State of California
Regional Water Quality Control Board
Central Coast Region

# Scientific Peer Review and Staff Responses to Comments *to support* The Total Maximum Daily Load for Total Phosphorus to Address Cyanobacterial Blooms in Pinto Lake and the TMDL Implementation Plan for the Pinto Lake Catchment

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# 1. PREFACE

California Health and Safety Code section 57004 requires all California Environmental Protection Agency organizations to submit for external scientific review the scientific basis and scientific portion of all proposed policies, plans and regulations. The peer reviewer's responsibility is to determine whether the scientific findings, conclusions, and assumptions are based upon sound scientific knowledge, methods, and practices.

The University of California facilitated peer reviewer selection. The detailed step-by-step guidance for setting up and obtaining reviews appears in an Interagency Agreement between the California Environmental Protection Agency and the University of California (see Exhibit F of the guidance document). A January 7, 2009 Supplement to the Guidelines, in part, provides guidance to ensure confidentiality of the process. No person may serve as an external scientific peer reviewer if that person participated in the development of the scientific basis or scientific portion of the proposed rule, regulation, or policy.

Three individuals were selected to review this document for scientific adequacy:

Dr. Frank M. Wilhelm, Ph.D. – Department of Fish and Wildlife Services, College of Natural Resources, University of Idaho;
Dr. Dale M. Robertson, Research Hydrologist, U.S. Geological Survey, Upper Midwest Water Science Center; and
Dr. Thomas Johengen, Ph.D., Cooperative Institute for Great Lakes Research, School for Environment and Sustainability, University of Michigan.

These researchers collectively have substantial research experience in water quality, nutrient pollution, hydrology, and aquatic habitat.

The California Health and Safety Code states that if the external scientific peer reviewers find that a State agency failed to demonstrate that the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices, the reviewer's report shall state that finding, and the reasons explaining the finding .

Central Coast Regional Water Quality Control Board staff (Water Board staff) asked the reviewers to comment on whether the scientific portions of the Total Maximum Daily Load (TMDL) report and implementation plan are based upon sound scientific knowledge, methods, and practices. Specifically, the reviewers were asked to comment on four specific areas related to the documents:
1) Whether our use of water quality data and our use of published water quality criteria to derive a water quality approach for attaining water quality adequate for the protection of human health, aquatic habitat, and wildlife fundamentally is sound and scientifically defensible;
2) Whether the methodologies, data, and assumptions used, and conclusions made in identifying probable source categories and pollutant loads contributing to nutrient loading to Pinto Lake is fundamentally sound and scientifically defensible;

3) Whether the scientific and technical basis of the proposed TMDLs and allocations fundamentally are sound and technically defensible; and
4) Whether the technical basis of the proposed implementation strategy and timeline to achieve the loading capacity of Pinto Lake is fundamentally sound and scientifically defensible.
5) Reviewers were also asked to contemplate the broader perspective by commenting on any additional scientific issues related to the scientific basis of the TMDL project and to comment on whether - taken as a whole - the proposed TMDL project is based upon sound scientific knowledge, methods, and practices.

We reproduced the peer review comments herein based the dates provided on the three comment letters received; the comment letter with the earliest date is reproduced herein first, the comment letter with the latest date is reproduced herein third.

The Central Coast Regional Water Quality Control Board appreciates the thorough reviews provided by these referees. Their comments and insight have prompted us to clarify and improve technical information in TMDL and Implementation reports in several areas, as described in this document.

Format used for staff response to comments:
In the following sections of this document, we reproduce direct and unmodified transcriptions of the comments from each reviewer and insert staff responses using ***bold, blue italic text***.

# 2. PEER REVIEW COMMENTS OF FRANK M. WILHELM, Ph.D.

## 2.1. Water Quality Data Analysis and Water Quality Numeric Targets

Overall, it is my judgement that sound scientific knowledge, methods, and practices were applied and that the assumptions, findings, and conclusion for this component of the work are justified on that basis. I make this statement in the spirit of the TMDL process that encourages the process not to be held up by the lack of complete data and knowledge (see Text Box 1-4 p 14). The authors make use of local, regional and national datasets to provide the best numeric interpretation for narrative standards in the Basin Plan and these are summarized in Table 3-2; some developed from data and summaries presented in Section 2. Of particular note is the use of 0.172 mg/L for background total phosphorus (TP) as identified in the Ambient Water Quality Criteria, Recommendations, Lakes and Reservoirs in Nutrient Ecoregion III USPEA (2001) and summarized in Table 2-12 (p51) in the Draft Report. In Table 2-12, this value was flagged with the footnote of:

“U.S. Environmental Protection Agency states that this value appears inordinately high and may either be a statistical anomaly or reflect a unique condition. In any case, further regional investigation is indicated to determine the sources, i.e., measurement error, notational error, statistical anomaly, naturally enriched conditions, or cultural impacts. However, also worth noting is that the Central Coast Ambient Monitoring Program

emphasizes the fact that naturally high background levels of phosphorus are generally found in some parts of the California central coast region."

This need for further investigation is not addressed any further in the TMDL material presented and the value is used throughout. Given it forms the crux of the ultimate load assignment for TP to Pinto Lake (summer lake volume * 0.172 = 476 lbs. of TP including a MOS this is reduced to 450 lbs. TP/yr. – Table 7-2 p246), it deserves further investigation across the region by the Water Board and should be a priority, as this informs all target TP loads in lakes of the central coast region. The board may consider using inferential methods such as water quality reconstructions based on paleolimnological analysis of phytoplankton assemblages via transfer functions from undisturbed sediment cores (e.g., Smol 2019). Alternatively, the board could consider a sampling campaign across the region to identify springs and sample TP at their emergence; although this has a host of other assumptions associated with it. I would identify the uncertainly associated with the value of 0.172 as extremely high and would recommend using an envelope of values (mostly lower) to examine TP load reduction ranges. This is especially important because a TP value of 172 ug/L would cause Pinto Lake to continue to be classified as eutrophic from a nutrient perspective (see further discussion in Big Picture (a) comments).

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments validating the general appropriateness and scientific validity of the water quality data analysis and water quality numeric targets presented in the TMDL project report. Concerning the comment on the proposed total phosphorus numeric targets, we will take these comments, as well as the comments of peer reviewer Dr. Johengen into consideration and make modifications to the TMDL Report. This includes allowing for the possibility of basing loading targets on the bioavailable fraction of phosphorus, aka orthophosphate, consistent with the guidance from Dr. Johengen, or evaluating an envelope of values (mostly lower) to examine TP load reduction ranges.***

Of interest too to this reviewer is the use of 0.8 µg/L as the concentration for microcystin toxins for recreational contact. In this case the OEHHA number is used, while for drinking water the USEPA value of 0.3 µg/L is used for infants and per-school aged children. Why this mix of state and National criteria? Especially in light of the fact that the USEPA guidelines for recreational contact were relaxed this spring (2019) from 4.0 to 8.0 ug/L based on recent additional evaluations and adjustments for likely ingestion while recreating. Thus, the concentration used as contact limit for Pinto Lake and CA lakes is 10× more stringent than the national criteria. This is likely to cause confusion among the public and the rationale should be explained in more detail in the report and future public meetings. It may also impose undue hardship on the economically challenged population around the Pinto Lake catchment to reduce microcystin concentrations to 0.8 µg/L in CA when other states follow the national guidelines. If a concentration of 8.0 µg/L was used, then Pinto Lake may be achieving delisting status

given the success of TP reductions from sediment-released P with the recent (2017) addition of alum. This should be given further consideration. Note; use of the OEHHA standard may be a CA law with which this reviewer is unfamiliar; if so, it should be cited in Table 3-2.

***Staff responses to comments***
***The Central Coast Water Board's Basin Plan designates multiple beneficial uses for Pinto Lake. Pinto Lake is on the USEPA approved 303(d) List of Impaired Waters for microcystins due to exceedances of evaluation guidelines for both Municipal and Domestic Supply and Water Contact Recreation uses. At this time, we are highlighting OEHAA's 0.8 µg/L public notice threshold and the USEPA drinking water threshold as the most protective and appropriate water quality management objectives to support all of the lakes beneficial uses.***

***Regarding use of the OEHHA 0.8 µg/L threshold for recreational beneficial uses, it is important to note the context and water quality goals. OEHHA's 0.8 µg/L and USEPA's 8.0 ug/L guideline threshold represent different levels of risk and different water quality management goals, to some extent.***

***OEHAA provided a range of microcystin thresholds based on levels of acceptable risk. This range of risk-based thresholds is characterized as ranging from a cautionary threshold, to a warning threshold, to a danger threshold. OEHHA's 0.8 µg/L is the lowest threshold, and represents a cautionary public-notification threshold. Unlike the USEPA 8.0 ug/L guideline, OEHHA's 0.8 µg/L does not preclude swimming; it is not a "no swimming allowed" guidance value. The guidance for this cautionary threshold states that swimming is allowed, but the public is urged to stay away from floating algae and scum in the water. Therefore, this represents a different level of risk management that the USEPA 8.0 ug/L "no swimming allowed" threshold. We chose OEHHA's 0.8 µg/L threshold as a conservative and protective water quality threshold to implement state water quality standards, and to imbue this TMDL with conservative assumptions which serve to support the implicit margin of safety USEPA requires in TMDL development.***

***Further, using the USEPA "no swimming" microcystin numeric target of 8.0 ug/L would arguably undermine the state's antidegradation goals as this level of microcystin is almost undoubtedly much higher than historic microcystin levels at the lake through the 1970s and 1980s. This could conceivably require us to make a finding allowing degradation to occur at the lake.***

***Regarding use of the USEPAs 0.3 µg/L threshold for municipal and domestic water supply beneficial uses, the risks to humans who may consume water from Pinto lake warrants a more stringent threshold that that needed to for recreational uses.***

***With that said, we recognize that there are different levels of risk and different microcystin numeric thresholds associated with those risks found in federal and state guidance. We recognize the threshold we identify are among the most conservative and stringent of those water quality management risk objectives for each of Pinto Lake's designated beneficial uses. At this time, we maintain the numeric thresholds identified in the TMDL are appropriate. TMDLs and water quality management goals are always subject to revision, as harmful cyanobacteria blooms are an area of active scientific research and policy development.***

The water quality data analysis section was huge and nearly intractable. While it is clear that the authors assembled a large data set, it is also clear that key elements were missing and should be considered going forward, especially during implementation so that gains made with different implementation phases can be quantified. For example, no hydrographs (for streams or the lake) were presented. Are streams and the lake gaged? If not, some effort should be made to obtain stage-discharge curves and deploy level loggers to obtain continuous flow data. This is the stuff of under-or graduate student theses and can be obtained for relatively little cost. A regular monitoring program in which strategic sites are sampled on a regular basis should be established to avoid data gaps. Some key figures I expected, such as Chl a as a function of bottom TP and microcystin as a function of Chl a were also missing.

