



County of San Diego

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Jessie Maxwell, Environmental Scientist
State Water Resources Control Board
1001 I Street
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Ms. Maxwell,

RE: Comments on Technical Work Products Developed for State Water Boards
Biostimulatory and Biointegrity Provisions

The County of San Diego (County) appreciates the opportunity to provide comments and participate in the ongoing discussions as the State Water Resources Control Board (State Water Board) is proposing to adopt a statewide water quality objective for Biostimulatory Substances (including nutrients) and a program to implement it as an amendment to the Water Quality Control Plan for Inland Surface Water, Enclosed Bays and Estuaries of California (ISWEBE Plan). As a part of this project, the State Water Board intends to establish a plan to protect and restore biointegrity. Collectively, these components are referred to as the "Biostimulatory-Biointegrity Provisions or Provisions" in the rest of the letter. The County appreciates and applauds the transparent process that the State Water Board has embraced in their development of these Provisions and provides these comments to constructively move the process forward.

As a part of this process a Science Panel was formed with the intent to provide ongoing advice and peer review of scientific products to support the project.

A Science Plan (Science Plan to Support the State Water Board's Biostimulatory-Biointegrity Project for California Wadeable Streams) was developed that articulates the conceptual approach and technical activities that will support the SWRCB's Biostimulatory-Biointegrity Provisions. The plan identified four major products, with five associated technical products recently completed and readied for Science Panel Review:

Biointegrity Products

- Algal stream condition index, ASCI, Theroux et al. in prep
- Biological condition gradient model, Paul et al. in prep
- Channels in Developed Landscapes; Beck et al., in review

Biostimulatory Products- Applicable Across Waterbody Type

- Scientific foundation for assessment of biostimulatory impacts to California estuaries, enclosed Bays, and inland waterbodies (Sutula SCCWRP Technical Report [TR] 871)

Wadeable Streams Biostimulatory Products

- Conceptual models, review of indicators, and synthesis of eutrophication thresholds in wadeable streams (Sutula et al, SCCWRP TR 1048)
- Empirical stress-response empirical models to produce range of eutrophication thresholds associated with biointegrity protection endpoints in wadeable streams (Mazor et al, in prep)

The County's understanding of the process is that on December 12-13 the Science Panel will meet with the stakeholder advisory group for the Provision development. At this meeting, the stormwater representatives (Karen Ashby, Ashli Desai, Chris Sommers, and Ewelina Mutkowska) will have an opportunity to provide the Science Panel with comments on the technical work products and pose additional questions for them to consider.

Additionally, the County's understanding of the process is that any written comments provided by individual stakeholders will be made available to the Science Panel for their review, SCCWRP for editing the technical work products, and the State Water Board staff to inform the development of their work plan for translating these scientific work products into amendments to the Inland Surface Waters, Enclosed Bays, and Estuaries Plan (ISWEBE). The State Water Board work plan is anticipated in early 2019.

The purpose of this letter is to provide comments to inform the State Water Board's work plan, gain Science Panel input on tools or data analysis that could inform potential policy options, and to request modifications or clarifications to the technical work products. The letter has been organized into the following sections.

Section I. Requested policy options for consideration in ISWEBE amendment development to be included in the State Water Board's work plan (page 3)

Section II. Science Panel questions (page 9)

Section III. General comments on technical work products for SCCWRP's consideration (page 9)

Section IV. Comments on each specific technical work product for SCCWRP, the Science Panel, and the State Water Board to consider (page 11):

- Technical concerns and issues. In many cases, these technical concerns provide a scientific basis for including the recommended policy options provided in the first section.
- Requested clarifications and questions
- Requested editorial changes

I. Policy Options for State Water Board Staff's Consideration in ISWEBE Amendment Development

A number of elements of the technical work products highlight potential limitations of the available science and challenges associated with developing the Provisions. Additionally, the County has significant concerns about the infeasibility of attaining many of the targets identified in the technical work. It is unclear if there are any available technologies that would allow urban runoff (or other discharges) to attain the potential thresholds shown in the technical reports. Additionally, it is likely that attaining reference biointegrity thresholds may not be feasible in all waterbodies.

For these reasons, even though a large amount of technical work has been conducted, it is possible that more work will need to be done to develop Provisions that are applicable to all waters in California. The development of the Provisions will require significant thought and evaluation of options to address the uncertainties, technical limitations, and implications for control measures and costs resulting from the technical analysis. As a result, the County recommends a phased approach to developing the Provisions in which high quality and reference waters are protected using the technical work developed to date and additional time is taken to evaluate options for other waters.

Independent of whether or not a phased approach is adopted, the County requests that the State Water Board staff's workplan for development of the Provisions include, at a minimum, evaluation of the following potential approaches and not rely solely on the potential thresholds presented in the technical work products. Additionally, the Science Panel should be directed to help identify any scientific work or additional analysis/revisions to the existing technical work that could be used to support these evaluations. Following is a summary of potential options the County requests be evaluated in the workplan and some of the key identified technical limitations that support the requests.

