Definition of ‘Microplastics in Drinking Water’
- DRAFT Responses to Public Comments –

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Overview

The State Board received 22 comment letters during the 30-day comment period (March 24 – April 24, 2020), and five speakers provided comments during the staff workshop (April 7, 2020).

The tables below provide the following:

1. A list of individuals providing written comments during the 30-day comment period. (Table 1)
2. A list of individuals providing oral comments during the Public Staff Workshop held on April 7, 2020 (Table 2). Note that in the case of commentators that provided both oral and written public comments, identical comment ID numbers were assigned.
3. Details regarding categorization scheme (Table 3).
4. Issues and issue numbers included in categorization scheme (Table 4).
5. A summary of substantive general comments received by the State Water Board during the allotted timeframes for the 30-day comment period for the subject proposed definition, along with responses (Table 5).
6. A summary of substantive specific comments received by the State Water Board during the allotted timeframes for the 30-day comment period for the subject proposed definition, along with responses (Table 6).

A number of comments were general in nature - some directed at the proposed definition, others not – as well as comments directed specifically at the proposed definition. Numbers assigned to comments are made up of two parts separated by a “period” (.): the first number corresponds to the number assigned to the commentator (Table 1), and the number following the period corresponds to the specific comment in the order that it appears in the comment letter. For example, comment 4.02 is the second comment from the fourth commentator on Table 1 (Association of California Water Agencies).

Whenever brackets appear in this document, the text contained within and/or formatting is attributable to State Water Board staff and is intended to either harmonize formatting and language to improve accessibility, change the format of a reference to a uniform nature, or classify comments by category. Brackets [ ] are insertions by State Water Board staff to either define a non-standard abbreviation or normalize formatting for citations. In several instances in which brackets were used in public comment letters, these have been changed to curly brackets { } in this document to clarify that they were included in the original letter. All emphases (i.e. bold or italicized text) was preserved from the original letters.

In all cases where citations appear in the comments or responses, their full references may be found in the References section at the end of this document. In many cases, formatting for in-text citations, and references have been changed from the original comment letters to ensure uniformity within this document, full proper citation, and accessibility.

Classification Scheme

Each comment is categorized using several qualifiers, allowing for enhanced organization and the ability to sort comments in a data table[1]. The categorization scheme contains information in the following order: whether the comment is general (G) or specific (S) in nature; the issue (#); whether the comment is in support of the issue as it is written in the proposed definition (a) or suggests a revision to the issue (b). For example, a comment suggesting that a biodegradability criteria be added to the definition would be categorized as: specific comment (S); biodegradability issue (#9); suggestion to revise the proposed definition (b); yielding **S9(b)**.

Table 3 lists categorization qualifiers and their symbols. Table 4 lists issues and their corresponding numbers.

[1] Comment letters and response to comments are available in filterable data table format at https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/microplastics.html

Acronyms and Terms

The following is a list of acronyms or abbreviated phrases, used in the subsequent discussions, and their meanings:

- ACC = American Chemistry Council
- ACWA = Association of California Water Agencies
- BPI = Biodegradable Products Institute
- DDW = Division of Drinking Water, State Water Resources Control Board
- ECHA = European Chemicals Agency
- EPA = Environmental Protection Agency
- EU = European Union
- HDPE = High Density Polyethylene
- HSC = Health and Safety Code
- ISO = International Standards Organisation
- MCL= maximum contaminant level
- MPs = Microplastics
- NOAA = National Oceanic and Atmospheric Administration
- OPC = Ocean Protection Council
- PE = Polyethylene
- PD = Proposed Definition
- PP = Polypropylene
- PVC = Poly Vinyl Chloride
- State Water Board = State Water Resources Control Board
- SB 1422 = Senate Bill 1422
- SBR = styrene-butadiene rubber
- SDWA = California Safe Drinking Water Act
- SFEI = San Francisco Estuary Institute
- SWRCB = State Water Resources Control Board
- REACH = Registration, Evaluation, Authorisation and Restriction of Chemicals
- Report = Staff Report on the Proposed Definition of 'Microplastics in Drinking Water'
- TRWP = Tire and Road Wear Particles
- USTMA = The U.S. Tire Manufacturers Association
- UCI = University of California, Irvine
- WEX = Water-Energy Nexus
- WHO = World Health Organization

Table 1: Commentators Providing Written Comments During 30-day Comment Period

No.	Commenter(s)	Submitted by:
1	American Chemistry Council on behalf of California Manufacturers and Technology Association, California Retailers Association, Consumer Healthcare Products Association, Personal Care Products Council, and Plastics Industry Association	Brett Howard
2	American Cleaning Institute	Kathleen Stanton
3	American Coatings Association	David Darling
4	Association of California Water Agencies	Cindy Tuck
5	Biodegradable Products Institute	Rhodes Yepsen
6	California Association of Sanitation Agencies	Jared Voskuhl
7	California Seed Association	Chris Zanobini
8	California Sportfishing Protection Alliance	Richard McHenry
9	California-Nevada Section of the American Water Works Association	Sue Mosburg
10	Center for Biological Diversity	Gus Glaser
11	Central Valley Clean Water Association	Debbie Webster
12	Clean Seas Lobbying Coalition The 5 Gyres Institute The Center for Oceanic Awareness, Research, and Education Plastic Pollution Coalition Save Our Shores Seventh Generation Advisors Heal the Bay UPSTREAM Wishtoyo Chumash Foundation Zero Waste USA Northern California Recycling Association Plastic Oceans International	Genevieve Abedon Anna Cummins Christopher Chin Dianna Cohen, Katherine O'Dea Leslie Mintz, Tamminen Emily, Parker Miriam Gordon, Mati Waiya, Ruth Abbe David Krueger, Julie Andersen
13	Fragrance Creators Association	Darci Ferrer
14	Household and Commercial Products Association	Nicholas Georges
15	Ocean Protection Council	Mark Gold
16	Orange County Sanitation District	Violet Renick
17	Orange County Water District	Jason Dadakis
18	San Francisco Estuary Institute	Diana Lin, Ezra Miller, Rebecca Sutton
19	Surfrider Foundation Orange County Coastkeeper	Miho Ligare, Ray Hiemstra

No.	**Commenter(s)**	**Submitted by:**
20	U.S. Tire Manufacturers Association	Sarah Amick
21	US EPA, Region 9	Luisa Valiela
22	Water-Energy Nexus Center at the University of California, Irvine	Diego Rosso

Table 2. Commentators Providing Oral Comment at the Public Staff Workshop[2]

No.[3]	**Commenter(s)**	**Submitted by:**
16	Orange County Sanitation District	Violet Renick
1	American Chemistry Council on behalf of California Manufacturers and Technology Association, California Retailers Association, Consumer Healthcare Products Association, Personal Care Products Council, and Plastics Industry Association	Brett Howard
23	Clean Water Action	Andria Ventura
4	Association of California Water Agencies	Cindy Tuck
5	Orange County Coastkeeper	Ray Heimstra
24	California Resource Strategies, Inc. on Behalf of Partnership for Sound Science in Environmental Policy	Craig Johns

[2] A video of the staff workshop and oral public comments is available at the following link: https://www.youtube.com/watch?v=tXumeAzMxi0&feature=youtu.be&t=12605. Note that oral comments that were effectively identical in content to their respective written comments were considered duplicative and not recorded in this document (four out of five). In the case of oral commentators who did not also submit a written comment (one out of five), a transcript of their oral comment is recorded in this document.

[3] When applicable, oral commentators numbers are matched with their respective public commentator numbers. The order in which public commentators spoke is preserved in the table.

Table 3. Categorization scheme of comment issues

Qualifier	Symbol
General Comment	G
Specific Comment	S
Issue	# (table 4)
Support	(a)
Revise	(b)

Table 4. Issues and Issue Numbers

Issue	Issue Number
1	process
2	definition
3	additional SB 1422 Requirements
4	applicability of definition to other sectors than drinking water
5	*substance*
6	'drinking water'
7	*dimensions* (lower limit)
8	solubility
9	biodegradability
10	*state*
11	*dimensions (*misc.)
12	*substance* - natural fibers
13	*dimensions* (upper limit)
14	*dimensions* (nomenclature)
15	*morphology*
16	*density*

Table 5. Comment and Response for 30-day Comment Period and Public Staff Workshop – General Comments[4]

No.	Issue	General Comment	DRAFT Response
1.01	**G1(b)- Revise Process**	**Support Development of a Definition of the Entire Phrase, “Microplastics in Drinking Water”** Section 116376 of the Health and Safety Code requires the SWRCB to adopt requirements for four years of testing and reporting of microplastics (MPs) in drinking water. To implement this program, the Board must adopt a standard methodology to be used in the testing of drinking water for microplastics. The Board is also mandated to “adopt a definition of *microplastics in drinking water {*emphasis added} in Section 116376(a). Under the law, only those microplastics that are in drinking water are subject to the program – as opposed to the much broader universe of microplastics that are not present. The program should thus first develop analytical test methods to detect microplastics in drinking water. What is actually present drives the definition of microplastic and the scope of the program under Section 116376. We recognize that SB 1422 took these steps out of sequence, and that the law requires the definition to be adopted before an analytical test method is developed. SWRCB should be prepared to update any definition it adopts in 2020 in order to meet the legislative deadline to reflect what is present in drinking water (if anything). We encourage the [SWRCB] to host a workshop and invite stakeholder comments on an updated definition for “microplastics	Thank you for your support. The State Water Board agrees that the definition should be revised in response to new information, as stated in the definition and page 2 of the Staff Report. The State Water Board intends to engage stakeholders during the revision process of the definition, as well as all other stages of development of requirements of SB 1422. Per Health and Safety Code (HSC) section 57004, all California Environmental Protection Agency organizations (including the State Water Board) are required to submit for external scientific review the scientific basis and scientific portion of all proposed policies, plans and regulations. The definition proposed on March 24, 2020 is not subject to the requirements of Health and Safety Code section 57004 until it becomes associated with proposed policies, plans and regulations, which is anticipated to occur before the July 1, 2021 deadline for additional requirements of SB 1422.

[4] Brackets [ ] are used as annotations to classify comment by category. Whenever brackets appear in this document, the text contained within and/or formatting is attributable to State Water Board staff, and is intended to harmonize formatting and language to improve accessibility.

No.	Issue	General Comment	DRAFT Response
		in drinking water". An updated definition should also be subject to peer review.	
1.10	**G2(b)- Revise Definition**	**Recommended definition text** Based on the discussion above, we recommend the following text to define "microplastics in drinking water": 'Microplastics in Drinking Water' are defined as solid plastic materials to which chemical additives or other substances may have been added, which are particles where all three dimensions are greater than 20 and less than 5,000 micrometers (μm), where those plastic particles have been identified as present in drinking water. The term "plastic" is defined by ASTM D883. [ASTM 2020] "Drinking water" is defined as water intended for human consumption as managed by a public water system consistent with SDWA.	Thank you for your comment. See responses to comment 1.01-1.09 for details.
3.01	**G1(b)- Revise Process**	**Support Development of a Definition of the Entire Phrase, "Microplastics in Drinking Water"** Section 116376 of the Health and Safety Code requires the SWRCB to adopt requirements for four years of testing and reporting of microplastics (MPs) in drinking water. To implement this program, the Board must adopt a standard methodology to be used in the testing of drinking water for microplastics. The Board is also mandated to "adopt a definition of *microplastics in drinking water* {emphasis added} in Section 116376(a). Under the law, only those microplastics that are in drinking water are subject to the program – as opposed to the much broader universe of microplastics that are not present. The program	See response to 1.01.

No.	Issue	General Comment	DRAFT Response
		should thus first develop analytical test methods to detect microplastics in drinking water. What is actually present drives the definition of microplastic and the scope of the program under Section 116376. We recognize that SB 1422 took these steps out of sequence, and that the law requires the definition to be adopted before an analytical test method is developed. SWRCB should be prepared to update any definition it adopts in 2020 in order to meet the legislative deadline to reflect what is present in drinking water (if anything). We encourage the SWCB to host a workshop and invite stakeholder comments on an updated definition for "microplastics in drinking water". An updated definition should also be subject to peer review.	
3.10	**G2(b)- Revise Definition**	**Recommended definition text** ACA supports the recommended ACC definition of "microplastics in drinking water": 'Microplastics in Drinking Water' are defined as solid plastic materials to which chemical additives or other substances may have been added, which are particles where all three dimensions are greater than 20 and less than 5,000 micrometers (μm), where those plastic particles have been identified as present in drinking water. The term "plastic" is defined by ASTM D883 [ASTM 2020]. "Drinking water" is defined	See response to 1.10.

No.	Issue	General Comment	DRAFT Response
		as water intended for human consumption as managed by a public water system.	
4.01	**G2(a) – Support definitition**	**ACWA supports staff's approach for the development of the definition.** ACWA appreciates that the State Water Board staff has reviewed existing definitions from various entities in detail and is building on that existing work.	Thank you for your support.
4.03	**G1(a)- Support Process**	**ACWA supports inclusion of the statement in the Proposed Definition that the definition is subject to change.** The Proposed Definition includes the following statement: "Evidence concerning the toxicity and exposure of humans to microplastics is nascent and rapidly evolving, and the proposed definition of "Microplastics in Drinking Water" is subject to change in response to new information. The definition may also change in response to advances in analytical techniques and/or the standardization of analytical methods." Inclusion of this statement is important. The public is used to the State taking action to protect public health based on health effects studies and exposure information. In passing SB 1422, the Legislature acted without having health effects studies for microplastics in drinking water. As noted in the staff presentation at the April 7 workshop: "Although there is insufficient information to draw firm conclusions on the toxicity related to the physical hazard of plastic particles, particularly the nano size particles, **no reliable information suggests that is a concern through drinking**	Thank you for your support.

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		water-exposure.” {Emphasis added.} - World Health Organization (2019) As more information becomes available, that information may bring clarity to how the term should be revised and how the other actions in SB 1422 (e.g., development of a testing method and testing requirements) can be taken in a reasonable way without very high costs. It is good for the statement to be part of the definition.	
4.04	**G1(a)- Support Process**	**ACWA is willing to collaborate with the State Water Board and other stakeholders as the staff start to work on the type of standard testing methodology that the Board should adopt.** At this writing, some of ACWA’s members that purvey drinking water are looking at what are likely to be some of the technical and cost issues associated with testing for microplastics in drinking water. For example, plastics are a wide group of polymers that have many different sizes, shapes, and chemical compositions. Hence, measurement using existing tools is difficult. Research methods are based on the identification of polymers, measurement of particle sizes, and quantitation of particles. Sample preparation procedures can physically break down the polymers, which increases the number of particles. The option to measure mass may be a better metric with better consistency, but those methods are very expensive and cannot determine visual characteristics or counts. Our point at this time is that the next step will be challenging.	Thank you for comment. The State Water Board appreciates your willingness to collaborate with staff and additional stakeholders, and recognizes the importance of maintaining positive, open relationships with ACWA and other organizations to manage public health matters related to microplastics and other emerging contaminants in drinking water.

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		Collaboration between the State Water Board and public water agencies (and other stakeholders) regarding the test method makes sense.	
5.01	**G1(a)- Support Process G2(a)- Support Definition**	We want to thank the State Water Resources Control Board (water board) for the opportunity to comment on the Proposed Definition (PD) for Microplastics in Drinking Water. The decision to start with the European Chemical Agency's (ECHA) definition as the basis for the water board's PD of microplastics in drinking water is correct.	Thank you for your comment.
5.12	**G1(b) – Revise Process**	The DP [Draft Staff Report] itself indicates that it is not clear whether there is scientific evidence of potential negative effects of microplastics in drinking water. Additionally, since "currently no standardized methods for the detection of 'microplastics' exist", it would make the most sense to develop these methods via round-robin testing to assess relative concentrations and types of plastic which might be in the drinking water. Once microplastics are quantified and identified, toxicity testing should be conducted which is relevant to humans and higher order vertebrates, such as pets, who might consume this water.	The State Water Board is contracting with the Southern California Coastal Water Research Project to conduct round-robin testing on methods to detect microplastics in drinking water and will hold a workshop to evaluate the method as well as human health effects. In accordance with the requirements of SB 1422, the adoption of a definition of 'microplastics in drinking water' must be adopted prior to the requirements to adopt a standardized method or understand the human health effects. Toxicological testing relevant to humans is being conducted by numerous organizations worldwide. While it is unclear exactly what species the commentator is referring to in the statement regarding "pets", it should be noted that the use of dogs and cats for toxicological research is considered to

No.	Issue	General Comment	DRAFT Response
			be unethical by most regulatory, research, and funding institutions except in that case that animals of no other species are suitable for the intended purposes (Webster 2014).
6.01	**G1(a)- Support Process G2(a)- Support Definition**	<u>Commentary on the Definition</u> With regard to the definition itself and accompanying staff report, we applaud the State Water Board's success in providing a succinct definition based on strong science, for providing extensive rationale and discussion in the accompanying staff report, and for being accessible by engaging in open dialog with commenters during the State Water Board's microplastics definition workshop on April 7, 2020. These efforts will greatly assist stakeholders to better understand the origins and intent of this definition, especially as robust microplastics analysis methods eventually follow. Accordingly, as the State Water Board moves forward with its regulation of microplastics in drinking water, we would appreciate a similarly clear, articulated approach for further refinements to the definition, the development of methods (multiple approaches may be needed to address the broad range of substances), prioritization of subsets of microplastics with the most significant impacts, and stakeholder engagement for all three. As is, the absence of standardized methods and definitions for categorizing microplastics are a significant hurdle for comparisons between the datasets of studies to date.	Thank you for your comment.

