SCIENCE ADVISORY BOARD
A Federal Advisory Committee to the U.S. Environmental Protection Agency

August 19, 2022

EPA-SAB-22-007

The Honorable Michael S. Regan
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: Transmittal of the Science Advisory Board Report titled "Review of the EPA's Draft Fifth Contaminant Candidate List (CCL 5)"

Dear Administrator Regan,

Please find the enclosed Science Advisory Board (SAB) report titled: *Review of the EPA's Draft Fifth Contaminant Candidate List (CCL 5)*. The EPA's Office of Ground Water and Drinking Water (OGWDW) requested that the SAB review EPA's *Draft Fifth Drinking Water Contaminant Candidate List (CCL 5)* (86 FR 37948) and three associated support documents: (1) *Technical Support Document for the Draft Fifth Contaminant Candidate List (CCL 5) – Contaminant Information Sheets;* (2) *Technical Support Document for the Draft Fifth Contaminant Candidate List (CCL 5) – Chemical Contaminants;* and (3) *Technical Support Document for the Draft Fifth Contaminant Candidate List (CCL 5) – Microbial Contaminants*. In response to the EPA's request, the Science Advisory Board Staff Office (SABSO) augmented the SAB Drinking Water Committee (DWC) with subject matter experts to conduct the review. The Agency developed charge questions on the clarity, transparency, and process used to derive the draft CCL 5 and associated support documents for consideration of the Committee.

The SAB DWC Augmented for the CCL 5 Review met virtually on January 11, February 16, and 18, 2022, to deliberate on the Agency's charge questions. Oral and written public comments were considered throughout the advisory process. The enclosed report conveys the consensus advice of the SAB.

The SAB has provided many recommendations in the report in response to EPA's charge questions and would like to highlight the following key findings and recommendations.

- EPA used occurrence information for unregulated contaminants to develop the Draft CCL 5. The SAB recommends that the EPA clarify the types of occurrence data that were included or rejected for consideration in development of the Draft CCL 5. In particular, it

is important to clarify how the literature review of the chemical contaminants in the Preliminary Contaminant Candidate List (PCCL) was conducted and used.

- It is not clear why expert opinion weighed more heavily in identification of microbial contaminants to be included on the Draft CCL 5 than in identification of chemical contaminants. The SAB recommends that EPA clarify its reason for the different approaches.

- The SAB recommends for included data (i.e., data supporting CCL 5 development) the EPA clarify the criteria for the dates of sampling and publication of results and the process for inclusion of wastewater effluent data.

- SAB supports the use of contaminant groups. EPA should provide a rationale explaining why some compounds are listed as groups. In addition, EPA should clarify whether individual contaminants or subgroups within the groups should be prioritized. EPA should also provide information on the criteria for grouping individual per- and polyfluoroalkyl substances (PFAS) and disinfection byproducts (DBPs) within the CCL 5.

- The SAB recommends that the EPA elaborate on how listing contaminants as groups impacts the regulatory process. In particular, the EPA should clearly communicate the relative levels of potential risk and gaps in information needed to craft risk management decisions for PFAS. The EPA provided a table in the Draft CCL 5 that includes the disinfection byproducts (DBPs) considered. The SAB finds this table is useful and recommends that the EPA include a similar table identifying the PFAS considered. In addition, the EPA should consider expanding the definition of PFAS to be more expansive to capture all relevant fluorinated compounds and degradates in commercial use or entering the environment.

- The SAB provides recommendations regarding the consideration of sensitive populations. The EPA should further clarify why immunosuppressed individuals are not considered sensitive populations. The EPA should elaborate on how sensitive populations were evaluated for chemical contaminant risks and specify terminology regarding chronic disease and serious illness as risk factors when assessing microbial contaminant risks.

- The definition and discussion of waterborne disease outbreaks (WBDO) as a criterion for microbial contaminant selection should be expanded and relocated to earlier in the Federal Register Notice (FRN). The discussion should include a clear outline of the definition of WBDOs, the limitations associated with the underlying data, how the data were used in the selection process, and how sensitive populations were considered.

- The SAB provides recommendations regarding prioritizing contaminants with the greatest health risks. The SAB recommends renaming “health effects” to “health risks” in the CCL 5 documents.

- The SAB recommends removing *Shigella sonnei* from the Final CCL 5 and including additional bisphenols, bisphenol F (BPF) and bisphenol S (BPS) on the Final CCL 5. In addition to saxitoxin (STX), the EPA should include other saxitoxins including neo-STX and dc-STX on the Final CCL 5.

- In general, the SAB finds that the CCL 5 development process is clear and transparent. The SAB provides the following recommendations for future CCLs to further strengthen the clarity, transparency, and scientific integrity of the approach used to list contaminants on the Draft CCL 5. In future CCLs, EPA should consider employing machine learning as well as data gathered in Europe during the implementation of the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) system to identify compounds of concern. In future CCLs, EPA should also consider identifying and assessing byproducts, impurities, transformation products (including metabolites and/or degradates), antimicrobials, microplastics, and nanoparticles in creation of its chemical universe. A focus on persistent and mobile organic compounds (PMOCs) would serve to identify and prioritize chemicals of particular concern for drinking water in future CCLs. The EPA should also develop a strategy to address the gap in occurrence data that will arise when the U.S. Geological Survey (USGS) ends its contaminants monitoring program.

As the EPA finalizes its CCL 5, the SAB encourages the Agency to address the Committee's concerns raised in the enclosed report and consider their advice and recommendations. The SAB appreciates this opportunity to review the EPA's Draft CCL 5 report and looks forward to the EPA's response to these recommendations.

Sincerely,

/s/

Alison C. Cullen, Sc.D.
Chair
EPA Science Advisory Board

/s/

June Weintraub, Sc.D.
Chair
EPA SAB DWC Augmented for the CCL 5 Review

Enclosure

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Review of the EPA's Draft Fifth Contaminant Candidate List (CCL 5)
FINAL REPORT, dated August 19, 2022

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ACRONYMS AND ABBREVIATIONS

BPA	Bisphenol A
BPAF	Bisphenol AF
BPB	Bisphenol B
BPD	Bisphenol D
BPE	Bisphenol E
BPF	Bisphenol F
BPS	Bisphenol S
CDC	Centers for Disease Control and Prevention
CIS	Contaminant Information Sheets
DBP	Disinfection Byproducts
FRN	Federal Register Notice
GWR	Groundwater Rule
IP-CHEM	Information Platform for Chemical Monitoring
Mn	Manganese
MP	Microplastic
NOAEL	No Observed Adverse Effect Level
NPDWR	National Primary Drinking Water Regulation
NTM	Non-Tuberculous Mycobacteria
OECD	Organization for Economic Co-operation and Development
OGWDW	Office of Ground Water and Drinking Water
OPES	Organophosphate Esters
ORP	Oxidation-Reduction Potential
PCCL	Preliminary Contaminant Candidate List
PFAS	Per- and Polyfluoroalkyl Substances
PMOC	Persistent and Mobile Organic Compounds
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
RfD	Reference Dose
SAB	Science Advisory Board
SDWA	Safe Drinking Water Act
STX	Saxitoxin
SWTR	Surface Water Treatment Rule
W	Tungsten
UCMR	Unregulated Contaminant Monitoring Rule
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
V	Vanadium
WBDO	Waterborne Disease Outbreaks
WHO	World Health Organization