1. Consideration of alternative approaches for non-reference waterbodies are needed to account for uncertainties and constraints identified in the technical work. For example, attainment of thresholds identified in the technical work products may be infeasible.¹ Analysis of reference reach data in Southern California shows that many reference sites would not be able to attain thresholds identified in the technical work.² Additionally, landscape constraints could limit the ability of implementation

¹ Sutula et al, comments 10, 11

² Mazor et al., comments 5, 10

actions to improve biological conditions in some waterbodies.³ Alternative approaches that account for the technical infeasibility of obtaining the potential numeric thresholds should be considered, including, but not limited to:

- As noted above, phased approaches that start with protection of high quality waters and bring in constrained channels at a later date after more science has been developed
 - Consideration of approaches that have been used in other states and internationally
 - Consideration of approaches suggested by the Science Panel in 2017 (e.g. Tiered aquatic life beneficial uses)
 - Use of threshold ranges that trigger different management and investigation actions depending on waterbody expectations
 - Categorization of different waterbody types with different expectations for those waterbodies (categorical approach)
2. Waterbodies can respond differently to the same stressor.⁴ Watershed-specific approaches that do not require significant regulatory efforts to use (e.g. not considered site-specific objectives that require Basin Planning processes) should be included in the workplan.
3. Multiple lines of evidence approaches that consider a broader range of potential stressors, the use of causal assessments, and avoid using single numeric thresholds for an individual indicator as an evaluation of attainment of the objective should be considered. Additionally, options that consider the range of natural variability over time and can be adapted to address these temporal variations (see discussion by Charles Hawkins in 2017 Science Panel Report) should be evaluated. Finally, consideration of regional indices, rather than a single statewide index should be evaluated. Inclusion of these options are requested for the following reasons:
- A range of CSCI and ASCI scores are associated with the characterization of ecosystem status associated with each BCG bin. The selection of specific values within the range could have significant impacts on the cost, benefit and implementation requirements of the provisions.⁵
 - Throughout the technical documents⁶ and in comments by the Science Panel in 2017⁷, stressors other than just nutrient concentrations can impact

³ Beck et al.

⁴ "For example, Hawkins et al. (Hawkins, C. P., Cao, Y., & Roper, B. 2010. Method of predicting reference condition biota affects the performance and interpretation of ecological indices. *Freshwater Biology* 55:1066-1085) showed that communities in different reference condition streams responded differently to the same simulated stress (Fig. 2) implying that the specific trajectory of community alteration to stress depends on either initial (reference) taxonomic composition or local environmental conditions." - Wadeable Streams Nutrient Objectives Science Panel Report. April 2017. Quotation by Charles Hawkins

⁵ Paul et al., comment 1

⁶ Mazor et.al, comments 1, 2, 3

⁷ "The presumption that higher concentrations lead to reduced structural and functional integrity is plausible but, as noted above, other stressors may confound the relationships."-Paul Stacey, Wadeable Streams Nutrient Objectives Science Panel Report. April 2017.

biointegrity and biostimulatory results. Though discussed as potentially significant factors, they are not accounted for in the technical analysis provided.

- The results presented in Mazor et. al. result in questions about the underlying presumption of much of the technical work that improvement in biointegrity is linked to improving biostimulatory conditions in all waterbodies.
 - Science Panel input in 2017 noted that “The BCG is part of the Wadeable Streams Science Plan to assist stakeholders and decision makers understanding of the ASCI and the CSCI. Neither of these is a direct statement of the beneficial uses to be protected.”⁸ However, all of the technical work is based on the presumption that the ASCI and CSCI are representative of the beneficial uses and that biostimulatory conditions and biointegrity are linked in all waters.
 - Variability in reference condition amongst regions in California is lost by using statewide datasets to develop the CSCI and ASCI thresholds and leads to sites being compared to inappropriate targets.⁹
4. The development of the Provisions needs to contain a robust California Water Code analysis that attains reasonable protection of beneficial uses and fully considers achievability and cost.
 5. The data used as a basis for the technical work was all collected during dry weather conditions. The technical work does not adequately address non-perennial, intermittent and ephemeral streams that are common in the San Diego area.¹⁰ Separate objectives and/or implementation procedures for wet and dry conditions should be evaluated.
 6. Specific 303(d) listing procedures for biostimulatory/biointegrity should be included to identify the appropriate use of the objectives and numeric thresholds in evaluating waterbody impairment given all the uncertainties identified above.

Additionally, based on the review of the technical work products the County requests the following issues be addressed:

- The technical work shows a lack of accuracy in measuring algal biomass for some of the selected indicators (AFDM and % algal cover).¹¹ As a result, the County recommends removing AFDM and % cover as potential indicators.
- Remove Trihalomethane formation due to increased dissolved organic carbon as a beneficial use impact concern.

Below is a more detailed description of each of the options summarized above to consider in the development of the Provisions.

⁸ Wadeable Streams Nutrient Objectives Science Panel Report. April 2017. Quotation by Ken Reckhow.

⁹ Theroux et al., comments 2, 3; Mazor et al., comments 8, 9, 10

¹⁰ Sutula et al., comment 1

¹¹ Mazor et al., comments 6, 10; Sutula et al., comment 2

1. *Alternative Approaches to Address Constrained Channels*

The scientific work products completed to date (with the exception of Prioritizing management goals for stream biological integrity within the developed landscape context (Beck et al)) have focused on different analyses to compare waterbodies to reference conditions with the presumption that attaining reference conditions will result in the protection of beneficial uses. This presumption does not include an evaluation of the beneficial uses present in non-reference waters and the thresholds needed to achieve the beneficial uses in these waterbodies.

Beck et al. identified that landscape conditions may constrain the ability of some waterbodies to attain reference condition biointegrity scores. While we recognize that the Provisions should not set up a structure that writes off certain types of waterbodies as not being able to be improved, the County requests that the provisions set up a structure that provides reasonable protection of beneficial uses (as required in the Water Code), protects high quality and reference waters, and allows for effective prioritization of resources on implementation actions that can result in improvements to waterbody condition. The County has identified a number of options that should be considered in the development of the Provisions that could provide this framework.

Other states and countries have approached development of biointegrity and biostimulatory objective development in a number of ways. The approaches used in other states should be reviewed and considered for their applicability to California. Examples of the approaches that should be considered include, but are not limited to:

- Classification of waterbodies in Maine and setting expectations using BCG bins.
- Incorporation of “best achievable” condition in objectives in Australia and Ohio.

