required number of samples rather than collecting the number of samples that actually reflect the specific system. In concluding his remarks, Dr. McElmurry stated that there is a need for greater transparency throughout the sampling process.

Chris Owen explained that it is very challenging in a DS to identify sampling sites, citing her experience as being responsible for regulatory compliance for two large utilities. These systems are subject to primacy agency oversight and there are also sampling requirements that can be challenging (e.g., shipping/moving and analysis). She noted the need to think about additional ways to identify sampling sites, to enhance our understating of the DS and the water quality. Also, there is a need to ensure that the water sampled is representative in the DS rather than the building sites. Ms. Owen also cautioned against having utilities be responsible for premise plumbing systems. She highlighted the need to think about disadvantaged communities in two ways (communities versus systems) since their financial constraints are different and different tools are needed for those different cases. As a final comment, Ms. Owen stated her perspective that utilities do not have sole responsibility to address EJ issues, but they do play a role in providing good quality water to EJ communities.

Facilitated Discussion

Rob Greenwood opened the facilitated discussion with the WG members. The WG members were prompted for any clarifying questions in addition to three specific questions: 1) What additional EJ considerations within the specific context of the MDBP rules are important to acknowledge; 2) What are the predominant components of the MDBP rules that present opportunities to mitigate underlying EJ concerns; and 3) What communities can EPA look to as case studies of potential EJ concerns related to the MDBP rules?

A WG member, interested in a discussion on financial capacity associated with disadvantaged communities (economically challenged) and particularly in aging infrastructure, asked Mr. Rotert to elaborate on EPA's long-term plans on these EJ issues and if EPA is discussing this as a systemic issue. Mr. Rotert responded that there are funds specifically set aside for disadvantaged communities in EPA's State Revolving Fund and under the Bipartisan Infrastructure Law (BIL). Those funding mechanisms get to the long game in terms of infrastructure improvements in disadvantaged communities. Additionally, Mr. Rotert added that EPA plans to evaluate EJ issues as part of the rule development process. Mr. Burneson added that the EJ problems extend beyond BIL, but there are additional partners in OGWDW that have programs on capacity development in addition to tools for states and technical assistance providers. EPA has numerous programs in partnership with states to address capacity issues in addition to BIL. Mr. Greenwood also noted that that there are many underlying systemic problems, so the WG will need to keep the focus on the scope that the NDWAC WG has been given. The WG can acknowledge that additional recognition is needed for systemic EJ issues, but this discussion may be more appropriate during the intervention section rather than the problem characterization phase of the NDWAC WG meetings.

Another WG member highlighted issues seen in Flint, MI and Jackson, MS, which are lower income communities, in trying to support a large distribution system that they cannot maintain (i.e., shrinking city syndrome). These communities have lost population or have had homes abandoned, such that minority populations are receiving sub-standard quality water. With the decline in population, water may sit in the distribution system for longer than initially designed which may result in contaminant increase and decrease in disinfectant residual. This WG member went on to ask 'where is the priority being given to distribution system upgrades' since we are seeing prioritization for commercial areas rather than older parts of the cities that are lower income areas. Disadvantaged communities often lack O&M funding, as seen in Jackson, MS and elsewhere, and this applies to microbes and DBP issues. Dr. McElmurry responded by acknowledging that shrinking cities are a problem and that there is a need to update and reevaluate systems as they age. He also noted that there is a huge bottle neck at the state level to designate and

distribute funds to disadvantaged communities. Additionally, Dr. McElmurry mentioned a potential lack of technical expertise or guidance within the states that may affect the capacity or ability to quickly process and administer funding (responding to cash infusions), which may exacerbate existing disparities.

A separate WG member stated that the role of sampling sites and their representativeness is very important. Under the current MDBP rules, 5% of samples can be non-detects for disinfectant residual, which means that the most vulnerable locations in the DS may not be getting adequate residual even when a system is in compliance if the samples are not taken in areas serving disadvantaged populations. Timeliness of public notification and whether it is meaningful to the consumers served is also a concern. The WG member called for more information to be added to SDWIS Fed, which would include more reporting, more data, and more transparency. Specific case studies on systemic issues as applied to the MDBP rules are also needed to better characterize existing EJ-related issues. The WG member provided the example of Benton Harbor, MI in which they received a loan and expanded treatment capacity at the same time as their population declined; this resulted in taking on a large loan with fewer people to serve. In 2018, Benton Harbor identified eight significant deficiencies (e.g., CTs calculations were off, lack of public notice) before a lead crisis was revealed; however, the MDBP issues had been present all along. Two additional case studies that were shared by the WG member were Flint, MI and Highland Park, MI. Flint's use of intermittent blending of sources and their elevated turbidity (no turbidity requirements for consecutive systems) were cause for concern. The WG member expressed that if there are more opportunities for consolidation to help disadvantaged communities, then the systems also need to look at implications like turbidity to ensure the rules are protective of public health. In Highland Park, MI, they were not able to apply for loans to help with the MDBP issues due to court disputes but there may be changes to the rules that could have mitigated these issues.

A WG member added that they agree with points made earlier in that federal funding is often aimed at capital investment but there are needs for more funding on O&M, particularly in disadvantaged communities. This was echoed by another WG member who noted how regulatory infrastructure is needed in each state to push improvements in these areas. Regarding tradeoffs between affordability and public health protection, this WG member questioned that if costs were to increase, would the customers be able to afford it since their rates may increase? The workgroup member stated that a high percent of many family budgets going towards water would mean less funds for other things such as food. The WG member added that additional costs will result from increased MDBP-related regulations, and there may not be enough in federal funding to fully offset the costs of these regulations.

Another WG member pointed out that the object of sampling in the DS was to represent the system. Systems are not homogenous and speaking of the "system" may not be appropriate, as this assumption does not account for different portions of the system and potential disparities among populations being served. There is variation within those shrinking systems, and it may be more appropriate to measure those variations. This member asked the WG if sampling sites could be tied to population density since this might better capture disproportionate impacts.