1. INTRODUCTION

The U.S. Environmental Protection Agency (EPA) Office of Ground Water and Drinking Water (OGWDW) requested that the Science Advisory Board (SAB) review the *Draft Fifth Drinking Water Contaminant Candidate List (CCL 5)* (86 FR 37948) and three associated support documents: (1) *Technical Support Document for the Draft Fifth Contaminant Candidate List (CCL 5) – Contaminant Information Sheets;* (2) *Technical Support Document for the Draft Fifth Contaminant Candidate List (CCL 5) – Chemical Contaminants;* and (3) *Technical Support Document for the Draft Fifth Contaminant Candidate List (CCL 5) – Microbial Contaminants.* The Safe Drinking Water Act (SDWA), amended in 1996, requires that every five years EPA identify a list of contaminants that are currently not subject to any proposed or promulgated national primary drinking water regulations. The list of contaminants, both microbial and chemical, are known or are anticipated to occur in public drinking water systems and may require regulation under the SDWA. The final list of contaminants becomes the Contaminant Candidate List (CCL). The CCL identifies priority for potential future regulations and is used to inform research and monitoring needs. Through the CCL process EPA considers health effects and occurrence information for unregulated contaminants to identify contaminants that present the greatest public health concern related to exposure from drinking water. EPA considers the effect of contaminants on sensitive populations, identified as being at greater risk of adverse health effects due to exposure to contaminants in drinking water (such as infants, children, pregnant women, the elderly, and individuals with a history of serious illness or other subpopulations). In a separate Agency action, EPA is required to select a minimum of five contaminants from the CCL to undergo regulatory determination to determine whether to regulate contaminants with national primary drinking water regulations (NPDWR) under the SDWA. The SDWA requires the Agency to consult with the scientific community, including the Science Advisory Board (SAB), regarding the CCL.

In response to EPA's request, the SAB convened the Drinking Water Committee (DWC), augmented with additional subject matter experts to conduct the review. The Science Advisory Board DWC Augmented for the CCL 5 Review (later referred to as Committee) convened three virtual public meetings to conduct a peer review of EPA's draft documents. Meetings were held on January 11, February 16, and 18, 2022, virtually. The Committee also met on June 6, 2022, to discuss its draft report. Any oral and written public comments were considered throughout the advisory process. The Agency requested that the Committee provide feedback on four charge questions regarding the clarity, transparency, and process used to derive the draft CCL 5 and associated support documents.

This report is organized to state each charge question raised by the Agency, followed by the SAB's consensus response and recommendations. Recommendations are prioritized to indicate relative importance during EPA's revisions. The recommendations have the following priorities:

- Tier 1: Short Term – Actions that are necessary to improve the critical scientific concepts, clarity, issues and/or narrative within the document.
- Tier 2: Suggestions – Actions that are encouraged to strengthen the scientific concepts, clarity, issues and/or narrative within the document, but other factors (e.g., Agency need) should be considered by the Agency before undertaking these revisions.
- Tier 3: Future Considerations/Long term –Actions that are necessary to improve the process, science, and clarity for future CCLs.

All materials and comments related to this report are available at:
https://sab.epa.gov/ords/sab/f?p=100:19:7721309776017:::RP,19:P19_ID:965

2. RESPONSE TO CHARGE QUESTIONS

2.1. Charge Question 1: Transparency in approach

Please comment on whether the Federal Register Notice (FRN) published on July 19, 2021 (86 FR 37948) (Docket ID Number EPA-HQ-2018-0594) and associated support documents are clear and transparent in presenting the approach used to list contaminants on the Draft CCL 5. If not, please provide suggestions on how EPA could improve the clarity and transparency of the FRN and the support documents.

The EPA is to be commended for its level of effort in developing the Draft CCL 5 and support documents. In general, the SAB finds that the CCL development process and documentation are clear and transparent. The SAB commends the EPA for the presentation of the decisions used to generate the universe of potential contaminants, the screening process used to generate the Preliminary CCL (PCCL), and the ranking and prioritization of contaminants to produce the Draft CCL 5. The chemical universe includes over 22,000 compounds which were screened for health effects and occurrence. The PCCL was developed using literature searches to formulate calculated health concentrations; final hazard quotients; and attributed scores for prevalence, magnitude, potency, and severity. Review of this process by EPA scientists and through public input enables a robust evaluation of pending contaminant risks. The logistic regression model used to validate the selection of the top scored chemicals for the Draft CCL 5 is another strength of the program, as it affords an independent review of the ranking process. The SAB provides the following recommendations to further strengthen the clarity, transparency, and scientific integrity of the approach used to list contaminants on the Draft CCL 5.

2.1.1. Selection process for contaminants

The SAB suggests that the EPA explicitly describe the process for screening chemical contaminants from the initial universe of contaminants to form the PCCL (i.e., before the point-based scoring is applied). The technical support document for the chemical contaminants states that the EPA identified and selected a finite number of chemicals (250) in consideration of the resource requirements for compiling additional information, developing Contaminant Information Sheets (CISs) and conducting evaluations teams' review during the classification step. However, the document does not explain why the number 250 was chosen. The SAB recommends that the EPA provide a rationale for this number. The SAB also suggests that in future CCLs the consideration of short-lived pesticides to transform into long-lived metabolites or degradates be included as part of the selection process.

Regarding differences between the chemical and microbial contaminant selection processes, the SAB finds that the published FRN and associated support documents outline a clear, stepwise approach used to derive the contaminants and groups proposed for Draft CCL 5. However, the SAB suggests that the processes followed for chemical versus microbial contaminants be further clarified to describe the differences between the two approaches.

For microbial contaminants, the initial universe was built from prior CCLs and further modified following a literature search, consultation with experts, and public nominations. During the screening phase of the initial universe, 12 exclusion criteria were used in selecting microbes. All microbes not excluded by the 12 criteria were moved to the PCCL. EPA then followed three scoring protocols to assign ranking for risks associated with each candidate based on: (1) waterborne disease outbreaks (WBDO); (2) occurrence in water; and (3) health effects. The microbial list was then finalized based on expert opinion (U.S. EPA and the Centers for Disease Control and Prevention, CDC) and risk scores from the three protocols. In contrast, a primarily point-based process was used to develop the chemical

list. It is not clear why expert opinion weighed more heavily in the identification of microbial contaminants to be included on the Draft CCL 5 than in the identification of chemical contaminants to be included. In addition, the process used to establish the list of chemicals for the Draft CCL 5 was more transparent and robust than the process used to establish the list of microbial contaminants; the SAB suggests the EPA provide greater detail on the approach for microbial contaminants and describe the reasoning behind why the different approach was chosen for establishing the list of microbial contaminants for the Draft CCL 5.