In the 2017 Science Panel Report, a number of potential approaches to policy development were identified for consideration by the Panel members including, but are not limited to:

- Tiered aquatic life beneficial uses
- Using approaches that set different risk thresholds for different types of waterbodies
- Using predictive distributions of indicators and a probability of exceedance approach rather than single threshold values
- Defining reference conditions based on the range of natural variability and with consideration for temporal variability
- “Using the experts assembled to produce the BCG to improve our understanding of what type and amount of biological alteration, as assessed with the CSCI, represents an unacceptable change in biology rather than solely relying on statistical distributions to set thresholds”
- “Use models and default numbers and adaptive management for TALU/BCG levels and numeric nutrient endpoints (NNEs)” rather than the relationship of BCG bins to percentile of reference. “Here, you set NNEs to protect important elements of biological condition, not a multimetric index, and thresholds (tipping points) in responses help develop stakeholder consensus for NNEs because risk of losing valued attributes changes so much at those NNEs.”

Stakeholder Advisory Group members have previously presented and provided information to the State Water Board on potential policy frameworks that should be discussed for

consideration in development of the Provisions. These options have included using the landscape model described in Beck et. al along with other landscape characteristics to identify different categories of waterbodies. The Provisions would then include different requirements for the different categories. There are many options for developing the different requirements, including many of the options described in the Science Panel report and used in other states, but also potentially including using different analyses of the technical work to create different risk thresholds for each category or a narrative objective with different required implementation provisions for different waterbody types.

Finally, the State Water Board could consider a phased approach that only establishes numeric guidance for high quality waterbodies at this time with a narrative objective and implementation guidance for other waters. Then, the options discussed above could be evaluated to set numeric guidance for other waters if needed in the future.

2. Watershed Approaches

As discussed in the technical work products and noted in recent State Water Board presentations on potential policy options¹², a watershed approach allows for consideration of site-specific conditions, stressors and relationships that cannot be adequately captured in the statewide analysis that has been done to date. It appears that this approach will be considered in the development of the Provisions based on the recent State Water Board presentations, however, the usefulness of the approach will be determined by the regulatory mechanism by which the approach can be applied. Alternatives to a traditional Basin Plan Amendment process for adopting site-specific objectives should be included in the Provisions. Options could include developing technical guidance and minimum requirements to be met in order to apply the alternative numeric guidance developed at a watershed scale.

3. Multiple Lines of Evidence, Consideration of Natural Variability, and Regional Thresholds

The results presented in the technical reports show that different waterbodies respond in different ways to stressors and that a single indicator is often not appropriate for determining whether or not a waterbody is protecting beneficial uses. In developing the policy, the State Water Board should use an approach that considers multiple lines of evidence rather than relying on any single indicators identified in the scientific work products. The Sediment Quality Objectives provide a good model of a way in which a narrative objective combined with multiple lines of evidence evaluating numeric thresholds could be developed.

When developing the multiple lines of evidence approach, using single threshold values as “bright lines” for identifying impairments or objective exceedances should be avoided. Ranges of thresholds that account for natural variability, changes in waterbody conditions based on natural variations in things such as precipitation and temperature, and potentially regional thresholds should be included to account for different waterbody responses that could all be within the range of natural conditions during different time periods in different regions.

¹² October 26, 2018 presentation by Lori Webber, SWRCB staff.

4. Water Code Analysis

An overview of the Water Code requirements that the State Board is obligated to meet in setting water quality objectives (or equivalent enforceable metrics) must be articulated as part of the SWRCB's work plan. Under the California Water Code, water quality objectives are adopted to provide reasonable protection of beneficial uses. Additionally, the Water Code analysis needs to include a program of implementation describing the nature of actions required to achieve proposed objectives. Three of the requirements for the adoption of water quality objectives in California are: (a) consideration of past, present and probable future beneficial uses of water (Section 13241 (a)), (b) consideration of the water quality condition that could reasonably be achieved through coordinated control of all factors which affect water quality in the area, and (c) consideration of economics (Section 13241 (c)). Typically, these provisions are analyzed in a general manner, do not include a robust evaluation of the attainability of the objectives and do not contain consideration of differences between wet and dry weather conditions. The Water Code analysis should be built into the development of the Provisions and used to help determine the proposed numeric guidance rather than being conducted after values have already been selected. Additionally, the 13241 analysis conducted as part of the Provision development needs to consider wet weather separately from dry weather to adequately address these factors:

- dry and wet weather have different reasonably foreseeable methods of compliance that could impact the analysis of the water quality that could be reasonably achieved (13241 (b)),
- different costs for that compliance could impact the economic analysis (13241 (c)), and
- potentially different beneficial use impacts to be considered (13241 (a)).

The Science Panel should be asked to provide input regarding the type of information needed to address the Water Code requirements, particularly for waters that are deemed to be either likely or possibly constrained.

5. Differentiation of Wet and Dry Conditions

Many implementation concerns for permitted stormwater agencies arise due to application of water quality objectives developed primarily based on data collected during dry weather conditions, which are then applied to wet weather without guidance or consideration for implementation. The process for establishing the Provisions should assess the ecological impact of wet weather exceedances to determine if the Provisions should even apply during wet weather conditions. The State Water Board should consider seasonal or dry weather only objectives with implementation provisions to address situations where discharges that occur during rain events may cause exceedances of objectives during dry weather (e.g. sediment loads carrying nutrients that are deposited in a lake during storm events and contribute to algal blooms during dry weather). These implementation procedures could

include considerations for permit or TMDL development but should not be the basis for determining that objectives or numeric guidance apply during wet weather.

6. Specific 303(d) Listing Procedures

The Provisions should contain 303(d) listing procedures that clearly specify how the provisions should be evaluated for impairment. The Phase 2 Sediment Quality Objective Amendments included 303(d) listing provisions that accounted for the multiple lines of evidence approach in the objectives and recognized the different sampling procedures and timelines appropriate for evaluation of the data. Given the likelihood that the Provisions may contain multiple lines of evidence or multiple indicators and options for watershed-specific approaches, the Provisions should include clear methods of using the objectives and numeric guidance for evaluation of impairment and placement on the 303(d) list.