A WG member then asked how these EJ issues have an impact on the MDBP rules themselves particularly when water rates have been kept at artificially low levels for some time. Many customers are not realizing the true cost of utilities to function and provide good water quality. This WG member explained that it is not sustainable and smaller systems may not be able to survive. There may be a need for consolidation with increased regulations for decision makers to have an impact on EJ issues.

Another WG member reiterated the need to keep linking the EJ issues back to the MDBP rules (e.g., monitoring plans, sampling sites, public notification). These are components of the rule that the WG could look to improve while keeping EJ issues in mind. Other things may be outside of the MDBP rules (e.g., capacity development) and some problems can be addressed through other programs (e.g., technical assistance programs at the state level).

A WG member brought up the political component to many EJ issues and discussed experiences in Wisconsin. Most of the population in Wisconsin is served by municipal systems and infrastructure project selection for such systems in that state has been impacted by politically-motivated decisions. Some of these communities have also experienced fraud with people pretending to be water utilities and most utilities cannot afford to hire public relations employees to create better relationships with the community.

A separate WG member highlighted capital budgeting, which is a complex process (i.e., budgeting the number of breaks per mile). He noted the challenge of figuring out how to factor EJ challenges into capital planning such as with prioritizing the pipe replacement. He suggested that the WG's scope is not to regulate the capital projects, and that concerns about the MDBP rules is only going to be one of many factors considered in capital planning.

Another WG member added articles to the webinar chat (see below) that highlighted disproportionate violations and lack of enforcement in EJ or lower income and/or minority communities. The WG member stated that these published resources helped show exactly how the MDBP rule revisions could address the EJ issues discussed earlier, but there is a continuing need to understand how these potential rule changes could be implemented and enforced. This WG member also reminded others of the CDC presentation from Meeting 5 that showed a larger burden of legionellosis on Black populations and the need for the WG to explore this further. Lack of adequate health care may also be contributing to these disparities in health outcomes and additional disproportionate impacts.

References submitted:

David Switzer, Manuel P. Teodoro, The Color of Drinking Water: Class, Race, Ethnicity, and Safe Drinking Water Act Compliance, JAWWA, Volume109, Issue 9, Pages 40-45, September 2017, https://doi.org/10.5942/jawwa.2017.109.0128.

Dr. Kristi Pullen Fedinick et al., 2020, Watered Down Justice, https://www.nrdc.org/resources/watered-down-justice

Segment 3

Problem Characterization Relevant to MDBP Implementation and Compliance Challenges

Mr. Greenwood introduced speakers for Segment 3. Laura Cummings, Executive Director for Southeast Morris County's Municipal Utility Authority of New Jersey (SMCMUA), and her colleague Drew Saskowitz, the Authority's Water Quality Superintendent and licensed operator for water treatment and distribution, presented on the perspective of large water systems. Ms. Cummings also serves as the alternate treatment and distribution licensed operator for the Authority and is the plant's former Superintendent and licensed treatment operator.

Dr. Delvin DeBoer presented on the perspectives of small and rural systems. Dr. DeBoer held a teaching and research career as a Professor of Civil Engineering at South Dakota State University, and currently works as a consulting engineer with Advanced Engineering and Environmental Services.

Ms. Cummings opened the presentation with challenges, specifically on cost, risk balancing, and balancing resilience associated with water quality and its protection. A key part is how 'risk' is defined, whether in the context of public health, safety, security, or protecting systems against climate change. Physical and cyber security threats along with

the general day-to-day asset management of reinvesting in new infrastructure, and existing infrastructure, all contribute to significant costs. The questions presented were: 'How much risk do we want to reduce? How much resilience do we want to improve? How does that affect our water rates? How do we define a critical path?' A compounding issue includes staffing and the pressures associated with retaining staff, as well as recruiting new, qualified staff. This runs in tandem with layering additional work across multiple programs while vacancies remain and new staff undergo training.

Ms. Cummings noted how the regulatory landscape also plays a role and presents its own solutions and future challenges. New Jersey's state legislature is considering a bill (S1006) focused on distribution systems, disinfectants, residual management, as well as building water management. It would also apply to certain types of healthcare facilities and structures. For example, for buildings 10 or more stories high, the bill would require a written program compliant with specific standards or comparable ones, alongside *Legionella* testing requirements, for annual reporting out to state agencies as well as the governor's office, including a requirement of a public awareness campaign. In 2016, the State moved forward in requiring lead testing in schools. The state legislature also mandated lead service line replacement for all of its public water systems, with completion aimed over a 10-year period (and an option to extend that time-frame through another five years). Separately, the Water Quality Institute considered an MCL for 1,4 dioxane but that had not moved into the regulatory atmosphere at the time.

SMCMUA is a large public water system, producing an average of 8,000,000 gallons per day, for a population of about 65,000. A 600-elevation change is notably present across the system, resulting in eight different hydraulic gradients with 10 locations allowing water to move from one gradient to the next. Fifteen water storage tanks are distributed through those gradients, and there are 340 miles of water mains, along with 17,500 service connections. They use 12 different sources of treated water between ground and surface waters which are supplied to different gradients. Morris County owns a reservoir at the western end of its system, along with 9 wells spread across different gradients. In addition, water is purchased from the Passaic Valley Water Commission (PVWC) and a Municipal Utility Authority from one point of entry.

Ms. Cummings emphasized that while the system is in compliance with all primary MCLs, the next set of discussion points will describe proactive approaches. To stay ahead of revisions to current rules for emerging contaminants, surface water treatment plants include membrane ultrafiltration, followed by Granular Activated Carbon (GAC) for taste and odor control, along with corrosion inhibitors and free chlorine disinfection. They are in the process of adding pH control for reducing corrosivity. SMCMUA is taking proactive steps to address multiple goals, all of which will require feasibility studies. They provided an example for the goal of reducing total and dissolved manganese at intakes by relocating the water treatment plant recycling streams to the middle of the reservoir. The aim is to improve oxidation of manganese with a new hydrolytic aeration system. A separate step includes removing cyanotoxins and enhancing taste and odor control by adding to existing GAC absorber capacities. Further, they aim to reduce DBP precursors by optimizing current treatment procedures and protocols. The utility also aims to improve primary disinfection by increasing free chlorine contact times. There are currently no issues with meeting New Jersey's MCLs for PFOA, PFOS, and PFOA however, in anticipation of regulations pushing compliance limits to current reporting limits, feasibility studies will likely be required for nine wells. Three wells currently have 1,4-dioxane detections.