***Staff responses to comments***
***In this preliminary draft TMDL Report, we defaulted to including most of the substantial volume of data, data presentations, and analyses we generated during TMDL development. We felt it would be preferable over the long run to omit information if needed than to generate new information. In our final draft TMDL we will omit data analysis that are of only marginal importance to the overarching goals and objectives of the TMDL, if time allows.***

***Concerning the comment on stream flow data, unfortunately there are no gages streams, no hydrographs, and no flow data for the small creeks entering Pinto Lake. These streams are typically dry and during stormwater runoff events, when loading is taking place, the flashy nature of those flows prevents field crews from conducting flow measurements. Therefore, this kind of data was not available for TMDL development. Based on this comment, we will add a narrative to the Implementation Plan articulating that some effort should be made to obtain stage-discharge curves and deploy level loggers to obtain continuous flow data, and that furthermore, this is kind of information is ripe for under-or graduate student theses and can be obtained for relatively little cost.***

***Regarding the reviewers expectation for an analysis (key figures) showing the chlorophyll a concentrations as a function of lake bottom phosphorus, and microcystin concentration as a function of chlorophyll a concentrations, we agree***

***these would be informative and will endeavor to create these graphs for future evaluation of the implementation plans success.***

In section 5 the authors used a well-documented and rationalized approach to identify the water quality targets for Pinto Lake.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments validating the general appropriateness of our approach to identifying relevant water quality targets for Pinto Lake.***

### 2.2. Source Analysis

With respect to conclusion 2, it is my judgement that methodologies, data, and assumptions used, and conclusions made in identifying probable source categories and pollutant loads contributing nutrient loading to Pinto Lake are fundamentally sound and scientifically defensible. The authors used the EPA endorsed STEPL model, a watershed-scale water quality spreadsheet tool to estimate watershed pollutant loads for nutrients (e.g., Nandi et al. 2002). Use of this tool, while relatively simple, required a series of parameters which are given in Table 6-1 p226. Output form the model is then summarized for each source in Table 6-18 p 242. What was disappointing was the lack of any error (variation) estimates – each source is assigned a single number without a ± making the estimates appear as certainties. While scientific uncertainty is addressed early in the Draft Report, it would be good to have some estimate of variation for the data presented in Table 6-18. As well, some discussion to which parameters the STEPL model is most sensitive would also not be out of place as the tendency will be to take single numbers as absolute.

Clearly, internal loading at 1900 lbs/year represents over 60% of the annual TP load to Pinto Lake. However, it is not clear how much of this load is actually bioavailable because it is loaded into the hypolimnion and is out of the photic zone, and thus the reach of phytoplankton – unless it is entrained across the thermocline. Future work should focus on quantifying this to ensure that no undue emphasis is placed on curbing sediment-release P to the detriment of another source that could be just as, or more important because it delivers its load into the epilimnion.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments validating the fundamentally sound and scientifically defensible approach we used and conclusions we reached concerning source analysis. If time permits, we will consider adding additional information to the report variation estimates to the source loads, and will more clearly articulate that that the source load estimate values are not certainties, and are subject to significant uncertainties.***

***We appreciate the insight concerning how much of the internal load is actually bioavailable. The commenter notes that it is loaded into the hypolimnion and is out of the photic zone, and thus the reach of phytoplankton – unless it is entrained across the thermocline. Based on the comment we will include, in the Implementation Plan, guidance suggesting future work which focuses on quantifying this to ensure that no undue emphasis is placed on curbing sediment-release phosphorus to the detriment of another source that could be just as, or more important because it delivers its load into the epilimnion.***

### 2.3. TMDLs and Allocations

In my initial response I indicated that I was not comfortable evaluating this section because I fundamentally disagreed with expressing the load as an allowable annualized load rather than a daily load – the essence of TMDL. This is based on the following scenario: If a Lake is determined to have a capacity of 365 units of P – that load can be reach in two extreme ways – 1) receive 1 unit each day for each of 365 days, or 2) receive 0 units on 364 days and 365 units on one day. I'm certain that the phytoplankton community responses in the lake would vary widely, the latter probably producing a bloom. The authors state that an allowable annual load is appropriate 'because the growth of phytoplankton and macrophytes responds to changes in annual rather than daily loadings of nutrients" (p 248 bottom). I believe the authors present data and narrative in the Draft Report that directly contradicts this statement and assumption. For example, there is repeated narrative that cyanobacteria blooms develop in response to increased P accumulation in the water column from the sediments; that chl a decreases in response to reduced P availability over the course of the year e.g., Figure 4-44. While I respect that daily monitoring is onerous and costly, other TMDLs of which I am aware have used a seasonal approach, e.g., limit P input to nearshore areas to 9 lbs or less during the summer (Jun-Sep) growth period. A similar approach could be used here.

***Staff responses to comments***
***Concerning the comment on daily loads, we will modify the TMDL so that it reflects a daily load expression. Towards that end, we provide below a relevant examples from the USEPA-approved TMDLs developed by State of New York as a precedent to follow:***

> ***"The maximum annual phosphorus load (i.e., the annual TMDL) that will maintain compliance with the phosphorus water quality goal of 20 µg/L in Silver Lake is a mean annual load of 1,650 lbs/yr. The daily TMDL of 4.5 lbs/day was calculated by dividing the annual load by the number of days in a year." State of New York (2010)***
> ***"The maximum annual phosphorus load (i.e., the annual TMDL) that will maintain compliance with the phosphorus water quality goal of 20 µg/L in the South basin of Chautauqua Lake is a mean annual load of 11,243.4 lbs/yr. The daily TMDL of 22.8 lbs/day in the North basin and 30.8 lbs/day in the South basin was calculated by dividing the annual load by the number of days in a year." State of New York (2012)***

***We appreciate and have considered the comments regarding a seasonal – and perhaps nearshore – approach to phosphorus loading and water quality response. However, at this time we maintain that an appropriate water quality management objective is to limit phosphorus loading on an annualized and daily basis; and not to limit allowable phosphorus loads to a seasonal basis, i.e. June to October.***

***We have considered the comment on an approach to phosphorus loading to nearshore areas. In terms of internal loading we are generally concerned with phosphorus-rich sediment accumulation occurring below the epilimnion (in deeper parts of the lake below the thermocline). Therefore, we maintain that an approach focusing on phosphorus loads to nearshore areas would not adequately address stakeholders' or the Central Coast Water Board's water quality management goals.***

***Sediment deposition and accumulation in the lake bottom during wet season runoff and high flow events serve as a sink where phosphorus can be stored. Even non-bioavailable phosphorus discharged to and accumulating in the lake during the rainy season or during high flow event can become bioavailable over time due to phosphorus cycling, i.e., when phosphorus bound to particulate and organic matter become bioavailable upon decay or release. We provide supporting information for this contention below.***

> ***"While orthophosphate is the biologically available form of phosphorus, it does not account for phosphorus in organic matter or bound to inorganic particulates, which can be biologically available upon decay or release."***
> ***From - scientific peer review guidance provided in 2012 to the Central Coast Water Board by Dr. Marc W. Beutel, Ph.D., Washington State University Department of Civil and Environmental Engineering (CCRWQCB, 2013)***
>
> ***"It is important to note that, in particular, phosphorus loads from headwater reaches which ultimately may be released from sediments when reduction-oxidation conditions changes may be a consequence of decades of natural loads that have nothing to do with current activities."***
> ***From - personal communication, Dr. Marc Los Huertos, Professor of Environmental Analysis, Pomona College, formerly of California State University-Monterey Bay, (Oct. 17, 2011).***

***Due to California's Mediterranean climate, most flow, runoff, sediment, and particulate phosphorus inputs to the lake are expected to occur outside the June-Sept timeframe. Phosphorus-rich sediment has accumulated on the bottom of Pinto Lake over the course of many years due to erosion, storm events, and runoff. These events frequently happen outside the Summer and early Fall season in California.***

*Many resource professionals around the world have recognized the efficacy of limiting phosphorus loading to lakes associated with the rainy season and runoff events. We support this contention with supplemental information below. This supplemental information reports that runoff, precipitation events, and long-term nutrient input to lakes over periods of years can result in the accumulation of phosphorus storage in lake bottom sediment which can be subsequently released to the water column. This appears to suggest control of phosphorus loading to lakes over the long term, on annualized time frames, and with consideration to runoff and wet weather conditions, should inform water quality management strategies.*

> *"Study ties phosphorus loading in lakes to extreme precipitation events: Previous research had found that waterways receive most of their annual phosphorus load in only a dozen or two events each year, reports Steve Carpenter, director emeritus of the University of Wisconsin-Madison's Center for Limnology and lead author of a new paper published online in the journal Limnology and Oceanography. The paper ties those phosphorus pulses to extreme rain events. In fact, Carpenter says, the bigger the rainstorm, the more phosphorus is flushed downstream. Carpenter and his colleagues used daily records of stream discharge to measure the amount of phosphorus running into Lake Mendota in Madison, Wisconsin, from two of its main tributaries."*
> *From - National Science Foundation Research News (2018).*

> *"Internal loading is the release of stored nutrients from bed sediments to the water column…Sources of nutrient loading during this time period might have included discharges from [point sources], discharges from storm drains, and surface runoff from undeveloped areas…. Sediments within all three lakes have likely accumulated nutrients from these sources over time. Nutrients stored in sediments can be released into the water column by multiple processes including anoxic conditions, wind perturbation, and the movement of fish and macroinvertebrates. Internal loading from bed sediments is the most significant source of nutrients to Elizabeth Lake and Lake Hughes."*
> *From - Los Angeles Regional Water Quality Control Board (2016).*

> *"Phosphorus in any lake or in any stream at the point where it enters the lake should not exceed 0.05 mg/l. The excessive phosphorus levels during very wet years and very high inflow periods need to be lowered for reduction in algal blooms and improvement in water quality, as well as for reduction in DO level depressions in the lake and supplies of nutrients to macrophytes."*
> *From - University of Illinois State Water Survey Division (1982).*

***Wrapping up, we maintain that limiting watershed sediment and phosphorus inputs on an annualized and daily basis, including during the wet season when flows are high, is appropriate and is an important TMDL water quality management goal to prevent the build-up and accumulation of phosphorus-rich sediment to the lake bottom over long duration time frames. It is noteworthy that stakeholders have actively been constructing sediment control structures around Pinto Lake with the express purpose of capturing wet season and high-flow sediment and phosphorus discharges before it can reach Pinto Lake.***

### 2.4. Implementation Strategy

It is my judgement that the technical basis of the proposed implementation strategy and timeline to achieve the loading capacity of Pinto Lake are fundamentally sound and scientifically defensible. Having stated this, there are some qualifications. Those actions directly controlled by law, e.g., Agricultural Order, Industrial General Permit, and MS4 stormwater discharge entities which require waste allocation plans will have highly structured timelines and targets. However, other load allocations will depend on voluntary compliance or the acquisition of grant funding before they will be implemented. The region's designation as a disadvantaged community, and the focus on environmental justice should continue to allow access to grants to move implementation forward. It would have been good to have stated a review timeline of the TMDL, as well as provide more details of the county's sampling program (Section 4.8 p 16/17), map with sites and frequency of sampling and constituents monitored at each site to assure that coverage will be adequate to allow evaluation using criteria given in Box 4-2 p 11.

Obviously, some implementation has already occurred and been successful, such as the sediment/run-off diversion and the in-lake alum application to reduce the sediment-released P. It should be noted that given the limited section 319 funds, the lake was only partially treated with alum, and did not receive the full dose to achieve the 90% desired reduction identified in Table 7-4 of the Draft Report. To achieve the full 90% reduction will require a future application at significant expense. I suggest a plausible alternative below in the Big Picture question.