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		Additionally, while the proposed definition’s breadth may be appropriate for capturing the range of microplastics that could be in source waters, the specific substances encompassed by it will require further refinement before reporting levels and MCLs can be developed, similar to how regulations for metals or other broad categories of constituents are. We agree with the Board that this field is an emerging science and our understanding of the toxicity and exposure of humans to microplastics is still developing. We stress that health effects, ability to measure and quantify, treatability, and source control each will vary based on multiple factors such as size, form, and substance, and it is important not only to confirm the presence of particles but also understand what the quantities mean for the safety of water supplies.	
6.03	**G1(b)- Revise Process**	<u>Extension to Matrices Other than Drinking Water</u> We understand that this definition of microplastics is currently being proposed for only drinking water. However, in response to a question during the staff workshop on April 7 about uses of this definition of “microplastics in drinking water,” State Water Board staff indicated that their plan is for this definition to be the default one utilized by programs outside of the Division of Drinking Water. At the same time, the definition is qualified by a statement that it may be updated in the future. We respectfully request the Staff Report include a description of the process for how such changes will be made and the associated notice and opportunities for comment.	Thank you for your comment. The Staff Report has been revised to include a general description of the process for how such changes will be made. When available, the State Water Board webpage will be updated with details regarding associated notices and opportunities for comment for a revised definition.

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6.04	**G3(b) – Additional SB 1422 Requirements (suggestion)**	Future Actions: Source Control and Pathways We understand that this definition is only the first step in the administrative process for regulating microplastics at various levels, and as such we would like to underscore two important points about the role of microplastics in wastewater for future consideration. First, we wish to emphasize the importance of source control for preventing microplastic pollution. The wastewater community has been involved in several research efforts on this topic that have been initiated recently. As you are aware, one significant study undertaken by the San Francisco Estuary Institute (SFEI) that was published last year examined microplastic loadings in the San Francisco Bay [Sutton et al. 2019]. SFEI's seminal report concludes the section on wastewater with the finding that "*it is likely far more cost-effective to prevent pollution in the first place or to control it directly at the point of entry* {than employing tertiary treatment to significantly lower microparticle concentrations in discharges.}(emphasis added)." To that end, CASA would like to note our sponsorship of legislation over the last several years to ban microbeads (AB 888, 2015), for the Ocean Protection Council to develop a statewide microplastics strategy (SB 1263, 2018), and for wet wipes containing plastic to be labeled "Do Not Flush" (AB 1672, 2019-20), as well as our support for legislation requiring washing machine filters to capture microfibers. Second, we recognize that source control efforts will not prevent all microplastics from entering our	Thank you for your comment.

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		waters, so it is important to understand contributions from different pathways of microplastics to the aquatic environment, as well as the differences in particle types which are conveyed, in order to develop a strategy to prioritize addressing microplastic pollution that distinguishes between relative sources, the associated risks of each source, and pathways into the aquatic environment. As an example, SFEI's 2019 report [Sutton et al. 2019] observed "because stormwater loads are so much greater than wastewater loads, even a polymer making up a very small percentage of the total [stormwater load] would still be very significant relative to the entire wastewater load (e.g., a plastic polymer that is 1% of the stormwater microplastic load would be three to five times greater than the entire wastewater microplastic load)." Extrapolating out from this finding and with respect to management decisions, a *de minimis* prevention of microplastics pollution from one pathway could result in the elimination of the equivalent of the entire loading from another.	
7.01	**G1(b) – Revise Process**	I respectfully request that the comment period regarding the "Microplastics in Drinking Water Definition" be extended for 14 additional days to Noon on May 8, 2020. There are multiple film coating technologies that are used in California's seed industry primarily to promote seed health and improve worker health and safety. There are several companies that operate internationally and in California that have and are	Thank you for your comment. HSC section 116376 requires adoption of a definition by July 1, 2020. The State Water Board cannot extend the public comment period for this iteration of the definition and still meet this legislative mandate. The State Water Board intends to revisit the definition before taking action on additional requirements of SB 1422 before the July 1, 2021

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		developing film coating technologies to address the use of microplastics. The comment period for this regulatory action is occurring during a once-in-a-life-time pandemic where federal, state and local public health orders have designated the seed industry as critical infrastructure. As you might imagine, our attention over the last month has been on assuring that seed supply chains to farmers across the U.S. are uninterrupted and to make sure our essential workforce is protected. I would appreciate an extra 14 days so we can reach out directly to seed film companies for their input who rightfully for the last month have been focused on their roles as essential businesses to the State of California. They may have no concern over the proposed definition, but it is important that they have the opportunity to comment.	deadline. The State Water Board encourages the California Seed Association, and all other stakeholders to participate in further public comment opportunities related to SB 1422.
9.01	**G1(b) – Revise Process**	It is critical that a final definition reflect the current state of available, reliable and cost- effective analytical methods able to measure Microplastics in water according to the target size/shape/type defined. A definition should not be finalized until such time.	As mentioned in the definition, and on page 3 of the Staff Report, the State Water Board intends to update the definition in response to new information, including toxicity and exposure to humans, as well as advances in analytical techniques and/or the standardization of analytical methods. Upon adoption of a standardized method as required by SB 1422 by July 1,2021, the definition may be revised.

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9.02	**G1(b) – Revise Process**	A definition should not be finalized until research on Microplastics' health effects (which is extremely limited at the present time) is available.	Thank you for your comment. See response to 9.01.
9.03	**G1(b) – Revise Process**	For purposes of complying with SB1422, DDW must adhere to the requirements of the Administrative Procedures Act in lieu of developing a Policy Handbook.	HSC section 116376 (c) states:, "The state board may implement this section through the adoption of a policy handbook that is not subject to the requirements of Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code."
9.04	**G3(b) – Additional SB 1422 Requirements (suggestion)**	State Water Board should exempt certain systems (i.e. based on size or source water type) from the SB1422 monitoring requirements or assign less frequent testing requirements or waiver options versus systems most susceptible to Microplastics.	Thank you for your comment. State Water Board staff will consider various factors in developing the monitoring requirements.
9.05	**G3(b) – Additional SB 1422 Requirements (suggestion)**	Given the lack of research on health effects and very limited overall exposure of Microplastics from drinking water, the State Water Board should request from the Legislature a revision to the milestone dates set in SB1422, to accommodate key research considerations and analytical technology development.	Thank you for your comment. We suggest that you contact the Legislature directly to raise these concerns.
9.06	**G3(b) – Additional SB 1422 Requirements (suggestion)**	The testing requirement from SB1422 should be based solely on drinking water entry points (treated samples) only, since the intent of the legislation is to evaluate occurrence in drinking water and not health effects.	Thank you for your comment. State Water Board staff will consider various factors in developing the monitoring requirements.

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9.07	**G3(b) – Additional SB 1422 Requirements (suggestion)**	The State Water Board should provide funding assistance as part of SB1422 monitoring, since the legislation also included funding.	Thank you for your comment. At this time, the Legislature has not allocated funding for that purpose.
10.01	**G3(b) – Additional SB 1422 Requirements (suggestion)**	The Center for Biological Diversity strongly supports the State of California Water Board’s initiative to monitor microplastics in drinking water. This new monitoring program will assist in assessing microplastic presence and concentration across a wide variety of untreated and treated drinking waters. For this new program to be successful and useful the State needs to develop a rigorous standard method for measuring and mitigating microplastics in drinking water, and the current proposal does not yet do that.	Thank you for your comment. The State Water Board, in collaboration with The Southern California Coastal Water Research Project, is performing an interlaboratory validation on a method to measure microplastics in drinking water with over 35 laboratories in seven different countries. A public workshop will be held to review the results late in 2020.
10.03	**G3(b) – Additional SB 1422 Requirements (suggestion)**	Drinking water distribution systems occur in a wide variety of geological settings and are composed of a wide variety of piping materials, including High Density Polyethylene (HDPE) and Poly Vinyl Chloride (PVC), and are typically replaced only once every 50 to 100 years. The State of California Water Board must take into consideration not only raw and treated water quality when interpreting microplastic results but also, feasibly, corrosion of plastic water main material and privately-owned plastic plumbing lines.	Thank you for your comment.
11.01	**G1(a) – Support Definition**	As an initial matter, we wish to compliment the State Water Board on a very informative overview of this issue at the April 7 workshop. The staff presentation was clear, thorough, and helpful in understanding	Thank you for your comment.

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	G2(a) – Support Process G3(a) – Support additional SB 1422 Requirements	both the development of the proposed definition and how it may be put to use. As acknowledged at the workshop, the proposed definition is quite broad. This may be appropriate for capturing the range of microplastics that may be present in source waters. However, the broad definition is best viewed as a category of substances that will require further refinement before analytical methods, reporting levels, and MCLs can be developed, similar to metals or other broad categories of constituents. Health effects, ability to measure and quantify, treatability, and source control will vary based on factors such size and form (fiber versus particle). As the Board moves forward with its regulation of microplastics in drinking water, it should clearly articulate the approach to methods development (multiple approaches may be needed to address the broad range of substances), as well as how it will prioritize the subset of microplastics with the most significant health impacts. We agree with the Board that evidence concerning the toxicity and exposure of humans to microplastics is still developing, and stress that it is important not only to confirm the presence of these substances but also to understand what these levels mean for the safety of water supplies.	
11.02	**G4(b) – Applicability of definition to other sectors**	In addition, while this definition is intended to be used in the drinking water context, staff have indicated that they envision the definition being applied in other contexts. Before the definition migrates into other sectors, such as wastewater and stormwater, we need to better understand the	Thank you for your comment.

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	than drinking water (suggestion)	exposure pathways and risk levels associated with these potential conduits and develop methods specific to these matrices. The definition may need to be modified for these sectors. We recommend focusing on additional research regarding microplastics to inform future phases of implementation beyond drinking water.	
14.02	**G1(a) – Support Process**	**HCPA believes that the definition for Microplastics in Drinking Water should adapt as the scientific community's understanding of microplastics evolves** HCPA supports the use of sound science as the basis for all decisions. While the science and our knowledge of microplastics is continually improving, HCPA is concerned that policy on microplastics is moving much more quickly than the underlying science. The scientific communities' knowledge and data on the impacts that microplastics have on human health and the environment is very limited with a number of gaps, making it difficult to properly develop a definition. In 2019, the World Health Organization (WHO) published their study on microplastics in drinking water [World Health Organization 2019] and concluded that the quality and quantity of data on microplastics in different types of water (marine water, fresh water, tap and bottle water) vary and the data on occurrence in drinking water are limited. HCPA readily acknowledges that SWRCB needs to proceed forward to meet statutory requirements. HCPA urges SWRCB to be flexible while developing this initial definition and be open to modifying the definition as	Thank you for your comment.

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		the science and our understanding of microplastics evolves. Further, the lack of methods for sampling and analyzing microplastics in the environment (and drinking water) means that comparisons across studies are difficult. A recent systematic review [Koelmans et al. 2019] of existing literature identified 50 studies detecting microplastics in fresh water, drinking water, or wastewater. Of the 50 studies reviewed, nine studies measured microplastics in drinking water. In general, groundwaters are well protected from particulate contamination and conventional drinking water treatment is expected to provide an effective barrier for a wide range of particle sizes. However, the lack of standardized methods for sampling and analyzing microplastics in the environment (and drinking water) means that comparisons across studies are difficult. In addition, few studies of those that were reviewed were considered fully reliable due to a variety of issues such as contamination, analytical detection techniques, physical separation techniques, and sampling protocol. HCPA is concerned with moving forward with a definition in the absence of standardized testing methodology, or multiple testing methodologies, for measuring microplastic contamination. As testing methodologies are developed and validated, HCPA believes that SWRCB and all stakeholders must look at the definition and potentially modify so that we can properly quantify.	

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15.01	**G1(a) – Support Process G2(a) – Support Definition**	OPC may use the Water Board's definition for microplastics in the microplastics strategy and other policy documents. Overall OPC staff supports the Water Board's draft definition for microplastics in drinking water. The draft definition is thoughtful and aims to address the complexity of microplastics as a pollutant class. However, we recommend a smaller size range for "microplastics," the current size range covers particles that require different identification methods and that have different hazards.	Thank you for your comment. Please see response to comment 15.02 regarding updates to size classes in the revised definition and staff report.
16.01	**G2(a) – Support Definition**	**Overall support for the proposed definition of 'Microplastics in Drinking Water'** Overall, the proposed definition of 'Microplastics in Drinking Water' (hereby referred to as 'proposed definition') is scientifically sound and appropriate in its coverage of what most subject matter experts consider to be 'microplastics.' We agree with its broad and inclusive nature based on the specifically defined criteria of substance, state, and dimensions. By this definition, anthropogenic constituents that are in a solid state, are polymeric in composition, with at least two dimensions between 1 – 5,000 μm in size are generally included. We appreciate that this definition builds on work proposed by leading experts (Hartmann et al. 2019) and governmental agencies such as the European Chemicals Agency (ECHA 2019). Consensus among inter-agencies is an important step towards harmonization of a microplastic framework. We also believe that the definition strikes an appropriate balance between science-based inclusivity and exclusions for	Thank you for your comment.

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		compounds that may not be technically feasible to measure or quantify at this time (e.g. polymer gels). Given this, we would like to propose two modifications to ensure appropriate coverage of materials and a set timeline for re-evaluation of the definition.	
16.02	**G1(b) – Revise Process**	**Timeline for re-evaluation of the proposed definition** OCSD recognizes the difficulty in proposing a definition for a class of contaminants that are still emerging and for which methodology is still nascent. A flexible and adaptive definition of microplastics in drinking water as proposed by the State Water Board is necessary to incorporate changes as the science and methodology evolves (Hartmann et al. 2019). However, the concept that the definition may be modified or expanded at any time or frequency, with consequences for methodology and response limits, can be daunting for regulated agencies. OCSD encourages the State Water Board to consider a concrete timeline for re-evaluation of the definition on a fixed schedule, such as every two years. This would allow regulated agencies the ability to master the microplastic analysis methods built upon the definition and provide the State Water Board an appropriate period to re-evaluate the proposed definition as the science progresses.	Thank you for your comment. The definition will be revisited before adopting the additional SB 1422 requirements by June, 2020. Any revised definition will be available for public comment prior to adoption. The State Water Board webpage will be updated as soon as a definitive timeline is available.
17.03	**G1(b) – Revise Process**	The proposed definition of microplastics in drinking water includes an asterisk with the statement that "Evidence concerning the toxicity and exposure of humans to microplastics is nascent and rapidly	Thank you for your comment.

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		evolving, and the proposed definition of 'Microplastics in Drinking Water' is subject to change in response to new information. The definition may also change in response to advances in analytical techniques and/or the standardization of analytical methods." This statement along with the proposed broad definition is concerning, as it indicates that providing a clear definition of microplastics in drinking water is not currently possible. Such ambiguity in the underlying definition would seem to preclude the required future certification of a robust and reliable analytical method, much less any future drinking water regulation that supports the protection of public health.	
17.04	**G1(b) – Revise Process**	• <u>No Established Human Health Risks</u> - In March 2020, the SWRCB issued a an accompanying "Staff Report for Proposed Definition of Microplastics in Drinking Water" which included a statement that "To date, there is no universally agreed- upon definition for "microplastics." The Staff Report also quotes the recent 2019 WHO report, "Few studies are available regarding human exposure and health hazards of plastic particles, and significant data gaps remain (World Health Organization 2019)." Based on these statements, the SWRCB should not issue any monitoring requirements or establish any advisory Notification or Response levels for drinking water until more information/research on microplastics and human health are available.	Thank you for your comment. State Water Board staff will consider various factors in developing the statutorily mandated monitoring requirements. Please also see response to comment 10.01.