For potential regulations on disinfection residuals in the distribution system, whether a numerical level that might be established by EPA or the 0.3 mg/L under consideration by New Jersey, there are ongoing designs for comprehensive feasibility studies to meet either goal. Designing new unit treatment processes at the points of entry or adding booster chlorination throughout the distribution system are two options. They are also considering improving mixing in water storage tanks or reduce water age in tanks by altering storage levels at different times. A key consideration is how either option might impact the supplies available for fire demand or through flushing, which would have negative

impacts to meet allocation permits and water conservation requirements. Another consideration includes revenue impacting staffing or requiring significant capital funds to add automatic flushers throughout the system.

Morris County is part of a consecutive system, with water purchased from two utilities, one which is a wholesaler of groundwater. Treatment goals for this supply are to reduce corrosivity, while improving free chlorine distribution. A new treatment facility is currently under construction. The other purchased supply is from surface water which can either be a blend of water treatment from Sage Valley Water Commission (who upgraded treatment to include rapid sandblasted flocculation, sedimentation followed by ozonation, sand filtration, secondary free chlorine disinfection, and corrosion control). Other supplies are derived from the North Jersey District Water Supply Commission which is strictly a wholesaler system with conventional treatment and is located further up the supply pipeline.

Based on the receipt of blended water, taste and odor complaints periodically arrive based on Methyl-Isoborneol (MIB) and Geosmin concentrations, or from DBP concerns based on water age of the water traveling from the North Jersey District Water Commission. Under a contractual agreement, water from these two points of entry must meet regulatory compliance.

The SCMUA system's two points of entry from separately purchased waters and different pressure gradients requiring dedicated but different treatment present complex challenges. In some cases, it appears more cost effective to add treatment at the source rather than adding treatment at multiple entry points for consecutive systems. In order to facilitate evaluation for potential additional treatment, wholesale and bulk supplies would need to monitor DBP and disinfectant residual concentrations at their points of entry for contracted customers. An option under consideration is to create monitoring plans with Operational Evaluation Levels (OEL) set up with a shared evaluation by the wholesaler and purchaser. The disinfectant residual target would be to maintain or exceed a 0.2 or 0.3 mg/L requirement to minimize any need for booster chlorination by the purchaser (minimizing further potential issues with DBPs).

Factors SCMUA must consider include: 'How much are we going to invest in risk reduction and improving our resilience and how much does it cost?' Looking at various different improvements, whether for drinking water quality regulations, flood mitigation improvements, asset management, or operational cost, the perspective returns to strategic planning. In particular, solutions point towards critical paths for achieving different improvements that will result in the least cost to customers.

Mr. Greenwood thanked the presenters from SMCMUA for their presentation and opened Dr. DeBoer's presentation which covered MDBP regulation implementation challenges for small and rural water systems. The first topic included system characteristics separated in two categories: one on rural water systems and one on small water systems.

One significant characteristic of rural water systems is that customer density can be very low. The context can be one customer per square mile or 10,000-50,000 customers depending on whether a municipality is hooked pn to the system. In addition, they can be served by multiple water sources with substantial differences in water chemistry. Water sources may be 50 or 100 miles apart and serve very different ends of a region or system. When water is blended into distribution systems, unique situations are created where multiple water sources with many changes in water chemistry will present particular challenges, especially in terms of how disinfection demand might appear across a distribution system receiving blended waters. Regional water systems routinely have branched distribution systems as opposed to looped systems (more commonly found in municipal systems). The result are longer water ages as water moves from one customer to another through small-sized pipes such as 2-6 inches. This may lead to disinfectant residual decay, DBP formation, and increased risk for growth of Opportunistic Pathogens (OP). Other organisms can also contribute to chlorine demands or create water quality issues separate from those associated with MCL violations but still can complicate water quality maintenance efforts.

Although they may not have been included in the original footprint, some smaller (consecutive) systems that exist in a service area of a smaller, regional water system have found it increasingly difficult to meet compliance due to economic or technological factors. As a result, this creates a need to approach treatment and management differently to address potential non-compliance or complaints associated with water received from other systems.

For small water systems, low customer populations in many cases makes best available treatment unaffordable. In addition, older infrastructure is more frequently found in smaller systems, which similarly to those mentioned earlier for rural systems, can contribute to additional disinfectant residual demand. Small systems may also find it difficult to employ qualified operators. For these systems just collecting compliance samples on a timely basis is a major effort. Required maintenance needs for continued operations is an added, compounding issue. Many small systems are focused on maintaining regulatory compliance on a month-to-month basis, as opposed to planning ahead and studying feasibility to address regulatory changes, as was described in the large systems presentation. Geographical features also play a strong role into the quality of water sources that small systems are reliant on, which can vary greatly from one area of the country to another. An increasingly common issue is how groundwater contains a combination of organic matter, naturally occurring ammonia, and inorganic contaminants that complicates MDBP treatment. Where some small systems encounter high concentrations of ammonia, TOC, or traces of arsenic, the same system might need to prioritize contaminant removal against iron and manganese, or DBP formations.

Dr. DeBoer moved into the challenging features of current rules. Some treatment techniques which exist to minimize DBP formation may cause other water quality issues. An example includes systems using chloramine as an alternative disinfectant but having difficulty to hold chloramine residuals to prevent microorganism growth, and concerns about chloraminated water nitrifying and causing corrosion. While significant work has been done to learn optimal techniques for use of chloramines, small systems face the specter of the unknown that at some point chloramination will not be available as a technique. Issues like this are more directly impactful to a small system, particularly where source water can cause operational issues which seem insurmountable to a small system operator.