***Staff responses to comments***
***Staff appreciates the comments that the Implementation Plan is "fundamentally sound and scientifically defensible." We agree and recognize that voluntary compliance and grant acquisitions may play substantial roles in restoring Pinto Lake and the associated catchment. We will add a recommendation to the Implementation Plan regarding the need for planning and grant acquisition to support continued maintenance and future application of the alum treatment.***

***At this time, we are aware of significant stakeholder buy-in, which include voluntary efforts and grant acquisition occurring in the watershed, allowing for some measure of confidence that these types of implementation practices will be effective. Concerning the comment on the county's sampling program, we will***

***make note in the Implementation Plan that future reviews, updates, or revisions to this TMDL should provide more details of the county's sampling program, map with sites, and frequency of sampling and constituents monitored at each site to assure that coverage will be adequate to allow evaluation.***

***We are addressing the comment concerning a plausible alternative to alum application in the section below.***

### 2.5. Big Picture Questions

As mentioned above, the authors have used a value of 0.172 mg/L of P as the basis for achieving water quality criteria with respect to phosphorus in Pinto Lake. This equates to 172 µg of P/L and will maintain the lake firmly in a eutrophic state as Carlson (1977) and Carlson and Simpson (1996) indicate eutrophy at TP concentrations >48 µg P/L. These authors also suggest that cyanobacteria may dominate lakes with TP concentrations in the range of 48 to 96 µg/L, which is far below the 172 µg/L proposed. Thus, while it is this reviewer's opinion that the addition of Alum to alleviate internal loading from the sediment is a viable path forward for the short-term, the State Water Board should not be surprised if blooms of cyanobacteria persist. What has not been considered, is the ratio of TN:TP as this is often at the root of blooms of cyanobacteria and was highlighted by Stanfield (2013) in the data considered for the development of the TMDL. There are two ways to rebalance the N:P ratio; one is the approach taken to-date to focus on reducing phosphorus. Given that the reduction in phosphorus as proposed will not return Pinto Lake across a trophic boundary – i.e., it will remain classified as eutrophic; the other method to rebalance the N:P ratio is to add N. Yes, you read this correctly – add N to solve a nutrient problem. The logic is as follows: by adding N and rebalancing the N:P ratio, the competitive advantage of diazotrophic phytoplankton (nitrogen fixers) is removed, allowing green algae to outcompete cyanobacteria given the N:P ratios are replete. Green algae and picoplankton are highly grazable by zooplankton and thus allow carbon to flow through the food web instead of being bottlenecked by accumulating in inedible cyanobacteria. Harris et al. (2014) successfully demonstrated this approach in large enclosures in eutrophic Willow Creek Reservoir in Oregon. After N additions, the abundance of toxin-producing species of cyanobacteria declined rapidly

***Staff responses to comments***
***Central Coast Water Board staff will take into consideration, and make modifications as necessary, the comments on the USEPA ecoregional reference criteria 0.17 mg/L phosphorus threshold. Concerning the comment on rebalancing the N:P ratio by adding nitrogen, we will add this information to the future studies section of the Implementation Plan, as a possible lake management measure which could be considered, and which might be a plausible alternative to another expensive alum application.***

# 3. PEER REVIEW COMMENTS OF DALE M. ROBERTSON, PH.D.

## 3.1. Water quality data analysis and Water quality numeric targets.

One of the major problems I have with the way that the TMDL for phosphorus was developed for Pinto Lake is that the criteria that was used for phosphorus, which was 0.172 mg/L (also the value described for dissolved orthophosphorus concentration of 0.06 mg/L). This total phosphorus concentration, which was identified by the US EPA for this ecoregion, was qualified by the US EPA with "it appears inordinately high and may either be a statistical anomaly or reflect a unique condition". This concentration (and that for orthophosphorus) were based on the 25th percentile of the data in the US EPA database, and may have been driven by water quality measured in one lake in the ecoregion – possibly Pinto Lake itself back in the 1990s (I found this after looking at the original US EPA publication which was not cited in this study; https://www.epa.gov/sites/production/files/documents/lakes3.pdf). This concentration is extremely high, and if it was maintained in the lake, it would result in hypereutrophic conditions with no reduction in cyanobacteria blooms. Therefore, the authors should find a concentration that makes sense and base the TMDL on that value (and an appropriate value for orthophosphorus). If the mean dissolved orthophosphorus concentration was 0.06 mg/L, this would mean that phosphorus is not limiting the productivity in the lake. The results of the 2012 National Lakes Assessment (Table 2-13) had a maximum total phosphorus concentration of 0.040 mg/L from 18 other measured lakes in the ecoregion. This should have made the authors question the value they were using.

Another problem I have with the TMDL, if the EPA's 0.172 mg/L TP concentration was correct for ecoregion, is that given the measured data from Pinto Lake in Table 4-6, it appears that the current TP concentration in the lake is less than that value already. Based on all the data at the Pinto Lake Dock prior to 2016, the median TP concentration is 0.118 mg/L and the mean is 0.154 mg/L. So, why does the phosphorus loading have to be reduced? If the answer is to get the secondary factors to reasonable values, then the original 0.172 mg/L criterion is not correct.

***Staff responses to comments***

***We will take this comment into consideration, and make modifications if necessary, concerning the comments on the USEPA ecoregion III-6 reference criteria of 0.17 mg/L phosphorus threshold. Worth noting is that this ecoregion reference criteria is not outside the boundaries of reported national phosphorus water quality criteria developed for lakes and reservoirs (USEPA webpage for State Development of Numeric Criteria for Nitrogen and Phosphorus). The USEPA ecoregion III-6 reference criteria is indeed within the high-end of national total phosphorus criteria for lakes and reservoirs, falling between the 90th (0.1 mg/L TP) and 95th percentile (0.25 mg/L) of all reported national total phosphorus lake and reservoir criteria.***

***It should also be noted that this TMDL project uses a multiple lines of evidence approach for assessing progress towards later quality management goals. These include the use of water quality criteria for chlorophyll a, microcystin, and***

***dissolved oxygen. While reductions in total phosphorus should lead to improvements in these other water quality parameters and ultimately removing Pinto Lake from the Clean Water Act section 303(d) List for these parameters.***

Specific Concerns:
Water quality standards:
1. Some of the values in the water quality objectives do not make sense: 0.172 mg/L for TP, 10 mg/L of nitrite (I think this would kill anything that got this).

***Staff responses to comments***
***See staff comments above, concerning the comments on the USEPA ecoregion III-6 reference criteria 0.17 mg/L phosphorus threshold.***

***Central Coast Water Board staff include the 10 mg/L threshold for nitrate because it is appropriate for protection of the municipal and domestic supply beneficial use (the drinking water objective). Pinto Lake is designated for municipal and domestic water supply, and this TMDL project identifies all relevant numeric water quality thresholds to support all designated beneficial uses for the lake. In this TMDL project, we have not identified a numeric threshold for nitrogen to protect aquatic habitat, as this TMDL focuses on phosphorus reductions to reduce the frequency and toxicity of harmful cyanobacteria blooms. Our understanding is that nitrogen water quality criteria and reductions are not generally identified as a critical water quality management objective in reducing cyanobacteria blooms in lakes. The research we considered appeared to overwhelmingly indicate that phosphorus reductions in lakes should be the focus water quality management strategies to reduce harmful cyanobacteria blooms.***

2. “Dissolved oxygen concentrations shall not be reduced below 7.0 mg/L at any time”, will probably be impossible given the summer water temperatures and the saturation of dissolved oxygen.

***Staff responses to comments***
***Pinto Lake is also designated as spawning habitat and as such, Water Board staff include the 7.0 mg/L dissolved oxygen objective for Spawning Habitats.***

3. Antidegradation – if this is important, it should be discussed with respect to the water quality in Pinto Lake in 2017.

***Staff responses to comments***
***Antidegradation generally applies to constituents that are currently at acceptable levels and therefore when beneficial uses are currently supported. Thus, as a lake management goal, lowering (degrading) of water quality on the basis of these constituents or beneficial uses should be not occur, unless consistent with the***

***provisions of the state Antidegradation Policy. Since the alum treatment in 2017, water quality data under consideration generally focuses on water quality impairments (microcystin, phosphorus).This is not so much an issue related to Antidegradation Policy, but rather represents an attempt to manage the lake to restore impaired beneficial uses and document that restoration with water quality data showing improvement.***

4. Somewhere in the Report, it should be stated that Pinto Lake has several designated uses. The designated use that is used to drive the TMDL should be the one that is the most stringent because it should protect all the other designated uses.

***Staff responses to comments***
***Central Coast Water Board staff agree that the most stringent beneficial use should be supported and that will have the consequence of supporting other designated beneficial uses of the lake. As such, this TMDL project establishes loads, allocations, and numeric targets that are protective of human health and aquatic habitat (thereby including the most stringent beneficial use.***

Water quality data analysis
1. This section is just a download of everything that the authors found with very little interpretation. Here are a few suggestions:
a. Only describe the data from sites that have sufficient information to describe either seasonal variability in the lake or long-term trends.
b. To describe spatial variability, the data have to all come from the same time period otherwise you may be comparing one value in late summer with an annual average.
c. Given the size of the lake, detailed spatial data are probably not really needed.
d. To describe long term trends adequate years of data are needed. I would concentrate on developing long term data sets at a limited number of key sites.
e. Limit the number of plots of the data. Maybe for just one for the tributaries (one for each constituent) and one for the lake (one for each constituent), right now there are at least 34 plots….
f. Trend analysis. Trend analysis should not be done for all sites (Table 4-10). Most of this is simply meaningless. Only sites that have several years of data should have been included in this table (basically two sites).
g. Why are data shown only included up to 2015? Data after the alum treatment in 2017 totally changed the water quality of the lake and would be very useful. Without the data after 2017, it appears that the TMDL is being developed for a lake that no longer exists.

***Staff responses to comments***
***We will take these comments into consideration, and make revisions as appropriate. In this preliminary draft TMDL Report, we defaulted to including most of the substantial volume of data, data presentations, and analyses we generated during TMDL development. We felt it would be preferable over the long run to omit information if needed than to generate new information. If time allows, we***

***will omit data analysis that are of only marginal importance to the overarching goals and objectives of the TMDL.***

***Regarding the comment about data through 2015, the data analysis was based on data collected through 2015 because the draft TMDL Report was mostly complete by 2017; at that time Central Coast Water Board staff were re-directed to work on other priorities, deferring the TMDL to a later date. As a matter of resource allocation, we decided against investing further effort into data collection and analysis when we circled back to the TMDL in 2019 but staff did include data provided by the City of Watsonville for references (see Section 7.1 and Figure 7.1 in the TMDL Report).***

***It is worth nothing that by their nature, data analysis efforts associated with Basin Plan amendment TMDL projects are often a few years out of date by the time they are brought to the Central Coast Water Board and USEPA for approval. This is a result of the time and resources needed to address both the technical needs of a TMDL and the administrative protocols and requirements needed in developing an approvable Basin Plan amendment. These data in this TMDL being four to five years out of date by the time it is ready for Central Coast Water Board approval is undoubtedly a time lag we wish we could avoid, but it is not completely out of the temporal lag and nature of other complex Basin Plan amendment TMDLs.***

***Central Coast Water Board staff agree that data collected after the alum treatment is very important, and the Implementation Plan recognizes that ongoing data acquisition and analysis will be a critical part of TMDL implementation.***

### 3.2. Source Analysis

Source analysis is the process of quantifying all the phosphorus supplied to the lake. The authors did make an attempt at doing this, but they did not collect any data to confirm the approach that they used.

Specific Concerns:

1. STEPL is notorious for over-estimating downstream loading unless instream decay is carefully incorporated. I think it is important to have a gaged station to confirm the total loading from STEPL makes sense.
2. All septic systems fail for retaining nutrients. Bacteria cannot breakdown phosphorus, so unless they are pumped out, they all fail.
3. In this write up, it makes it sound that wetlands only remove phosphorus. In reality, older wetlands can be a major source of phosphorus. Several of studies have shown this.
4. Even though this analysis has shown internal loading is the dominant source of phosphorus to Pinto Lake, estimating internal lake loading of phosphorus from incubated sediment core can significantly underestimate internal phosphorus in shallow lakes because of wind mixing and fish activities, so it may even be more important than stated.