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		• Microplastics is a Concern in Environmental Water Sources - Available research has shown that microplastics appear to be a much greater concern to receptors in environmental water sources such as inland surface waters (e.g., lakes and rivers) and in the ocean. Before drinking water systems, especially groundwater system, spend considerable time and resources on microplastics testing, additional research findings must become available to clearly define microplastics occurrence and potential human health effects. • Exclusion of Groundwater systems - Future assessment of microplastics in drinking water monitoring should also consider the likelihood of occurrence in source waters. As stated in the World Health Organization report, research continues to show that groundwaters are well protected from particulate contamination and have significantly lower microplastic occurrence as compared to surface waters. If any future monitoring is required, consideration should be given to limited monitoring requirements for groundwater sources. • Lack of Standardized Methods - The current analytical methodology that will be reviewed following this proposed definition is limited and not standardized. Some of the common analytical techniques currently employed are Fourier transform infrared spectroscopy (FTIR), [Raman], Light microscopy and scanning electron microscopy (SEM). Although	

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		practically useful for qualitative work, they have associated limitations, such as identification amongst complex mixtures and the detection levels of the instruments are limited by resolution. This makes it difficult to identify small particle sizes (<50 μm) and to quantify low level material [Lusher et al. 2017; Song et al. 2015]. These legislated requirements for microplastics have been imposed on DDW and water agencies throughout California. There is limited scientific basis for these new requirements related to actual detectability and no human health risks have been established. The proposed definition, methodology, and monitoring requirements should be developed with this information in mind, as the limited resources available to DDW and water agencies throughout California would be better spent on assisting small water systems or addressing contaminants such as 1,2,3-TCP and PFAS.	
18.01	**G2(a) – Support Definition**	In general, we found the staff report provides a thorough explanation and context for defining microplastics in drinking water very broadly. We agree with the concept of defining microplastics broadly based on our experience monitoring microplastics in San Francisco Bay (Gilbreath et al., 2019; Miller et al., 2020; Sutton et al., 2019), where we identified a wide variety of microparticles and microplastics, including polymers, polymer blends, and materials that may not traditionally be considered plastic (which the staff report accurately	Thank you for your comment. Please see response to comment 10.01.

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		notes is ill- defined), including rubber, cellulose acetate, and polyester/cotton blends... …While the proposed definition is intended to be specific to microplastics in drinking water, the definition is likely to influence investigations and monitoring of microplastics in other matrices, such as surface waters (including non-drinking water sources), soil, sediment, and tissue. The proposed definition is rigorously defined based on characterizing the substance, state, and dimensions, and we support developing a rigorous definition to support standardizing methods for measuring microplastics. Lack of standardized methods and definitions for characterizing microplastics are major challenges to comparing data sets from different studies.	
19.01	**G2(a) – Support Definition**	During these uncertain times, the Surfrider Foundation (Surfrider) and Orange County Coastkeeper (Coastkeeper) appreciates your ongoing and committed efforts to engage stakeholders in defining microplastics in drinking water and offers the below comments.We are supportive of the State Water Resources Control Board's (SWRCB) broad inclusionary approach using the best available science to determine the definition of microplastics in drinking water with the flexibility to reconsider the definition in the future as new research and results are made available.	Thank you for your comment.

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19.02	**G2(a) – Support Definition**	**Protecting public health and the environment should be top priorities.** Surfrider and Coastkeeper encourage the SWRCB to be precautionary and inclusive with the definition of microplastics in drinking water as there are extreme uncertainties about the human health impacts of ingesting microplastics. There is currently not enough research and data on ingested microplastics, but we know that plastics can cause negative human health impacts [Rustagi et. al 2011] including DNA damage, endocrine disruption, cancer, and diabetes. Therefore, we agree that the microplastic in drinking water definition should be defined broadly, and with as few exclusions as possible, to ensure that policies, regulations, and standardized methodologies based on the definition capture a wide diversity of plastic particle types. Specifically, we support the substance, size, and state criteria of the definition as well as the inclusion of biodegradable polymers and natural fibers with synthetic coating and/or dyes due to the unknown human health impacts.	Thank you for your comment.
19.04	**G4(a) – Support for applicability of definition to sectors other than drinking water**	**We highly recommend that this definition be used to not only sample and monitor drinking water but also wastewater and stormwater discharges.** Emerging science highlights the ability for microplastics to accumulate in marine life and up the food chain - causing unknown impacts to human health through seafood consumption [Smith et al. 2018]. Recreation in the marine environment may be	Thank you for your comment.

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		another significant source of exposure to microplastics that needs to be better understood.	
20.02	**G5(b) – Revise *substance***	**A. Tire wear is essential to tire safety and performance** Tires are one of the most important safety components of a car. In addition to supporting the vehicle's weight, and providing performance in multiple weather conditions, tires are a vehicle's only connection to the road. This is why the grip between a tire and the road surface is essential to tire safety and performance, and this critical grip also leads to abrasion of both tire and road surface, producing tiny debris called TRWP [tire and road wear particles]. **B. There are many factors that impact the generation of TRWP** Many factors affect tire tread abrasion rates; or the total amount of mass lost from the tire surface due to interaction with the road per unit of distance. The quantity and characteristics of generated particles and rate of tire abrasion are linked to tire design choices that must provide traction under a variety of surface and environmental conditions. In addition, the rate of tire abrasion is influenced by factors unrelated to tire design, including driving behavior, vehicle and road characteristics, weather conditions and tire pressure. These external factors can cumulatively have a bigger influence on the rate at which TRWP are formed than tire design or construction alone. For example, a 2006 study by the Arizona State University, titled "Tire Wear Emissions for Asphalt Rubber and Portland Cement Concrete Pavement	Thank you for your comment. Please see response to comment 10.01.

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		Surfaces," found that emission rates of tire wear per kilometer driven on concrete pavement road surface are 1.4-2 times higher than emission rates of tire wear on rubber modified asphalt road surface [Allen et al. 2006]. Thus, road surface is a major factor in TRWP generation. Additionally, certain driving behaviors can have a positive impact on the reduction of TRWP generation, including but not limited to: accelerating gently, maintaining a steady speed, anticipating traffic, avoiding high speeds, coasting to decelerate, maintaining correct tire pressure, and avoiding carrying unnecessary weight. These driving behaviors also have an added benefit of improving gas mileage thereby reducing GHG emissions. **C.Tire and Road Wear Particles** The friction between the road surface and tires during driving results in the abrasion of tire tread, as well as the road surface. This interaction creates TRWP. TRWP are a mixture of tire tread and road pavement matter and have been characterized according to their size, morphology and general composition by Kreider et al. (2010). The size distribution of freshly generated TRWP has been reported to range from 1-350 um with a central tendency value of 77-100 um and the morphology shows that they are elongated in shape (Kreider et al., 2010).TRWP contains polymer and carbon black from the tread rubber as well as plasticizers, and minerals from the tread and pavement. When viewed under a microscope, the encrustation of the tread	

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		with pavement particles can be seen (Kreider et al, 2010, Sommer et al 2018, Dall' 'Osto et al. 2014). The release, fate and transport of TRWP have been evaluated and found to partition to ambient air (2%), on-road (49%) and to roadside soil (49%) (Unice et al., 2019). Those that are deposited on the road can be mobilized during storm events, along with other components of road dust and be transported via stormwater. Depending on local infrastructure, TRWP may proceed to a water treatment facility or be directly discharged into surface water such as a stream, creek or river. Airborne particles arising from tire wear have been researched extensively as part of the non- exhaust emissions particulate matter category. The literature regarding its morphology and composition, size distribution, emission rates and air concentrations were summarized by Panko et al., (2018). More recent studies of the airborne TRWP include that of the PM2.5 fraction (Panko et al., 2019) and the coarse fraction >10 um which may settle roadside (Sommer et al., 2018). In order to understand the potential for ecological exposure to TRWP, several watershed sampling studies were conducted and included Seine River (France), Chesapeake Bay (U.S.), and Yodo-Lake Biwa (Japan). The studies were designed to characterize wide diversity of population densities and land uses. TRWP in the surficial sediment of watersheds were detected in 97% of the 149 sediment samples collected. The mean mass concentrations of TRWP for the characterized portions of the Seine, Chesapeake	

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		and Yodo- Lake Biwa watersheds were 4500 µg/g, 4400 µg/g and 770 µg/g, respectively (Unice et al., 2013). TRWP concentration in sediment was not corelated to location relative to the city centers. **VI. No validated methods for identification of single particles of TRWP are currently available** Currently, the most accurate way to quantify TRWP in the environment is through measurement of its mass concentration using pyrolysis GC-MS (Unice et al., 2019, ISO TS 21396:2017, Wagner et al., 2018). This method, while accurate for quantification of TRWP by mass, has not been demonstrated to be useful for the identification of single particles in environmental matrices. Recently, the San Francisco Bay Estuary Institute (SFEI) conducted a study to characterize microplastic levels and transport pathways in the environment. In this study, SFEI characterizes both microparticles (all particles smaller than 5 mm) and those microparticles that are confirmed to be microplastic using Raman or Fourier Transform Infrared (FTIR) Spectroscopy. The microparticles were also classified according to their overall morphology as fragments, fibers, spheres, and foams. Through qualitative observations, SFEI determined that rubber particles (present as fragments), likely from tires, were present in stormwater and sediment, and that, in the stormwater, the black rubbery particles may constitute 50% of the microparticles. There are several important limitations associated with SFEI conclusions. First, SFEI was not able to	

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		chemically identify particles from tire wear because TRWP are darkly colored or black and the standard application of Raman or FTIR spectroscopy cannot be used on black materials. SFEI, therefore, qualitatively tested the particles using forceps to compress individual particles and if compressible identified them as "unknown black rubbery particles" that they hypothesized are from tire wear. However, other black particles, such as those arising from pavement preservation materials (i.e, coal tar sealants, seal coats, chip coat, etc.), and rubberized hot mix asphalt which contain polymers, may exhibit compressibility with forceps and therefore be mis-identified as TRWP. The second important limitation is that the morphology of the particles that SFEI identified as "unknown black rubbery" is not consistent with that of TRWP. The pictures of the unknown black particles collected by SFEI in stormwater do not have the characteristic "cigar" shape of TRWP and the microscope pictures that were published in the report do not show encrustation by pavement particles. Sommer et al. (2018) proposed that TRWP could be identified based on their distinctive shape, and surface characteristics because variation in tire composition and encrustations of road dust can confound the analytical results. Similarly, Leads and Weinstein (2019) acknowledged the difficulty of enumerating individual TRWP in environmental matrices and thus used morphological feature coupled with ATR-FTIR (only for large particle > 500 um) for identification. In analyzing the particles, the	

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		authors classified tire wear particles based on: black color, elongated/cylindrical shape, rough surface texture/encrustations, and rubbery consistency that maintained its shape when manipulated with forceps. New methods for the identification of individual TRWP in an environmental sample are currently under development. The Tire Industry Project is examining various analytical techniques to explore and optimize methods for detecting TRWP in various environmental matrices. For example, ongoing research is exploring methods for particle separation as well as microscopy techniques that analyze morphology and chemical composition. As each analytical method has advantages and disadvantages, it is likely that a combination of techniques will be necessary to detect individual TRWP. However, until methods are validated, the use of microscopic techniques and knowledge of TRWP's unique morphological features coupled with mass quantification using pyr-GC/MS are the best approaches currently available to quantify the number of TRWP in an environmental sample.	
20.05	**G1(b) – Revise Process G3(b) – Additional SB 1422 Requirements**	**USTMA recommends the SWRCB engage industry on the development of methodologies to test drinking water for microplastics** We recognize that SB 1422 requires the SWRCB to adopt a definition of microplastics in drinking water on or before July 1, 2020, and also requires the SWRCB to: "(1) adopt a standard methodology to be used in the testing of drinking water for microplastic; (2) adopt requirements for four years of testing and	Thank you for your comment. Please see response to comment 10.01.

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	(suggestion)	reporting of microplastics in drinking water, including public disclosure of those results; (3) if appropriate, consider issuing a notification level or other guidance to aid consumer interpretations of the results of the testing required pursuant to this section, and (4) accredit qualified laboratories in California to analyze microplastics” [Coffin 2020]. The tire industry, through TIP has been a leader in developing peer-reviewed scientific studies and methodologies related to TRWP and is engaged in ongoing research relating to TRWP. Hence, the tire industry through USTMA welcomes the opportunity for a continued dialogue with the SWRCB to share research findings from TIP studies as they become available. Once the SWRCB has finalized a definition of microplastics in drinking water, and begins their work on development of a test method to assess and identify microplastics in drinking water, USTMA encourages the SWRCB to engage our industry on the development of methodologies to identify TRWP in water.	
21.01	**G2(a) – Support Definition**	The definition of Microplastics in Drinking Water proposed by the California State Water Board is the first definition of its kind in the U.S. with the potential to set national precedent and direction. We acknowledge the stated desire on the part of the Water Board to establish consistency between the size class of trash (of which plastics is a subset) designated in the CA State MS-4 Permits, i.e. trash above 5mm in the smallest dimension, and the size class being developed for microplastics in drinking	Thank you for your comment.

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		water, specifically plastic less than 5mm in size in at least 2 of its dimensions. The background research supporting the State's proposed definition is extensive and we commend and support the many considerations given to the thoughtful conclusions.	
22.01	**G1(a) – Support Process**	The presence of microplastics in the environment is a rising concern, as they appear ubiquitously detected in natural and engineered water systems. The UCI WEX Center supports the State Water Boards' initiatives to standardize the definition of microplastics in drinking water. We believe that, as currently proposed, the State Water Boards definition provides a set of criteria for microplastics based on scientific evidence and technical practice. The standardization of the definition will satisfy the need for characterization and for the analytical methods and techniques required.	Thank you for your comment.
22.03	**G5(a) – Support *Substance***	Specialized instruments are required to identify the substance composition in the aggregate and for different sizes. Given the potential for prevailing abundance of certain polymer types and size groups within the defined range of 1-5,000 μm (e.g., Eerkes-Medrano et al. (2019); Mintenig et al. (2019)), separation and classification should be standardized as well as the quantitative and qualitative analytical methods. As a result, the individual water agencies would be provided with a complete reference for analytical work for their routine monitoring. Developing a further understanding of these topics and addressing these needs can be accomplished	Thank you for your comment. Please see response to comment 10.01.

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		by leveraging the existing research expertise of the University of California system. At UC Irvine in particular, expertise on water and wastewater treatment processes and the water-energy nexus are currently being applied in research that is relevant to California's policy goals. We look forward to engaging in the process for enhancing interaction with other stakeholders to identify and pursue research needs of importance in these areas.	
23.01	**G2(a) – Support definition G9(a) – Support Biodegradability**	[*transcript*]: "I am very glad to see that you have not excluded the so-called 'biodegradable plastic' in your definition, and that comes back to a bill I worked on a few years ago where we banned microplastics in personal care products. This definition is not so dissimilar to that bill (back in the day). One of the things we struggled with was how long does it take for a plastic or polymer to biodegrade, and if there are health impacts, we need to consider that. Also, we all have to remember that we're making decisions about drinking water here, and that's what we're talking about and focused on, drinking water goes down the drain too- it's the same source that is coming out of our faucets. These things [microplastics] do get out into the environment, and that's why the wastewater community was very involved in that bill and the definition. Thank you for that, and I want to publicly support that."	Thank you for your comment. See responses to comments 1.07 and 5.03 for additional discussion regarding the omission of a biodegradability criteria.
23.02		[*transcript*]: "I guess my question is and maybe it's just something that I'm not understating is we talk about the health impacts in terms of the definition and I	The commentator makes an interesting point about the order in which the definition should be developed (and what considerations should be made,

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		totally understand that there's a lot of uncertainty, and that this [drinking water] is a small exposure route. And that how we're going to make decisions to about how to communicate (public etc.) regarding the health impacts is really 'up in the air' at this point. What I don't understand is, what "that" has to do with the actual definition when you're talking about a material. So, you know, as we look at the definition of what a 'microplastic ' is, and then we can decide whether it's a health issue or not seems to be two separate things and I wonder if you can just explain that to me, for my own clarification, actually. I'm asking a question here. It's not necessarily a comment, it's a true question."	and when): should 'microplastics' be defined based on what science determines they are as a material type (regardless of whether or not they are thought to be harmful to humans)? Or should the initial definition reflect only what science determines (or anticipates) to be harmful to humans? These questions were considered early and frequently during formative discussions regarding the definition by an inter-agency CalEPA group focused on plastic pollution. Understanding that the intent in defining 'microplastics in drinking water' is to determine what to monitor for in drinking water and to investigate in regard to human toxicities in accordance with the requirements of SB 1422 (Portantino 2018), it would be sensible for the definition to only include hazardous microplastic particles known to be found in drinking water. While such an approach would, in theory, be the most time- and cost-effective, in practice it is currently unachievable due to the inability to satisfactorily characterize risk (World Health Organization 2019) and significant uncertainties in the types of microplastics found in drinking water (Q. Zhang et al. 2020). Although

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			microplastics have been studied for over fifty years, (Kenyon and Kridler 1969), most developments in definitions have occurred within the past two decades (Courtney Arthur, Baker, and Bamford 2008; GESAMP 2015), and it is only within the last year that significant steps towards high specificity and scientific consensus have occurred (Rochman et al. 2019; Hartmann et al. 2019). A notable catalyst for the refinement of the definition is the European Chemicals Agency's proposal to restrict intentionally added microplastics in commerce (European Chemicals Agency 2019a). Likewise, the legislatively-mandated requirement to define 'microplastics in drinking water' provides impetus for determining the definition of microplastics, in addition to developing other critically-necessary components to understanding the contaminant class, such as method standardization and human health advisory levels (Portantino 2018). Microplastics present unique (likely unprecedented) challenges in estimating their hazards and characterizing their presence in the environment due to their extreme diversity as a contaminant suite. Due to a myriad of defining