Small systems are also looking to wholesalers to provide water which meets requirements of the Safe Water Drinking Act (SDWA). DBP rule compliance remains a significant concern, especially for those being served by consecutive systems. This issue relates to economic or market factors which affect implementation. Supply chain issues relative to availability and deliverability of treatment chemicals are depended on by small and large systems alike and how that supply chain is managed and maintained is a key concern, particularly for smaller systems. System age is another area affected by supply chain because it can be more difficult to find replacement parts for older, smaller systems. Many such small systems like this are those which house disadvantaged communities where water budgets can't financially support operations or afford escalating maintenance or capital improvement costs. A one-size-fits all MCL then becomes difficult to explain to smaller systems. When new system compliance requirements enter, there are often community sentiments that requirements should not be applicable to them the same as to those of larger systems. A hidden reality includes smaller systems waiting to conform to new compliance requirements only when asked by their primacy agency, as compared to proactive measures taken by larger systems.

With conclusion of the presentation, Mr. Greenwood opened the floor to WG members to engage in dialogue with presenters. In addition, the following questions were posed:

- Clarifying questions?
- Do you have additions or refinements to characterization of implementation challenges?
- What additional information will be helpful to further understand implementation challenges?
- Within the drinking water value chain, what do you believe are the most prominent root causes of implementation challenges?

A WG member raised questions on the effectiveness of technical assistance provisions to small systems and asked if many small systems are getting access to such provisions and optimization programs. In addition, are small systems aware of how to access such services (if available), do they reach out when in need of them, and has EPA quantified what it would take to meet technical assistance needs of all communities considered to be disadvantaged?

Dr. DeBoer noted that as part of the Capacity Development Program, states are required to identify all of their small systems and prioritize them based on a variety of factors. In addition, technical assistance efforts are designed around those small systems with unique needs whether that includes trainings, or questions on dosage and rate feed settings. Questions could also be related to filtration plants and optimization for distribution systems. Once there is an ability to evaluate needs, the path of program creation follows, and certified operators are paid to help and train, whether at the system or state level. In some cases although systems reach out first, there are instances where states will reach out to systems based on their priority ranking.

A WG member pointed out how large systems in Arkansas may be less comfortable suggesting treatment techniques to assist smaller systems because those larger systems are overwhelmed addressing their own needs. The WG member noted that EPA has performed well with providing technical assistance and that the Rural Water Association retains boots on the ground. They help systems with a large range of problems where identified. For small systems, a continual issue is funding. Published and vetted treatment techniques often cost more than a small public water system with a community of 300 can afford. Furthermore, some techniques won't work well for smaller systems, such as when installation of new mixing systems require flushing a significant percentage of water out which they cannot afford to lose. Those same techniques might require continual or additional flows from the wholesaler, which the wholesaler will need to produce and the purchaser will need to account for with costs. In some situations, some small systems were not able to produce their own water anymore, which resulted in discontinued use of their treatment plants, wells, etc. In those cases, there is increased reliance on consecutive systems with big infrastructure issues. The WG member emphasized keeping eyes towards this issue and ensuring that rule revisions adequately address small systems, as well as regions, which fall into this issue.

With respect to Florida, one WG member noted how EPA provides states with a health-based violation list on a quarterly basis for addressing compliance. Florida receives approximately 100 of those on that list, and most are related to DBPs. Engineers on staff at the Rural Water Association are technically adept and can concentrate on addressing issues with specific systems though most measures are temporary for allowing compliance to be met. This is attributed to limited staffing at the utility and therefore systems will find themselves out of compliance until those technical experts can return to assist. When we talk about small systems remember this could be as few as 15 connections and 25 people. Whether an individual or group has the financial ability to be in the public water system supplying business is another question. A question posed to the WG: Can a more significant change be devised that will improve water quality beyond just managing MCLs? In this member's experience, there are tools in the toolbox, although not all are acknowledged nationally, but there is not enough testing and water quality science to efficiently determine which tools to apply to a particular water system. Although engineers can undertake significant effort to design the best solution, repeated testing for a variety of treatments takes time and funding to determine which technique if any might be fruitful. The WG member also noted how best available technology is often available for larger systems though not smaller systems. Many solutions require research at a smaller system level to suggest possible effective solutions, while also addressing affordability.

A WG member noted three categories with the first being improvement on implementation of current rules, as particularly with smaller systems solutions are often not 'one size fits all'. While states work with these systems, despite resources being short, it's often that a tremendous amount of time and effort is required to realize success. The cost is great to regulatory entities as there is often limited time to put into such efforts. A separate point raised pointed to the 'true cost of water', where the cost of water is two-fold. Currently, surface water treatment plants have

moved into industrial and chemical-physical plants. These are expensive and costly to run, and often times municipalities or smaller systems can't commit to such plants and sustain them in rural areas or for rural customers. An added cost comes from consultants, and for the time it takes for consultants to travel and assist. This brings into the question appropriate technologies for these areas. If extremely sophisticated, different processes that are difficult to operate and maintain in functioning order, which is a detriment because small municipalities, systems, and rural areas may not have the needed expertise. In addition, they are unable to obtain prompt attention from external sources of assistance. Though funding for construction might be attainable and the Drinking Water State Revolving Fund (DWSRF), operational expertise is a separate funding issue. Consolidation of systems is a solution but it was pointed out again that sometimes systems are so far removed that sharing expertise and conducting maintenance remains expensive, particularly with extended miles of piping. An additional point raised noted the challenge on retention of operators, not only due to insufficient salaries but often times small systems will have just one operator trying to accomplish everything.