The SAB finds that the EPA provided an incomplete explanation of the rationale for continuing to include microbial contaminants from prior CCLs on the Draft CCL 5. The SAB notes, for example, that waterborne viruses are already regulated by treatment techniques under the Surface Water Treatment Rule (SWTR) and the Groundwater Rule (GWR). EPA states in the *Technical Support Document for the Draft CCL 5 – Microbial Contaminants*, that it listed certain viruses and *Legionella pneumophila* on the Draft CCL 5, even though they are already regulated, because these organisms "have been implicated in various WBDOs for which EPA did not have dose response or treatment data when promulgating its treatment technique requirements" (U.S. EPA, 2021). EPA states that "there are no monitoring, treatment, or notification requirements within those NPDWRs that are specific to *Legionella pneumophila* or the specific viruses. Therefore, EPA considers *Legionella pneumophila* and the specific viruses listed on CCL 5 to be unregulated contaminants for purposes of eligibility for the CCL" (U.S. EPA, 2021). Outside of this statement, there is no other justification provided for including these organisms.

The SAB also notes that the EPA should address the variability in quality of the literature that could lead to either overstating or understating health risks, especially of many of the microbial contaminants, including adenoviruses, *Acinetobacter baumannii, Arcobacter butzleri, Blastocystis hominis, Comamonas testosteroni, E. coli O157, Exophiala jeanselmei, Helicobacter pylori* and mycobacteria species.

The following recommendations are noted:

<u>Tier 1</u>

- Provide an explicit list of the criteria used to screen chemical contaminants from the initial universe to form the PCCL before the point-based scoring is applied.
- Provide greater clarity on the process used to establish the list of microbial contaminants for the Draft CCL 5.
- Clarify why expert opinion weighed more heavily for the microbial list than the chemical.
- Explain the rationale for setting the threshold for the number of chemicals to be included on the Draft CCL 5 at 250.

<u>Tier 2</u>

- Explain the rationale for carrying over most of the microbial contaminants from prior CCLs.
- Provide the cited literature and elaborate on the following statement: "...there are no monitoring, treatment, or notification requirements within those NPDWRs that are specific to *Legionella pneumophila* or the specific viruses. Therefore, EPA considers *Legionella pneumophila* and the specific viruses listed on CCL 5 to be unregulated contaminants for purposes of eligibility for the CCL." (U.S. EPA, 2021).

Tier 3

- For future CCLs, the SAB suggests that the EPA bring the processes for selecting the chemical contaminants and the microbial contaminants into better alignment with each other, since currently the two processes differ in detail and technique.
- The SAB suggests future CCLs include as part of the selection process the likelihood of transformation (including metabolites and/or degradates).

2.1.2. Criteria for inclusion or rejection of occurrence data

The SAB finds that incorporation of occurrence data into the Draft CCL 5 development process is well founded. The process entails assessment of exposure to contaminants through the drinking water route and prioritization of contaminants that cause the greatest potential health concern. The SAB provides the following recommendations to clarify the inclusion or rejection of occurrence data throughout the CCL 5 process.

The SAB recommends clarifying the types of occurrence data that were included or rejected for consideration during the development of the Draft CCL 5. In particular, the SAB recommends that the EPA clarify how the literature review of the chemical contaminants in the PCCL was conducted and used. It was not clear if occurrence data from water sources not used as drinking water were included, or if data from direct or indirect potable reuse water supplies were included. The SAB questions whether state agency reports were considered as sources of occurrence data, even though the process of reviewing these data may differ from the traditional academic peer-review process. For some of the included data, the inclusion criteria or the process for inclusion were not clear. The SAB recommends clarifying the following: whether contaminant concentrations estimated from passive sampling were included; the acceptance criteria for the dates of sampling and publication of results; and the process for inclusion of wastewater effluent data. The SAB recommends that the EPA provide more information indicative of when production values were used and why the point assignments were made from the lower end of ranges specified.

The SAB's review of the data sources and *Technical Support Document for the Draft CCL 5 – Contaminant Information Sheets* (hereafter referred to as CIS) suggests that the literature review may not be complete. To explain why some studies were not included in the data compilation process, the SAB recommends that the EPA clarify which data were considered valid. It was not clear whether the included data were all generated using standard methods or if data generated using other methods were also considered. Lastly, the Draft CCL 5 did not include urban runoff data. Urban runoff can be a major, though episodic, pathway for discharge of some contaminants to surface and groundwater drinking water sources during storm events. For example, a USGS-led characterization of runoff from 50 urban stormwater events over 16 months across 21 U.S. sites demonstrated that this pathway transported significant loads of diverse contaminants, including some on the draft CCL 5 (Masoner et al., 2019). The analysis indicated that, during these occasional events, "organic [contaminant] concentrations and loads were comparable to and often exceeded those of daily wastewater plant discharges." For some contaminants in some settings, dry weather urban runoff may also result in discharge of significant loads (e.g., Budd et al., 2015, 2020). Therefore, the SAB recommends that the EPA provide a rationale or justification for not including these data and take into consideration the addition of urban runoff occurrence data for future CCLs.

The following recommendations are noted:

Tier 1

- Clarify the type of occurrence data included or rejected during the development of the Draft CCL 5, particularly how the literature review of the chemical contaminants in the PCCL was conducted and used.
- Clarify whether: occurrence data from water sources not used as drinking water were included; direct and/or indirect potable reuse water were included; and state agency reports were considered.
- Clarify whether included data were all generated using standard methods or if other methods were also considered (i.e., targeted and/or suspect screening/nontargeted analytical methods).
- Clarify whether concentrations estimated from passive sampling were included.
- For included data, clarify the acceptance criteria for the dates of sampling and publication of results, and the criteria for inclusion of wastewater effluent data.
- Provide a rationale for excluding urban runoff occurrence data.

Tier 2

- Clarify which data were considered valid for the CISs.
- Elaborate on when EPA relied on production volumes and when they were used, and why the lower end of the production volumes was chosen (rather than a mid-value or maximum value).

Tier 3

- For future CCLs, the SAB suggests that the EPA include urban runoff occurrence data in parallel with wastewater occurrence data.

2.1.3. Use of groups in the Draft CCL 5

The SAB finds that it is useful to have some contaminants listed as groups. However, the EPA's justification for grouping certain contaminants while leaving others as standalone in the Draft CCL 5 was not clear. Examples of contaminants that could usefully be grouped are triazines and organophosphate esters. Additionally, the criteria for grouping per- and polyfluoroalkyl substances (PFAS) and disinfection byproducts (DBPs) were not clear. There are thousands of PFAS and providing a method of prioritization would guide research and optimize the utilization of resources. The SAB recommends that the EPA provide information on the criteria for grouping PFAS and DBPs. In the Draft CCL 5, the EPA provided a table that includes the disinfection byproducts (DBPs) considered for inclusion. The SAB finds that this table is useful and recommends, if feasible, that the EPA include a similar table identifying the PFAS considered. The SAB recommends that the EPA clarify how listing contaminants as groups impacts the regulatory process. Within these groups there are diverse modes of action and potencies, as well as widely varying occurrence. The SAB recommends that the EPA clarify whether the contaminants within the groups can be prioritized, given the orders of magnitude difference in concentrations that cause health impacts. There are also multiple methods for bulk organofluorine analysis that can quantify concentrations of aggregated PFAS without indicating which specific chemicals are present (McDonough et al., 2019). These methods may be useful if the EPA prioritizes broader occurrence and exposure of PFAS, rather than individual compounds.

Regarding cyanotoxins, the SAB recommends that the EPA clarify the justification for inclusion of cyanotoxins as a group despite relatively low occurrence data in the Unregulated Contaminant Monitoring Rule (UCMR) 4. The SAB recognizes that cyanotoxins are unique and can occur in acutely toxic concentrations due to harmful algal blooms of widely varying, and sometimes short lived, periods

of time. Thus, occurrence at concentrations relevant to human health effects may often not be captured in the UCMR approach.