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			factors, each rich with variability, (e.g. size, shape, solubility, polymer composition, sorbed chemicals and biota, etc.), the term "microplastics" encompasses a vast universe of possible particles (Rochman et al. 2019). A useful proxy for understanding the diversity and uncertainty of microplastic varieties present in the environment is the number of polymer types that are currently in commerce (>75,000), of which the compositions of most of the polymers cannot be determined due to "confidential business information" protections or similar reasons (Zhanyun Wang et al. 2020). Further complicating the characterization of hazards is that plastic is known to contain (either intentionally added, or sorbed in the environment), a wide variety of chemicals (Zimmermann et al. 2019), which can be transferred to biota upon ingestion (Coffin et al. 2019). Due to the vast diversity of chemicals (>70,000) approved for use in the United States with little to nothing known about their toxicological behavior (Zhanyun Wang et al. 2020), hazard profiles of microplastics may likely contain dramatic uncertainties for an extended period of time . Based on dramatic

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			uncertainties of the hazards of microplastics to humans, no human-made polymeric particles can be reasonably excluded from the definition. Since risk is the combination of hazard and exposure, particles could theoretically be excluded from the definition if they are known to not occur in drinking water. While very little is known about the removal of microplastics from drinking water treatment plants (Novotna et al. 2019), it is unlikely that particles larger than the proposed upper limit (5mm) will be present (Pivokonsky et al. 2018; Zhifeng Wang, Lin, and Chen 2020b). Further exclusions based on parameters such as polymer type, solubility, density, and biodegradability were considered in the development of this definition, and are discussed in the draft staff report (Coffin 2020) as well as in responses to comments (1.04, 1.07, 1.06, 5.03 ,20.03). For all such parameters, exclusions cannot be made for the purposes of a definition of 'microplastics in drinking water' without potentially ignoring risks to humans. These conclusions regarding the need for a widely inclusive definition are synonymous with the European Union's

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			in their defining of 'microplastics' for intentional uses, with the exception of biodegradable polymers, in which the following rationale is stated, "…the persistence of a synthetic polymer-containing particle in the environment is a key, but not the only, criterion underpinning the 'microplastic concern'…"(European Chemicals Agency 2019a). Due to the differences in regulatory contexts, considerations for environmental persistence as a defining criterion is less relevant for the State Water Board's definition of 'microplastics in drinking water' than in the European Union's intentional use in products (see responses to comments 1.07 and 5.03). Since exclusions cannot be reliably made based on known occurrence in drinking water or human health hazards, another potential consideration for the definition is the ability (theoretical or practically) to detect microplastics in drinking water. This consideration proved to be neither useful nor stable in regards to developing the definition due to the rapid evolution of separation and measurement techniques (Primpke et al. 2020). Additionally, a material class should be theoretically defined before measurement techniques are

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			developed, otherwise one would not know what it is that they are supposed to looking for. Based on extreme uncertainties regarding the hazards of microplastics to humans and their occurrence in drinking water, the State Water Board's proposed definition of 'microplastics in drinking water' is deliberately inclusive. Standardized methods, sampling and analysis plans, and health-based guidance levels will be based on the most up-to-date science to most effectively utilize limited resources. When appropriate, the definition may be refined in accordance with advances in the understanding of health effects and occurrences in drinking water.
24.01	**G4**	[*Transcript*] "Did I read the notice and some of the staff report correctly saying that the definition that the State Board is likely to adopt (assuming that it goes to do so in June or July, or whenever that might be), will become a static definition of microplastics applied throughout the waterboards programs or is it just for DDW programs?"	The intention of this definition is to be used for the drinking water program and is the first iteration in defining a rapidly emerging contaminant. In response to new information, the definition will be updated accordingly. Other programs within the Water Boards and other Boards, Departments, and Agencies, might use this definition as a starting point and modify as needed. However, additional regulatory steps would likely be necessary for the adoption of this definition by another organization.

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24.02	**G3**	[*Transcript*] "So as I understood it, I think from Dr. Coffin's presentation, but also in some of the staff report materials that I saw, that there is currently no methodology that can test down (with confidence) and detect microplastics below a certain size (certainly not down to the 1 micrometer that is proposed). So, A: Is that correct? And B: What is sort of the standard methodology that exists now that drinking water labs or wastewater treatment labs (for that matter) can test down to and detect these microplastics, and at what sizes?	A. There are currently no standardized methods available for the sampling and analysis of microplastics in wastewater or drinking water at the time of writing. Recently, guidelines for quality assurance, quality control, and reporting have been developed (Primpke et al. 2020; Cowger et al. 2020; GESAMP 2019). B. Standardized, inter-laboratory validated methodologies have been recently developed for microplastics in sediment, biota, and plankton (Gerdts 2019). Such methods can achieve a high degree of reliability in analyzing plastic particles down to 20 microns using common spectroscopic techniques (micro-Raman or micro-Fourier-transform infrared). However, such techniques have been demonstrated to achieve lower size limits of detection: 1 micron for micro-Raman and 10 microns for micro-Fourier-transform infrared (Primpke et al. 2020). Furthermore, a number of methods are available that for characterizing plastic particles below 1 micron, with several methods capable of achieving lower size limits of detection of 1 nanometer or smaller (Schwaferts et al. 2019).

Table 6. Comment and Response for 30-day Comment Period and Public Staff Workshop – Specific Comments

No.	Issue ID	Specific Comment	Response
1.02	**S6(b) – Revise ‘drinking water’**	**SWRCB Should Clarify that the Definition of “drinking water” as part of the definition of “microplastics in drinking water” means “drinking water” consistent with federal Safe Drinking Water Act (SDWA) and state law.** Under federal and California law, drinking water is water for human consumption provided by a regulated public water system. We recommend that the SWRCB clarify that it is using the same working definition for drinking water. This is consistent with SWRCB’s mandate and legislative intent and will also help focus the program and conserve limited resources. Importantly, that approach incorporates the recommendations from the recent World Health Organization (WHO) report which concluded that monitoring drinking water for microplastics is a poor use of government resources and that government funding should be spent elsewhere to improve drinking water quality and safety [World Health Organization 2019]. The WHO report also determined that firm conclusions on the risk associated with ingestion of microplastic particles through drinking-water cannot yet be determined. At this point, no data suggests overt health concerns associated with exposure to microplastic particles through drinking-water. A recent systematic review of the literature identified 50 studies detecting microplastics in fresh water, drinking-water or wastewater and reinforces the WHO report’s conclusions [Koelmans et al. 2019]. A total of nine studies measured microplastics in drinking-water. In general, groundwaters are well protected from particulate contamination. Similarly, conventional drinking-water treatment is expected to provide an effective barrier for a	Defining ‘drinking water’ is not a requirement of HSC section 116376, and the California Safe Drinking Water Act does not contain an express definition for ‘drinking water.’

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		wide range of particle sizes. The lack of methods for sampling and analyzing microplastics in the environment (and drinking water) means that comparisons across studies are difficult. In addition, few studies were considered fully reliable due to a variety of issues such as contamination, analytical detection techniques, physical separation techniques, and sampling protocol.	
1.03	**S4(b) – Revise applicability of definition to other sectors than drinking water** **S5(b) – Revise *Substance***	**Plastics, Polymers and Microplastics** ACC appreciates the SWRCB's consideration of existing definitions as it undertook its task of creating a specific definition of "microplastics in drinking water". We also appreciate SWRCB's preparation of an accompanying guidance document that explores technical issues encountered during the drafting process under the EU's REACH program, which addresses "intentionally added" microplastics. The Proposed Definition as written, however, fails to overcome several problems. Notably, the [SWRCB] has proposed an overly broad definition that encompasses particles 1) unlikely to be found in drinking water; 2) impossible to detect with current analytical techniques; and 3) that degrade and thus do not satisfy the microplastic definition. As noted above, HSC § 116376 requires the SWRCB to define the phrase "microplastics in drinking water." Given the statutory charge, each term must be looked at in relation to the entire phrase. The statute specifies that the context for "microplastics" is only those found in "drinking water" and consequently the microplastic definition should be tailored to detectable plastic particles one would find in "traditional" tap water managed by public systems.[5] As	Few studies to date have characterized microplastics in drinking water (Q. Zhang et al. 2020), and a comprehensive understanding of all potential polymer types that could be found in treated drinking water is currently unavailable. Furthermore, the development of a comprehensive global inventory of polymer types in commerce (and thus potentially in the environment and drinking water) is unlikely to be developed due to significant challenges in identifying the over 37,000 registered polymers, which in the majority of cases, cannot be identified due to a lack of available distinguishing information in the public domain (Zhanyun Wang et al.

[5] The Proposed Definition noticeably lacks a rigorous description of what "drinking water" entails. ACC suggests a definition in line with the Safe Drinking Water Act (SDWA). That is, water for human consumption provided by a public water system regulated under the SDWA.

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		proposed, therefore, the SWRCB’s definition is too broad, encompassing not only traditional MPs from major resins in consumer products such as polyethylene (PE), polypropylene (PP), styrene- butadiene rubber (SBR), and polyester, but also particles not associated with plastic, such as dyed wool and polyethylene glycol [Coffin 2020, Table 1, p.17]. These latter examples are unlikely to be found in drinking water because drinking water is produced in closed systems preventing infiltration by these exogenous materials. The Proposed Definition exceeds the statutory scope and accordingly must be revised to focus on MPs that one would actually find in drinking water.	2020). Accordingly, the exclusion of certain polymer types from a theoretical definition of ‘microplastics in drinking water’ based on currently limited evidence of low or no abundance would be considered to be an assumption with a high degree of uncertainty. While available evidence suggests that it is unlikely that microplastics will occur at substantive quantities in groundwater used for drinking water (Mintenig et al. 2019), microplastics are known to occur in surface water at high detection frequencies, and at a range of levels (Eerkes-Medrano, Leslie, and Quinn 2019). Removal efficacies of microplastics by drinking water treatment processes vary dramatically (~5% to 99.9%) (Y. Zhang et al. 2020; Ma, Xue, Hu, et al. 2019a; Ma, Xue, Ding, et al. 2019), with a large degree of variability in polymer types and morphologies measured in

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			finished drinking water (Novotna et al. 2019), suggesting the source of microplastic contamination in finished drinking water is not confined to the “closed systems” in which it is produced. In response to the comment regarding the *substance* criteria in the proposed definition that, “*particles not associated with plastic, such as dyed wool and polyethylene glycol*”: scientific consensus on the classification of such polymer types has not yet been reached (Hartmann et al. 2019; Arp and Knutsen 2019). In particular, polyethylene glycol is considered to be “microplastic” by a number of researchers in the field (Liu et al. 2019; Collard et al. 2017; Klein et al. 2018). Slightly modified natural polymers (e.g., dyed wool, dyed cotton) are unlikely to be considered ‘microplastics in drinking water’ based on the proposed definition (Coffin

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			2020, Table 1, p.17), as their principle ingredient is a natural polymer and would be expected to contain less than 1% synthetic polymer (by mass). It should be noted that although the theoretical definition includes a mass percentage threshold for determining the synthetic polymer content within a single particle, the State Water Board does not expect that such measurements will be required under a proposed sampling and analysis plan, and the extent to which this mass-based threshold would determine the reporting of microparticle characteristics in a sample will depend on the technical feasibility of the standardized methodology employed. Additionally, the State Board staff disagrees with the commenter's narrow interpretation of the statutory mandate, as well as the assumptions underlying the accompanying premise. The

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			commenter appears to contend the specified contaminants would not be found in post-treatment finished water. However, many public water systems have rudimentary, if any treatment.
1.04	**S5(b) – Revise *Substance***	**Polymer definition – ASTM and ISO Plastic** One expedient way to solve the issue is for the SWRCB to adopt the plastic definitions put forth by ASTM or ISO. Both are similar in that they define plastic as being shaped by flow, a traditional method for manipulating heated polymers into end products during manufacturing. ASTM defines plastic as: "a material which contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and at some stage in its manufacture or processing into finished articles can be shaped by flow." [ASTM 2019][6] Including "plastic" in the definition rather than "polymer" is more appropriate because plastic MPs can be properly detected and quantified. Non-plastic polymer particles often have complex dissolution behaviors in water and are very difficult to detect in drinking water matrices. Developing adequate methods to detect non-plastic polymers would take concerted effort and time, likely extending beyond the July 2021 deadline. Furthermore, detecting several polymer	As stated on page 13 of the staff report (Coffin 2020), the ISO definition for 'plastic' has been criticized for being too narrow, as while it would include common, high-production classes of polymers such as thermoplastics and thermosets, some elastomers (e.g. anthropogenic rubbers) would be excluded (Hartmann et al. 2019). The ASTM definition is more narrow than the ISO definition due to its explicit exclusion of rubber, textiles, adhesives, and paint (ASTM 2020). Exclusion of textile- and rubber-derived microparticles from a definition of 'microplastics in drinking

[6] The ASTM definition explicitly excludes rubber, textiles, adhesives and paint, which the ISO definition does not. Either definition would be suitable for the SWRCB's purposes as they both capture MPs one would expect to find in drinking water

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		classes in the Proposed Definition – dyed wool, for instance – is not possible with current analytical methods. Thus, traditional plastic particles that are solid and insoluble in drinking water should be the focus. Referencing the ASTM and ISO definitions for plastics would help ensure this. Moreover, the ASTM plastic definition already has broad acceptance from a wide range of experts, industry, government, and other stakeholders. OMB Circular A-119 encourages adoption by reference of voluntary consensus standards such as those developed by ASTM, so this is likely to be influential and the leading standard used by federal agencies such as EPA, NOAA and others, as well as researchers across the US.	water’ may exclude a significant portion of particles from analysis. Textile-derived fibers that would meet the ISO definition of ‘plastic’ may constitute 50-99% of ‘microplastics’ found in drinking water (Pivokonsky et al. 2018), and rubber-derived particles that would meet the ISO definition of ‘plastic’ have been found at high concentrations in aqueous samples (48% of 11 trillion microparticles entering the San Francisco Bay) (Sutton et al. 2016). Furthermore, the *substance* criteria in the proposed definition is virtually synonymous (with the exception of biodegradability criteria) with the proposed definition of ‘microplastics’ by the European Chemicals Agency (European Chemicals Agency 2019a), and is supported unanimously by a panel of five leading experts commissioned for external peer review (California State Water Resources Control Board 2020).

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			While HSC section 116376 states that the State Water Board must "adopt a standard methodology to be used in the testing of drinking water for microplastics", there is no such provision that states that the standardized methodology will be capable of characterizing and distinguishing all particle types within the proposed theoretical definition. For many drinking water contaminants, detection limits for the purposes of reporting (DLRs) are established at concentrations of contaminants greater than at levels at which those contaminants are known or expected to be toxic (public health goals), as is the case for many contaminants with maximum contaminant levels[7]. Please see responses to comments 1.03 and 10.01.
1.05	**S7(b) – Revise *Dimensions* (lower limit)**	Turning to the "microplastics" definition, draft ASTM standards use the traditionally accepted maximum MP size of 5 mm, which comports with the SWRCB's Proposed Definition [ASTM under development]. Alignment with this	See responses to comments 1.04 and 8.02. Furthermore, light-based spectroscopic detection

[7] https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLsandPHGs.html

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		generally recognized upper limit will substantiate boundaries for MP research and regulatory efforts. The Proposed Definition's lower limit of 1 µm, however, is not realistic for high-throughput drinking water analysis because state-of-the art FTIR, LDIR, and Raman spectrometers simply cannot detect particles that small. We suggest an alternative minimum threshold compatible with current analytical detection capabilities, roughly 20 µm. SWRCB's Report explains that the definition may change in response to new analytical capabilities and standards, so the initial minimum threshold can serve as a starting point and be revised downward in the future as needed, following notice and comment. Draft analytical standards reinforce the 20 µm limit as an appropriate lower threshold consistent with light-based detection techniques. The SWRCB can meet its statutory requirement to develop a definition by deciding now to adopt the microplastics definition within these standards by reference when completed.	techniques are currently available to characterize microplastics at the initial proposed lower size limit (1 µm) using Raman spectroscopy (Cabernard et al. 2018; Araujo et al. 2018; Schymanski et al. 2018; Imhof et al. 2013).
1.06	**S8(b)- revise solubility**	**Solubility** Reframing the microplastic definition on plastics rather than polymers will focus SWRCB efforts on creating analytical methods for traditional plastic particles that are solid and completely insoluble in water. As the Report notes, ECHA originally excluded solubility as a criterion for its MP definition [Coffin 2020, p.22]. This exclusion implicated many materials not involved with microplastic pollution, such as polyethylene glycol and polyvinyl alcohol. That is not to say these polymers might not be without risk – risk is a function of hazard and exposure. But as used in commerce at present, these polymers are not widely detected in environmental or biotic screens looking for	The claim that, "drinking water simply does not have any scenario where soluble polymers may be introduced" is not substantiated by the commentator. Furthermore, insufficient evidence is available to make such a claim, due to the relatively few studies that have characterized microplastics in drinking water to date (~10