In addition, disinfection requirements can be more protective with a minimum numeric disinfectant residual requirement for distribution systems. Extending the requirement for the life of a treatment facility and establishing minimum values for removal of *Giardia* and viruses might go a long way to protection of water quality. With that point, the introduction of DBPs created complicated situations for maintenance of disinfectant residuals, specifically with its calculation of CT. Separately, the WG member raised an idea of multiple systems becoming one central system, and having different parts work together, with cooperation to assist on impacts to one another. Consecutive systems assisting one another might go a long way to proactively heading off problems such as with DBP formations. Several other points included sampling at points of connection, maintaining more quality control in the distribution system, understanding the nature of rural lines, evaluation of treatment technique requirements (such as for TOC), driving down TOC at plants and distribution systems, developing more effective and less expensive ways to improve existing regulations of DBPs, and include cost-effective measures for managing TOCs at treatment plants such that high costs of treatment will not cause water systems to fall out of compliance when affordability becomes an issue.

Another WG member bridged discussion from TOC to Dissolved Organic Carbon (DOC). They encouraged learning more about the nature of organics leading to DBPs, specifically with that of groundwater. A separate comment pointed to chlorine measurements being taken at the same time and locations as coliform samples. Smaller systems under 500 connections are required to collect so few samples in a month and this may not be sufficient for groundwater or surface water systems.

Another WG member emphasized making any rule revisions less burdensome and potentially less complex as other members are repeatedly mentioning complex issues and tradeoffs with risk trade-offs and simultaneous compliance, while also extending public health protections out into the distribution systems and tackling opportunistic pathogens. WG expressed needing additional clarity on burden reduction measures and how to best create and institute such measures.

A WG member returned to a point about technology, where one best-utilized technology in one part of the country might also work in the same part if water quality issues were understood regionally. One potential approach is to work on an innovations committee to come together with solutions across multiple states. Regulators repeatedly question whether pilot studies are needed, which technologies work best, or how to help expedite approvals for solutions that need to be put in place for systems of varying sizes. Targeted technical assistance is allowed for in the current DWSRF structure. Capacity Assessment Programs also help identify which systems need assistance whether technical, managerial, or financial and sharing knowledge on how to make these programs best work in other states could also be helpful.

Another WG member brought up tribal communities such as in South Dakota, where there are serious challenges related to environmental justice. The WG member pointed out that Congress added a provision in the SDWA called the

Capacity Development Provision ensuring that states oversee that all community water systems demonstrate technical, managerial, and financial capacities. Asking them to comply with every National Primary Drinking Water Regulation (NPDWR) without the capacity was underscored as an important issue.

A separate point was raised by this WG member regarding turbidity monitoring regarding sequential systems that are not required to monitor turbidity at connection points, and whether discussion needs to be opened on elevated influent turbidity to downstream systems.

Another WG member noted successes in implementing rules. An example described LT2 Enhanced Surface Water Treatment Rule (LT2) where sampling was required to find out the actual presence of *Cryptosporidium*, its actual amount, and the treatment required along with associated real trigger actions. The WG member suggested this as a route for the WG to consider for the MDBP rule revisions though there are alternative ways to regulate or learn lessons from the LT2.

Another WG member noted the importance of conveying the value of water especially in situations where water costs are rising. In particular, the member underscored that good water quality has value, and that value is not only relevant when there is an insufficient quantity of water. An underpinning of what it takes to bring the service and quality to the public and why it is valuable to them is important.

Another WG member related to communicating risk when setting regulatory limits. Conveying how far is needed to go with any associated cost and benefits is especially important for consumers and utilities to hear.

Segment 4

Synthesis of OP and DBP Data and Analysis, and Preliminary Findings for Problem Characterization

Introduction

Rob Greenwood reviewed a draft facilitator's presentation titled MDBP Problem Characterization (Topics 1-5), which contained compilations of previously shared information organized into five topic areas focused on opportunistic pathogens and disinfection byproducts (DBPs). Mr. Greenwood explained that the presentation is intended to serve as background reference material for facilitating Working Group (WG) discussion. To create the slides, the facilitation team, in collaboration with EPA staff and the Technical Analysts, reviewed previously provided presentations and reference materials to identify the most salient information for drawing conclusions related to opportunistic pathogens and DBPs problem characterization. Because the draft presentation slides were provided to the WG members well in advance of Meeting 6, Mr. Greenwood had collected feedback individually from WG members and shared a high-level review of the comments received on each slide. Mr. Greenwood explained that the comments will be incorporated into the next version of the synthesis materials.

Following his review of the slide feedback, Mr. Greenwood opened the floor for group discussion, encouraging members to state their narrative problem characterization takeaways on each of the identified topics to allow WG members to understand each other's perspectives on problem characterization.

For this Meeting Segment, the summary text assembles WG member comments thematically (rather than chronologically) and under each of the individual topic areas to enhance reader understanding of the areas of convergence and divergence among WG members. Topics 1 through 3, which focus on opportunistic pathogens, were setup for WG member discussion using the following question: "For Opportunistic Pathogens, (e.g., *Legionella*, MAC, *Pseudomonas*), based on the presentations, resource material, and discussions to date, what conclusions are

emerging for you with respect to: public health outcomes; the primary root causes; and the degree of certainty we have for these conclusions?" Topics 4 and 5, which focus on DBPs, were setup for WG member discussion using the following question: "For regulated DBPs (e.g., THM4, HAA5) and unregulated DBPs (e.g. brominated HAAs, haloacetonitriles, iodinated DBPs, nitrosamines, chlorate) based on the presentations, resource material, and discussions to date, what conclusions are emerging for you with respect to public health outcomes; the primary root causes; and the degree of certainty we have for these conclusions?"

Topic 1 – Drinking water system pathogen-related public health impacts – evidence and root causes related to water quality conditions in distribution systems and their relationship to outbreaks/illness.

Legionella

A consistent theme emerging from WG discussions was the perspective that drinking water is a contributor to *Legionella*-related public health impacts, and there is an opportunity to improve public health outcomes through improved drinking water quality management. Furthermore, consistency in the belief that both public water systems and building water systems have a role to play in improving these outcomes was indicated.