***Staff responses to comments***
***We appreciate these insights. Concerning the comment about collecting additional data to confirm our source analysis method, ideally it would be preferable to have more data. USEPA expects TMDLs to be developed on the basis of existing information, and there is no requirement to acquire new data to support development of TMDLs. Given more resources and time, we agree that it would be useful to have more data to validate our source analysis methodology.***

***Concerning the comments on STEPL, we provide narrative in the TMDL Report concerning significant uncertainties associated with STEPL's ability to estimate loading. Worth noting here is there is some expert disagreement on the efficacy of this load estimation tool. For example, two scientific peer reviewers herein indicated that our use of STEPL for load estimates was reasonable, in general. One peer reviewer highlighted the limitations and substantial uncertainties that may result from STEPL load estimates.***

***Concerning the comment on over-estimation of sources by STEPL when instream decay is not incorporated we attempted to account for instream decay based on guidance from the TetraTech STEPL helpdesk (TetraTech STEPL helpdesk, 2014, email communication dated October 31, 2014). To that end, we attempted to appropriately apply the sediment delivery ratio as calculated in STEPL according to guidance from the TetraTech STEPL helpdesk. Sediment yield depends on gross erosion in the watershed and on the transport of eroded material out of the watershed. Only part of the material eroded from upland areas in a watershed is carried out of the watershed (USDA-NRCS, 1983). STEPL provides an opportunity to treat nested catchments as part of one single watershed, applying an appropriate sediment delivery ratio. In effect, this attenuates pollutants as they move through the nested catchments, lowering the total amount of phosphorus, nitrogen, and sediment calculated as the load exported from the whole watershed. We will nonetheless caveat our source load estimates with the caution that significant overestimation is a possibility.***

***Regarding the comment on gaged stations, unfortunately there are no stream gaging stations on the small, intermittent tributaries which flow into Pinto Lake. We will add a narrative to the Implementation Plan articulating the need for these data.***

***Concerning the comment that septic systems fail to retain nutrients because bacteria cannot breakdown phosphorus, we revisited the STEPL model and applied a septic system failure rate of 100 percent for phosphorus to evaluate the results. Applying a 100 percent failure rate increased the estimated annual phosphorus watershed load to the lake by over 400 percent – from about 1,100 pounds per year to over 6,000 pounds per year. We deem this to be unreasonable and implausible for the following reasons:***

- ***Applying a 100 percent septic failure rate for phosphorus to the watershed yield (lbs./acre/year) of phosphorus in the Pinto Lake catchment would be about 4.3 pounds phosphorus lbs./acre/year. In a recent nutrient TMDL for the larger Pajaro River basin (including the Pinto Lake catchment and 36 subwatersheds in the basin), the average phosphorus yield was 0.6 lbs./acre/year, with a range of 0.2 to 1.4 pounds per year.***

- ***Central Coast Water Board staff acknowledge that phosphorus in septic systems is loaded to the watershed. The question is how much of that is delivered to the lake. Because phosphorus readily binds to sediment, and some phosphorus may be lost to deeper aquifers which are not in hydrologic communication with shallow groundwater and the lake, only a fraction of the phosphorus is loaded to the lake. We therefore assume the septic system failure rate for phosphorus we identified in our STEPL spreadsheet model is a plausible proxy for the amount of phosphorus from septic systems which is actually loaded to the lake.***

***Consequently, we did not change the septic system failure rate for phosphorus in our STEPL spreadsheet. This does not change the fact that septic systems may completely fail at containing phosphorus.***

***Regarding the comment on internal loading, we will identify opportunities to articulate in the TMDL Report, uncertainties about the scope of the internal load. In the context of our scientific peer review, one of our peer reviewers has stated that internal loads may be underestimated while another of our peer reviewers has stated that the internal flux rate is generally supported by a mass balance calculation.***

***Concerning the comment on wetlands, we will add narrative to the TMDL Report clarifying that there is uncertainty and expert disagreement about our assertions of negligible loading from wetlands. We will note that one of our peer reviewers noted that older wetlands can be a source of phosphorus, while a second peer reviewers noted that, in general our assumption of zero contribution from wetlands is reasonable. Both peer reviewers indicated that there are localized hydrologic and environmental conditions in which wetlands can be net contributors of nutrients. It is merited to highlight these uncertainties in the TMDL Report.***

### 3.3. TMDLs and Allocations

A major problem I have with this TMDL and the allocations that were made was that even if the 0.172 mg/L TP concentration was appropriate, the approach used to determine the allowable incoming phosphorus load makes no scientific sense. The authors used a “volumetric analysis” that is never described (see page 246). In essence what I think the authors did was simply divide the desired concentration in the lake (0.172 mg/L) by its volume. This is not how lakes work. If this was a plausible approach,

then the total phosphorus concentration in the lake in 2015 would have been 0.844 mg/L (based on stakeholder derived annual loads) or 2.482 mg/L (based on the annual loading of phosphorus in this TMDL). The appropriate way is to use eutrophication models to see how the TP loading is translated into inlake TP concentrations. Many of the eutrophication models are relatively simple and easy to use. See for example Vollenweider, Canfield-Bachman models or a little more sophisticated BATHTUB models. These models have been extensively used in developing TMDLs in Wisconsin lakes (https://dnr.wi.gov/topic/TMDLs/ especially see: https://dnr.wi.gov/topic/TMDLs/documents/UFW/USGSWinnebagoPoolModeling.pdf , or in lakes in other states: https://www.pca.state.mn.us/sites/default/files/tmdl-medicinelake-bathtubmodeling-0309.pdf or https://www.pca.state.mn.us/sites/default/files/wq-iw1-10.pdf).

All of these Reports describe how these type of models can be used to determine required phosphorus load reductions. This is what the authors stated: “In light of the forgoing information, we maintain the recent and substantial improvements in TMDL water quality goals at Pinto Lake render the need for time and resource intensive water quality modeling unnecessary based on current lake conditions. This is consistent with USEPA guidance previously highlighted in Text Box 7-1.” Without actual water quality models, there is no way to determine the load reductions needed for Pinto Lake to get the desired inlake water quality and resulting conditions in the secondary variables.

Another major problem I have with this TMDL is that even if the 0.172 mg/L TP concentration was appropriate and the determined desired phosphorus load made sense, comparing the percent required reduction from this TMDL with the Stakeholder derived load reduction in which their percentages were just pulled out of the air and then say that the “the reasonably good agreement between the loading capacity and load reduction estimates nonetheless adds a measure of confidence that stakeholder-derived water quality management objectives for phosphorus should result in substantial water quality improvement and reductions in the frequency of cyanobacteria blooms” makes no sense.

***Staff responses to comments***
***We appreciate the insights, and we will supplement the total maximum daily load analysis using suggested water quality modeling which use secondary factors such as chlorophyll, Secchi depth, and cyanobacteria concentrations to define allowable phosphorus loading. We updated the TMDL Report using the outputs from the California NNE BATHTUB spreadsheet model for assessing water quality response to nutrient loading.***

***Concerning the comment on the proposed total phosphorus numeric targets, we will take these comments, as well as the comments of peer reviewer Dr. Johengen into consideration. The draft proposed USPEA ecoregion III-6 water reference criteria of 0.17 mg/L total phosphorus would fall in a range at about the average***

***total phosphorus concentration in the lake up until 2015. We recognize 0.17 mg/L could reasonably seen as a relatively high concentration for a water quality goal.***

***The Central Coast Water Board staff determined the USEPA ecoregion III-6 reference criteria of 0.17 mg/L are appropriate for this watershed and Pinto lake after considering the following:***

- ***The Pinto Lake catchment generally has soils which are substantially more enriched in phosphorus and discussed this in tables and figures of Section 2.12 of the TMDL Report.***
- ***The ecoregion III-6 reference criteria of 0.17 mg/L total phosphorus is within the boundaries of reported national phosphorus water quality criteria developed for lakes and reservoirs (USEPA webpage for State Development of Numeric Criteria for Nitrogen and Phosphorus). Specifically, falling between the 90th (0.1 mg/L) and 95th percentile (0.25 mg/L) of all reported national total phosphorus lake and reservoir criteria.***
- ***This TMDL project uses a multiple lines of evidence approach for assessing progress towards water quality management goals. This includes evaluating water quality data in the context of the water quality criteria for chlorophyll a, microcystin, and dissolved oxygen. Reductions in total phosphorus should lead to improvements in these other water quality parameters and ultimately removing Pinto Lake from the Clean Water Act section 303(d) List for these parameters.***

***Because of uncertainties concerning this threshold, we note here that the total phosphorus TMDL and water quality management goals are always subject to revision and updating as harmful cyanobacteria blooms are an area of active scientific research and policy development.***

Specific Concerns:
1. This section really should be the main section of a TMDL and yet it seems to be skimmed over (especially after the background was about 100 pages longs). I think more detail should be provided, especially for the stakeholder information.
2. I agree that phosphorus control is the answer to solving most of the problems in Pinto Lake, but not for many of the reasons provided in Section 7.1 First P is not limiting in this lake given the high DOP concentrations. Based on the data prior to 2015, almost all of the phosphorus in the lake is in dissolved forms (I am not sure I believe the results shown in the tables). But I don't think N is limiting either. The idea in reducing phosphorus loading is to make phosphorus limiting, and the way to do that is to reduce phosphorus inputs even if they are not currently limiting productivity in the lake.
3. I looked for the stake-holder derived current loading and target phosphorus loading but I could not find this information in the references. But their reductions seem to be based on "let's see what kind of reductions we think we can get"… rather than any modeling analysis.
4. See my General Comments on concerns over volumetric analysis and the comments on the Draft.

5. Why mention Linkage analysis, when there is none? This is where some type of eutrophication model is needed to link loading to inlake phosphorus concentrations to secondary inlake constituents. Without modeling or analyses of the inlake data, there is no way to know how the secondary factors will respond to changes in phosphorus loading.
6. The final sentence in this section reads: “For loading estimation, our lake volumetric analysis is based on a digital lake polygon that comports reasonably well with areal lake extent for late summer conditions. Therefore, our volumetric analysis should reasonably approximate a critical condition, when lake levels, water volume, and loading capacity are near their annual minimum.” makes no sense. This is not how lakes work.

***Staff responses to comments***
***We appreciate the insights, and we will modify the TMDL analysis using suggested water quality modeling (the California NNE BATHTUB spreadsheet model) which uses secondary factors such as chlorophyll, Secchi depth, and cyanobacteria concentrations to define allowable phosphorus loading.***

***Concerning the comment on phosphorus control, we agree that goal of reducing phosphorus loading is to make phosphorus limiting, and the way to do that is to reduce phosphorus inputs. Alum treatment has already proven to greatly improve bloom severity and duration and is evidence that phosphorus control is a viable solution for Pinto Lake.***

### 3.4. Implementation Strategy

The major problems I have with the Implementation of this TMDL is that: 1) it really does not provide any specific plans on how external loading will be reduced, it simply says there are rules out there for each of the sources that if they were followed would make everything OK, 2) it does not discuss anything about the longevity of the alum treatment, and 3) it does not really talk about how the load reductions will be documented. Therefore, I really don’t see external loading to the lake changing in the future and once the alum no longer limits phosphorus release from internal loading, all of the water quality problems in the lake will gradually return. If actions are actually taken in the watershed to reduce phosphorus loading, somehow tributary loading needs to be documented.