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		microplastic pollution. More common, however, is that these chemicals dissolve when formulated into consumer products. For instance, functional polymers used in cosmetic and other products may be manufactured as solid particulate materials but dissolve when used in aqueous formulations and remain dissolved after use and disposal. While these functional polymers share the same backbone with their larger structural polymeric relatives, it is the unique and subtle co-monomer profile that effectively differentiates a functional and a structural polymer. These small and often proprietary differences in the co-monomer content may lead to significantly altered polymeric properties that allow, among others, for an enhanced solubility but also may considerably change the applicability of analytical test methods. Including these functional polymers within "microplastics in drinking water" unnecessarily broadens the definition scope beyond plastics one would expect to find – drinking water simply does not have any scenario where soluble polymers may be introduced. Based on this information – as well as comments from NGOs and industry – we understand that ECHA is considering amending their definition to include solubility as a component. We propose a 100 mg/L solubility threshold to ensure the SWRCB definition for "microplastic in drinking water" can facilitate proper analytical method development for polymers relevant to human ingestion.	studies) (Q. Zhang et al. 2020). The commentator provides evidence that reinforces the State Water Board's decision to omit a solubility threshold from the pre-exemption of polymer types based on their theoretical solubility in the proposed definition of 'microplastics in drinking water.' Specifically, the commentator notes that "small and often proprietary differences in the co-monomer content may lead to significantly altered polymeric properties that allow, among others, for an enhanced solubility…", implying that certain polymers may or may not be found as solid particulate matter in an aqueous sample. Additionally, once in the environment, soluble polymers (such as polyacrylamide) may appear as solid microscopic particles due to a number of poorly understood factors, including low pH synthesis (Berndt et al. 1991), cross-linking (Rivas,

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			Urbano, and Sánchez 2018), or other processes (Arp and Knutsen 2019). This heterogeneity and uncertainty in the solubility of so-called, "soluble polymers" is demonstrated in the findings of such polymers as solid particles in environmental monitoring studies. For instance, polyvinyl alcohol has been found as solid particle in the guts of deep-sea amphipods (Jamieson et al. 2019), benthic crustaceans (Cau et al. 2020), wastewater treatment plant influent and effluent (Kang et al. 2018; Mintenig et al. 2017), and stormwater (Liu et al. 2019). In a 2018 review of environmental microplastic monitoring studies, polyvinyl alcohol (in solid particulate form) represented approximately 1% of the total relative polymer composition in water, and approximately 11% of the total relative polymer composition in sediment (Burns and Boxall 2018). Polyethylene glycol,

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			which is a type of synthetic "polymer gel" industrially produced in large quantities, has been detected in solid particulate form in various environmental compartments (e.g. stormwater (Liu et al. 2019), fish guts (Collard et al. 2017)) using typical microplastic sampling protocols and detection techniques (i.e. Raman or FTIR spectroscopy). The concept of a solubility threshold becomes particularly challenging when considering nanoscale sized polymeric particles. For instance, degraded polyacrylamide (a "soluble" polymer) appears as a solid particle ranging from 18 to 350 nm in size (Jop et al. 1997), which can agglomerate to make larger polymeric nanocomposites and micro-scale particles (Rivas, Urbano, and Sánchez 2018). Furthermore, test methods to determine "solubility" can be confounded for particle dispersion, which is highlighted in a recent

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			regulatory registration guidance document for nanoparticles (European Chemicals Agency 2019b). In consideration of challenges over the determination of solubility of particles (particularly in the nano-sized range), the European Chemicals Agency considers polymer "solubility" to not be a useful term to define "microplastics", concluding that additional defining terms such as "solid" and "particle" sufficiently captures "that a polymer has kept its shape in the medium into which it is placed and can move as a unit" (European Chemicals Agency 2019a). By omitting a solubility threshold, the proposed definition of 'microplastics in drinking water' is in harmonization with the proposed definition for 'microplastics' by the European Chemicals Agency (European Chemicals Agency 2019a).
1.07	**S9(b) – revise biodegradability**	**Biodegradability**	Thank you for your comment regarding the availability of

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		Similarly, the Proposed Definition does not exclude biodegradable polymers because, according to the Report, they "lack…adopted standards" to determine biodegradability and uncertainty regarding health effects [Coffin 2020]. As an initial matter, several new standards from ISO were published recently (ISO 22404:2019 and ISO/DIS 23977-2 – both related to plastic biodegradability in seawater and marine sediment) [ISO 2019]. Testing methods, and associated pass/fail criteria, for assessing the biodegradability of substances are well established within chemical regulatory schemes in all developed countries (United States, Canada, European Union, Japan, China, etc). Relevant testing methods have been subject to standardization at the international level for many years (e.g. there are numerous relevant OECD and ISO testing guidelines). We recommend excluding biodegradable polymers from the Proposed Definition in part because MP standards are still being developed. Exclusion may provide an incentive for companies to develop biodegradable polymers that have more benign end of life issues, which, we believe, is or should be an important interest of the SWRCB. It is also important to note there should be a distinction between polymers that are "biodegradable" and those that are "biocompostable". Biocompostable polymers will only degrade under composting environments, as the name implies, rather than environmental conditions such as marine environments or sediment.	biodegradability standards for polymers. The Staff Report will be updated to reflect this information. Note that additional justification for the inclusion of biodegradable polymers is detailed in response to comment 5.03. While a reduction in the environmental persistence of polymers may reduce potential environmental risks and should be given consideration in defining restriction standards (as is the case with the ECHA 2019 definition pertaining to intentionally added microplastics) (European Chemicals Agency 2019a), the inclusion of such criteria in the definition of 'microplastics in drinking water' is unrelated to the purpose of the definition, which is aimed at understanding the exposure and health effects of microplastic particles in

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			humans through drinking water. The State Water Board's rationale for omitting a biodegradability criterion for the inclusion of polymers in the definition of 'microplastics in drinking water' is described on page 15 of the Draft Staff Report (Coffin 2020). In response to new information regarding the human health effects of biodegradable polymers, the Draft Staff Report will be updated to include additional information. For the ease of the reader, this expanded rationale is copied below: It is worth noting that "biodegradable" polymers (e.g. poly-lactic acid [PLA]) have demonstrated *in vivo* toxic effects similar or equivalent to their conventional, non-biodegradable counterparts (Green et al. 2017; 2016). Further, few studies have investigated the health effects of biodegradable microplastics in organismal models, with exceptionally few studies

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			relevant to humans (Shruti and Kutralam-Muniasamy 2019). A recent study assessing the ability of microplastic particles to transfer sorbed hexavalent chromium into a simulated human gut found that a common biodegradable polymer (polylactic acid) demonstrated higher oral bioaccessibility of hexavalent chromium than four non-biodegradable polymers (polyethylene, polypropylene, polyvinyl chloride, polystyrene) (Liao and Yang 2020). Uncertainties regarding the human toxicological effects of biodegradable polymers, the proposed State Water Board definition of 'Microplastics in Drinking Water' does not exclude "biodegradable" polymers.
1.08	**S10(b) – Revise *state***	**Proposed Liquid Definition** The Report [Coffin 2020] defines a liquid as: a substance or mixture which (i) at 50 degrees Celsius (˚C) has a vapor pressure less than or equal to 300 kPa; (ii) is not completely gaseous at 20 ˚C and at a standard pressure of 101.3 kPa; and (iii)	Thank you for your comment. This is a typographical error, and the proposed definition and draft Staff Report will be updated accordingly.

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		which has a melting point or initial melting point greater than 20 ˚C at a standard pressure of 101.3 kPa. In section iii, the definition requires a melting point or initial melting point greater than 20 ˚C at a standard pressure. Taken literally, a substance with a melting point greater than 20 °C would be a solid at standard pressure, not a liquid. For consistency, we recommend amending the definition to read "*less* than 20 °C".	
1.09	**S11(b) - *dimensions* (misc.)**	**Required Microplastic Dimensions** We suggest that the size requirements within the Proposed Definition include three dimensions to conform with the stated justification that the SWRCB wants to exclude fibers and films with dimensions longer than 5 mm. The SWRCB explains their rationale for defining MPs as requiring two dimensions between 1 and 5000 µm to "exclude large fibers and films". This is understandable because fibers and films with larger dimensions are not typically considered to be microplastics. The two-dimensional requirement in the current definition, however, captures microfibers with dimensions larger than 5000 µm. Regardless of shape, all particles have 3 dimensions: width, height and length. Consider a hypothetical fiber as a long, straight cylinder with a length of 4 mm (4,000 µm) and a diameter of 30 µm. In this instance, the height and width are both 30 µm which satisfy the dimensional requirements outlined in the Proposed definition – two dimensions larger than 1 µm and less than 5000 µm. The 4 mm length also fits within the Proposed Definition because there are no size requirements for the third dimension. While the 4 mm length is below the typical	Thank you for your comment. This rationale is sound, and the inclusion of three dimensions in the proposed definition of 'microplastics in drinking water' would reduce uncertainties and prevent potential scenarios described in comment 1.09. The Draft Staff Report and proposed definition will be updated accordingly.

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		5 mm threshold other organizations use to describe microplastics, in this hypothetical example, the length could be extended out to 10 mm, 100mm, or longer, and it would still meet the Proposed Definition requirements because the height and width still satisfy the two dimensional requirement. Said differently, the definition captures microfibers of any length if the height and width fall between 1 and 5000 µm. We propose changing the definition to plastic particles where all three dimensions are greater than 20 µm and less than 5000 µm.[8]	
2.01	**S5(b) – Revise *Substance***	**Recommended definition text (inclusion of "plastic")** ACI recommends that the standardized term "plastic" be included and referenced as part of the definition for microplastic in drinking water. The definition would therefore read: *'Microplastics in Drinking Water' are defined as solid plastic materials to which chemical additives or other substances may have been added, which are particles which have at least two dimensions that are greater than 1 and less than 5,000 micrometers (µm). Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis) are excluded.* Plastics have been defined by both the International Organization for Standardization (ISO) and ASTM International. ISO defines plastic as a "material which contains as an essential ingredient a high molecular weight polymer and which, at some stage in its processing into finished products, can be shaped by flow". Two notes to this definition: 1) elastomeric materials, which are also shaped by flow, are not considered to be plastics; and; 2)	See response to comment 1.04.

[8] In the alternative, ACC also supports the OECD definition for microfibers: a water insoluble particle, of aspect ratio (length/diameter) ≥ 3 and diameter ≤ 100 µm. *See* OECD Guideline for Testing of Chemicals 110 "Particle Size Distribution/Fibre Length and Diameter Distributions", May 1981.

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		In some countries, particularly the United Kingdom, the term "plastics" is used as the singular form as well as the plural form. The ASTM definition, "a material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and at some stage in its manufacture or processing into finished articles, can be shaped by flow (rubber, textiles, adhesives, and paint, which may in some cases meet this definition, are not considered plastics…)", is also an acceptable, consensus-based definition of plastic. ACI recommends the use of the term "plastic" within the definition of "Microplastics in Drinking Water" to ensure that traditional plastic particles are the focus of the definition and are the materials which will be detected and quantified in drinking water.	
2.02	**S8(b)- revise solubility**	To further focus on the issue of microplastics, we recommend the inclusion of a solubility criterion of 100 mg/L to ensure the definition of "Microplastic in Drinking Water" is robust enough to facilitate the development of proper analytical detection techniques. ACI has included references for addition detail [ISO 2013, ASTM 2020, OECD 2019].	See response to 1.06.
2.03	**S9(b) – revise biodegradability**	ACI also recommends that materials that biodegrade should not be included in a regulation against persistent microplastics. Biodegradability is an important attribute of all chemicals. Testing methods, and associated pass/fail criteria for assessing the (bio)degradability of substances are well-established within chemical regulatory schemes including those in the United States, Canada, European Union, Japan, China, etc. Relevant testing methods have been subject to standardization at the international level for many year (e.g., there are numerous relevant OECD and	See response to comment 1.07 and 5.03.

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		ISO testing guidelines). For these reasons, the European Chemical Agency has proposed that the EU Microplastics Restriction Dossier should include a derogation for biodegradable microplastics.	
3.02	**S(6) – revise 'drinking water'**	**SWRCB Should Clarify that the Definition of "drinking water" as part of the definition of "microplastics in drinking water" means "drinking water" consistent with federal Safe Drinking Water Act (SDWA) and state law.** Under federal and California law, drinking water is water for human consumption provided by a regulated public water system. We recommend that the SWRCB clarify that it is using the same working definition for drinking water. This is consistent with SWRCB's mandate and legislative intent and will also help focus the program and conserve limited resources. Importantly, that approach incorporates the recommendations from the recent World Health Organization (WHO) report which concluded that monitoring drinking water for microplastics is a poor use of government resources and that government funding should be spent elsewhere to improve drinking water quality and safety [World Health Organization 2019]. The WHO report also determined that firm conclusions on the risk associated with ingestion of microplastic particles through drinking-water cannot yet be determined. At this point, no data suggests overt health concerns associated with exposure to microplastic particles through drinking-water. A recent systematic review of the literature identified 50 studies detecting microplastics in fresh water, drinking-water or wastewater and reinforces the WHO report's conclusions [World Health Organization 2019]. A total of nine studies measured microplastics in drinking-water. In	See response to 1.02.

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		general, groundwaters are well protected from particulate contamination. Similarly, conventional drinking-water treatment is expected to provide an effective barrier for a wide range of particle sizes. The lack of methods for sampling and analyzing microplastics in the environment (and drinking water) means that comparisons across studies are difficult. In addition, few studies were considered fully reliable due to a variety of issues such as contamination, analytical detection techniques, physical separation techniques, and sampling protocol.	
3.03	**S4(b) – Revise applicability of definition to other sectors than drinking water** **S5(b) – Revise *Substance***	**Plastics, Polymers and Microplastics** The Proposed Definition as written, fails to completely overcome several hurdles, arriving at a definition that is broad enough to encompass 1) particles unlikely to be found in drinking water; 2) particles that are impossible to detect with current analytical techniques; and 3) particles that degrade and thus do not satisfy the microplastic definition. HSC § 116376 requires the SWRCB to define the phrase “microplastics in drinking water.” Given the statutory charge, each term must be looked at in relation to the entire phrase. The statute specifies that the context for “microplastics” is only those found in “drinking water” and consequently the microplastic definition should be tailored to detectable plastic particles one would find in “traditional” tap water managed by public systems. It does not include bottled water, beverages, or other sources of fresh water. As proposed, therefore, the SWRCB’s definition is too broad, encompassing not only traditional MPs from major resins in consumer products such as polyethylene (PE), polypropylene (PP), styrene-butadiene rubber (SBR), and polyester, but also particles not associated with plastic,	See response to 1.03.

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		such as dyed wool and polyethylene glycol. These latter examples are unlikely to be found in drinking water because drinking water is produced in closed systems preventing infiltration by these exogenous materials. The Proposed Definition exceeds the statutory scope and accordingly must be revised to focus on MPs that one actually finds in drinking water. Recent studies have shown that MP presence in drinking water aligns with production volume and density, with highest detection rates for PE, PP, PS, PVC and PET. We suggest a narrower definition tailored to these resins will not only fulfill SWRCB's statutory obligations, but also focus the agency on microplastics that that can be and are likely to be detected in drinking water with current analytical capabilities.	
3.04	**S5(b) – Revise *Substance***	**Polymer definition – ASTM and ISO Plastic** One expedient way to solve the issue is for the SWRCB to adopt the plastic definitions put forth by ASTM or ISO. Both are similar in that they define plastic as being shaped by flow, a traditional method for manipulating heated polymers into end products during manufacturing. ASTM defines plastic as: "a material which contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and at some stage in its manufacture or processing into finished articles can be shaped by flow."	Thank you for your comment. See response to 1.04.
3.05	**S7(b) – Revise *Dimensions* (lower limit)**	The Proposed Definition's lower limit of 1 µm, however, is not realistic for high-throughput drinking water analysis because state-of-the art FTIR, LDIR, and Raman spectrometers simply cannot detect particles that small. ACA supports a lower level threshold compatible with current analytical detection capabilities, roughly 20 µm.	See response to 1.05.

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		SWRCB's Guidance explains that the definition may change in response to new analytical capabilities and standards, so the initial lower threshold should align with current methods and can be revised – with additional stakeholder input – in the future as needed. Draft analytical standards reinforce the 20 µm limit as an appropriate lower threshold consistent with light-based detection techniques. The SWRCB can meet its statutory requirement to develop a definition by deciding now to adopt the microplastics definition within these standards by reference when completed.	
3.06	**S8(b)- revise solubility**	**Solubility** Reframing the microplastic definition on plastics rather than polymers will focus SWRCB efforts on creating analytical methods for traditional plastic particles that are solid and completely insoluble in water. Including polymers within the "microplastics in drinking water" unnecessarily broadens the definition scope beyond plastics likely to be found in tap and bottled water – drinking water simply does not have any scenario where soluble polymers may be introduced. ECHA is considering amending their definition to include solubility as a component. To that end, ACA suggests a 100 mg/L solubility threshold to ensure the SWRCB definition for "microplastic in drinking water" can facilitate proper analytical method development for polymers relevant to human ingestion.	See response to 1.06.
3.07	**S9(b) – revise biodegradability**	**Biodegradability** The Proposed Definition does not exclude biodegradable polymers from the definition because, according to the Guidance, they "lack…adopted standards" to determine biodegradability and uncertainty regarding health effects. As an initial matter, several new standards from ISO were	See response to 1.07 and 5.03.