The initial problem characterization statement put forward from a WG member was that there is convincing data from the Centers for Disease Control and Prevention (CDC) and other sources that *Legionella* in drinking water is problematic. Placing the issue within the context of modern public health threats, the WG member stated that the public health impact is not COVID-19 level, and it is not zero. The WG member continued that *Legionella* is clearly a problem we need to look at. Generally, WG members agreed with this initial problem characterization statement with one adding that the National Academies of Science, Engineering, and Medicine Report: Management of *Legionella* in Water Systems provides further compelling evidence that there is an issue with *Legionella* that needs to be better addressed in drinking water. Several WG members indicated that *Legionella* needs to be looked into at the utility level, and there is a role (for some WG members a leading role) for public water systems in addressing public health impacts from *Legionella*. Another WG member indicated the current evidence supports considering "tweaks" (minor changes) within the current regulatory and operating environment, with some WG members then cautioning that what might seem like minor changes for certain utilities could represent substantial changes for others.

A complementary perspective on this initial problem characterization statement was that, while we do not have all of the information we need, we have strong reason to believe there are disparate, from an equity standpoint, public health impacts from *Legionella* that are important to consider. Further, a WG member identified that there are regional disparities in *Legionella* public health impacts, as the Mid-Atlantic states and Pennsylvania see relatively larger numbers of Legionnaires' disease outbreaks. In those regions, state regulators have been in a position to address outbreaks, but nationwide measures should be considered based on the CDC data.

Some WG Members offered that, while in agreement with the initial problem characterization statement, it is important to note that the increases seen in disease from *Legionella* are important but not all are attributable to drinking water systems. These WG members indicated that, while there are some actions that can be undertaken on the treatment and distribution system side of drinking water, improvements to building water quality management will be critical if public health improvements are to be realized. WG members added further cautions to the discussion including:

- utilities face many risks and challenges (e.g., other priorities such as investing and managing for climate impacts) that need to be considered in the context of framing pathogen control;
- any additional controls put in place to address opportunistic pathogens will also have to be weighed with the other public health impact risks from DBPs;
- and *Legionella* occurrence data within water distribution systems? remain limited at this time leaving an open question as to the degree of need for further federal regulatory action.

Mycobacterium avium* Complex (MAC) and *Pseudomonas

WG member observations were more limited related to MAC and *Pseudomonas*, and their perspectives were influenced by the limited availability of research associating drinking water to public health impacts, as well as an overall sense that there are more significant routes of exposure than that of drinking water. Specific observations included:

- We do not have enough input to draw conclusions about these opportunistic pathogens.
- There are multiple opportunistic pathogens that have a role in drinking water quality. The WG has had less focus on MAC and *Pseudomonas* and there is less research, leaving the WG with less ability to draw conclusions related to problem characterization.
- MAC and *Pseudomonas* also (in addition to *Legionella*) have public health impacts and are "not to be trifled with."
- In hospital outbreaks, *Pseudomonas* and MAC do not have the same level of exposure as *Legionella* because they are related to a specific building or specific spigot within a building.

Topic 2 – Premise plumbing pathogen-related public health impacts – evidence and root causes related to water quality conditions in premise plumbing and their relationship to pathogen-related outbreaks/illness.

A theme that emerged under this topic is that improvement to building water quality requires attention if opportunistic pathogen related public health impacts linked to drinking water are to improve. A second theme is the concept of shared responsibility between building owners/managers and public water systems for addressing opportunistic pathogen drinking water-related public health impacts. Additionally, WG members highlighted the importance of 1) distinguishing between different types of buildings and related premise plumbing systems being managed (e.g., those providing treatment and therefore regulated under the Safe Drinking Water Act (SDWA) and residential buildings including single family residences), and 2) establishing reasonable assumptions about knowledge level and water quality management practices implemented by those controlling/managing the building plumbing.

An initial problem characterization perspective shared by a WG Member was that utilities and building water managers share responsibility for public health impacts from opportunistic pathogens and both need to do their part to solve the problem. Utilities need to deliver as clean of water as possible into buildings and should expect that building water managers will operate in compliance with all CDC recommendations (e.g., CDC Building Water Management Program) to continue the provision of safe water. This member stated that it would be helpful to break out *Legionella* occurrence between commercial and residential buildings. Another member agreed with the concept of shared responsibility between utilities and premise plumbing and pointed out that building codes and insurance requirements for building water management plans may be effective vehicles for achieving public health protection on the premise plumbing side (in response, one member raised the question of how effective building codes are at influencing water quality management behavior in buildings). Additional aligned perspectives shared included:

- improving public health impacts from opportunistic pathogens is a multi-party effort that will have to include the building side;
- it would be helpful to learn more about educating building water system managers and encouraging more action on their part, as well as being able to communicate to homeowners the dangers of water age and stagnation in their home plumbing;
- and part of the shared responsibility means that utilities cannot be expected to account (or have responsibility) for changes that a homeowner or premise owner may make to water quality through additional on-site treatment or filtering.

As an example of shared responsibility, one WG Member relayed their experience investigating Legionnaires disease outbreaks in buildings and needing to look upstream into the public water system for red flags as to causes of outbreaks, including in distribution systems. In a building such as a nursing home or hospital, water conditions can contribute to outbreaks in those systems, but the seeding of the opportunistic pathogens is coming from somewhere, either the distribution system or on-site causes. This member stated that, although there are limits to regulatory jurisdiction over building water quality, the WG can give recommendations for building owners to understand their necessary role in water quality management. Other members reinforced that, while in agreement with shared responsibility, *Legionella* is seeded in premise plumbing by water from distribution systems and limiting *Legionella* and other pathogens in the distribution system is very important. In response, one member expressed interest in learning more about the effectiveness of building water management regulations adopted by the State of New Jersey.