II. Questions for Science Panel

Following are a number of questions related to some of the issues identified above and the technical work products for consideration by the Science Panel.

- Do you feel your previous comments on the work plan were addressed by the work developed? If not, what other work do you suggest?
- Do you have any thoughts on how the work products could be used to develop a multiple lines of evidence or broader stressor index that could consider more than a single stressor at one time for developing the relationship to biological integrity scores?
- In Sutula, 2018, organizing principles are proposed for development of the B&B Provisions. Do you feel that the scientific work supports the following organizing principles:
 - 5. Statewide indices of biological integrity can be used as assessment endpoints from which to derive ranges of biostimulatory targets that are protective of aquatic life related beneficial uses.
 - 6. To address total “biostimulatory” potential, thresholds should be based on total nutrients (as opposed to dissolved inorganic form) and for both nitrogen and phosphorus, as opposed to just controlling what is considered the limiting nutrient on-site (either nitrogen or phosphorus).
- Is the salinity definition for rivers and streams appropriate?
- Do you have any input regarding the type of information needed to address the Water Code requirements, particularly for waters that are deemed to be either likely or possibly constrained (i.e. will not achieve aspirational metrics)?

III. General Comments on Technical Work Products

All of the work products are initial scientific work products developed by a Science Team and do not represent any policy decisions. As a result, all implied policy decisions in the reports should be removed. For specific examples of language that we see as problematic, please see the marked up documents that will be provided by CASQA in their comments and specific language highlighted in the comments on the specific work products below. (https://www.dropbox.com/sh/44iimbqv8ca8pcm/AAD_27XC5dY-rp7mfQDQvCf4a?dl=0).

Paul, et al. is the technical work product that comes the closest to avoiding these types of statements and the other comments provided in this section.

Ms. Jessie Maxwell

December 7, 2018

Page 10

The technical work products should clearly indicate that all of the analysis results from a comparison to reference conditions and not be stated in terms of protection of beneficial uses or impairments. Determination of protection of beneficial uses and impairments is a policy decision that should be made during the development of the Provisions. Additionally, each document should include an upfront disclaimer to this effect, clarifying that any numbers presented in the science reports should not be used for regulatory decisions (e.g. effluent limitations, 303(d) listings, TMDLs, etc.) until the Provisions are developed.

When potential impacts to beneficial uses are discussed, the discussion should be clear that an impact to a beneficial use may occur, but no presumption of impairment should be made. Some impact may not equate to impairment and the potential for impact without a demonstration of impact is definitely not an impairment. As much of the technical work shows, there are many examples of waterbodies that meet various ASCI or CSCI values while not meeting one or more indicator thresholds. Additionally, no policy decision has yet been made on what CSCI and/or ASCI scores may be considered impacted or the process for defining when an impacted score equates to an impaired beneficial use. Please remove all references to impairment from all the technical documents, including those in conceptual model figures.

It is not clear how the Science Panel comments from 2017 were addressed in the documents. The Science Panel had a number of caveats and concerns about the proposed Science Plan. At a minimum, the Science Panel caveats on the use of the information and potential alternative approaches should be captured in the relevant technical documents. For example, the discussions of the limitations of the ability to relate individual stressors to the CSCI and ASCI because of the potential for multiple stressors in the environment impacting those scores, the discussion of the definitions/limitations in using analyses based on reference conditions, and the temporal variability that exists in bioassessment scores discussed above should be included.

The technical work products should not reference the San Diego Regional Water Board biological thresholds, particularly for documents that are proposed to be published. The documents that were released by the San Diego Water Board were administrative draft documents to start the discussion of potential objectives. Substantial comments were submitted on the proposed objectives and it is premature to indicate that these are proposed thresholds. Additionally, the technical work products do not accurately characterize the information presented in the administrative draft objectives which included both the 1st and 10th percentile of reference. Finally, the San Diego Water Board thresholds were proposed based on prior technical work produced by SCCWRP and do not yet represent an independent policy evaluation that has been conducted in accordance with California Water Code requirements.

All of the work products should clearly present the full ranges associated with the results rather than single numbers and present all options that were evaluated where applicable.

All of the work products should clearly state the assumptions and limitations of the work to allow full consideration of the limitations in development of the Provisions.

The definitions and policy ramifications of the following terms that are used throughout the various science documents should be clearly outlined:

- a. Index values or scores
- b. Thresholds
- c. Targets
- d. Goals
- e. Indicators

IV. Specific Comments on Technical Work Products

Document: A Non-Predictive Algal Index for Complex Environments (Theroux et al)

Technical Concerns and Issues

1. Page 5, paragraph 1 – Text states: “For evaluating ecoregion responses, we divided the state into 6 ecoregions (North Coast, Central Valley, Chaparral, Sierra Nevada, and South Coast) based on modified ecoregional (Omernik 1987) and hydrological boundaries (Ode et al., 2016).” Given what is stated about the fragmented nature of algae assemblages later in the document (page 10), were other division scenarios evaluated that may better represent ecological diversity of algae, and may have increased the predictive capability of the model?
2. Similar environmental context is important when selecting appropriate biological target thresholds for specific sites. The percentile of reference thresholds established are based on the distribution of reference sites statewide and may not provide similar environmental context for streams in particular regions of the state. The underlying assumption of this model is that sites statewide all respond to stressors in a similar way. These differences in characteristics indicate that applying a single ASCI threshold derived from a statewide dataset may not adequately accommodate the distinctly different biological characteristics or goals in other ecoregions. For example, based on the percentiles of reference from each of the six individual ecoregions established in this document, some regions are similar to each other and to the statewide reference percentiles, while others (particularly the Sierra Nevada region) have meaningfully different region-specific thresholds. The lower statewide thresholds relative to the Sierra Nevada region could allow some streams within the Sierra Nevada region to degrade while still being considered “Likely Intact”. Conversely, reference streams within the Desert Modoc region have lower region-specific percentile thresholds, and therefore a stream that would meet the 10th percentile of the Desert Modoc reference pool, would be considered as not meeting the biological expectations of the statewide dataset. Development of regional indices instead of one statewide index should be considered.
3. Table 10 – While the document states that a consistent set of statewide criteria was used to designate “reference, intermediate, and stressed” condition classes from each other (Table 1), there appears to be substantial differences in algal community