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		published recently, ISO 22404:2019 and ISO/DIS 23977-2 – both relate to plastic biodegradability in seawater and marine sediment. Testing methods, and associated pass/fail criteria, for assessing the biodegradability of substances are well established within chemical regulatory schemes in all developed countries (United States, Canada, European Union, Japan, China, etc). Relevant testing methods have been subject to standardization at the international level for many years (e.g. there are numerous relevant OECD and ISO testing guidelines). ACA recommends excluding biodegradable polymers from the Proposed Definition in part because MP standards are still being developed. Exclusion may provide an incentive for companies to develop biodegradable polymers that have more benign end of life issues, which, we believe, is or should be an important interest of the SWRCB. Furthermore, a microplastic that biodegrades will not be present in the environment (water, soil, etc) and therefore should not be included in a regulation against persistent microplastics. For this reason, ECHA has proposed and European Members States have agreed that the EU Microplastics Restriction Dossier should include a derogation for biodegradable microplastics. The proposed restriction dossier outlines specific test methods and criteria that must be met for a microplastic to be considered biodegradable and be derogated from the restriction. ECHA and the Member States understand the importance of biodegradability as an exemption to encourage and enable innovation to more sustainable non-persistent alternatives to many current microplastic materials.	

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3.08	**S10(b) – Revise *state***	**Proposed Liquid Definition** ACA recommends amending the proposed Liquid Definition as follows: "a substance or mixture which (i) at 50 degrees Celsius (˚C) has a vapor pressure less than or equal to 300 kPa; (ii) is not completely gaseous at 20 ˚C and at a standard pressure of 101.3 kPa; and (iii) which has a melting point or initial melting point ~~greater~~ ***less*** than 20 ˚C at a standard pressure of 101.3 kPa.	See response to 1.08.
3.09	**S11(b) - *dimensions* (misc.)**	**Required Microplastic Dimensions** ACA suggests that the size requirements within the Proposed Definition include three dimensions to conform with the stated justification that the SWRCB wants to exclude fibers and films with dimensions longer than 5 mm. The two-dimensional requirement in the current definition, however, captures microfibers with dimensions larger than 5000 µm. Regardless of shape, all particles have 3 dimensions: width, height and length. The current proposed definition captures microfibers of any length if the height and width fall between 1 and 5000 µm. ACA suggests changing the definition to plastic particles where all three dimensions are greater than 20 µm and less than 5000 µm.	See response to 1.09.
4.02	**S12(b) – Revise *substance - natural fibers***	**ACWA suggests that the State Water Board exclude dyed natural fibers from the proposed definition.** State Water Board staff is proposing that "Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis) are excluded." State Water Board staff cites various examples of such natural polymers, including wool and silk. ACWA agrees with the proposed exclusion and suggests that the language additionally specify that dyed natural fibers are excluded. Dyed natural fibers are not microplastics.	Slightly modified natural polymers (e.g., dyed wool, dyed cotton) are unlikely to be considered 'microplastics in drinking water' based on the proposed definition, as their principle ingredient is a natural polymer and would be expected to contain less than 1% synthetic polymer (by

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			mass). Accordingly, a specific exclusion for dyed natural fibers does not currently seem to be necessary. However, as noted in the proposed definition, the State Water Board intends to update the definition in response to advances in analytical techniques and/or the standardization of analytical methods. Natural and biodegradable fibers differ from most synthetic fibers in their predicted degradation rate in the environment, thus reducing the likelihood that natural fibers would interact with biota (or be ingested by humans) over time (Barrows, Cathey, and Petersen 2018). Despite this predicted higher degradation rate, natural fibers are found in many environmental compartments, including rivers (Hoellein et al. 2015; Mccormick 2015), guts of birds, fish and macrofauna (A. L. Lusher, McHugh, and Thompson 2013; A. Lusher 2015; Remy et al. 2015;

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			Rochman et al. 2015; Wilcox, Van Sebille, and Hardesty 2015), and air (Dris et al. 2017; 2016). Many dyes and chemicals used in natural textiles are carcinogenic to animals (Lithner et al. 2009; Remy et al. 2015), which may be transferred into biota upon ingestion (Zhao, Zhu, and Li 2016). Based on this limited, but suggestive evidence that dyed natural fibers may be present in the environment (and therefore potentially in freshwater used as a drinking water source) and exhibit toxicological effects similar to synthetic fibers, the proposed definition of 'microplastics in drinking water' includes the following *composition* criterion defining "polymeric material" as "either (i) a particle of any composition with a continuous polymer surface coating of any thickness, or (ii) a particle of any composition with a synthetic polymer content of greater than or equal to 1% by mass" (Coffin 2020). This inclusion is identical to the

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			proposed definition of ‘microplastics’ considered by the European Union (European Chemicals Agency 2019a). Depending on the standardized methodology adopted by the State Water Board, dyed natural fibers with less than 1% synthetic polymer by mass may or may not be able to be differentiated from dyed natural fibers with greater than 1% synthetic polymer using the adopted standardized methodology (identification of natural fibers using spectroscopic techniques such as FTIR may be challenging (Cai et al. 2019), especially when dyes are present (Halstead et al. 2018)), and the proposed definition may require updating to specifically exclude dyed natural fibers with guidance for their classification through complimentary use of additional spectroscopic techniques (i.e. Raman), interpolation from a single reliable factor (e.g. rotation of

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			incident polarized light), or a combination of factors (e.g. size, crimp, color, luster) (Goodpaster and Liszewski 2009). Due the evolving nature of methodology and science regarding microplastics, the State Water Board encourages continues dialogue and collaboration with ACWA and other stakeholders to update and improve the definition of 'microplastics in drinking water', standardized methods, sampling and analysis, reporting, and more.
5.02	**S(6) – revise 'drinking water'**	The definition of "drinking water" is not clear. The PD [proposed definition of 'microplastics in drinking water'] would benefit from a clear definition of "drinking water". If it is the water which has been processed at a waste water facility, it is unlikely that significant quantities of microplastics will be present. Modern processing systems are efficient at removing microplastics. More clarity is required in the regulation, for example, where would microplastics be introduced into the drinking water, as defined.	Thank you for your comment. See response to comment 1.02.
5.03	**S9(b) – revise biodegradability**	The stringent European regulatory system, based on the precautionary principle, is well-known, and for this reason, ECHA's robust scientific criteria was chosen as the basis to	Thank you for your comment. Several principle points in this comment are covered in the

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		draft the drinking water proposal. However, suggested deviations from the ECHA definition related to biopolymers is arbitrary and not supported by referenced documents. If the section criteria for polymer types is based on the ECHA definition, a consistent approach must be followed. A lack of consistency is shown by arbitrarily not excluding biodegradable plastics, yet still exclude natural polymers. Again, this is an arbitrary decision made without scientific justification. The staff report references Green et al. [2016, 2017]; in relation to the decision to include biodegradable polymers. However, these references provide no scientific justification for the decision. Further, the staff report [Coffin 2020] (pg. 15) states “Due to a lack of refined and widely accepted standards to determine biodegradability…”; this is not the case at the European Standards Commission and the ASTM both have well established standards for biodegradability or compostability. The Proposed Definition states that PLA has “demonstrated in vivo toxic effects similar or equivalent to their conventional, non-biodegradable counterpart,” referencing Green et al. [2017]. It is important to note that in both Green studies (2016 & 2017), there is no control to demonstrate whether the impacts which were demonstrated were due to simple physical contamination or due to chemical properties of the polymer comprising the microplastic. For the report to reach a scientifically valid conclusion, it would have been necessary to have a non-microplastic physical control (eg. sand) as well as a natural polymer control. The staff report alludes to a scientific validation of the decision to include biodegradable	response to comment 1.07. Additional points specifically in response to this comment are made below: Lacking consensus information on the human health effects of microplastics in drinking water (World Health Organization 2019), the exclusion of synthetic polymers based on the unproven assumption that environmental persistence is a determinant factor in the human health effects of microplastics would be arbitrary and without scientific justification. While there is extremely limited- and as the commentator points out in regards to the Green et al 2016 and 2017 studies- imperfect evidence regarding the health effects of biodegradable polymers in non-human biota, even fewer studies are available for models representative of humans (with one such study actually demonstrating enhanced toxicity relative to “non-biodegradable” polymers

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		polymers and exclude natural polymers, but under this cursory review, no validation exists. In the absence of data which distinguishes between physical and chemical impacts on a given system, the ECHA definition regarding polymer types should be maintained. The staff report provides no valid evidence to include biopolymers and exclude natural polymers. Indeed, in Green et al. [2016], the report states that, "The current study did not attempt to separate the physical and chemical effects of microplastics…" The Proposed Definition acknowledges the lack of available data justifying exclusion of natural polymers by stating "…few toxicological studies have compared synthetic polymers with natural polymers…." The conditions of Green et al. [2016] and [2017] are not representative of conditions related to drinking water. The Green et al. [2017] study referenced by staff was conducted under saltwater conditions, in a mesocosm to model natural environmental conditions, using oysters and mussels. The authors state "the extrapolation of results from any mesocosm experiment should, however, proceed with caution...." Additionally, it goes on to caution that "The current study provides ecologically relevant data on the effects of contamination by microplastic of different polymers…" Because both the environment studied (saltwater) and the species evaluated (oysters and mussels) are not comparable to drinking water nor to humans, the staff is asking for the water board to ignore the serious gaps that exist in using Green et al. [2017] as a basis for such an important decision. Green et al. [2016] is based on lugworms in sediment under seawater conditions, which is not a relevant system	(Liao and Yang 2020)). Based on available research in models representative of non-human biota, biodegradable microplastics often demonstrate similar or greater toxicity than "non-biodegradable" conventional microplastic particles, due in part to their more rapid breakdown into nanoplastic particles (Shen et al. 2020; González-Pleiter et al. 2019). In addition to the more rapid formation of nanoplastics, biodegradable polymers demonstrate enhanced chemical transfer kinetics to biota upon ingestion (Liao and Yang 2020; Zuo et al. 2019). For instance, one such biodegradable polymer poly(-butylene adipate co-terephthalate) demonstrated higher desorption/adsorption capacity for a persistent organic pollutant (phenanthrene) than the conventional, highly persistent polymers polyethylene and polystyrene (Zuo et al. 2019).

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		for drinking water, which would have no sediment and low salinity. Additionally, it is worth noting that this study reference neglects to have a non-microplastic physical control and a natural polymer control. To conclude, neither Green et al. [2017] nor Green et al. [2016] provides any evidence that biodegradable polymers should be treated differently from natural polymers, nor that there is inherent risk from the presence of biodegradable polymers. As stated in the PD, ECHA has clearly stated the criteria by which they selected polymers of interest, which is by persistent, bioaccumulative, and toxic (PBT) and very persistent and very bioaccumulative (vPvB) criteria. We see commentary about persistence of some biodegradable polymers, such as PLA, in both the PD and Green et al. 2016. It is important to note that all plastic materials, whether biodegradable or not, can have a different impact on a system based on their chemistry. It is important to not assign performance or impacts of one chemistry, whether it is PVC, PET, or PLA to others which might be associated. For example, comparing properties of PET and PE does not make sense, even though they share an ethylene monomer. Likewise, with inherently biodegradable polymers, there is a wide range of polymers which are certified compostable or certified soil biodegradable, and these polymers do not necessarily biodegrade at the same rate in a given environment. And one polymer can biodegrade at different rates in different environments, as this rate can be impacted by a range of factors, including the microbial activity, presence of oxygen, temperature, and moisture [Zumstein et al. 2019]. Green et al. [2016] openly states that the chemistry of each polymer must be addressed individually with regard to	The State Water Board's decision to deviate from the ECHA 2019 definition on the matter of biodegradability criteria, while mirroring the ECHA 2019 exclusion of natural polymers from the definition of 'microplastics in drinking water' is based on two principle factors: 1) the general scientific consensus is that synthetic biodegradable polymers are considered to be 'microplastics' (Shruti and Kutralam-Muniasamy 2019; Markowicz and Szymańska-Pulikowska 2019); biodegradable polymers demonstrate similar or enhanced toxicity to persistent, petroleum-based microplastics (see above); and their inclusion in the definition is supported unanimously by a panel of five leading experts commissioned for external peer review (California State Water Resources Control Board 2020) and; 2) the vast scientific consensus is that natural polymers (not chemically modified other than

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		impact on the lugworms. "From a policy perspective involved in addressing plastic pollution, it is important to assess the relative risks posed to natural habitats by different microplastics..." Drinking water is not water in a "natural habitat", but it is a unique environment where relevance must be assessed due to both the presence of microplastics and the associated health impacts.	by hydrolysis) are not considered 'microplastics' (Hartmann et al. 2019). The State Water Board acknowledges that the decision to exclude natural polymers (not chemically modified other than by hydrolysis) is indeed an arbitrary decision with the intent to harmonize with the scientific community, for which there is virtually unanimous consensus.
6.02	**S12(b) – Revise *substance - natural fibers***	One technical consideration we suggest for the definition is in regard to omitting dyed natural fibers from it. This is supported by leading microplastics experts who suggest that they not be included in a harmonized definition of microplastics. Moreover, their inclusion into the definition on the basis of mass would unintentionally restrict analysis methods to the use of Pyrolysis GC-MS, which is the only widely-used technology capable of determining polymer mass in a fiber. This method also requires additional optical techniques to manually pick individual fibers from samples, which seemingly would not be compatible with laboratories conducting sample analysis for routine monitoring.	Thank you for your comment. See response to comment 4.02.
8.01	**S13(a) – Support *Dimensions* (upper limit)**	**Upper Microplastic Size Limit** The Staff Report cites that: "the upper size limit of 5 mm corresponds with the lower size limit for the requirement of particle filtration by "full capture systems" in storm drains as required by the Water Quality Control Plan for Ocean	Thank you for your comment.

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		Waters of California" [Coffin 2020]. This upper size limit is consistent with definitions for microplastics used by other agencies and with the available literature. While the upper size is consistent with other agencies' definitions, the maximum size was based on possible ecological effects and not on California's Ocean Plan and required filtration for storm drains. Storm drains may be designated as sources of drinking water; however, the Federal Surface Water Treatment Rule requires water systems to filter and disinfect surface water sources which better reflects drinking water quality. The available literature suggests that in addition to ecological effects, that the term "micro" indicates use of a microscope eliminating large plastic particles visible to the naked eye. We do not object to the proposed upper size limit of 5 mm in the proposed microplastic definition.	
8.02	**S7(b) – Revise *Dimensions* (lower limit)**	**Lower Microplastic Size Limit** The proposed definition for microplastics states that; "*Microplastics in Drinking Water' are defined as solid polymeric materials to which chemical additives or other substances may have been added, which are particles which have at least two dimensions that are greater than 1 and less than 5,000 micrometers (µm) …*" This is inconsistent with all of the Staff Report cited agency definitions of "*plastic particles <5 mm*" with no lower limitation. This is critically important, as cited in the Staff Report and the available literature that "*Current toxicological knowledge suggests that smaller particles are more hazardous*." The lower limit is added to the definition solely based on the citation that: *"…below the lower size limit of 1 µm, particles may not be characterized directly using light-based microscopy, thus requiring fundamentally*	Thank you for your comment. Based on the expected toxicity (and extreme uncertainties of hazards and exposure) of sub-micron plastic particles (World Health Organization 2019), the State Water Board cannot justify the inclusion of a lower size limit of 1 micron in the definition of 'microplastics in drinking water'. The State Water Board will revise the *dimensions* criteria to drop the lower size limit in the proposed definition to be synonymous with the definitions of

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		different techniques and instrumentation." The Staff presentation at the State Board's workshop confirmed that nanoplastics (particles less than 1 um) likely present a greater threat to public health. • Adding a lower limit eliminates sampling and analysis of particles less than 1 um. This conflicts with the Staff Report conclusion that: "*Current toxicological knowledge suggests that smaller particles are more hazardous*." The proposed definition allows for elimination of the more hazardous microplastic data. • Adding a lower limit is inconsistent with the definition of microplastics by all of the Staff Report cited agencies and the available literature definitions. Elimination of the more hazardous microplastic data by adding a lower limitation would make data sharing inconsistent and therefore worthless. • Elimination of the more hazardous microplastic data by adding a lower limitation would skew the data reported to the public with regard to the safety of their drinking water and prevents transparency. It seems evident that the legislative intent was to present information to the public regarding plastic particles in drinking water. It is doubtful that the legislature considered any difference between micro and nano plastic particles. • It is not uncommon to have laboratory methods that do not currently measure compliance with regulatory limitations. The California Toxics Rule (CTR) is a good example where water quality standards are lower in some cases than can be achieved by laboratory analysis.	'microplastics' by the Ocean Protection Council (Ocean Protection Council and National Ocean and Atmospheric Administration Marine Debris Program 2018), US EPA (Murphy 2017), National Oceanic and Atmospheric Administration (Courtney Arthur, Baker, and Bamford 2008), International Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP 2019), which do not have lower size limits, and nearly synonymous with the proposed definition of 'microplastics' by the European Chemicals Agency (2019a), which currently has a lower size limit of 1nm.