Emphasizing the importance of distinguishing among the different types of buildings and responsible parties, another member offered that water systems extend from public into private spaces, and the WG needs to be thinking beyond just larger buildings (some of which do their own treatment) to include individual households. Because the average homeowner or member of the public knows very little about the existence and threats from microbials (e.g., little public information is available on building water quality due to limited or no monitoring on the building side), it should not be assumed that they can (or should) effectively protect themselves from microbial exposures. From this member's perspective, consumers expect the utility to provide water that is safe, and it is the utility's responsibility to provide safe drinking and showering water, in contrast to placing the burden on residential consumers. An additional WG member perspective related to important factors to consider when distinguishing different types of buildings highlighted multi-family buildings where individuals or building owners cannot afford to use certain best management practices such as flushing, or have not been educated in and/or information has not been provided to them to implement best management practices and how those situations should be included in any opportunities for improving public health impacts. Additional WG member observations included that Point of Use (POU) devices used for lead control may provide a platform for OP growth, and Leadership in Energy and Environmental Design (LEED) certifications requiring water conservation measures can negatively impact building water quality.

Topic 3 – Distribution system water quality conditions related to opportunistic pathogens – evidence and root causes of variable conditions and related vulnerabilities within the distribution system.

Regarding opportunistic pathogen growth root causes in distribution system water quality conditions, a primary theme from the WG discussions was that there are a variety of distribution system operating conditions that can support the growth of opportunistic pathogens in drinking water. A second theme that emerged was the uniqueness of every distribution system and the complexity of changing practices that can promote growth conditions throughout the system.

The initial perspective shared on this topic was that drinking water utilities need to do their part to deliver safe water through their distribution systems. Other members agreed with this perspective, with one member specifying that water conditions in distribution systems such as water age, nitrification, and sediment buildup are underlying conditions that exist within distribution systems that contribute to an environment that can contribute to outbreaks. This member stated that low or variable disinfectant residual could be a significant root cause for opportunistic pathogen growth in distribution systems. Other members agreed that there are variable distribution system management conditions that could be improved upon, and there will be value in raising attention and understanding of distribution system and treatment plant practices that can improve the consistency and safety of water quality delivered to buildings.

Several members focused on variable disinfectant residual as a root cause, with several members indicating that, in future discussions on possible interventions, a numeric minimum disinfectant residual could provide an improvement to existing conditions in distribution systems. Other members shared interest in investigating this intervention, while noting the complexities of changing distribution system conditions which could require significant capital investment and operational changes, depending on the scale and status of a water system. Additional root causes include biofilms and storage tank management practices. A WG member noted that practices that could limit biofilms and sediments may address this root cause, in particular, increasing the amount of disinfectant residual levels to account for pathogens.

The uniqueness of every distribution system was emphasized by several members, and the opportunities to address root causes through adjustments to the current regulations was noted as an item for future discussion. A more specific perspective offered on this theme was that distribution systems are not, and are not intended to be, sterile. This member indicated that there will always be biofilms in distribution systems, and, due to the unique complexities of individual distribution systems, there is a need to focus on realistic, implementable, and reproducible practices. This member agrees there may be changes within currently regulated practices that can offer improvement but cautioned that significant changes to distribution system infrastructure would be hard to achieve (e.g., for municipalities that are experiencing loss of industry or population, it will be very difficult to right-size the water infrastructure).

Topic 4: Drinking water DBP-related public health impacts – evidence and root causes related to DBPs in drinking water and their relationship to public health risks. (NDWAC charge areas 1, 2)

WG members discussed that research undertaken since the implementation of Stage 1 and 2 D/DBPRs signal that certain unregulated DBPs have the potential to pose both cancerous and non-cancerous health effects. Some members noted that more data are needed to inform future discussions related to which DBPs could have the greatest public health impact, including which ones, if controlled, have the potential to limit formation or occurrence of other DBPs.

The WG member discussion related to DBPs of concern included the following observations:

- Some members noted that data made available since the implementation of Stage 2 D/DBPR reinforced concerns about various regulated as well as unregulated DBPs including nitrosamines (such as NDMA), brominated DBPs, and haloacetonitriles (HANs). The data indicate (the discussion included careful characterization from some members such as may indicate, indicate a trend towards, indicate the potential for) risks for certain cancers from long-term exposure, while reproductive and developmental studies indicate the risk to pregnant women and their offspring from short-term exposure. One member suggested that the current regulatory framework focused on THM4 and HAA5 may have allowed more potent DBPs to form. Another member indicated that some unregulated DBPs could affect different populations in different ways. Overall discussion pointed in the direction that the potential for public health impacts from regulated and unregulated DBPs merits further attention from the WG during the intervention phase of WG discussions.
- One member noted that one of the key strategies utilized in implementation of the original D/DBP rules was a switch to chloramines, as an affordable treatment technique for utilities, though we now know that treatment can generate other types of unregulated DBPs. The member further noted that this situation demonstrates the complexity of managing for DBP formation and the challenges and the risk-risk tradeoffs that must be considered in response to the available information on health effects. Overall, there are more data available related to chlorination DBPs and less available related to chloramination impacts.
- Another member observed that there are hundreds of uncharacterized DBPs, and uncertainty in this context will persist well into the future, while at the same time new data presented to the WG signals there are gaps

in the current regulations. The original intent of the D/DBP rules was to address certain DBPs (THM4 and HAA5) with the expectation that their control would limit other DBPs as well. One suggestion to move forward is to look for "win-win" solutions focusing on temperature, precursors, and better source water protection for bromide sources.

WG members identified some areas where more information is needed:

- One member indicated that more data are needed to understand and balance risks, (e.g., if there is a need to focus on addressing brominated haloacetic acids first, or if drinking versus inhaling DBPs have different impacts).
- This member also suggested there is a need to understand to what extent public health and drinking water quality has improved since the last D/DBP rule update, and what additional interventions could have the greatest public health impact moving forward.
- In response, another member noted that the regulatory framework has three aspects (understanding occurrence, understanding toxicity, and understanding treatment options), two of which currently have enough available data (e.g., occurrence data from UCMR4 for HAA9; some consensus within the water sector that brominated DBPs are more toxic). The third aspect, treatment, requires more data. In response some members indicated that, at this time, health effects data are weak.