The following recommendations are noted:

Tier 1

- Provide the rationale for listing only some compounds as groups.
- Clarify whether contaminants within the groups can be prioritized.
- Provide information on the criteria for grouping PFAS and DBPs within the CCL 5 including why the specific DBPs featured in the list were chosen out of the universe of known DBPs.
- Elaborate on how listing contaminants as groups impacts the regulatory process.
- Provide a table containing the considered PFAS, similar to the table for DBPs.

Tier 2

- Consider grouping other compounds, such as organophosphate esters and triazines.
- Clarify the justification for inclusion of cyanotoxins as a group.

Tier 3

- The SAB has no specific recommendations for this tier.

2.1.4. Control of Communicable Disease Manual

The SAB notes that EPA is citing the 18th Edition of the Control of Communicable Diseases Manual (Heymann, 2005) throughout the technical documentation. More recent editions are available, and the SAB suggests that the EPA verify the accuracy of content citing the 18th edition against the 20th (Heymann, 2014) or 21st (Heymann, 2022) editions. Future CCL processes should ensure that the most up-to-date edition of this important reference be utilized.

The following recommendations are noted:

Tier 1

- EPA should verify the accuracy of content citing the 18th edition of the Control of Communicable Diseases Manual (Heymann 2005) against the 20th (Heymann, 2014) or 21st (Heymann, 2022) editions.

Tier 2

- The SAB has no specific recommendations for this tier.

Tier 3

- EPA should ensure that future CCL processes incorporate the most up-to-date version of the Control of Communicable Diseases Manual.

2.2. Charge Question 2: Process used to derive the Draft CCL 5

Please comment on the process used to derive the Draft CCL 5, including but not limited to, the CCL 5 improvements to assess potential drinking water exposure, consider sensitive populations, and prioritize contaminants that represent the greatest potential public health concern.

In general, the EPA's process for developing the Draft CCL 5 was well-reasoned, effective, and clear. However some aspects of the process were complex and challenging to understand. The SAB

recommends the following changes to elaborate on the current process to increase understanding. The SAB provides additional recommendations for the future CCL process, to improve upon the already effective assessment for the CCL.

2.2.1. Assessment of potential drinking water exposure

Because one of the uses of the CCL is to inform data collection efforts such as the UCMR, the SAB suggests that the EPA make clear which contaminants on the CCL had only health effects data but no occurrence data. The agency may also consider employing machine learning, in addition to expert judgement based on a scoring system, to identify whether there may be other contaminants of concern within the baseline list of contaminants. Assessing data gathered in Europe during the implementation of the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) system, which requires documentation of chemicals' properties prior to market access, as well as utilizing NORMAN network, a network of reference laboratories, research centers and related organizations for the monitoring and biomonitoring of emerging environmental substances, and Information Platform for Chemical Monitoring (IP-CHEM) databases for assessment of contaminants in surface or drinking water may be helpful.

The SAB has specific concerns regarding selection of microbial contaminants. The SAB recommends that early in the FRN, the EPA provide a clear outline of the selection process, including definitions, limitations, and consideration of sensitive populations regarding WBDOs. As an example of the need for this clarification refer to the discussions of *Shigella sonnei* and Calicivirus below, which describe questions around the relevance of non-confirmed outbreaks and/or outbreaks in non-community systems.

Regarding occurrence data, the SAB notes that there may be limitations of the EPA's Office of Pesticide Programs (OPP) occurrence estimates for pesticides that have urban applications, as well as uncertainties in method detection or reporting limits for datasets used. Reporting the ranges and the median method detection limits would help the readers better interpret the strength of data used in the context of uncertainties. Lastly, the SAB is aware that the NOAELs identified for nonylphenol may be based on non-qualifying data sources and suggests the EPA ensure that for future CCLs the primary sources in secondary citations be evaluated.

The following recommendations are noted:

<u>Tier 1</u>

- Clarify the process of selecting contaminants for monitoring under the UCMR when contaminants had *only* health effects or occurrence data.

<u>Tier 2</u>

- The definition and discussion of WBDOs as a criterion for microbial contaminant selection should be expanded and relocated to an earlier point in the Federal Register Notice (FRN). The discussion should include a clear outline of the definition of WBDOs, the limitations associated with the underlying data, how the data were used in the selection process, and how sensitive populations were considered.

<u>Tier 3</u>

- For future CCLs, consider employing machine learning to identify whether there may be other compounds of concern within the baseline of compounds.

- For future CCLs, it may be helpful to assess data gathered in Europe during the implementation of the REACH system, the NORMAN network, and IP-CHEM databases to assess contaminants in surface or drinking water.
- For future CCLs, the SAB recommends reporting the range and median method detection limit and reporting limit for each occurrence dataset listed in the CIS and using this information to inform the prevalence score for chemical contaminants.
- The SAB suggests that for future CCLs the EPA ensure that data cited in secondary sources are from qualifying primary sources.

2.2.2. Consideration of sensitive populations

The SAB commends EPA for the consideration of sensitive populations in creating the Draft CCL 5. The SAB has three specific recommendations to further support this effort. The EPA should further clarify why immunosuppressed individuals are not considered sensitive populations, and if relevant consider including immunosuppressed individuals in future CCLs. In general, reasoning that explains how sensitive populations (including those in specific life stages) were evaluated for chemical contaminant risks is sparse. Terminology regarding chronic disease and serious illness as risk factors is vague and could be made more specific when assessing microbial contaminant risks.

The following recommendations are noted:

Tier 1

- Further clarify why immunosuppressed individuals are not considered sensitive populations.
- Elaborate on the explanation of how sensitive populations were evaluated for chemical contaminant risks.
- Specify terminology regarding chronic disease and serious illness as risk factors when assessing microbial contaminant risks.

Tier 2

- The SAB has no specific recommendation for this tier.

Tier 3

- The SAB has no specific recommendation for this tier.

2.2.3. Prioritizing Contaminants with the Greatest Public Health Concern

In developing the Draft CCL 5, the EPA prioritized contaminants that cause the greatest public health concern. The process used to prioritize the contaminants appears reasonable and responsive to the stated goals. The SAB commends the EPA for comparing chemical contaminants with highly variable types of data and information, including those with limited health effects data but high levels of occurrence, and contaminants with no or limited drinking water data but available health effects information. To provide greater clarity for the prioritization of contaminants, the SAB identified a few areas to clarify and provides recommendations for future CCL efforts. The SAB recommends clarifying the reason for using a 10-year timeframe in the supplemental literature review for the chemical contaminants' occurrence data. The SAB recommends the EPA consider using the term "health risks" rather than "health effects" throughout the CCL 5 documents for both chemical and microbial contaminants, since so much of the data relied on are from epidemiologic studies characterizing risk rather than clinical effects. Regarding microbial contaminants, the validity of the health effects linear scoring system can be better described, and clarification of reasons for calculating the Pathogen Total Score is recommended.