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		• Addition of a lower limitation in the definition of microplastics could limit the analysis to light-based microscopy and eliminate the development of advanced and fundamentally different techniques and instrumentation. “Fundamentally different techniques and instrumentation” if capable of providing scientifically defensible and reliable data should be encouraged. • Light based microscopy is documented to have deficiencies in the identification and quantification of microplastics, specifically identification charts for numerous microplastics are unavailable. One would hope that the intent of the legislature in requiring adoption of a standard methodology to be used in the testing of drinking water for microplastics would be based on the best available science, which may not be light based microscopy. • There does not appear to be a legal or technical requirement to use light-based microscopy, thereby eliminating consideration of “fundamentally different techniques and instrumentation.” The available literature indicates that there is little research and/or data regarding microplastics and their environmental impacts, this will help establish the sampling and analysis bar. Using the best available science is imperative to provide a defensible response to the legislative mandate. • Consideration of a notification level or other guidance to aid consumer interpretations of the results of the microplastic testing would be inaccurate if smaller, potentially higher toxicity plastic particles are eliminated from the sampling and analysis. With the	

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		lower size limit in place it seems imperative that public notification of the microplastic data would have to contain a statement that "small particle microplastics less than 1 um which are possibly toxic have been eliminated from the sampling". For consistency, accuracy, transparency and simply good science, the lower limitation of 1 um should be removed from the proposed definition of microplastics. Its significantly easier to change a laboratory procedure and detection level than it is to change a legislatively mandated definition, standard laboratory methodology, notification level and laboratory accreditation.	
10.02	**S7(b) – Revise *Dimensions* (lower limit)**	The State here has produced a definition for microplastics, which appears to be comprehensive and sound. The proposed definition includes numerous common polymers and fibers, including biodegradable polymers. The definition is broad enough to capture most, if not all, microplastics; but does not include plastic particles less than 0.1 micron. Particles less than 0.1 micron are considered nanoparticles and fall outside the proposed definition of microplastics, but may have health implications because these nanoparticles can, once ingested, migrate into our neurology. Further research is needed to assess the public health related significance of detected microplastics and nanoparticles.	Thank you for your comment. See response to comment 8.02.
12.02	**S(6) – revise 'drinking water'**	Does drinking water need to be defined? Or is the intention specifically to define microplastics?	Thank you for your comment. See response to comment 1.02.
12.03	**S5(b) – Revise *Substance***	We think 'synthetic' should be added here, given that the last sentence in the paragraph captures bioplastics.	Thank you for your comment. The term 'synthetic' is effectively captured by the statement in the definition that,

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			"*Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis) are excluded.*" The commentator is correct that bioplastics that meet this criterion are included in the definition. Rationale for the omission of the word 'synthetic' from the definition is described in detail in the proposed definition of 'microplastics' by the European Chemicals Agency (2019a).
12.04	**S5(b) – Revise *Substance***	We think that "to which chemical additives or other substances may have been added" limits the definition unnecessarily and should be removed. Though most plastics will have additives, some will not, and some will have adsorbed chemicals to their surface once in the environment. For instance, many virgin resin pellets and their fragments will not have additives added to them. It seems ambiguous that if polymers with no intentionally added additives would not considered a microplastic (and therefore allowed in drinking water?)	Thank you for your comment. The use of the word "may" in this statement allows for particles without any chemical additives. In order to reduce ambiguities, an additional clarification will be included on page 17 of the Draft Staff report to indicate that this statement does not exclude polymers without intentionally added chemicals.
12.05	**S7(b) – Revise *Dimensions* (lower limit)**	The current definition excludes microfibers 1μm or less. This size would put them into the nanoplastic category, and in terms of harm, these nanoparticles can penetrate through the gut or tissue barrier. How are nanoparticles in drinking water being addressed?	Thank you for your comment. See response to comment 8.02.

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12.06	**S13(b) – Revise *Dimensions* (upper limit)**	This definition also eliminates particle sizes >5mm. Such a narrow definition can make unintended consequences permissible, similar to when the plastic bag industry made a thicker bag following the size restrictions for thin grocer bags.	Thank you for your comment. Justification for the upper size limit is detailed on page 19 of the Draft Staff Report, and copied below for convenience: "The proposed upper size limit for of 5,000 µm is the most widely used in the scientific literature, dating back to 2003 (Hartmann et al. 2019; A. L. Andrady 2003). NOAA adopted this upper size limit based on the likelihood of particles smaller than these dimensions being ingested relative to larger items (C. Arthur, Baker, and Bamford 2009). Further, this upper size limit is congruous with ECHA's definition of 'microplastics'[9] (European Chemicals Agency 2019a)."
12.07	**S5(b) – Revise *Substance***	The phrase 'derived in nature' can be ambiguous because of the fact that materials such as cellophane or cellulose acetate (in cigarette filters) that are in a sense, derived from natural polymers. Cellulose acetate can be non-biodegradable, especially in the human body. A second complication is a category called bio-based plastics that are derived from biomass (therefore derived in nature?) But	Thank you for your comment. An earlier draft of the proposed definition included the term "occur" in nature, which, upon suggestion from expert peer reviewer, was later revised to "derived" in nature

[9] Except in the case of "fibres", which ECHA further defines as having, "a length of 3nm ≤ x ≤ 15mm and length to diameter ratio of >3" (European Chemicals Agency 2019a).

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		bioplastics too are man-made and identical to the fossil-fuel based plastic. Suggest avoiding the word ‘derived’ and instead change it to 'naturally occurring polymers.' Good sentence otherwise since it captures bioplastics.	noting that microplastics would “occur” in nature once emitted into the environment (California State Water Resources Control Board 2020). To the best of the State Water Board’s knowledge, the current wording would include bio-based plastics that are derived from biomass so long as they are not chemically modified other than by hydrolysis. In the case of cellulose acetate, the natural polymer cellulose is typically chemically modified in two principal ways: acetylation, and hydrolysis (Steinmeier 2004), and would therefore be included in the proposed definition.
12.08	**S5(b) – Revise *Substance***	*“‘Polymer’ means a substance consisting of molecules characterized by the sequence of one or more types of monomer units. Such molecules must be distributed over a range of molecular weights wherein differences in the molecular weight are primarily attributable to differences in the number of monomer units. A polymer comprises the following: (a) a simple weight majority of molecules containing at least three monomer units which are covalently bound to at least one other monomer unit or other reactant; (b) less than a simple weight majority of molecules of the same molecular weight.”*	Thank you for your comment. This definition of ‘polymer’ is consistent with Article 3(5) of Regulation (EC) No 1907/2006 of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). The requirements pertaining to *state,* which are synonymous to the definition proposed by the European Chemicals

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		This is a somewhat unusual definition of a polymer. A molecule with three monomer units is not a polymer in the conventional sense and not even a solid. Take polyethylene, the most common plastic in the ocean. Until the molecule becomes very long (say 1000 monomer units) the material is a liquid or a wax. Common plastics have a much higher molecular weight. However, the definition does say 'solid' - therefore excluding all low molecular weight polymers and some waxes as well as any molecule with three monomer units. Other than the internal inconsistency in the document it still includes microplastics within the general understanding of the term.	Agency (2019a) do not *a priori* exclude low-molecular weight polymers, granted that they meet the requirement of having at least three covalently bound monomer units. The definition of 'particle' (a minute piece of matter with defined physical boundaries; a defined physical boundary is an interface) provides further specificity regarding the *state* characteristics. Liquid or wax are not 'particles' and would be excluded from the definition.
13.01	**S9(b) – revise biodegradability**	As the Water Board discussed in the Staff Report for the proposed definition of microplastics and the Public Workshop held on April 7, 2020, the European Chemicals Agency (EHCA) has been developing a definition of microplastics over the past few years. The EU Microplastics Restriction Dossier should grant a derogation for biodegradable microplastics within the definition. ECHA has established criteria for the demonstration of biodegradation of microplastics within the proposed definition in the Restriction Dossier. Fragrance Creators encourages the Water Board to align with ECHA and exempt biodegradable microplastics from the proposed definition if specific criteria are met. The Industry understands the purpose of the definition is to establish a monitoring program of microplastics in drinking water.	See response to comment 1.07 and 5.03.

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		Analytical method development for detection of biodegradable microplastics would prove challenging. In addition, an exemption of biodegradable microplastics would incentivize innovation in the development of new sustainable alternatives to current microplastics. *Point for Consideration* Biodegradable solid polymers provide an alternative to solid, persistent plastic waste. These materials have the potential to be sustainable alternatives to traditional solid plastics. The enactment of Senate Bill No. 567, Chapter 5.7 Plastic Products approved by the legislation, prohibits the labeling of plastic products as "biodegradable" plastics unless an ASTM standard method is met that was approved by the legislature. The inclusion of biodegradable plastics in the proposed microplastics definition, further strains industry's efforts to develop new non-persistent solid polymers, as they would be repeatedly categorized as traditional plastic or microplastic materials by California's definitions. This is problematic as their physico-chemical characteristics are different than traditional persistent plastics. SB 567 in conjunction with the proposed definition of microplastics as it stands, would impede the marketability of such materials.	
14.03	**S5(b) – Revise *Substance***	**HCPA recommends that the definition replaces "polymeric" with "plastic"** HCPA understands the challenge in developing this definition due to the vast array of types of plastic; however, we are concerned with the proposed definition using the term "polymeric" rather than "plastic." Polymers are large molecules composed of a repeating sequence of one or more types of monomers. Every plastic is a polymer while not every polymer is a plastic.	Detailed rationale for the use of the term 'polymeric' in the proposed definition is available on pages 13-16 of the Draft Staff Report. See response to comment 1.04 for additional rationale.

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		While polymers that are derived in nature and have not been chemically modified (other than by hydrolysis) are excluded, HCPA is concerned that this definition is too broad and captures other materials that are not plastics. HCPA recommends that SWRCB add the term "plastic" in the definition for Microplastics in Drinking water as follows: *'Microplastics in Drinking Water' are defined as solid* ***plastic*** ~~*polymeric*~~ *materials to which chemical additives or other substances may have been added, which are particles which have at least two dimensions that are greater than 1 and less than 5,000 micrometers (µm). Polymers that are derived in nature that have not been chemically modified (other than hydrolysis) are excluded.* It is critical to properly define plastics within this definition so that they can be properly detected and quantified. HCPA recommends incorporating the ASTM (American Society for Testing and Materials) and ISO (International Organization for Standardization) standards for plastics into the definition for Microplastics in Drinking Water. By including the ASTM [ASTM 2020] and ISO [ISO 2013] definitions of plastics and focusing on plastic particles that are solid and insoluble, the definition of Microplastics in Drinking Water can be developed so that microplastics are properly detected and quantified, while excluding materials that are not plastic. HCPA understands however, SWRCB's reluctance to adopt either ISO or ASTM definition due to the exemption of elastomers and fibers and therefore proposes the adoption of these definitions with omission of the elastomer exemption.	
14.04	**S8(b)- revise solubility**	**HCPA recommends that solubility is included into the consideration of the proposed definition**	Thank you for your comment. See response to 1.06.

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		HCPA appreciates that the defining criteria includes substance, state and dimensions; however, HCPA believes that solubility also must be taken into consideration. The Staff Report for the proposed definition of Microplastics in Drinking Water noted that the European Chemicals Agency’s (ECHA) original proposed definition of microplastics excludes solubility [Coffin 2020]. ECHA has since responded to stakeholder comments (NGO and industry) about their proposed regulation and is considering including solubility as a component of the microplastics definition. By including solubility as a criterion in the definition of Microplastics in Drinking Water, the definition may be robust enough to facilitate the development of proper analytical detection techniques. HCPA suggests using the OECD (Organisation for Economic Co-operation and Development) definition of water solubility of 100 mg/liter [OECD 2019] as a reasonable starting place for a value. HCPA also suggests that the use of this number is re-evaluated in the future as the science of microplastics evolves.	
14.05	**S9(b) – revise biodegradability**	**HCPA recommends that biodegradability is included into the consideration of the proposed definition** A microplastic that biodegrades will not be present in the environment (water, soil, etc.) and therefore should not be included in a regulation against persistent microplastics and should also be considered in the proposed definition of Microplastics in Drinking Water. Biodegradability is an important attribute for all substances. Testing methods, and associated pass/fail criteria, for assessing the (bio)degradability of substances are well established within the chemical regulatory schemes in all	See response to comment 1.07 and 5.03.

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		developed countries/regions (United States, Canada, European Union, Japan, China, etc.). Relevant testing methods have been subject to standardization at the international level for many years (e.g. there are numerous relevant OECD and ISO testing guidelines). For these reasons, ECHA has proposed and European Member States have agreed that the EU Microplastics Restriction should include a derogation for biodegradable microplastics. The proposed restriction dossier outlines specific test methods and criteria that must be met for a microplastic to be considered biodegradable and be derogated from the restriction. ECHA and the European Member States understand the importance of biodegradability as an exemption to encourage and enable innovation to more sustainable non-persistent alternatives to many current microplastic materials. HCPA urges SWRCB to do the same.	
15.02	**S14(b) – Revise *dimensions* (nomenclature)**	OPC staff recommends classifying particles from 1-5 mm as "mesoplastics" and particles below 1 mm to 1 µm as "microplastics." Particles in the 1-5 mm range may be identified using visual sorting. Sorting and identification of plastics in this size range offers community science opportunities and is an easy, simple, and fast method for experts and volunteers to engage in plastic pollution monitoring [Shim et al. 2017]. Particles below the 1 mm size class are more challenging to identify visually, and would require the use of a microscope, or a microscope and a spectroscopic analysis technique for accurate identification. Additionally, smaller-sized plastics have different modes of action to harm organisms and may have higher risk of harm [Besseling et al. 2019].	Thank you for your comment. Based on additional public comments received regarding difficulties in measurements or communication of findings due to the overly broad size range (17.01), request for the inclusion of sub-micron particles (8.02, 10.02, 12.05, 19.03, 21.02), and call for a size classification scheme (17.01, 19.03, 21.02, 22.02, 22.03), the Draft Staff Report will be updated to include *non-*

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		Additionally, strategies for management of mesoplastics will be substantially different than microplastics. California's Trash Amendment is a strong policy for preventing plastics greater than 5 mm in diameter from entering our waterways, and other policy efforts at the Water Board are already focusing on plastics in the meso size range. In response to AB 258 (Krekorian) in 2007, the Water Board instituted a program to reduce releases of nurdles (preproduction plastic pellets 1-2 mm in diameter) to receiving waters. The program includes inspections, enforcement, some monitoring, and stakeholder outreach and coordination. The nurdle program targets a significant portion of mesoplastic sources, but not all of them. OPC staff recommends revising the size criteria for microplastics because the size of the plastic particle leads to different detection techniques, ecological impacts, and management interventions.	*defining* size classification criteria. Classifying 'microplastics in drinking water' into distinct categories based on size would reduce complexities when communicating such findings to consumers and stakeholders. The commentator's proposed classification schema of 'mesoplastics' as 1-5mm seems to be unique and not widely accepted. More commonly, 'mesoplastics' are defined as either 1-25mm (Anthony L Andrady 2015; GESAMP 2015) or 5-25mm (Institute for Environment and Sustainability (Joint Research Centre) , MSFD Technical Subgroup on Marine Litter 2013; Wagner 2017; Frias et al. 2018; Bessa et al. 2019). Despite an overall lack of consensus on size classifications, a particular schema has been promulgated frequently in recent peer-reviewed publications (Van Cauwenberghe et al. 2015;

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			Gigault et al. 2018), and was agreed upon at a recent microplastics monitoring workshop (Bessa et al. 2019; Frias et al. 2018): i. “Nanoplastics” (1 to <1,000 nm); ii. “small microplastics” (1 to < 1,000 μm); iii. “large microplastics” (1 to <5 mm) iv. “mesoplastics” (5 to <25 mm); v. “macroplastics” (>2.5 cm) However, in an effort to harmonize more closely with the suggested scheme from the commentator, and due to significant distinctions in both analytical techniques (Primpke et al. 2020) and toxicological behavior of particles below 100 μm in size (e.g. potential translocation of particles into tissues in humans) (Wright and Kelly 2017), and particles greater than 1 mm, as well as harmonizing with SI units (such that the “micro” prefix refers specifically to particles within the micrometer range)

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			and the widely accepted definition of “nanomaterials” (European Chemicals Agency 2019b) the above classification framework is revised slightly and will be included in the revised Draft Staff Report as follows: i. “Nanoplastics” (1 nm to <100 nm); ii. “sub-micron plastics” (100 nm - <1 µm) iii. “small microplastics” (1 µm to < 100 µm); iv. “large microplastics” (100 µm to 1 mm) v. “mesoplastics” (1 mm to <2.5 cm); vi. “macroplastics” (>2.5 cm) Within the definition of ‘microplastics in drinking water’, the classification for “macroplastics” would not be included due to the minimum size range not overlapping with the upper size range of ‘microplastics in drinking water’. Within the defined size range for ‘microplastics in drinking water’, “nanoplastics”,

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			"sub-micron plastics", "small microplastics", and "large microplastics" should be used for reporting purposes.
16.03	**S12(b) – Revise *substance - natural fibers***	**Exclusion of naturally derived fibers** An important element of the proposed definition is the statement that "Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis) are excluded." While we agree with this statement at the outset, we do object to the inclusion of one of the examples provided in Table 1 in the Staff Report (page 18) [Coffin 2020]. Specifically, Table 1 lists that dyed natural fibers such as dyed cotton or dyed wool be considered as 'microplastics' in this definition. Although these materials may be slightly chemically altered by the dyeing process, their essence remain naturally derived (e.g., cotton or wool). More research is needed to understand how dyes or pigments can change the physical and chemical characteristics of naturally derived fibers before they are considered as microplastics. A clarifying statement is presented on page 18 of the Staff Report [Coffin 2020]: "Slightly modified natural polymers (e.g., dyed wool) may be excluded so long as they satisfy the criteria of being composed of <1% synthetic polymer by mass." It is likely that a dye or stain would comprise a negligible proportion of the fiber's weight, however to our knowledge this has not been studied in detail and this issue would benefit from further investigation. In practical terms, when using standard spectroscopic methods (μFTIR, μRaman) for microplastic analysis it would not be possible to measure the weight of a dye or a pigment on a fiber of any composition.	Thank you for your comment. It is highly unlikely that dyed wool or cotton would satisfy the stated criterion for inclusion in the definition. To reduce confusion, these examples will be removed from Table 1 of the revised Staff Report.