Topic 5: Distribution system water quality conditions related to DBP formation – evidence and root causes of the occurrence of DBPs in drinking water. (NDWAC charge areas 1, 2)

Overall, WG members indicated that there are some commonalities with root causes for microbial and DBP conditions. Members also highlighted that more discussion and data are needed on the different treatment techniques and their impacts.

The WG member discussion related to DBP formation root causes included the following observations:

- One member noted that Stage 2 D/DBPRs has shown that evaluation of distribution system water quality has benefits for both DBPs and water quality in general. They further noted that water quality in the distribution system may degrade when a system switches from use of free chlorine to chloramines. The member also noted that mixing chlorinated water (with chlorine as a residual) and chloraminated water (with total chlorine as a residual) could lower both free chlorine and total chlorine levels, resulting in being out of compliance of maintaining the minimum residual level.
- One member clarified that there is a difference between total organic carbon (TOC) and dissolved organic carbon (DOC) when considering organic matter as a precursor and mentioned that most TOC in GW systems is DOC. Additionally, there is a need to focus on ways to reduce precursors, but also address water age, water temperature, and simultaneous compliance. Another member added that there are some commonalities with root causes for microbial and DBPs issues. The focus areas that would be a win-win for everyone could be organic matter/nutrients, water age, storage tank management, temperatures, and other actions that help keep water flowing in the distribution system.
- Some members indicated that bromide as an DBP precursor in source water presents an important and difficult major issue since there is not a cost-effective way to remove bromide from water.

WG members, looking ahead to the next phase of discussions, offered some potential actions that can be taken to address DBP concerns, including:

- One member indicated that there is opportunity to do more to control DBP precursors as they are being identified and ultimately limit formation of DBPs.
- One member observed that the SDWA requires looking at what additional contaminants would be removed as an ancillary benefit of requiring any particular treatment technology (e.g., if there is a transition to GAC treatment for PFAS, what implications will that have for improved outcomes related to DBPs). In response, another member explained that GAC removes PFAS and TOC but does not remove bromide, and that GAC could actually increase water toxicity due to formation of more brominated byproducts. Another member added that current efforts to regulate PFAS in drinking water has important implications for the WG discussions regarding further interventions for managing DBPs and suggested ensuring WG member awareness of these other regulatory actions is needed.
- One member observed that the ongoing and increasing complexities of DBPs need to be considered in the context of the existing utility technical capabilities to improve public health, in that there may not be additional, feasible actions currently available, and we are still gaining an understanding of how previously considered affordable and effective options may have unforeseen consequences. Chloramination, for example, may be efficient in some areas, but in certain locations it may cause more problems due to factors such as organics or temperature. Very oversized distribution systems are also dealing with nitrification and biofilm buildup, all of which can be operational effects of chloramination. The member provided the example of certain utilities that use a free chlorine burn to better control biofilm growth in the distribution system and reduce the likelihood of incurring nitrification, and this action may lead to the formation of elevated concentrations of DBPs and exposure for water consumers during the period of chlorine burn.

As part of the discussion, WG members identified a few areas where more information is needed:

- One member highlighted that the current DBP occurrence evidence has been collected from the UCMR4 which provides the number of distribution systems that were switched to chloramines, but they perceive that there is not the same robustness of information on DBP exposure and health effects. They also state that there are also other elements like brominated species that need to be further investigated. They believe that any major system investments or regulatory action should be based on robust and compelling evidence. Other members agreed that there is a need to look holistically to address the DBP problem.
- One member noted that treatment is the third aspect of the regulatory framework (see point made under Topic 4 related to the three aspects of the SDWA regulatory framework), for which more data are needed. For example, there has been progress on addressing precursors such as TOC, but there is not a cost-effective way to remove bromide from source water, generating the need for further research.

Segment 5

Meeting 7 Agenda and Next Steps

Mr. Greenwood shared that implementation challenges would be revisited on the agenda. Problem characterization discussions from this meeting will continue in the next meeting. Engagement with WG members may occur between Meeting #6 and #7 with a plan to take discussions on opportunistic pathogens and DBPs towards potential common understanding of its problem characterization. Differences in perspectives may also be shared with WG members ahead of Meeting #7. The facilitators intend to gather input leading to further discussion at Meeting #7. A summary of existing discussions around DBPs may be shared with WG members with specific follow-up for those who were unable to weigh in or are still pulling together their thoughts. Slides will also aim to include environmental justice, as well as implementation challenges, source water, storage tanks, and consecutive systems (in advance of Meeting #7). Mr. Greenwood explained that a strategy for dealing with the complexities noted through Meeting #6 would be

devised and it would ensure that silos are not created. A full draft agenda for Meeting #7 will be shared in advance and input is welcome from WG members. Mr. Greenwood thanked EPA team members and listeners for joining. Mr. Greenwood emphasized the sensitivity and importance of topics covered and further extended appreciation for all perspectives shared today.

Ms. Corr also thanked WG members and appreciated thoughtful responses and appreciation of information shared, as well as the variety of perspectives brough to the table.

Ms. Daniels noted the many great ideas from all and thanked all for their participation.

Ms. Corr extended final thanks to WG members for all efforts and participation, and added thanks to technical analysts for their contributions, as well as to presenters who shared their perspectives on important topics. Ms. Corr then adjourned Meeting #6.

Appendix 1: MDBP Working Group Meeting Attendance – January 24, 2023

Name	Attendance
Andy Kricun, WG Co-Chair	
Lisa Daniels, WG Co-Chair	x
Alex Rodriguez	x
Benjamin Pauli	x
Bill Moody	x
Elin Betanzo	x
Erik Olson	x
Gary Williams	x
Jeffrey Griffiths	
John Choate	x
Jolyn Leslie	x
Kay Coffey	x
Lynn Thorp	x
Lisa Ragain	x
Michael Hotaling	x
Nancy Quirk	x
Rosemary Menard	x
Scott Borman	x