condition for these categories across the six regions. For example, the North Coast Region has almost identical proportions of reference, intermediate, and stressed sites in the highest algal condition class (i.e. likely intact), while the Sierra Nevada Region has an inverse relationship of condition class and algal community condition. This

seems somewhat counter-intuitive. In contrast, the Chaparral and South Coast Regions, have what appears to be a more intuitive response of the algal community to its designated condition class, with a lower proportion of stressed and intermediate sites in the "likely intact" category, and a higher proportion of stressed and intermediate sites in the "likely altered" and "very likely altered" categories. It is unclear how a high proportion of "stressed" sites could end up in the highest algal community condition class for the North Coast and Sierra Nevada Regions, and may again highlight the distinct differences inherent among the various designated ecoregions.

4. Page 13, second paragraph under Relationships To Environmental And Stressor Gradients - The finding and rationale for the O/E indices having a low correlation to environmental gradients based on the geographical modelling accounting for some regional variability, seems to contradict the earlier finding that there were no geographical stratifications based on algal assemblages. Sites with similar biological assemblages were intermingled and dispersed across the state.

Clarifications and Questions

5. Page 4, paragraph 1 - Define autoecological traits
6. Page 7, last paragraph – Text states: "For identifying "sensitive" and "tolerant" California taxa as part of this study, we used an Indicator Species Analysis as implemented in the multipatt function in the indicpecies R package (Caceres and Legendre, 2009) and classified sensitive taxa as enriched at reference sites and tolerant taxa as those taxa enriched at stressed sites." By enriched, do you mean more abundant?
7. Page 16, paragraph 2 – ASCI is first mentioned here, and need to be defined. Also, is this term used interchangeable with "hybrid MMI"? This appears to not be the case, as scoring Table S6 has both h_MMI and h_ASCI listed with different scores for the same site.

Document: Eutrophication Indicator Thresholds Protective of Biological Integrity in California Wadeable Streams. (Mazor et al)

Technical Concerns and Issues

1. The abstract notes that "Applying thresholds to a statewide dataset showed that % cover was the most pervasively exceeded threshold (46% of sites), although exceedances of the other organic matter thresholds were common in the urbanized South Coast region (73% of sites), and nutrient exceedances were common in the agricultural Central Valley (67% of sites). Although each threshold was independently validated, sites that exceeded a single threshold were still frequently (i.e., 71%) in good condition (i.e., they met biointegrity goals when measured with all four indices), suggesting a high error rate associated with these thresholds; the frequency dropped to 38% when two thresholds were exceeded. Therefore, consideration of multiple thresholds may be useful to avoid erroneous determinations of eutrophication impacts." This statement and the additional

discussion in the document to support the statement indicates not only that multiple thresholds may be useful, but also that the underlying presumption in the technical work that reducing biostimulatory conditions will improve biointegrity scores in all waterbodies. Lowered biointegrity index scores can be caused by many factors and

the technical work product should acknowledge this fact more clearly and potentially do a similar analysis of other stressors to compare the strength of the biostimulatory relationships.

2. Also, as noted in the manuscript, "Thresholds were validated by assessing the relative risk of failing biointegrity goals when the associated eutrophication threshold was exceeded in both calibration and withheld validation data sets. Relative risk ratios (calculated as the frequency of sites that fall short of biointegrity goals where eutrophication thresholds are exceeded divided by their frequency where eutrophication thresholds are met) greater than 1 were interpreted to mean that the thresholds were valid. Specifically, the lower 95% confidence limit of the ratio needed to be greater than 1 for both calibration and validation data sets." Does this indicate that only slightly more than 50% of the sites could be not meeting the threshold while just under 50% are meeting it and the threshold would be considered valid? This further supports that these relationships should be further examined for use in policy decisions.
3. "The wedge-shaped relationships suggest that other indicators (e.g., habitat degradation, contaminants) may limit biointegrity scores when measurements of eutrophication pressure are low. Although high scores were sometimes observed at sites with high eutrophication pressure, these observations were comparatively rare." The impact of other indicators and stressors should be more fully explored prior to presuming that biostimulatory thresholds can be derived to protect biointegrity scores in all cases, as would be presumed by the development of statewide objectives in this fashion.
4. Consider evaluating a larger range of TN and TP concentrations to determine if any relationships emerge at higher concentrations.
5. Thresholds set for TN, TP, benthic chl-a, AFDM and % cover are very low even for reference locations, particularly for the biomass endpoints. Reference sites sampled in San Diego and Riverside counties frequently have biomass values well above these thresholds. Historical, biomass values observed at Adobe Creek and Cole Creek on the Santa Rosa Plateau Reserve were 30 and 122 mg/m² chlorophyll-a and 7.2 and 2.1 mg/m² AFDM, respectively during their most recent sampling. Sampling at Upper San Jacinto North Fork in eastern Riverside County measured chlorophyll-a and AFDM at 27 mg/m² and 5 mg/m², respectively. Recently, AFDM in Long Canyon Creek in San Diego County was observed at 30 mg/m², and chlorophyll-a measured at Kitchen Creek in San Diego County was 82 mg/m².
6. AFDM and % algal cover mass are not accurate measures of algae biomass in a stream. AFDM is a measure of ALL organic matter in the sample not just algae, including leaf litter, sticks, detritus, and even organisms. In a large number of cases in the South Coast, leaf litter at reference sites can be quite high and will give a false positive for algal biomass. The problematic nature and error potential in these measures is recognized in multiple places throughout this document with statements such as AFDM being subject to "false positives" from non-algal organic matter, and macroalgal % cover being a 2-dimensional measure that can underestimate total biomass. Additionally, both of these measures are affected by external factors such as light availability and overhanging vegetation, independent of water column nutrient concentrations. This same issue is brought up in *Sutula et al. Assessment of Biostimulatory Impacts to Wadeable Streams 10052018*.