Specific Concerns:
1. It would be nice have this written in a more concise manner. Many things are repeated several times.
2. It should be noted that given the extensive problems with the TMDL itself, I limited my review of the Implementation plan.
3. There is very little actual guidance provided in this “Implementation Report”. Specifics really should be provided rather than saying how to reduce phosphorus losses from each of the sources should be described elsewhere. Without additional actions, I don’t think phosphorus inputs will be reduced. It is stated in several places that this TMDL is not proposing the adoption of additional regulatory requirements. If this is the case, I do

not see the external phosphorus loading decreasing and the loads set in the TMDL being reached.
4. In many places it sounds like water quality data are being collected to assess the magnitude of external loading. If this is to be done, a stream gage has to be installed upstream of the lake and water quality at that site needs to be systematically documented.
5. Climate change considerations. To simply say climate change should be considered doesn't say very much. To actually address climate change would require some information to be known on runoff volumes and actually use that information in the TMDL.
6. Success stories. It is obvious that the alum treatment in Pinto Lake was a huge success. But this management strategy really needs to be incorporated into the current TMDL and its longevity needs to be evaluated. Without really reducing external loading, high internal loading will return, which will drive high internal loading, and the return of all of the other water quality issues. Also, it is important to continue to use binding agents that cannot release phosphorus if the sediments go anoxic or the pH increases.
7. Success stories. One thing that happens to a lake following in-column phosphorus reductions is excessive weed growth. This should be addressed. In a few of the studies I have been involved with, the community bought weed harvesters before the weeds even appeared.

***Staff responses to comments***
***Regarding the comment on conciseness, we will look for opportunities to economize this report. In this preliminary draft Implementation Plan, we defaulted to including as much information as possible. We felt it would be preferable over the long run to omit information if needed than to generate new information. In our final draft TMDL we will omit repetitive data and economize the report where needed, if time allows.***

***Regarding the comment on the lack of detailed guidance on specific actions in the Implementation Plan, we will review the plan and add detail if necessary. That being said, we have received guidance from management at State Water Resources Control Board that TMDL Reports are intended as planning documents; a TMDL is not a permit. The Implementation Plan should be appropriate for a planning document (personal communication, Jonathan Bishop Deputy Director and Philip Wyels, Assistant Chief Counsel State Water Resources Control Board, 2014). Permit-scale details about specific actions to be taken are generally reserved for permits, grant applications, enforcement actions, etc. We are not proposing additional regulatory action be taken, because we are relying on current permits, updates or revisions to current permits, local enforcement agencies, and grant funding to implement the TMDL.***

***Concerning the comment about stream gages, unfortunately there are no gaged streams, no hydrographs, and no flow data for the small creeks entering Pinto Lake. Therefore, this kind of data was not available for TMDL development. Based***

***on this comment, we will add a narrative to the Implementation Plan articulating that some effort should be made to obtain gaged stream flow data.***

***Regarding the comment on climate change considerations, we currently do not have any localized data about runoff volumes, or specific localized data allowing us to identify specific actions to mitigate climate change. We were unable to ascertain from the comment how runoff volumes would inform us about climate change response, thought presumably it is reference to change precipitation patterns and timing. The climate change research and modeling for California at this time focuses on regional analyses, rendering the opportunity for finer-scaled climate change data and information sparse to non-existent. The State Water Resource Control Board's most recent guidance provided to the regional boards primarily focuses on efforts to identify modeling data and studies which will help inform us at local-scale conditions moving forward.***

***Concerning the comment on success stories, we will add information as appropriate to the Implementation Plan regarding the alum treatment program and its longevity be evaluated. We will add information on the importance of continuing to use binding agents that cannot release phosphorus if the sediments go anoxic or the pH increases, and to address excessive weed growth that can occur following water column phosphorus reductions.***

### 3.5. The Big Picture

The timing and purpose of this TMDL seems unusual to me. First, the timing of the Report…. This TMDL was started in 2015 when the lake clearly had water quality issues. But, at present (as of February 2018), it appears that the water quality in Pinto Lake does meet all of its criteria for its beneficial uses (Figure 7-1). In essence, it appears all of the necessary actions (at least the most important one needed) may have already been implemented. So, is there a purpose for a TMDL? I think the main purpose for a TMDL for Pinto Lake is to describe how to keep the water quality in the lake similar to that measured in 2017-18 (basically antidegradation)?

***Staff responses to comments***
***Central Coast Water Board staff agree that the timing of this TMDL is unusual considering that many phosphorus loading control projects have been implemented since 2015 and as previously mentioned we will revise the Implementation Plan to articulate the importance of ongoing maintenance of the alum treatments and watershed phosphorus loading to the lake to maintain and improve upon the 2017-2018 water quality.***

***Concerning the comment on the purpose for this TMDL, we cited of the following rationale for the development of this TMDL:***

1. ***Regulatory requirement to develop TMDLs under Clean Water Act section 303(d)(2).***

2. ***Regulatory requirement to develop TMDLs under Clean Water Act section 303(d)(3).***
3. ***Identification of water quality management goals, including necessity of establishing acceptable water quality thresholds for phosphorus, microcystin, chlorophyll a.***
4. ***Establish a total load (TMDL) necessary to achieve identified water quality management objectives, establishment of waste load allocations and load allocations for identified pollutant sources.***
5. ***Assess nonpoint source pollution in the watershed to support the management goal of preventing long-term continuing accumulation of sediment-rich phosphorus in the lake bed after the alum treatment.***
6. ***Establishing an administrative basis to allow for additional Clean Water Act section 319(h) grant funding opportunities in the future.***
7. ***Articulating an antidegradation water quality management goal for waterbodies in the Pinto Lake catchment (e.g., tributary streams, ditches, groundwater bodies) which have water quality that is currently better than existing standards.***
8. ***Developing an implementation plan which identifies the regulatory tools, voluntary compliance measures, sources of funding, and ongoing monitoring needed to ensure the TMDL is implemented and progress towards improving or protecting existing water quality is reasonably assured.***

***It is worth noting that the Clean Water Act requires states to develop TMDLs all waterbodies and pollutants that are suitable for such calculations. TMDLs are not just limited to impaired waterbodies. "Cleanup" TMDLs, pursuant to Clean Water Act section 303(d)(2) are developed generally for waterbodies on the 303(d) List. "Informational" TMDLs are developed pursuant to Clean Water Act section 303(d)(3) which states the following:***

> ***"For the specific purpose of developing information, each State shall identify all waters within its boundaries which it has not identified under paragraph (1)(A) and (1)(B) of this subsection and estimate for such waters the total maximum daily load with seasonal variations and margins of safety, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculation and for thermal discharges, at a level that would assure protection and propagation of a balanced indigenous population of fish, shellfish and wildlife."***

***These Clean Water Act requirements justify developing this TMDL even in lieu of the fact we are currently seeing significant water quality improvements as a result of the alum treatment.***

In order to determine the "proper" phosphorus loading to base a TMDL on for Pinto Lake would be to develop response models for the secondary factors (chlorophyll, Secchi depth, and cyanobacteria concentrations. This requires that desired values for

each of the secondary factors are first defined. Then use those values in the models to define the phosphorus loading. There are many other TMDLs that have been published that provide a systematic approach in doing this. Without these models, there is no way do determine what the phosphorus load should be. Without a defined meaningful phosphorus load, proper allocations are not possible.

***Staff responses to comments***
***Central Coast Water Board staff appreciate these insights, and will incorporate analysis of nutrient loading using suggested water quality modeling tool (California NNE BATHTUB spreadsheet model) that uses secondary factors such as chlorophyll, Secchi depth, and cyanobacteria concentrations to define allowable phosphorus loading. This additional analysis is reflected in the TMDL Report and proposed Basin Plan amendment.***

# 4. PEER REVIEW COMMENTS OF THOMAS JOHENGEN, PH.D.

## 4.1. The Big Picture

Water quality standards applied for this TMDL appropriately address the State's requirement to develop a basin plan to meet the over-arching goals of protecting all beneficial uses of Pinto Lake, setting water quality objectives, and addressing antidegradation policies. The plan is aimed at controlling the amount of phosphorus input to the lake to address the primary concern of human exposure to cyanotoxins during recreational contact. Additional water quality objectives were established for other water quality parameters that represent a direct biostimulatory response to excess nutrient availability including algal abundance as estimated by chlorophyll-a, and low dissolved oxygen which results from the remineralization of the excessive algal biomass upon senescence. The beneficial uses that were identified most at risk and intended for restoration or protection include: contact and non-contact recreational use, aquatic habitat conditions supportive of wildlife, fish, vegetation, and invertebrates, including potential commercial or recreational consumption, potential use a municipal or domestic water supply, and use of waters for agricultural supply related to farming, horticulture and ranching.

The TMDL plan is consistent and complimentary to the established 2014 303d listed impairments and the Implementation Strategy builds largely from efforts initiated in response to this impairment listing. This process helped to assure that all regulatory and non-regulatory elements for monitoring and controlling pollutant loads within the catchment were considered. In developing the TMDL the CCWB staff assembled and evaluating over a decade worth of monitoring data. Appropriate monitoring data was obtained to the fullest extent possible to address all of the identified sources of nutrient loading within the catchment. Load allocations were computed using an accepted and previously applied watershed analysis model, STEPL. While large uncertainties in loading rates can occur using these modeling tools, the application of this load estimation approach seems appropriate under consideration of time, effort, resources, and available data. The data used in the model were appropriate and subjected to

quality control checks as possible. Default model parameters when used were evaluated in the context of larger regional or national level comparisons to ensure reasonable approximations.

The TMDL recognized that successful implementation of the load allocation management plans must involve the local land-owners and stakeholders within the catchment. To this end, a component of the TMDL includes flexibility in how, when, and where to best apply control practices in non-regulatory situations. The TMDL appropriately consider the issue of environmental justice and recognized that the population impacted by beneficial use impairments within the affected area was xxx. Finally, the plan addressed the requirements of the State's anti-degradation policy and recognized that continuous monitoring should be conducted as management actions are applied in order to confirm progress and ensure that any previous high water quality conditions are not made worse.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's "Big Picture" global comments validating:***

- ***The appropriateness of the water quality standards applied in this TMDL project;***
- ***How the nature of the water quality problem was characterized;***
- ***How monitoring data appropriately obtained and used to the fullest extent possible to address all of the identified sources of nutrient loading within the catchment;***
- ***The appropriate use of the watershed analysis model STEPL to estimate loading and establish load allocations; and***
- ***How the TMDL appropriately addressed environmental justice and antidegradation issues.***

### 4.2. Water Quality Data Analysis and Water Quality Numeric Targets

A TMDL is being established pursuant to the Clean Water Act requirements to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The defined water quality standards within the TMDL are intended to protect human health and ensure all beneficial use designations are being met. The Basin Plan established water quality objectives and numeric thresholds for cyanotoxins, biostimulatory nutrients and associated water quality conditions. The relationship between excessive nutrient input, especially dissolved phosphorus, and the stimulation of harmful cyanobacterial blooms is recognized worldwide and justifies the approach undertaken for this TMDL. The cyanotoxin numeric threshold of 0.8 ug/L is appropriate for the protection of direct exposure during recreational activity and agricultural irrigation and the more stringent EPA guideline of 0.3 ug/L is an appropriate target to ensure the lake could be used as a drinking water source that might serve infants. However, the plan does not consider the possibility of the accumulation of toxin in fruits and vegetables that use irrigation water containing cyanotoxins. A recent study by Lee et al (2017) demonstrated that toxins

associated with irrigation water (at test concentrations of between 1 and 10 ug/L) accumulated in both the soil and the edible portion of food crops. So in addition to human exposure during the application there can be risk in the transfer of toxins to food crop itself.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments validating the appropriateness of the cyanotoxin numeric thresholds identified in the TMDL Report to protect designated beneficial uses including recreation, agriculture, and drinking water.***