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		We suggest that naturally derived fibers that have been slightly modified by dyes or pigments be omitted from the examples in Table 1 of the Staff Report. Additionally, the proposed definition itself could be expanded to exclude naturally derived fibers that have been slightly modified by dyes or pigments. This concept is supported by other leading experts in microplastics who suggest that "dyed natural fibers not be included in a harmonized definition of microplastics" (Hartmann et al. 2019).	
17.01	**S7(b) – Revise *Dimensions* (lower limit)**	**Too General and Broad Size Range** The size range listed in the proposed definition for microplastics in drinking water is very broad as it currently describes microplastics as "greater than 1 and less than 5,000 micrometers (µm)." There is limited research available on the accuracy of detection of the lower end of the defined size range, ~1 µm. A standardized method to quantify microplastics has not been developed or published. It is also challenging to detect micropollutants smaller than 50 to 100 µm with current methods [Sullivan et al. 2019]. Although the technical capability may exist to possibly detect microplastics down to 1 µm, the practical capabilities of detecting and properly identifying such a small particle have not been confirmed. Extending the definition down to this range may limit the method certification options to less reliable methods.	Thank you for your comment. See response to comments 1.04, 1.05, 8.02, and 15.02.
17.02	**S12(b) – Revise *substance - natural fibers***	**Exclusion of Dyed Naturally Derived Fibers in Definition** The proposed definition includes a statement that "Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis) are excluded." This statement is problematic when considered alongside one of the examples provided in Table 1 in the	Thank you for your comment. See responses to comments 4.02 and 16.03.

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		Staff Report [Coffin 2020] that lists that “dyed natural fibers such as dyed cotton or dyed wool be considered as ‘microplastics’ in this definition.” The cotton and wool may have been “chemically modified” by the dyeing process but the majority of material still remains naturally derived (e.g., cotton or wool). There is a further clarifying statement on page 18 of the Staff Report [Coffin 2020] that states “Slightly modified natural polymers (e.g., dyed wool) may be excluded so long as they satisfy the criteria of being composed of <1% synthetic polymer by mass.” This statement would be difficult to confirm practically with available technology as it would be very difficult to measure the weight of a dye or pigment on a fiber to be able to assess if it consists of >1% of the weight of the particle. We would recommend that the proposed definition be expanded to state an exclusion for naturally derived fibers that have been slightly modified by dyes or pigments only. This exclusion of dyed natural fibers is consistent with other research by leading experts in microplastics who have stated “dyed natural fibers not be included in a harmonized definition of microplastics [Hartmann et al. 2019].”	
18.02	**S8(a)- support solubility**	A broad definition of microplastics is also important for capturing industry and market adaptations to regulations as well as improvements to analytical methodologies. For example, wax microbeads used in personal care products may be melted through microplastic sample digestion methods, and thus may be inadvertently removed and undercounted (Munno et al., 2018). There is also regulatory ambiguity as to whether these wax microbeads would be considered plastic.	Thank you for your comment.
18.03	**S9(a) – support biodegradability**	We also agree with not providing an exception for biodegradable polymers, because products marketed as	Thank you for your comment.

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		biodegradable may persist in the environment for years and may fragment further into microplastics (Lambert and Wagner, 2017).	
18.04	**S5(a) – support *Substance***	We recommend cellulose acetate be explicitly listed as an example of natural-based polymers in Table 1 of the staff report to avoid any ambiguity. Cellulose acetate is a chemically modified natural polymer, which appears to be included in the proposed definition. Cellulose acetate fibers were among the top five polymer-shape categories identified in all Bay samples, including stormwater, sediment, prey fish, and bivalves (Sutton et al., 2019; Miller et al., 2020), indicating cellulose acetate is an important component of the microplastic count in the environment. We also want to call attention to observations of specific particles in stormwater and wastewater, which may be of interest should this definition for drinking water influence efforts in other matrices. In stormwater samples, we saw an abundance of black rubbery fragments, which composed nearly half of the microparticle counts in Bay Area urban stormwater (Sutton et al., 2019). These particles were challenging to identify using FTIR and Raman spectroscopy due to their small size, rubbery texture, and fluorescence from other components; therefore, a few of these particles were sent to another laboratory for analysis using pyrolysis GC-MS and were confirmed to be tire wear particles. Tire wear particles are typically an agglomeration of tire derived rubber and road wear formed from the shearing forces and heat between the tire and road. In wastewater samples, we saw an abundance of white particles with a foam-like texture, which were categorized as stearates, lubricants, and waxes. Stearates are a component of soap scum, and were readily identified by	Thank you for your comment.

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		FTIR spectroscopy. Long-chain lubricant polymers were identified using Raman spectroscopy, and were fragile in texture. It appears that these particles may be included in the proposed definition. The presence of these particles in wastewater may be relevant to inform the Water Board's policies on direct potable reuse. Additionally, it would not be unreasonable to anticipate broader application of many technical aspects of this drinking water definition to microplastics in other matrices.	
18.05	**S15(b) – revise morphology**	The proposed morphology categories for microplastics in the staff report appear to be incomplete, though it is noted that these are not considered to be defining criteria and are tentative. The description of the pellet category is of particular interest, based on our monitoring experience in San Francisco Bay. Currently, the category for pellet is defined as "every surface point has the same distance from the center." This appears to define the shape category for spheres defined in the provided reference (Hartmann et al., 2019), but does not include the categories spheroid and cylindrical pellet, also defined in Hartmann et al. (2019). Our experience with Bay microparticle samples is that environmental samples typically fall under two categories: 1) perfectly smooth, round spheres or hemispheres that are smaller than 3 mm in size, with no irregularities, that will not crumble when pinched, and are often clear in color; and 2) cylindrical pellets and flattened spheroids that are larger than spheres (3-5 mm), that sometimes have clear "machine cut" edges, and are often clear, opaque, or white in color. In San Francisco Bay sediment samples, we saw an abundance of clear polystyrene spheres, which we have been told anecdotally are widely used in ion-exchange columns for water purification in laboratory settings, for	Thank you for your comment. The Draft Staff Report will be revised to include two additional morphological classifications: "spheroid" and "cylinder".

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		which down the drain disposal is a common practice. The proposed description for pellet may need to be broadened to include spheroids and cylinders, or another category may need to be added. Additionally, we used the morphology category for foam particles, which are particles with a unique sponge-like texture. These particles were ubiquitous in surface water, wastewater, and sediment samples, and we found recording this foam-like texture to be important to inform the material and potential source of the particle. For example, characterizing polystyrene particles as having a foam-like texture may better link the particle to products using expanded polystyrene foam. The Water Board may want to consider including a category to record this type of information.	
19.03	**S14(b) – Revise *dimensions* (nomenclature)**	**Regarding the dimension criteria in the definition, requiring covered particles have "*at least two dimensions that are greater than 1 and less than 5,000 micrometers (µm)",* we are in support of having two dimensions to capture a wider array of microplastics.** However, we recommend creating distinct categories that are still considered under the broad and inclusive definition of microplastics in drinking water; 5mm to 1mm, 1mm to 1µm, and <1µm. Plastics that are 5mm to 1mm in size can be identified with the eye while particles smaller than 1mm require different techniques and instruments for identification and classification. Microplastics that are smaller than 1mm are also more likely to be found in drinking water [Mason et al. (2018)] and could be more toxic to human health compared to larger particles. While particles <1µm may not be included in this current definition, future iterations of the definition are encouraged	Thank you for your comment. See response to comment 15.02.

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		to do so when more precise identification and classification technologies are available, as similar concerns exist regarding enhanced toxicity and bioavailability in drinking water. Further research is needed to assess the public health related significance of detected microplastics and nanoparticles. In addition, the 5mm overlap in the definition is important as it aligns with the Water Quality Control Plan for Ocean Waters of California. The Ocean Plan includes provisions for the control of trash, including a requirement to install "full capture systems" in storm drains to restrict trash particles larger than 5mm	
20.03	**S16(b) – Revise density**	**USTMA recommends that the definition of microplastics in drinking water focus on particles with a density less than 1 g/cm3** Microplastics researchers have observed that the physical properties of a particle are good predictors of its behavior in the environment. Along with shape and size, the density of microplastics is considered to be a key property that influences their environmental fate because those with a density greater than 1 are expected to sink in water, while those with a density less than 1 are expected to float. (Rochman et al. 2019). The density of plastics and their buoyancy in water can also be influenced by the coating of plastics with microorganisms, algae, or plants (i.e., biofilms) (Woodall et al. 2014). Densities of plastic polymers such as PE, PS and PVC can range from 0.9 to 2.3 g/cm3 (WHO 2019). The density of tire rubber has been reported to range from approximately 1.15 to 1.18 (USFHA, 2016, Banerjee et al., 2016, Dumne et al., 2013). The density of TRWP has been estimated to be 1.8 g/cm3 (range 0.94 – 2.4) and was incorporated into	Thank you for your comment. The draft staff report will be updated with a statement regarding densities. Additionally, this criteria as a potential defining factor 'microplastics in drinking water' may be revisited in accordance with new information. Despite the expectation that particles with densities greater than 1 g/cm^3 would not be found in raw water or treated drinking water, such particles have been found in a number of studies. For instance, one study found that polyacrylamide particles

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		the fate and transport model by Unice et al. (2019a, b). This value is based on observations that laboratory generated TRWP consists of approximately 50% tread and 50% mineral encrustations from the road and literature estimates of tread and road aggregate density. Additionally, researchers evaluating the presence of TRWP in environmental matrices have found that the particles can be isolated from sediment samples using liquid separation techniques where the separation solution has a density of at least 1.2 g/cm3, but that the highest recovery occurs with solutions that have densities >1.9 g/cm3 (Klockner et al. 2019). Particles with densities >1 g/cm3 are unlikely to remain suspended in source surface waters and therefore also unlikely to be present in finished drinking water that has been processed for human consumption. As such, excluding particles with densities >1 g/cm3 will allow the water districts to focus valuable resources on identification and measurement of particles most likely to be present in drinking water.	(density = 1.30 g/cm^3)[10] comprised approximately 7-25% of total polymeric particles characterized (338-628 particles/liter) in treated drinking water across three different treatment plants (Pivokonsky et al. 2018). Another study found that polyacrylamide particle abundance significantly increased approximately three times following sedimentation, with a raw water abundance of (37 ± 33 particles/liter) and advanced-treated[11] drinking water abundance of 112 ± 15 particles/liter), however particle concentrations of all other polymer types characterized were significantly reduced following sedimentation (Zhifeng Wang, Lin, and Chen 2020a). The study's conclusion that sedimentation significantly contributed to the quantity of

[10] https://polymerdatabase.com/polymers/polyacrylamide.html

[11] Treatment processes included sedimentation, followed by sand filtration, followed by ozonation, then granular activated carbon filtration (Zhifeng Wang, Lin, and Chen 2020a). Polyacrylamide accounted for 10.1-14.7% of the total polymeric particle content characterized in the final effluent (Zhifeng Wang, Lin, and Chen 2020a).

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			polyacrylamide particles is supported by the fact that polyacrylamide is commonly used as a coagulant in drinking water treatment plants. While the use of polyacrylamide in water treatment processes result in the occurrence of such particles in treated drinking water, it's use is known to effectively remove other polymeric particles such as polyethylene (Ma, Xue, Hu, et al. 2019b). In addition to polyacrylamide, other polymers with densities greater than 1 g/cm^3 have been characterized in raw and treated drinking water. For instance, polyethylene terephthalate (density = 1.34 g/cm^3) accounted for 55.4-63.1% of polymeric particles (3,843 ± 598 particles/L) in influent (raw surface water), and made up 47.2-58.8% of polymeric particles in effluent (advanced treated drinking water)[11] (485 ± 53 particles/L) (Zhifeng Wang, Lin, and Chen 2020a). In an additional study

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			characterizing microplastics in 38 tap water samples taken from different cities in China, polyethylene terephthalate represented 3.3% of total polymeric particles (Tong et al. 2020) In bottled water, polyamide ("nylon") (density=1.14 g/cm^3) and polystyrene (density= 1.05 g/cm^3) were reported as being 16% and 11% of total polymeric particles, respectively, in 11 brands of bottled water (Mason, Welch, and Neratko 2018). However, the source of such particles in bottled water samples could not be determined as the abundance of particles in raw water was not characterized (Mason, Welch, and Neratko 2018). Additionally, contamination of certain polymeric particles in bottled water has been attributed to the degradation of plastic bottle caps and bottles (Winkler et al. 2019), and in the case of fibers, contamination is highly likely to occur due to shedding from

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			clothing of anyone involved in the process (e.g. operators in bottling plants, treatment plants, or during the sampling process) (Scopetani et al. 2020). Based on the limited available evidence regarding microplastics in treated drinking water and their source waters, polymers cannot be reliably excluded from the definition of 'microplastics in drinking water' based on density thresholds.
20.04	**S15(b)- revise morphology**	**USTMA recommends that morphology be included as a defining criterion for "Microplastic in Drinking Water"** The staff report indicates that in order to define a particle as 'Microplastics in Drinking Water' specific criteria related to substance, state, and dimensions must be satisfied, and that additional characteristics including morphology and color should be recorded, but are not critical to the definition. The rationale for this is that while common classifications for the morphology of microplastics include spheres, pellets, fragments, films, and fibers, the SWRCB is not yet aware of a standardized taxonomy for the morphology of microplastics. Nevertheless, the staff report recommends that morphological features proposed by Hartmann et al. (2019) be followed along with the addition of "black rubbery fragment - typically anthropogenic crumb	Thank you for your comment. The Draft Staff Report will be updated to include this morphological description (Leads and Weinstein 2019).

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		rubber derived from tires which is technically challenging to identify using common spectroscopic techniques." A variety of researchers have observed TRWP in environmental samples (ie., air and sediment) and have concluded that they have distinct morphological features that can aid in their identification. Although Kreider et al. (2010) described these features for freshly generated particles in a laboratory, others have observed the features with particles isolated from environmental samples ([Dall O'sto], et al., 2014; Sommer et al., 2018, Leads and Weistein, 2019). As such we recommend that the morphological feature "black rubbery fragment - typically anthropogenic crumb rubber derived from tires which is technically challenging to identify using common spectroscopic techniques" be replaced with those used by Leads and Weinstein (2019) where TRWP are "black in color, elongated/cylindrical in shape, rough surface texture/encrustations, rubbery consistency that maintained its shape when manipulated with forceps".	
21.02	**S11(b) - *dimensions* (misc.)**	Drinking water would likely contain only the very small sizes of microplastics and potentially nanoplastics because of the level of treatment drinking water receives. To monitor the occurrence of microplastics in drinking water, standardized methods are needed. The collection, preparation and identification protocols and methodologies required for the size class between 1 mm and 1 micron is significantly more complex than that required for the larger size ranges between 1 and 5 mm. The occurrence and impacts of nanoplastics in drinking water are also areas of concern for researchers. This size range, i.e. less than 1 micron, necessitates that new	Thank you for your comment. See response to comments 8.02 and 15.02.

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		collection, preparation and identification protocols and instrumentation technologies be developed that are likely different from those used for microplastics. Nanoplastics measurements and monitoring are potential challenges to be confronted after collection, preparation and identification standards for plastics in the micron-size range are established.	
22.02	**S7(a) – Support *Dimensions* (lower limit)**	Upon reviewing the document PROPOSED DEFINITION OF 'MICROPLASTICS IN DRINKING WATER', we support the emphasis on the role of size in the definition. In fact, the need to document size and size-distribution of microplastics reflects the literature studies where smaller microplastics were found in higher abundance in drinking water (*inter alia*, [Pivokonsky et al. (2018); Novotna et al. (2019)]). Given the link between particle size and removal efficiency during water treatment, the considerations on size-distribution would qualify the applicability and efficiency of removal technologies.	Thank you for your comment.

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