From Figure 3 it appears that there is quite a bit of overlap between reference sites and both intermediate and stressed sites for AFDM and especially % algae cover. This again highlights the imprecise measurement and the inherent error in sampling this extremely patchy indicator. This is further indicated by the statement made on Page 11: "Another factor behind the comparatively weak responses to OM gradients may be related to challenges in measuring OM indicators that are patchily distributed across sampling reaches. Fetscher et al. (2009) found relatively poor precision in streams with benthic chl-a values exceeding approximately 50 mg/m². Therefore, a higher density of measuring than is currently done in standard protocols (e.g., Ode et al. 2016a) may be needed to better estimate the potential impacts of OM on biointegrity (Sheath et al. 1986, Wehr and Sheath 2003)". The paragraph beginning at the bottom of Page 13 provides a good rationale for why switching from AFDM to a biomass method that can distinguish between terrestrial and aquatic sources of biomass should be considered. Recommend that AFDM and % algal cover be removed as potential indicators in development of the provisions or at a minimum not be used as a primary line of evidence when evaluating protection of beneficial uses.

7. Methods, Page 6, paragraph 3 – It is unclear if the non-predictive ASCI_H or MMI_H threshold is being used. The Theroux et al paper suggests the MMI_H is the optimal metric, but ASCI_H is used throughout here. Table S6 of the Theroux et al. document has very different percentile reference thresholds for these two metrics that would have very different implications during implementation.
8. The State Water Board established five guiding principles which frame the regulatory approach for the Biostimulatory-Biointegrity Project. One of these is: "There should be statewide consistency with eco-regional flexibility. Statewide consistency is important for equity among stakeholders; however, the State has many different ecosystems, each of which has varying biological characteristics. Therefore, a defensible statewide program must accommodate the unique qualities of each ecoregion."

The basic principle used in deriving TN, TP, and algal biomass-based thresholds is using percentiles of the statewide reference pool (e.g. Ref30, Ref10, etc.). The underlying assumption of this model is that sites statewide all respond to stressors in a similar way. Applying a CSCI threshold of 0.79 (Ref10) to all sites and regions across the state does not adequately accommodate the distinctly different biological characteristics in the southern California ecoregions. When the CSCI was developed, 11 biologically similar groups across the state were identified through cluster analysis of 473 state-wide reference sites. Four of the 11 reference groups identified during the initial CSCI development contain sites that are primarily in southern California (Groups 8 to 11), although these groups do contain a substantial proportion of sites across other areas of the state. These four groups display distinctly different biological characteristics than the remaining 7 groups, which are primarily restricted to central and northern California. These differences are illustrated in the table below. In evaluating the Ref10 percentile CSCI scores of these two reference groups, reveals that they are distinctly different.

Differences Between Northern and Southern California Reference Pool Groups

Groups	Predominant Region	Taxa Richness	Percent Intolerant Taxa	Percent of Regional Reference Sites Below Statewide Ref10 CSCI (0.79)	Range of Group Ref10 Percentile Scores
1 - 7	Northern CA	30 - 43	22 - 36	0 - 6	0.82 – 0.96
8 - 11	Southern CA	15 – 31	6 - 16	9 - 46	0.40 – 0.80

In striving towards statewide consistency in application of a single threshold, the inherent biological differences across the state have been minimized. Using a single Ref10 threshold to derive TN, TP, and algal biomass thresholds for statewide application does not adequately take into account the inherent biological gradients across the state. Using the various regional reference sites to derive percentile values for each region would still maintain a consistent approach statewide, in that they are all using Ref30, Ref10, or otherwise, but would allow the regions to have a more appropriate and applicable standard by which to comply.

9. Results, Page 9, last paragraph – Text states: “Regional models rarely resulted in thresholds that could be validated, with thresholds only meeting validation requirements in data-rich regions, such as the South Coast and the Chaparral. Furthermore, thresholds that could be validated varied very little across regions, nor did they vary much from thresholds established from a statewide dataset...”. This seems to understate the issue and does not provide an adequate rationale against using regional thresholds. Of all of the 6 regions, the South Coast and Chaparral likely have the most in common and happen to be the most data rich for validation, so the fact that the thresholds did not vary much might be expected, compared to other more distinctive regions like the North Coast or Sierra Nevada.

10. Page 10, first paragraph under Comparison Of Derived Eutrophication Thresholds With Reference Distributions And Taxon Specific Changepoints – The exceptions pointed out in this section are worthy of note. It again points towards the amount of error in measures of biomass for estimating the amount of algae at a site. The results presented in Table 6 are troubling in that while only one nutrient (TN) Ref10 threshold is lower than that observed at the various regional reference locations, biomass Ref10 thresholds were lower than regional reference locations on 14 occasions. And all values for % cover at reference locations were above the Ref10 threshold. This was particularly evident for the South Coast region where, as stated in the text, 40% of South Coast reference sites would exceed the derived Ref10 threshold for AFDM. If many of the reference sites within particular regions do not meet the recommended biomass thresholds, municipalities should not be expected to meet these targets in more urbanized areas.