The SAB finds value in identifying and assessing by-products, impurities, and transformation products (including metabolites and/or degradates) in creation of the chemical universe and recommends EPA consider this strategy for future CCLs. Compounds like 1,4-dioxane, which can be formed as a byproduct (as well as being used as a solvent, stabilizer and chemical intermediate), and was included in the Draft CCL 5 through nomination, might not be adequately captured in the universe using existing data sources. 1,4-Dioxane is also known to occur frequently in drinking water, including occurrences at levels exceeding the EPA health-based Reference Concentration. 1,4-Dioxane was included in the EPA Unregulated Contaminant Monitoring Rule 3 (UCMR3) for which sampling occurred in 2013-15. In UCMR3, 1,4-dioxane was detected above the Minimum Reporting Level of 0.07 µg/L in 21.9% of the 4,915 public water systems tested and above the EPA health-based Reference Concentration (1×10^{-6} cancer risk level) of 0.35 µg/L in 6.9% of these water systems.

The concept of chemical groups may also be useful for assessing parent compounds and associated transformation products (including metabolites and/or degradates) in combination, such as the pesticide fipronil and commonly observed degradates like fipronil sulfide and fipronil sulfone. The SAB recommends the CCL process include a focus on persistent and mobile organic compounds (PMOCs) to identify and prioritize chemicals of particular concern for drinking water. As stated by Reemtsma et al. (2016), "PMOCs are highly polar (mobile in water) and can pass through wastewater treatment plants, subsurface environments and potentially also drinking water treatment processes." As a result, chemicals with these properties may be more likely to occur in drinking water and should be a focus of future work.

The SAB notes with concern that the U.S. Geological Survey (USGS) National Water-Quality Assessment (NAWQA) ended its contaminants monitoring program at the end of Fiscal Year (FY) 2021 and that there needs to be a nationwide monitoring program for contaminants, including pesticides, to replace the USGS effort. EPA should develop a strategy to address this upcoming gap in occurrence data.

The following recommendations are noted:

Tier 1

- Clarify the reason for using a 10-year timeframe for the supplemental literature review for the occurrence data of chemical contaminants.
- Rename "health effects" to "health risks" for microbial and chemical contaminants.
- Further describe the validity of the health effects linear scoring system for microbial contaminants.
- Clarify the reasons for calculating the Pathogen Total Score for microbial contaminants.
- Compare the CCL 5 list to the European-based data to identify overlooked compounds of high concern.

Tier 2

- The SAB has no specific recommendation for this tier.

Tier 3

- Identify and assess by-products, impurities, and transformation products (including metabolites and/or degradates) in creation of the chemical universe.
- Focus on persistent and mobile organic compounds (PMOCs) to identify and prioritize chemicals of particular concern for drinking water.

- Develop a strategy to address the gap in occurrence data that will arise when the USGS ends its contaminants monitoring program.

2.3. Charge Question 3: Contaminants that should not be listed

Based on your expertise and experience, are there any contaminants currently on the Draft CCL 5 that should not be listed? Please provide peer-reviewed information or data to support your conclusion.

2.3.1. Chemical Contaminants Recommended for Reconsideration or Removal

Tungsten and Manganese

The SAB recommends that EPA consider the points made below in determining whether to carry tungsten (W) and manganese (Mn) from the Draft to the Final CCL 5.

Tungsten is present in the Earth's crust at a level of 0.000126% and Mn is present at a level of 0.095% (Haynes et al., 2016). Manganese is an essential mineral in the human diet, and while uncommon, deficiency can lead to health impacts (NIH ODS, 2021). The SAB finds that the EPA's screening approach favors the inclusion of minerals such as these on the CCL because exposure is common across populations. However, the scoring approach appears to be consistently applied.

Tungsten

The Reference Dose (RfD) equivalent for W listed by EPA in the CIS is $8x10^{-4}$ mg/(kg·d). However, the no observed adverse effect level (NOAEL) in a critical study (McCain et al., 2015) was 47 mg W/(kg·d)[1], which would correspond to the ingestion of over 5-grams of sodium tungstate (Na_2WO_4) per day for a 70 kg adult [47 mg W/(kg·d) x 70 kg x (294 mg Na_2WO_4/184 mg W) x g/1000 mg], a substantial mass equivalent to 5.26 g W/d x 1000 mg/g x d/2L = 2628 mg W/L in drinking water. The maximum concentration found in the 21 U.S. surface waters recorded from 1991-2017 was 0.0221 mg/L according to the CIS, five orders of magnitude lower than the concentration calculated using this NOAEL and assuming exposure exclusively through drinking water. A similar calculation relying on the RfD results in a drinking water concentration of 0.045 mg/L, just twice the value of the maximum concentration observed at this time.

Manganese

For Mn, the EPA established a non-enforceable secondary maximum contaminant level of 0.05 mg/L with the goal of limiting aesthetic effects. The lifetime health advisory level is 0.3 mg/L nationwide, while the State of California requires water providers to notify customers if concentration exceeds 0.5 mg/L. The European Union recommends a safe level of Mn not to exceed 50 µg/L (0.05 mg/L), which aligns with the U.S. EPA standard. The World Health Organization reviewed human and animal studies and established an updated Mn provisional health-based guideline value of 80 µg/L in 2021 (World Health Organization, 2021).

Human exposure and effects lack consensus among researchers. A literature review conducted in 2015 found several studies associated Mn exposure with low intellectual and hyperactivity behaviors in children and concluded that nine out of twelve cognitive effects were found in children exposed to Mn from drinking water. Despite the acknowledged limitations to the compilation of knowledge, the body of literature, at the time, suggested that Mn may adversely affect children (O'Neal and Zheng, 2015). Human epidemiology and animal toxicology studies provide evidence that developmental (e.g., infant)

[1] Note the value 47 mg/(kg d) is derived from the published NOAEL of 75 mg/(kg d) for Na_2WO_4

exposures to manganese at levels that occur in drinking water may be associated with neurobehavioral toxicity according to Scher et al. (2021) and World Health Organization (2021). The World Health Organization (2021) guideline mentioned above, as well as three drinking water guidelines developed by other agencies (Minnesota Department of Health (2012) - 100 µg/L; Health Canada (2016) - 120 µg/L; National Institute of Public Health of Quebec (INSPQ) (2017); and Valcke et al., (2018) - 60 µg/L), are all based on neurodevelopmental toxicity in rat studies.

O'Neal and Zheng (2015) also concluded that exposure to Mn causes clinical symptoms similar to Parkinson's disease when medical doses exceed the 60 mg/day and that, although the half- life in blood is relatively short, the half-life of Mn in bones is in the 8–9-year range. However, caution is needed when associating symptoms of Mn exposure, especially from water ingestion, with symptoms similar to Parkinson's. Mn-induced parkinsonism, a condition observed mainly in certain worker populations exposed via inhalation to high levels of manganese in air in the workplace, shares some similarities with Parkinson's; however, as noted in a recent review comparing the two conditions, there are "striking differences in the clinical and pathologic manifestations between both disorders" (Kwakye et al., 2015). Not only is it important to distinguish the two conditions in terms of disease processes, but also to note that the relevance of the high-level inhalation worker studies to the low-level general population ingestion studies is limited, especially considering the differences in the pharmacokinetics of inhaled versus ingested Mn, and the role of homeostatic mechanisms associated with ingestion exposure of Mn (Yoon et al., 2019).