***Concerning the reviewer's insights about irrigation water containing cyanotoxins, the TMDL Report recognizes this water quality problem and provides context and guidance on numeric thresholds to assess this risk. Section 1.5 of the TMDL Report provides narrative information about the nature of this risk, as reproduced below:***

> ***"Pinto Lake used to be an irrigation source for food crops. Growers were forced to abandon the use of lake water and drill wells to tap into a deep aquifer because of threats to food and worker safety posed by the (cyanobacteria) toxins."***
> ***- Letter from California Legislature Assemblymen Luis Alejo and Mark Stone, and State Senator William Monning to State Water Resources Control Board Chair Felicia Marcus, dated October 4, 2013***
> ***-Parenthetical clarification added by Central Coast Water Board staff.***

***Central Coast Water Board staff provided photographic documentation (Figure 3-2, TMDL Report) illustrating an irrigation supply pipe, unused and abandoned due to risks to food safety and worker safety associated with Pinto Lake cyanotoxins.***

***Lastly, we provided guidance on microcystin numeric thresholds that may be used to asses impairments of the designated irrigation supply beneficial use of Pinto Lake waters.***

Due to the ecophysiological behavior of Microcystis blooms to form dense surface accumulations (scums) under quiescent lake conditions, it is possible to accumulate significantly elevated concentrations of chlorophyll and toxins. These conditions represent the highest risk of toxin exposure to wildlife, animals, and humans so are important to understand. However, it is equally important to understand that they represent an accumulation of algal biomass and not necessarily a volumetric representation of lake water conditions. To that point it is possible to generate very high concentrations which are orders of magnitude higher than normal during conditions when cells tend to accumulate on the surface (noted in tails of Box Whisker plots Fig. 4-19 to 4-21). It is important therefore to understand exactly how surface samples are

collected and to account for any unintended bias when analyzing spatial and temporal trends.

Water quality data encompassing Pinto Lake and associated ditches and tributaries within the catchment was accumulated from the City of Watsonville, Santa Cruz County, and researchers at USCS and SCU Monterey Bay. Additional groundwater data was obtained through USGS and the State's GeoTracker database. These data were quality control checked and filtered to improv representativeness and consistency for both statistical analysis and model application.

***Staff responses to comments***
***Time permitting, we will add guidance in the TMDL implementation plan highlighting the importance of adequate documentation on how surface water samples are collected to account for any unintended bias which may result from wind or hydraulic-driven accumulation conditions, more so than an accurate spatial representation of existing water quality.***

[TMDL Report Section] 4.2. Statistical Summary of Surface Water Quality Data: Numerical summaries of the available surface water quality data were compiled to examine both spatial and temporal trends, variation in range, and central tendency. A significant portion of the results for both the Lake and its tributaries exceeded basin plan standards for total nitrogen, ammonia, total phosphorus, dissolved phosphorus. Within the Lake chlorophyll exceeded the 15 ug/l target between 33 – 58% of the time covering over 600 samples and microcystin exceeded the 0.8 ug/l criterion between 0-24% of the time covering almost 800 samples. The lower frequency in part relates to the seasonal nature of cyanobacterial blooms and the timing of when samples are collected.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 4.3. Surface Water Quality Spatial Trends: Water quality data was spatially presented to examine whether there were specific locations where degraded water quality was occurring. Results were fairly indiscriminate but indicate that nutrient concentrations in the tributaries and ditches were relatively low which becomes very important for the latter consideration of nonpoint source watershed loading control versus controlling internal nutrient loading. Data also pointed to propensity for chlorophyll and microcystin to accumulate the most at the Pinto Lake Dock. This likely reflects circulation and hydrology more than variation in source inputs.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments, and the insight regarding the probable hydrologic effects resulting in elevated microcystin accumulation at Pinto Lake dock.***

[TMDL Report Section] 4.4 Temporal Trends: Many of the analyses for temporal trends presented in Tables 4-10 through 4-16 are uninformative given very limited timeframes, limited numbers of samples, and an undefined sampling strategy. Furthermore it is difficult to evaluate how microcystin concentrations are changing in Pinto Lake because the timeframes and sample numbers vary so greatly across the six monitoring sites summarized in Table 4-16. Would data from Pinto Lake Dock show a similar increasing trend as observed at the County Dock and Villa del Paraiso if the only using similar time periods?

***Staff responses to comments***
***Time permitting, we will modify the aforementioned sections to address reviewers' comments herein concerning timeframes and temporal trends.***

[TMDL Report Section] 4.5 Seasonal Trends: Seasonal patterns in water quality conditions reflect both differences in loading due to meteorological conditions and well as pattern of biological assimilation and production. Fig 4-37 shows a clear trend of hypolimnetic buildup of PO4 and subsequent dilution as water column overturn mixes build up into whole water column. Again these data point to importance of understanding the contribution of internal loading. Trends show very high surface PO4 concentrations and high assimilation rates (seasonal declines), consistent with accumulation of cyanobacterial biomass. It would be helpful to conduct further research or data analysis to understand how much of the iternal load is being utilized by the seasonal bloom. Would also be useful to understand how much of seasonal input seen in fall (Oct and Nov) at Pinto Lake Dock was due to input from hypolimnion during over-turn versus external loading. The timing of high NO3 concentrations appears several months before PO4 increase in the Lake. This suggests and external source for the NO3. The observed increase in chlorophyll (roughly 0.5 ug/L/d in summer) at Pinto Lake Dock is consistent with assimilation rate of PO4 (roughly 1 ugP/L/d which is stoichiometrically equivalent to about 0.8 ug CHL/L/d) again confirming the strong relationship and need to focus on phosphorus control in the TMDL.

Microcystin concentrations in Pinto Lake (fig. 4-45, 46, 47, 48, 49, 50) exhibit highly spatial variability. It is difficult to assess whether the spatial patterns are at all related to variability in nutrient inputs or more likely reflect hydrological and meteorological processes and stability of water column. The monitoring data confirm expected patterns of seasonal accumulation of cyanobacteria and toxins related to their thermal preferences and water-column stability preferences. Accumulations occurred from June through October but persistent through November at some sites like Pinto Lake Dock. It is possible that localized build-up earlier in the season at Eucalyptus Grove and Villa del Paraiso may be related to local tributary inputs or sources of the bloom coming from the tributaries themselves which may warm earlier.

It would have been helpful to see actual temperature data for surface and bottom from the buoy to help understand the exact timing and extent of stratification and later fall overturn. Fig 4-22 clearly demonstrates a hypolimnetic accumulation of PO4. Mass

balance checks extrapolating accumulation rate (roughly 7 ug/L/d) yield a 'sediment flux' rate of around 35 mg/m2/d. This agrees well with the Ketley et al 2013 report where they estimated about 200kg per month which if extrapolated to about 50% of the lake bottom (which is deep enough to stratify) yields a flux rate of about 31 mg/m2/day. It is important to consider that this input into surface waters during fall overturn does not completely correspond to the active summer seasonal growth period. But the magnitude of the input has major implications for ultimately reducing P concentrations in the lake without controlling for this internal recycling.

***Staff responses to comments***
***We will add a narrative to the TMDL Report highlighting a potential need for further study to understanding the contribution of internal loading; to understand how much of seasonal input seen in fall (Oct and Nov) at Pinto Lake Dock was due to input from hypolimnion during over-turn versus external loading. We appreciate the reviewer's independent mass balance validation that the sediment flux estimated in the Ketley et al., 2013 report appears reasonable.***

[TMDL Report Section] 4.8. Groundwater: Data summaries of the upgradient groundwater indicated low nitrate and phosphate concentrations appear to confirm the lack of need to assess any specific water quality impairments.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 4.10. Water Quality Standards Attainment Assessment: Depending on physical scale and the potential for hydrologic isolation, which are not large in the case of Pinto Lake, it is prudent to apply a conservative approach of assuming that if an impairment is identified in a portion of a waterbody that it is applied to the whole waterbody. On the basis of the hydrography and monitoring data that protocol is warranted in the case of Pinto Lake. The focus of this TMDL is to direct watershed management actions to reduce phosphorus loads to Pinto Lake with the goal of reducing the frequency and toxicity of cyanobacterial blooms, and the anticipated improvement in secondary biostimulatory problems such as dissolved oxygen concentrations. The accumulated data are robust enough to demonstrate that beneficial use impairments exist in: (1) Drinking Water Supply on the basis on both nitrate and microcystin concentrations; (2) Aquatic Habitat Use on the basis of excessive chlorophyll and un-ionized ammonia concentrations; (3) Recreational Uses including water contact on the basis of microcystin and chlorophyll concentrations and (4) Wildlife Habitat on the basis of microcystin and chlorophyll concentrations. While the impairments are often seasonal in nature and spatially variable they appear to be persistent across years and in several cases increasing in severity.

***Staff responses to comments***

***Central Coast Water Board staff appreciates the reviewer's comments, which validate the TMDL Report conclusions concerning water quality impairments of several designated beneficial uses.***

[TMDL Report Section] 4.12. Problem Statement: Cyanobacteria blooms, associated toxicity, and water quality degradation have been documented problems in Pinto Lake for many years. The strong relationship between phosphorus and toxic cyanobacteria blooms suggests that management efforts should focus on reducing water column phosphorus availability as a primary goal. This summary statement is robustly supported in the scientific literature with examples shown world–wide of biostimulatory water quality degradation as a result of nutrient enrichment with a particular emphasis on phosphorus. Statistical models using local monitoring data further indict this relationship.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments, which validate the TMDL Report statements concerning the strong relationship between phosphorus and toxic cyanobacteria blooms.***

[TMDL Report Section] 5.1. Primary Target for Microcystin to support recreational uses: The Basin Plan for microcystin utilizes a narrative toxicity water quality objective that states that waters shall be free of toxins at levels which produce detrimental physiological responses in humans, plants, animals and aquatic life. On the basis of the California Office of Environmental Health Hazzard Assessment suggested public health actions levels, the TMDL establishes a numeric target of 0.8 ug/L for microcystin. Due to a lack of scientific data the actions level is also assumed to be protective for livestock and wildlife.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 5.2. Secondary Target for Microcystin to support potential domestic and municipal water supply: The Basin Plan designation of Pinto Lake as a potential drinking water supply has led to the TMDL recommendation for an even more stringent numeric target for microcystin levels at 0.3 ug/L on the basis of current USEPA Drinking Water Health Advisory recommendations for infants.