Clarifications and Questions

11. The document is very technical. Make sure technical terms are defined early in the document and that terminology is consistent.
12. Abstract, second sentence – Text states: “Eutrophication is one of the most pervasive stressors impacting streams in much of the world, including California, and can lead to loss of biodiversity or change in natural functions. To protect against these impacts, managers can set targets for environmental indicators related to eutrophication that are likely to maintain high biological integrity.” This needs to be reworded. As written, this assumes that nutrients are either the sole impact or responsible for the vast majority of stress associated with degraded communities. This is good example of a statement with policy implications that should be removed or modified in the document.
13. Introduction, Page 3, paragraph 3 - Text states: “Indicators that assess the degree of organic matter accumulation (OM) in wadeable streams, such as benthic chlorophyll-a (chl-a), benthic ash-free dry mass (AFDM) and percent macroalgal cover (% cover)...”. There seems to be a mixing of terms “organic matter” and “algal biomass” throughout the document. Algal biomass is specific to algae, organic matter is not. The term “organic matter accumulation” is used to describe growths of macroalgal % cover, benthic chl-a, and AFDM. Each of these is a measure of algal growth. The term is confusing because organic matter often refers to non-algal allochthonous debris in a stream.
14. Discussion, page 13, 3rd paragraph – the AFDM values found to be protective of 90th percentile of CSCI and ASCI reference (20 to 37 g/m²), are 10x different from those reported in Table 4 and Supplement 3. The higher values of the two are more realistic.
15. Page 13, first paragraph: “algal indicators of both oxygen-saturated waters and oxygen-depleted waters showed benthic chl-a exhaustion thresholds of...”. This is a bit unclear, be more specific in describing what ‘exhaustion thresholds’ are.

Document: Scientific Bases for Assessment, Prevention, And Management of Biostimulatory Impacts in California Wadeable Streams. (Sutula et al)

Technical Concerns and Issues

1. The pull-out section on Page 4 defines the scope of water bodies under this document. Perennial and non-perennial stream distinctions are not made. A high proportion of streams in the San Diego Region are considered non-perennial, intermittent, or ephemeral. A study published by SCCWRP (SCCWRP, 2012)¹³ identified 73% of streams in the San Diego Region as being non-perennial. The study also stated that nonperennial streams support benthic macroinvertebrate communities that are distinct from those found in perennial streams, and that indices designed to assess the health

of BMI were applicable to these stream-types, as long as they flow long enough for the establishment of all benthic communities. More guidance is needed for intermittent streams that may have variable year-to-year flow periods, and when a stream might be excluded for lack of adequate period of flow for a robust invertebrate or algae

¹³ Raphael D. Mazon, Ken Schiff, Peter R. Ode, and Eric D. Stein. 2012. Final Report on Bioassessment in Nonperennial Streams. Report to the State Water Resources Control Board. SCCWRP Technical Report 695, June.

community to develop. Is it the intent of the board to include non-perennial streams as part of this policy, and if so where along the continuum of non-perenniality does it no longer apply? This also highlights the difficulty in being able to provide comments on these documents without having an idea of where the policy is headed or what options might or might not be under consideration.

2. Page 21, 2nd paragraph - Given that AFDM does not measure algal biomass exclusively, and the relatively poor relationships seen in the Mazor et al technical paper, this indicator might be used as a multiple line of evidence or second tier endpoint. CHN is a much better indicator of stream algal biomass, by being able to distinguish between aquatic and terrestrial sources. Multiple times in this document (and in Mazor et al) it is mentioned how AFDM is prone to false positives and that % macroalgae cover has poor signal to noise ratio. These two measures should be reconsidered as primary endpoints for this policy.
3. Inclusion of DOC and potential THM formation is beyond the scope of this policy. The impacts described are not direct (i.e. increased DOC does not result in a direct impact on human health if someone drank the water). The potential impacts completely depend on the treatment methods for the drinking water supplier and the burden of costs for addressing any potential treatment costs (e.g. the water supplier vs. the discharger) should not be presumed by this policy.

Clarifications and Questions

4. Page iii, Table – the chlorophyll-a value for ASCI Ref10 is reported as 35 in Mazor et al.
5. Page 20, Table 2.3 – What are the strength of measure numbers based upon?

Document: Prioritizing management goals for stream biological integrity within the developed landscape context (Beck et al)

Technical Concerns and Issues

1. Line 145 – Text states: “The model was developed and applied to all streams and rivers in California...” Did the model include highly intermittent or ephemeral streams? If so, how were expectations for those streams derived? If a consistent methodology was applied to all streams, the expectation for highly intermittent or ephemeral streams might be artificially inflated due to the known inherent differences in those biological communities, and how they respond the drying cycle.
2. Sentence beginning on Line 250 - Unless this is referring specifically to the validation sites, isn't this circular reasoning when using CSCI scores to develop the model and then using those same scores to prove the model performance?
3. Sentence beginning on Line 619 – The developed landscape model discussed in this document only takes into account BMI. If the algae MMI is going to be used in a regulatory context of the biostimulatory policy, then a developed landscape model needs to be performed for that as well.

Clarifications and Questions

4. Line 115 – Text states: “This approach is based on the limiting factor theory that proposes the most limiting biotic or abiotic factor as the primary regulator of species abundance and distribution.” Does this mean that only the most important factor was used in modelling, and not the potential for additive stressors?
5. Sentence beginning on Line 221 - Does this mean that the variables used in the model were seen as presence/absence, versus taking into account the magnitude of each stressor? So that a rural site with some lower level of urbanization would be given the same weight as a more urbanized site?
6. Line 245 - Isn't imperviousness one of the 5 landscape gradients used in the model? Why is it single out separately here?
7. Figure 2 - What are the 16 different segment types along the Y-axis? Are there really only 4 segment types, since they seem to be grouped in four identical classes? How were those segment types chosen/binning?
8. Sentence beginning on Line 372 – Why were large rivers across the state commonly classified as possible constrained? Even in undeveloped regions? What factors led to this?
9. Sentence beginning on Line 384 – Text states: “Over-scoring sites were slightly more common in certain regions (i.e., the South Coast and Sierra Nevada Regions)”. Why? It appeared that the South Coast Region had the best r^2 correlation, lowest intercept, and slope closest to 1.0 of all regions.