The SAB notes that much research has been conducted on Mn since the Mn RfD from 1995 and the associated Health Advisory level from 2004 were developed. Additionally, physiologically based pharmacokinetic (PBPK) models are available that correlate exposure to Mn in food and water to Mn in different body compartments, including the globus pallidus of the brain, in potentially susceptible populations (e.g., breast feeding infants, and young children), see for example, Yoon et al. (2019). These models can help in the interpretation of epidemiological studies of Mn in drinking water and in understanding the impact of different concentrations of Mn in drinking water on body burden.

The epidemiological literature continues to evolve, with some cohort studies of the general population now being available. The Health Canada (2019) report would be a good starting point. Note that Health Canada recommends a health-based maximum allowable concentration of Mn in drinking water of 0.12 mg/L based on neurobehavioral findings in rats, with qualitative support from the epidemiological studies, due to limitations in the human studies. This value of 0.12 mg/L may be compared with the EPA Lifetime Health Advisory Level of 0.3 mg/L.

As stated above, Mn is an essential mineral and is arguably associated with health effects due to deficiency (NIH ODS, 2021). The oral RfD of 0.14 mg/kg/day in the Integrated Risk Information System (IRIS) was established in 1995 based on concerns of central nervous system effects indicated in an epidemiological study with uncertain result (Kondakis et al., 1989; U.S. EPA 1995); this RfD has not been revised to incorporate newer findings.

Vanadium

The SAB recommends that before vanadium (V) is carried from the Draft CCL 5 to the Final CCL 5, that the EPA consider the following information. Vanadium speciation is extremely complex and not well understood with regard to exposure. Figure 1, a predominance area diagram, shows the predominance of 14 V species likely to be found in drinking water as a function of water pH and oxidation-reduction potential (ORP) (Al-Kharafi et al., 1997). The figure shows the species found to dominate others at equilibrium, as a function of the pH-E_H condition of the water. E_H is roughly equal to

ORP + 0.22 V and indicates the oxidation-reduction potential relative to the standard hydrogen electrode, influenced by the level of dissolved oxygen and chlorine species. Although the diagram does not indicate how rapidly equilibrium is reached for the many interacting reactions, the associated work and background references in the article indicate that V is generally water soluble and active in terms of speciation across pH and E_H regimes (Al-Kharafi et al., 1997). Of note, V_2O_5, the pharmaceutical species of possible health impact, does not appear in the diagram (it does not predominate at any pH-ORP couple in water). The SAB notes that, whereas untreated groundwaters can fall to negative E_H values, well-treated disinfected drinking waters would fall in the upper right quadrant of the diagram, as shown, where $VO_2(OH)_2^-$ and VO_3OH^{2-} predominate, and V_6O_{13}, or even V_2O_4, or V_3O_5, may precipitate. However, following ingestion, lower pH and E_H would be encountered. Hence speciation in the body could conceivably include V in (average) oxidation states of 5, 4, 4.3, 3, 3.3, or 2.

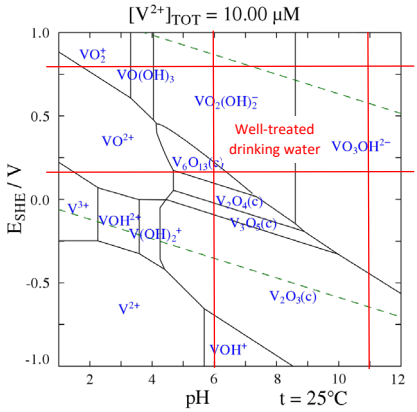

Figure 1. Predominance area diagram for vanadium in water, showing species likely to be present in drinking water, and in waters of varying pH – ORP status (Al- Kharafi et al., 1997)

A 2018 study tracked the pregnancy progress of 3,025 pregnant women in China (Hu et al., 2018). Low birthweights were associated with ~1.18 µg/L (0.00118 mg/L) of V excretion via urine. Assuming an estimated 12% of V intake eliminated via urine (Scibior et al., 2020), this level translates to a total ingestion of 9.83 µg/L (0.00983 mg/L) per day being associated with low birthweight outcomes in this study.

The U.S. Department of Energy set an acceptable safe limit level of V at 0.33 mg/L, while the California Department of Public Health established a notification level of 50 µg/L (0.05 mg/L) in drinking water (CA State Water Resources Control Board, 2022). Using mathematical models, a maximum environmental concentration is estimated for U.S. surface waters at 0.010 ppb (0.00001 mg/L) (Vasseghian et al., 2021); although vanadium's environmental concentrations are trending upwards and there is risk for higher concentrations in drinking water, these occurrence calculations suggest that vanadium's presence in drinking water is about three orders of magnitude lower than any levels of health concern. With this information the SAB recommends careful consideration of V and recommends incorporating the information provided into the scoring system to aid in the justification for removing V from or keeping it in the Final CCL 5.

The following recommendations are noted:

Tier 1

- The SAB has no specific recommendation for this tier.

Tier 2

- Incorporate speciation information, including the information provided above, into the scoring system to aid in the justification for inclusion or exclusion of V in the Final CCL.

Tier 3

- For future CCLs, the SAB recommends considering the observed and anticipated speciation of metals in drinking water, as well as in potential source waters including groundwater, in the prioritization process.
- The SAB suggests that the EPA carefully consider the points made above when deciding whether to include Mn and W on future CCLs.

2.3.2. Microbial Contaminants Recommended for Reconsideration or Removal

As outlined in the response to charge question 1, microorganisms that are already regulated by the SWTR or the GWR are listed on the Draft CCL 5. EPA stated that these microorganisms are considered unregulated for the purposes of the CCL process. The SAB finds that this statement does not provide the needed transparency for the CCL process since there is no evidence that existing regulations are incapable of managing these contaminants. Therefore, the SAB recommends that further justification be provided for keeping the microbes discussed below on the Final CCL 5, or they should be removed from the CCL 5.

Shigella sonnei

The SAB recommends that the EPA remove *Shigella sonnei* from the CCL 5. The score of 4 for the evidence of waterborne outbreaks is based on a suspected outbreak in 2015, in Arizona, but not confirmed to be waterborne; this outbreak also included Salmonella and Norovirus, suggesting a non-waterborne source. Excluding that, the most recent community waterborne outbreak reported in the CDC National Outbreak Reporting System (CDC-NORS) was in a cruise ship setting in Illinois in 2008, which was the first reported since an outbreak at a festival/fair in 1998. There is some evidence that *S. sonnei* is not a substantial waterborne risk. For example, McClung et al. (2020) concluded that a *Shigella* outbreak was not from drinking water.

Adenovirus

The SAB is concerned about the EPA potentially overstating the health risks of adenovirus. The adenoviruses can include both human and non-human strains and methods are needed to understand the specific human health risk. Traditional primary and secondary wastewater treatment is expected to achieve 3-4 orders of magnitude reduction of viruses. Human Adenovirus may exhibit resistance to tertiary and advance water treatments (Chen et al., 2021) including UV disinfection treatment ($40 mJ/cm^2$) as well as treatments that do not include chemical oxidants like chlorine dioxide (Schiijven et al., 2019). However, there is increasing knowledge of UV wavelengths and disinfectant doses needed for adequate treatment. Therefore, the SAB recommends that more information and rationale be provided if the Human Adenovirus is kept on the Final CCL 5.