Currently in the Great Lakes, where the water is used as public drinking water supply, there is no established numeric target for microcystin but public water utilities have optimized their treatment processes for removing microcystin to below detection level in the final distribution product. This level of treatment and required monitoring throughout the system has resulted in significant increased costs to the water treatment plants. Moreover the economic cost of having toxins break-through the treatment system can

be in the millions of dollars, not to mention the harm to the public trust. To that end a similar approach is being led to reduce agricultural based phosphorus loads to the lake, but it is currently being done under a voluntary approach. In the case of western Lake Erie the current recommended phosphorus load is 40% from a reference baseline in 2008.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 5.3. Target for Nitrate for potential domestic and municipal water supply: The Basin Plan uses a health-based numeric objective of 10 mg/L and is applied in the TMDL to protect the potential drinking water beneficial use.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 5.4. Target for Un-ionized Ammonia: On the basis of its toxicity, ammonia is prescribed at a numeric water quality objective of less than 0.025 mg/L within the Basin Plan and is adopted in the TMDL at this target.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 5.5. Targets for Biostimulatory substances of Phosphorus and Nitrogen: It is widely and uniformly accepted in the scientific literature that the primary driver of harmful algal blooms is excessive nutrient loading. While other environmental factors contribute to the timing and location of where blooms are prominent, the goal of any management plan has to address nutrient inputs in order to meet water quality objectives and protect beneficial uses. Numeric targets for nitrogen and phosphorus are established as guidelines and not regulatory criterion. The Basin Plan sets the guideline for Total P not to exceed 0.172 mg/L and for Total N not to exceed 0.51 mg/L.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 5.6. Targets for Nutrient Response Indicators: The USEPA and the State of California recognize the importance that nutrient criteria should not be defined solely on the basis of nitrogen and phosphorus concentrations but also include consideration of the biological or water quality responses to those nutrient inputs. Instantaneous measurements of nutrient concentration are an indirect indicator of potential biostimulatory conditions and exceedance of water quality conditions may only occur after dissolved nutrients have been reduced to low levels in response to biologic

uptake and growth. Response indicators are therefore often a more definitive indicator of excessive nutrient input. To ensure that basin water does not show biostimulatory conditions, the TMDL includes numeric targets for dissolved oxygen and chlorophyll-a. These biological response variables are critical for supporting aquatic habitat beneficial uses, and can create additional feedback loops to recycle significant amounts of nutrients internally when bottom water becomes hypoxic and loading rates of organic matter to the sediment are high. The numeric target for DO was set to not fall below 5.0 mg/L for Warm beneficial uses and 7.0 mg/L for spawning beneficial uses. Additionally DO concentration should not exceed 13 mg/L which would be indicative of super-saturation conditions owing to high rates of photosynthesis.

On the basis of published literature and comparisons of State management plans a numeric target for chlorophyll was established to not exceed 15 ug/L in order to meet the Basin Plan biostimulatory substances water quality objective.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments in support of identifying numeric targets for biostimulatory responses to nutrient enrichment in Pinto Lake.***

### 4.3. Source Analysis

The TMDL report thoroughly identified and quantified all of the known nutrient source loads within the Pinto Lake Watershed based on available monitoring data and the application of a suitably selected watershed extrapolation tool, the STEPL model. While it was acknowledged that the STEPL output are subject to significant uncertainty, the required level of inputs, the simple structure of the model, and its previously demonstrated TMDL applications make it an appropriate load estimation tool on the basis of time, cost, and effort. The model's ability to estimate relative proportions and magnitudes of loading from various source inputs should be of sufficient quality to guide the TMDL allocations and confirm assumptions based on surface water quality modeling. Analyzed load contributions included: Urban and residential runoff, Industrial facility runoff, Cropland runoff, Grazing Land runoff, Septic System failure potential, Undeveloped land runoff, Wetlands, Shallow groundwater inflow, Direct Atmospheric Deposition, and internal loading from sedimentary fluxes. Sources of input data and parameterization data for STEPL model, presented in Table 6-1, have been thoughtfully consider and appear appropriate to the evaluation.

The complexity of understanding and quantifying the amounts and timing of all sources of nutrient inputs, along with the associated water quality responses requires significant monitoring efforts and analysis of watershed processes. The report has thoughtfully compiled surface water quality data from a variety of sources including monitoring efforts led by the City of Watsonville, the County of Santa Cruz and academic researchers. There are obvious challenges evaluating the representativeness of 'secondarily-reported' data collected from disparate sources. However, the report authors applied an appropriate level of data quality control and filtering to the various

sources of data before inclusion in a final data set for statistical analysis. The report presented appropriate statistical summaries of the available data to evaluate both temporal and spatial variability in observed water quality conditions. Summaries in Tables 4-1 through 4-9 document sustained exceedance of established numeric targets or generic lake recommended levels for numerous parameters including total nitrogen, total phosphorous, ammonia, dissolved oxygen, orthophosphate, chlorophyll, and microcystins. Exceedances have been persistent often be traced back to as early as 2005.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments concerning the suitability of the STEPL source analysis methodology used in the TMDL Report, and the appropriateness of the statistical summaries provided in the report to evaluate temporal and spatial variability in water quality conditions.***

[TMDL Report Section] 6.2. Urban and Residential Runoff: As an identified NPDES permitted point source urban stormwater runoff (MS4 discharge) was a required component of the TMDL load allocation. The County of Santa Cruz was identified as the only MS4 entity within the Pinto Lake catchment. The estimated P load using STEPL was 150 lbs/yr represents roughly 5% of all source inputs. While a small contributor the potential controllable sources of this loading such as lawn fertilizers, grass clippings, organic debris, trash, and paste waste, along with locations and amounts of impervious cover could be managed to minimize this contribution.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 6.3. Industrial and Construction Stormwater: There was only one industry stormwater listed NPDES facility within the catchment. It was stated that there was insufficient data to meaningfully estimate a load contribution using the STEPL model. Loading was calculated indirectly using a derived export loading coefficient from the MANAGE database on a selected subset of Agricultural watersheds which matched similar surface water quality TP observations, then scaling the coefficient to the size of the industrial facility. Limiting the extrapolation to similar monitoring observations should provide a reasonable estimate. The resulting load contribution of 50 lbs/yr represents less than 2% of all sources and the uncertainty will have minimal impact.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 6.4. Wastewater Treatment Facilities: There were no NPDES permitted wastewater treatment facilities within the catchment.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 6.5. Cropland: Cropland represents the second biggest source of phosphorus input to Pinto Lake and the largest nitrogen and phosphorus input within the watershed contributions. It was estimated at 650 lbs/yr of TP and 4430 lbs/yr of TN which represent about 21% and 55% of the average loads, respectively. Loads were estimated with the STEPL model using estimated runoff nutrient concentrations from the Southern California Coastal Water Research Project Technical Report (2000). The yield of TP from the cropland using estimates of 650 lbs/yr and 300 acres of cropland (Table 2-3) are roughly 2.2 lbs/acre. This estimated yield is similar, but higher, than the 1.5 lbs/acre yield estimated within the highly agricultural Maumee River watershed in the Midwest (Scavia et al. 2014). The Maumee is considered the major source of nutrient input driving HAB blooms in western Lake Erie and loads are monitored on a daily basis. In general the model estimates seem reasonable.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments. We will add a narrative to the TMDL Report stating that peer reviewers found our estimates of nutrient yields reasonable, but generally higher that the highly agricultural Maumee River watershed in the Midwest. This seemingly indicates that our estimate of agricultural nutrient yield is conservative, or a "worst case" scenario. Incorporating conservative assumptions into the development of the TMDL calculation also acts to support an implicit Margin of Safety; an element of a TMDL development required by USEPA.***

[TMDL Report Section] 6.6. Grazing Lands: Inputs from animal waste deposited on grazing lands estimated using the STEPL model was 60 lbs/yr for TP. It was further noted that management of animal waste on gazing land is regulated under a separate TMDL allocation on the bases of fecal indicator bacteria levels.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 6.7. Septic System: It was estimated that approximately 50% of the population living within the catchment is served by septic systems. Input from this source was assumed to occur only in the event of system failure. No local failure rate data were available but informal monitoring did not observe obvious incidents. An assumed failure of 3% was applied on the basis of a larger reporting area for Santa Cruz County and used in the STEPL model applied conservatively to all septic systems within the catchment no matter distance from the Lake. The estimated load contribution was 150 and 390 lbs/yr for TP and TN, respectively. These are likely high estimates as

the actual delivery of a failing system will be highly dependent on proximity and hydrologic connectivity.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 6.8. Undeveloped Areas and Woodlands: Loading rates for undeveloped areas and woodlands were estimated using STEPL using default input parameters for flow-weighted concentrations input. Presumably these defaults match the literature based values shown in Table 6-12, but that was not explicitly stated. The estimated TP input was 100 lbs/yr which if applied to the estimated 722 acres within the catchment predicts a yield of 0.14 lbs/acres, or about 6% of the rate within cropland. These estimates are consistent with national level monitoring data.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 6.9. Wetlands: It was assumed that wetlands do not contribute to P and N loading and moreover could serve to reduce inputs from active assimilation. The report did not address seasonal cycles of plant growth and die-off. In a balanced system most of nutrients released from plant die-off should be curried or re-assimilated but high flow conditions through a wetland with scenescent or decaying vegetation could also be an intermittent source. In general the zero contribution is reasonable.

***Staff responses to comments***
***Central Coast Water Board staff appreciate the comment that, in general, it is reasonable to estimate that the nutrient contribution from wetlands sources is zero. We agree with this assumption and consequently did not include discussion of potential nutrient export from wetlands during high flow conditions.***

[TMDL Report Section] 6.10. Shallow Groundwater: Load contributions were estimated from STEPL using groundwater concentrations estimated from appropriate literature. The inputs were quite low for TP at 22 lbs/yr given its relative insolubility and high affinity for sediment, and 560 lbs/yr for TN which represented 0.7% and 7% respectively of all source inputs.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 6.11. Atmospheric Deposition: Source contributions of TP and TN were estimated using the STEPL model and literature based monitoring data of the USEPA. However, these inputs were assumed to un-controllable in terms of TMDL

proposed management guidelines so they were not included in the regulatory measures. Load estimates were 55 and 830 lbs/yr for TP and TN, respectively representing about 2% and 10% of all source inputs.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Report Section] 6.12. Internal Lake Loading: Internal loading rates were derived from incubated core experiments as reported in Ketley et al. (2013). This loading rate, averaged at 1,900 lbs/yr for TP, represents over 60% of all sources combined and is clearly a critical process to control for the TMDL. In referring back to the original source I did notice that the flux rates given in Table 3 of that report must have incorrect units for the rates expressed in mg/ft2/sec. Extrapolating those rates produces an input three orders of magnitude too large. However, the average monthly flux rate of 440 lbs/month in that same Table agrees with the annual loading rate given in Table 6-17 of the TMDL report, and would represent an active period of internal loading averaging around 4.3 months, which is consistent with observed in situ Lake data and match the likely duration of stratification and the presence of a hypoxic hypolimnion in which sediment P release is most likely to occur. This estimated internal flux rate is also generally supported by a mass balance calculation based on the observed increase in hypolimnetic phosphate concentrations presented in the report. I also conducted a numerical analysis based on both the reported monthly loading estimate by Ketley and the rate of increase in hypolimnetic concentrations to estimate an apparent internal nutrient flux rate. By assuming that approximately 50% of the lake surface area was deep enough to stratify and that the average water depth was 5 m, computed flux rates ranged between 34 to 36 mgP/m2/d. These rates are high but not uncommon common for eutrophic and hypertrophic lakes (see older review by Nurnberg 1987).

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments. We will add a narrative to the TMDL Report articulating that a scientific peer reviewer independently validated that that stakeholder estimated internal flux rate in Pinto Lake is high, but not uncommon for eutrophic and hypereutrophic lakes.***

### 4.4. TMDLs and Allocations

The purpose of this section was to estimate the assimilative capacity of Pinto Lake, i.e. loading levels at which the Lake would maintain acceptable water quality standards. The report acknowledges that there are not established loading capacities for controlling cyanobacteria at targeted levels and that their excessive growth is related to specific environmental conditions, including the availability of large amounts of nutrients. Specifically the report relies on the long established understanding that most lakes are P limited and concludes that the best way to manage the frequency and toxicity of cyanobacterial blooms in Pinto Lake comes from identifying plausible load reductions that could result from management actions on the controllable sources of P input. Thus

the established TMDL essentially equals the loading capacity of the Lake and establishes loads at which beneficial uses will be protected.