Document: Development of Benthic Macroinvertebrate and Algal Biological Condition Gradient Models for California Wadeable Streams (Paul et al)

Technical Concerns and Issues

1. The application of the BCG bin narratives to regulated streams is difficult to ascertain from the document. For example, if a site has a BMI (CSCI) score of 0.75, it could fall into BCG bins 3, 4, or 5, and these three bins cover a wide range of biotic condition according to the narratives for each bin. It is unclear how this would be reconciled in a regulatory context. These analyses indicate that a CSCI threshold, such as the 10th percentile of reference (0.79), should not be construed as a bright-line to determine impairment. This exercise demonstrated that sites considered as meeting the same narrative standard of structure and ecological function, could span a wide range of CSCI scores.
2. BCG bin separation was (statistically) pretty good for BMI, while there was much more overlap in ASCI scores between bins (Figure 4).

Clarifications and Questions

3. In the Discussion (p. 20, last paragraph) - “The BCG expert framework exhibited strong correspondence between BCG and CA bioassessment index scores...”. This is a bit of an overstatement for BCG bins 4 and 5, which exhibit a wide range of CSCI scores, and bins 3 and 4 with a wide range of h_ASCI scores.

Document: Approach to Assessment, Prevention and Management of Biostimulatory impacts to California Estuaries, Enclosed Bays, and Inland Waterbodies (Sutula, 2018)

Technical Concerns and Issues

1. Page 41 “To address total “biostimulatory” potential, thresholds should be based on total nutrients (as opposed to dissolved inorganic form) and for both nitrogen and phosphorus, as opposed to just controlling what is considered the limiting nutrient on-site (either nitrogen or phosphorus).” This statement presumes several policy decisions that have not yet been made (i.e. that thresholds for nitrogen and phosphorus will be developed). This should not be an organizing principle, but rather a scientific finding for consideration.
2. Page 33 and 34. The section discussing sources of nutrients should be removed. It is an incomplete discussion focused on only two nutrient sources and is not necessary to support any of the technical discussion in the documents.

Specific Comments on Technical Work Products

Document: A Non-Predictive Algal Index for Complex Environments (Theroux et al)

Editorial Changes

8. Page 10, first paragraph under RESULTS – The total number of sites, statewide percentages of each classification, and greatest/least number of reference sites among regions doesn't seem to match values in Table 10.
9. Page 15, last paragraph – Cannot find Table S5
10. Page 16, paragraph 2 – Text states: “The Sierra Nevada and North Coast regions had the greatest proportion of sites in agreement, with both indices giving high scores.” This sentence as written is awkward. Suggest: “The Sierra Nevada and North Coast regions had the greatest proportion of sites in which both indices indicated “passing” scores (i.e. exceeding the 10th percentile of reference).”
11. Page 16, paragraph 2 – Text states: “Notably, the South Coast and the Chaparral regions had strong agreement between the two indices, even when both indices scored a site below the 10th percentile of reference.” This sentence as written is awkward. Suggest: “Notably, the South Coast and the Chaparral regions had the greatest proportion of sites in which both indices indicated “failing” scores (i.e. below the 10th percentile of reference).”
12. Figure S7 – Four categories are listed in the legend, while five categories are shown in the figure. It appears that the darkest blue designation has no identity.

Document: Eutrophication Indicator Thresholds Protective of Biological Integrity in California Wadeable Streams. (Mazor et al)

Editorial Changes

16. Discussion, paragraph 1 – Text states: “The causal mechanisms for the decline are well documented (Figure 1), including direct effects of nutrients et al. eutrophication drivers on algal species composition (Stevenson 1996, Pan et al. 1996, Stevenson

Ms. Jessie Maxwell

December 7, 2018

Page 20

and Smol 2001), notably enhanced growth and accumulation of filamentous algae (Dodds and Gudder 1992), benthic cyanobacteria (Fetscher et al. 2016), and aquatic plants (Figure 1, e.g. Vitousek et al., 1997; Nijboer & Verdonschot, 2004, Allan 2004, Heiskary and Bouchard 2016), alteration of physical and chemical habitat (e.g. reduction in velocity; Dodds and Biggs 2002, diel DO and pH swings and lowered DO; Mallin et al. 2006, Dodds 2006), and enhanced heterotrophic bacteria biomass (Olapade and Leff 2005, Davis et al. 2010, Suberkropp et al. 2010).” This section is awkward and confusing. Suggest a re-write to clarify.

17. Page 13, second paragraph: “...variability in the algal C:chl-a ratio...”. Suggest spell out: algal carbon to chl-a ratio

Document: Scientific Bases for Assessment, Prevention, And Management of Biostimulatory Impacts in California Wadeable Streams. (Sutula et al)

Editorial Changes

6. Page ii, point 3, first bullet – the second TN should be TP.
7. Page 6, Section 1.2 - Seems like this should be placed prior to section 1.1

Document: Prioritizing management goals for stream biological integrity within the developed landscape context (Beck et al)

Editorial Changes

10. Line 80 – change line to read “urban or agricultural settings can be costly and it may be difficult or impossible to achieve regional reference”.
11. Line 94 – change line to read “index scores and has been associated with in-stream stressors, including, but not limited to excess phosphorus...”
12. Line 108 – change “difficult” to “difficult or impossible”
13. Line 412 – Figure 7 should be Figure 6b
14. Line 413 – Figure 6 should be Figure 6b
4. h_ASCl scores.

The County appreciates the opportunity to provide comments on this important work. If you have any questions or comments on this letter please contact Jo Ann Weber at 858-495-5317 or via e-mail at joann.weber@sdcounty.ca.gov.

Sincerely,

Handwritten signature in blue ink that reads "M. W. Snyder" followed by "FOR" in capital letters.

TODD E. SNYDER, Manager
Watershed Protection Program