Calicivirus

The SAB recommends careful evaluation of Caliciviruses because the evidence for risk of waterborne outbreaks in the score cards in the *Technical Support Document for the Draft CCL 5 – Microbial Contaminants* was based only on outbreaks in a few transient systems and one community outbreak listed in the CDC-NORS data.

Campylobacter

The SAB recommends that the EPA consider removing campylobacter from the Final CCL 5 because there is little evidence for its association with drinking water. A one-year study was conducted in Canada to identify sources and rule out a possible link of *C. jejuni* in drinking water and outbreaks (Inglis et al., 2021). The study found no detections of *C. jejuni* in drinking water post UV and chlorination treatments. The lack of matching subtypes of *C. jejuni* isolates from people and water sources led to the conclusion that the outbreaks were not related to municipal drinking water. The study concluded that the cases of campylobacteriosis in this rural area were likely attributable to waterfowl or other animal interactions with humans (Inglis et al., 2021). A similar study with a different outcome in Norway determined that the human isolates and water in the distribution system had identical core genome profiles and identified the breakthrough point at an aging storage reservoir in the distribution system which likely became contaminated with *C. jejuni* from birds' waste (Hyllestad et al., 2020). However, it would be unlikely for those U.S. drinking waters that maintain residual chlorine to become contaminated in the same way.

Enterovirus

The SAB recommends that the EPA provide further justification for inclusion of enteroviruses on the Draft CCL 5 since they are currently covered under the SWTR and GWR. If further justification is not available, the SAB recommends removing enteroviruses from the Final CCL 5.

Helicobacter pylori

The SAB recommends careful consideration of the evidence supporting inclusion of *Helicobacter pylori* on the Final CCL 5. Inclusion of *Helicobacter pylori* on the Draft CCL 5 was justified by a single 1999 study that used immuno-microscopy, a method that has potential for cross reactions (Hegarty et al., 1999). Since then, additional studies using PCR have investigated the presence of *H. pylori* in untreated waters outside the U.S., however the SAB is not aware of any other detections of *H. pylori* in the U.S. in finished drinking water or drinking water sources; EPA should consider providing additional supporting data if *H. pylori* is to remain on the Final CCL 5.

The following recommendations are noted:

Tier 1

- Remove *Shigella sonnei* for the Final CCL 5.

Tier 2

- More information and rationale are needed if the Human Adenovirus is kept on the Final CCL 5.
- Conduct careful evaluation of caliciviruses before they are included on the Final CCL 5.
- Consider removing *Campylobacter* from the CCL 5.
- Provide further justification for including enteroviruses on the Draft CCL 5.
- Consider removing *Helicobacter pylori* due to lack of supporting data.

Tier 3

- The SAB has no specific recommendation for this tier.

2.4. Charge Question 4: Contaminants that should be added

Based on your expertise and experience, are there any contaminants which are currently not on the Draft CCL 5 that should be listed? Please provide peer-reviewed information or data to support your conclusion.

2.4.1. Chemical Contaminants Recommended for Consideration or Inclusion

Bisphenol F, Bisphenol S and other Bisphenols

The SAB recommends that the EPA include the additional bisphenols, bisphenol F (BPF) and bisphenol S (BPS), on the Final CCL 5. In addition, the SAB recommends that the EPA consider including bisphenol AF (BPAF), bisphenol B (BPB), bisphenol D (BPD), and bisphenol E (BPE) on the Final CCL 5. Bisphenol A (BPA) was selected for the Draft CCL 5 based on the process described in the FRN. Manufacturers are using other bisphenols as alternatives to BPA (e.g., BPAF, BPB, BPD, BPE, BPS and BPF) in products (Liao and Kannan, 2013), and these have been detected in foods (Liao and Kannan, 2013; Xie et al., 2014; Yonekubo et al., 2008; Zou et al., 2012; Chen et al., 2016) and water (Fromme et al., 2002; Jiao et al., 2012; Chen et al., 2016). BPF is suggested to have estrogenic properties as does BPA (Baker and Chandsawangbhuwana, 2012). Other bisphenols that have been detected in environmental matrices, foods, and consumer products including bisphenol AP (BPAP), bisphenol P (BPP), and bisphenol Z (BPZ) (Chen et al., 2016); these bisphenols may merit examination in the future.

PFAS

The SAB recommends that the EPA expand the definition used to classify PFAS for inclusion on the Final CCL 5. The SAB also recommends that EPA more clearly communicate the relative levels of potential risk and gaps in information needed to craft risk management decisions for PFAS. An expansive definition of PFAS would allow a focus on a broad range of compounds of potential health risk. The current structural definition selected by EPA includes compounds that contain the unit R-(CF_2)- C(F)(R')R'', where both the CF_2 and CF moieties are saturated carbons, and none of the R groups (R, R' or R'') can be hydrogen. An inclusive definition was established by the Organization for Economic Co-operation and Development (OECD) in 2021, which defines PFAS as any compound that contains at least one fully fluorinated methyl or methylene carbon atom (i.e., without any H/Cl/Br/I atom attached to it) (Wang et al., 2021). This simplified and more inclusive definition was designed to distinguish PFAS more easily from other compounds and improves understanding by both experts and nonexperts. According to the EPA CompTox PFAS Master List there are approximately 9,252 known PFAS, a much larger universe of PFAS than what is included by the definition in the Draft CCL 5. Because the current U.S. EPA definition and other possible definitions of PFAS include thousands of compounds, the SAB recognizes that the EPA may not be able to accommodate the earlier recommendation to provide a list of PFAS considered.

Organophosphate Esters

The SAB recommends the addition of organophosphate esters (OPEs) as a group, rather than selecting individual compounds. Combining OPEs as a group would elevate this class of compounds and encourage additional research to elucidate the full impact of OPEs on children's health. Organophosphate esters are applied to a variety of consumer products, primarily as flame retardants and plasticizers. OPEs can leach out of products over time and are consequently prevalent in the environment and frequently detected in human biomonitoring studies. OPEs were associated with several female-specific cancers (Liu et al., 2021). A review published in 2019 provides support for why exposure during pregnancy is of particular concern, as OPEs are detected in placental tissues, suggesting they may transfer to the fetus. Also, this review cited several studies showing that children typically experience higher exposure to several OPEs compared with adults, indicating they may be disproportionately impacted by these compounds. An expanding body of research demonstrates that OPEs are associated with adverse reproductive health and birth outcomes, asthma and allergic disease, early growth and adiposity, and neurodevelopment (Doherty et al., 2019).

Antimicrobials

The SAB recommends that the EPA consider the inclusion of antimicrobials in the Final CCL 5. The SAB understands time may be a constraint, and if EPA is unable to include antimicrobials in the Final CCL 5, the SAB recommends EPA include them in CCL 6. As of 2015, U.S. antibiotic sales for use in agricultural animal feed was estimated at 70% of total U.S. antibiotic sales (U.S. FDA, 2015). Much of this amount passes through the animal unchanged, resulting in antibiotic presence in animal urine and manure on rangeland, and potential entry to water sources (Kumar et al., 2005). Studies show that resistance developed by bacteria for antibiotics may belong to the same genes that also regulate resistance to chlorination (Liu et al., 2018; Jin et al., 2020). Although this may seem to be an issue of greater concern for wastewater treatment than for drinking water, source water receiving non-point source pollutants may be prone to such adverse impacts (Sanganyado and Gwenzi, 2019).

Antimicrobial resistance genes

The SAB also recommends that the EPA consider adding the group of antimicrobial resistance genes to the Final CCL 5 as an important indicator for understanding the underlying mechanisms and the epidemiology of antimicrobial resistance in water supplies. The WHO Global Antimicrobial Resistance Surveillance System (GLASS) and the Centers for Disease Control and Prevention (CDC) National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS) can be important resources for input to the PCCL process.

Microplastics

The SAB recommends that the EPA consider the inclusion of microplastics in future CCLs. Microplastics (MPs) are transported in air and deposited in soil, with surface water considered the principal final environmental sink (Akdogan et al., 2019). Although health effects are yet unknown, microplastics are found globally in raw water sources and drinking water, especially in the size range of 1 - 10 micrometers (Cermakova et al., 2018). In a 2019 review, microplastics were frequently reported to be present in freshwaters and drinking water, and the concentration numbers spanned ten orders of magnitude (1×10^{-2} to 10^{8} particles/m^3) across individual samples and water types; it is noted the review cited important needs for methods development and standardization (Koelmans et al., 2019). Based on available evidence, the World Health Organization (WHO) recently concluded that the human health risks of microplastics in water are low (WHO, 2019). The agency, citing uncertainties in analysis, identified the need for well-designed and quality-controlled investigative studies to better understand the occurrence of: microplastics in the water cycle and in drinking-water throughout the water supply chain; the sources of microplastic pollution and the uptake; and fate and health effects of microplastics under relevant exposure scenarios (WHO, 2019). The California Safe Drinking Water Act (SB-1422) requires four years of testing for MPs in drinking water, and the state must consider guidelines to help water providers and consumers determine what levels may be safe to drink.

MPs can adsorb organics particularly polyaromatic hydrocarbons (PAHs), which may have concentrations several orders of magnitude higher than the concentration in the carrier water (Rochman et al., 2013). Although little is known at present about potential MP-PAH toxicity, ecological toxicity is being reported, and effect on human health represents an active area of research (Sun et al., 2021). While adsorption of organic contaminants like PAHs can occur, reviews suggest this may not be the most important exposure concern (Koelmans et al., 2016). More significant is the potential exposure to plasticizers and other ingredients in the microplastics themselves. Many of the compounds included in the draft CCL 5 are used in plastic, including bisphenols, organophosphate esters, and phthalates. Given the actions of WHO and States, the EPA should include microplastics in future PCCLs for research, methods development, and human and ecological risk assessment.

Nanoparticles

Nanoparticles are an emerging public health concern; the SAB recommends EPA consider nanoparticles, at very least in the PCCL. As summarized by Patil et al. (2016), nanoparticles in the aquatic environment affect aquatic life, especially plant life, bacteria and aquatic microbes, aquatic invertebrates and vertebrates, and human health. Consumption of contaminated drinking water or the inhalation of water aerosols containing some nanoparticles are the possible means of exposure (Daughton, 2004). Although the eco-toxicity of nanoparticles is clearer, particularly for silver, zinc, and titanium containing products (Baun et al., 2008; Turan et al., 2019; Moloi et al., 2021), the human health impacts are less clear and would benefit from prioritization through the CCL process.

Saxitoxin

Saxitoxin (STX) is only one compound in the suite of saxitoxin-related compounds. Other compounds of importance within the group include dcSTX, dcGTX2, dcGTX3 and LWTX1-6 (Foss et al., 2012; Onodera, et al., 1997; Carmichael et al., 1997; and Miller et al., 2017) based on U.S. studies. Studies from other countries observed neo-STX and various GTX in: Denmark (Kaas and Henriksen, 2010); Australia (Negri and Jones, 1995); Brazil (Sevonen and Jones, 1999; and Molica et al., 2005); New Zealand (Smith et al., 2011); Germany (Ballot et al., 2010); and China (Liu et al., 2006). The SAB suggests that instead of listing only STX, the EPA refer more generally to "saxitoxins" on the Final CCL 5, providing flexibility for consideration of any relevant saxitoxins in the CCL process.

The following recommendations are noted:

Tier 1

- Include additional bisphenols, BPF and BPS on the Final CCL 5.
- The EPA should consider expanding the definition of PFAS to be more expansive to capture all relevant fluorinated compounds and degradates in commercial use or entering the environment (e.g., the definition put forth by OECD is: "a compound that contains at least one fully fluorinated methyl or methylene carbon atom").
- Clearly communicate the relative levels of potential risk and gaps in information needed to craft risk management decisions for PFAS.
- In addition to saxitoxin (STX), EPA should include other saxitoxins including neo-STX and dc-STX on the Final CCL 5.

Tier 2

- Combine organophosphate esters as a group to elevate this class of compounds**.**
- Consider including BPAF, BPB, BPD, and BPE on the Final CCL 5.

Tier 3

- Consider the inclusion of antimicrobials in the Final CCL 5, if EPA is unable to include antimicrobials in the Final CCL 5 it is recommended to include antimicrobials in CCL 6.
- Consider including the group of antimicrobial resistance genes on future CCLs.
- Microplastics are recommended for inclusion on future CCLs or in future PCCLs for research, methods development, and human and ecological risk assessment.
- Nanoparticles should be included on the PCCL.

2.4.2. Microbial Contaminants Recommended for Consideration or Inclusion

The SAB commends the EPA for declining to include non-tuberculous mycobacteria (NTM) on the Draft CCL 5. However the SAB recommends EPA consider adding a group of pathogenic mycobacteria to focus research and public health protection on a more identifiable and actionable group of opportunistic pathogens, compared to the nondescript NTM designation.

The NTM terminology has its origin in the clinal usage as referring to infections caused by mycobacteria other than *M. tuberculosis*. NTM is an inappropriate use of terminology for environmental microbiology, particularly drinking water, since all environmental mycobacteria are "NTMs" (in that potable water is an insignificant route of exposure for *M. tuberculosis*). The inclusion of *M. avium* and *M. abscessus* in the Draft CCL 5 is helpful to point to the potential health risks of pathogenic mycobacteria in water supplies. However the SAB finds it surprising that EPA did not also include other pathogenic mycobacteria. EPA scientist M.J. Donohue (2016, 2018) reviewed clinical laboratory reports and found that clinical cases of mycobacteria increased from 8.2 per 100,000 persons in 1994 to 16 per 100,000 persons in 2014. Changes in mycobacteria diversity were observed in complex groups known to be clinically significant. Between 1994 and 2014 the rate of infections implicating *M. abscesses-chelonae* group and *M. avium* complex increased by 322% and 149%, respectively. In addition to the two mycobacteria listed on the Draft CCL 5, *M. fortuitum, M. gordonae*, *M. mucogenicum*, *M. chelonae, M. kansasii*, and *M. xenopi* all had significant rates of clinical illness. King et al. (2016) detected *M. avium* and *M. intracellulare* in 36% of treated drinking water samples examined.

The following recommendations are noted:

Tier 1

- The SAB has no specific recommendation for this tier.

Tier 2

- Consider adding a group of pathogenic mycobacteria to focus research and public health protection on a more identifiable and actionable group of opportunistic pathogens, compared to the nondescript NTM designation.

Tier 3

- The SAB has no specific recommendation for this tier.

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