The approach used to compute the TMDL was commensurate with time constraints, resources, and took into account recent observations of changing Lake conditions in response to underway management actions being conducted under the NPS Implementation Grant Program, most notably the application of alum in 2017. The staff concluded that the recent success in dramatically improving water quality and toxicity based on the alum treatment alleviate the need for using resource intensive modeling to compute TMDL allocations. Instead stakeholder defined goals were used to evaluate phosphorus load reductions expected to results in the attainment of desired water quality standards. The stakeholder derived water quality management goals for Pinto Lake used as the basis of this TMDL are: (1) reduce 50% of the sediment bound phosphorus load from the watershed over the course of the useful life of selected sediment control practices, and (2) reduce internal loading of phosphorus in Pinto Lake by 80%.

Since internal loading represents approximately 60% of the TP load and would be in a biological available form likely to the most stimulatory to cyanobacterial blooms the heavy reliance on reducing this source is logical and likely to produce the fastest and greatest effects. If successful this action alone reduces nutrient availability by 50%. The other stakeholder derived loading targets were based on the watershed runoff load component which amounted to 420 lbs/yr and the stated management goal of reducing this by 50% to 210 lbs/yr. Together the two load reduction targets amount to a 75% reduction from these two contributions and a 56% reductions from all computed loading sources, i.e. a reduction of 1730 lbs from a total of 3100 lbs.

A second approach used by the CCWB to corroborate the likely success of the stakeholder derived targets was to use an established TP concentration numeric target of 0.17 mg/L (USEPA Ecoregion 111-6 report) and a volumetric numerical analysis based on current versus required load to meet that target. When adding in a 5% safety the Board computed a target load reduction of 2,650 lbs/yr or an 85% reduction of current inputs. This reduction is substantially more than the 56% established by the stakeholder goals but does include all sources not just the internal and watershed runoff.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments concerning the suitability of the approach used to compute the TMDL was commensurate with time constraints, resources, and took into account recent observations of changing Lake conditions.***

[TMDL Report Section] 7.2. Margin of Safety: I appreciate the requirement that a safety margin be built within the TMDL and understand the concept of adding in an extra 5% load reduction goal. This approach is of course to address the variability and uncertainty

that is inherent in any of the load capacity water quality response relationships. In reality the level of uncertainty is substantially higher in any or all of the loading allocations and in lake water quality responses. However the margin of safety applied does not seem unduly burdensome or unreasonable. But it should be recognized that the more protective approach comes in setting conservative numeric targets under what are likely to be the worst case conditions for water quality, which the TMDL has also done.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments concerning the suitability of our approach in establishing a margin of safety. As noted by the reviewer, our approach is conservative and likely establishes a total maximum daily load under what are likely to be the worst case conditions.***

[TMDL Report Section] 7.3. Linkage Analysis: The goal of linking pollutant loads to resulting water quality is a fundamental requirement of the TMDL and the ability to justify load reductions to meet to established narrative and numeric targets for the protection of beneficial uses. As stated previously and recognized in the report, these linkages are encumbered by uncertainty due to the influence of many interacting environmental conditions and community interactions. Differences in the timing and forms of nutrient inputs can dramatically change the response of cyanobacterial growth. Similarly differences in temperature and wind mixing can dramatically alter bloom growth under identical nutrient conditions. This variability or uncertainty in water quality outcomes points to the need for continuous monitoring to understand the effectiveness of the load reduction management actions and whether water quality standards are being met.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments. We agree that continuous monitoring (i.e., diurnal monitoring) would provide useful data to evaluate the effectiveness of load reduction on nutrient response indicators such as dissolved oxygen and chlorophyll a. Existing monitoring will continue weekly, and is a core expectation of this TMDL.***

[TMDL Report Section] 7.4. TMDL and Allocations:
The report states, the TMDL is expressed in terms of allowable annual loadings of phosphors because the growth of phytoplankton and macrophytes respond to changes in annual rather than daily loadings of nutrients. This statement may be true for a relatively closed system where nutrients are going to cycle within the ecosystem. However, the primary interest is in controlling a SEASONAL cyanobacterial bloom. So there may be critical periods of time when loading input is more important. Again this would be largely related to hydraulic residence times and whether nutrient concentrations remained high during the cyanobacterial growing period no matter when the inputs occurred earlier in the season because of internal recycling.

The TMDL is expressed as a phosphorus-control management goal with source pollutant allocations based on phosphorus. The CCWB established a target goal of 450 pounds of TP loading to the lake. Ongoing research in western Lake Erie has suggested that a much more effective management goal is to base the phosphorus loading targets on the bioavailable portion of phosphorus. This is typically a combination of the soluble reactive phosphorus portion plus about 20% of the particle bound phosphorus. This approach was justified by recent observations in the Maumee River watershed where it was demonstrated that the resurgence of toxic cyanobacterial blooms starting around 2005 in western Lake Erie was associated with an increase in the proportion of the SRP load from the river and that no change in TP load occurred. This example is just to point out the obvious conclusion that not all nutrient reduction is equal, because not all forms or phases of the nutrient are equally biologically available.

Load allocations for the TMDL relied on an equal percent removal scheme, while recognizing that higher rates of removal are warranted for the most significant contributions. Consequently the source requiring the most intensive focus for control was the internal P loading from lakebed sediment fluxes.

I think a more deliberate load reduction scheme would be a better option. As stated above another consideration could be the forms or bioavailability of the P associated with each source loading. Fortunately in this case addressing the internal loading does exactly this, sediment fluxes will be recycling phosphate and ammonium which are readily bioavailable and bio-stimulatory for cyanobacterial growth. Additionally the feasibility of establishing effective management actions based on each source loading could be considered. This would require some understanding of the proposed effectiveness and costs of associated management practices. I understand this level of quantitative understanding of BMP effectiveness in sorely lacking and may perhaps justify striving for the more balanced approach of trying to generate reductions evenly across all of the other watershed sources.

The proposed addition of being able to document the attainment of P load allocations of the TMDL on the basis of receiving water TMDL secondary numeric targets for the nutrient-response indicators is appropriate. Again a change in the form or timing of a source load reduction may result in the desired water quality response somewhat independently of an actual mass-based load. Furthermore it emphasizes the need for continued, systematic monitoring.

As required, the TMDL addresses State and Federal anti-degradation policies. There is nothing in the proposed management goals of phosphorus control from any of the identified pollutant sources within the catchment that should violate this requirement or serve to worsen existing acceptable water quality conditions.

***Staff responses to comments***
***We will revisit the TMDL Report and make modifications to address the comments about the linkage between the timing (seasonality) and form (bioavailable phosphorus) of the loading. However, staff will continue to base the***

***TMDL on total phosphorus outputs from the recommended nutrient models and the USEPA recommended criteria.***

[TMDL Report Section] 7.5. Critical Conditions and Seasonal Variation: I disagree with the statement that the internal loading of nutrients from sediments can provide a source of nutrients to the lake water column year round. Although an attempt to clarify the processes is given in the follow on sentence. In most studies the release of PO4 from sediments only occurs under near anoxic conditions and that will only exist after and during complete stratification.

'The critical condition for the attainment of beneficial uses at Pinto Lake occurs during the summer and early fall months, most commonly from August to late October.' The TMDL accounts for seasonal and critical conditions of the summer months by assigning a load allocation to the lake sediments and requiring load reductions from watershed sources of nutrients to the lake.

***Staff responses to comments***
***We will modify the language to accommodate the insight provided by the reviewer.***

[TMDL Report Section] 8. Public Participation: EPA has fully supported public involvement in the TMDL development and basin planning process through a series of public meetings, scoping workshops, postings of progress reports, email notifications, data solicitations, and a formal public review and comment period. It is recognized that a placeholder exists to include received public comments as part of the final report.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

**4.5. Implementation Strategy**

The Implementation Strategy clearly defines the legal and regulatory framework for assigning specific responsibilities to the implementing parties for necessary implementation and monitoring actions. In accordance to the Porter-Cologne Act the CCWB does NOT specify or mandate the specific on-site actions needed to reduce nutrient loading to the TMDL targets and allocations. Instead the report gives suggested approaches and examples of management practices that are believed to be, or have proven to be, effective at reducing nutrient and sediment loading. The TMDL is designed to provide stakeholders, local public entities, properties owners, and resource professionals the flexibility to implement management strategies based on local conditions and processes. The CCWB provides oversight to ensure the local efforts comply with all required regulatory permits, waivers, or prohibitions.

The Implementation Strategy consists of 1) identification of parties responsible for taking action; 2) development of management/monitoring plans to reduce controllable sources of nitrogen compounds and orthophosphate in surface waters; 3) mechanisms by which the CCWB will assure actions are taken; 4) reporting and evaluation requirements that will indicate progress toward completing the actions; 5) and a timeline for completion of implementation actions.

A current suite of management measures has been identified as part of a Clean Water Act section 319 grant, some of which are already being applied. These include:

- In-lake treatments (alum) to limit release of phosphorus from lake sediments
- Erosion control/sediment capture practices to reduce nutrient loadings from agricultural and/or urban properties in the watershed.
- Irrigation and nutrient management programs for agricultural, commercial and residential properties in the watershed.
- Public education regarding management of on-site wastewater systems, gray water disposal and landscaping practices.
- Investigating options for sewer system extensions.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Implementation Plan Section] 4.3. Implementation for Discharges from Irrigated Lands: Owners and operators of irrigated agricultural land must comply with the current regulations under the Agricultural Order, Conditional Waiver of Waste Discharge Requirements for Irrigated Lands and subsequent monitoring requirements. The requirements and application of these orders are intended to implement the TMDLs and improve identified water quality impairments. No new requirements are proposed for this pollutant load allocation. The Strategy correctly identifies that implementation efforts should be focused on portions of the watershed where impairments provide the greatest to Pinto Lake, whether that be by proximity, the type of pollutant, or the magnitude of the waste load. The State's 319 NPS program will be the basis for load allocations, management implementation, and follow-up monitoring. Long-term watershed monitoring will serve to evaluate the effectiveness and progress of applied management practices. to meet load reduction goals.

The Strategy recognizes that tracking progress towards the attainment of the TMDL load allocations will be more effective by considering multiple water quality parameters or trends versus an annual mass loading rate (Text Box 4-2). Given the difficulties in quantifying direct relationships between any given loading source and resulting water quality response within the Lake, using this multi-faceted approach to evaluate and track progress is warranted.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Implementation Plan Section] 4.4. Implementation for Discharges from MS4 Stormwater Entities: The TMDL Strategy will address nutrient loading from municipal stormwater systems by regulating MS4 entities under the provisions of the State's NPDES General Permit system. The implementing parties of the City of Watsonville and the County of Santa Cruz will be required to obtain approved waste load allocations under the Permit. This approved plan includes source identification, implementing required management practices under a defined schedule, and monitoring discharges and receiving water quality to document progress (details provided in Text Box 4-3). As with Irrigated Land pollutant loads, progress and attainment will be evaluated using a flexible approach based on the criteria defined in Text Box 4-4.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Implementation Plan Section] 4.5. Implementation for Industrial and Construction Stormwater Discharges: The one registered industrial facility within the catchment operates under the 2014 Industrial General Permit and no additional regulatory measures for this source were deemed warranted under this TMDL.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Implementation Plan Section] 4.6. Implementation for Onsite Wastewater Treatment Systems: The Santa Cruz County LAMP manages onsite wastewater treatment systems and worked with CCWB during the development of this TMDL to address outstanding issues. The extent of potential waste inputs to Pinto Lake from septic systems is largely unknown but is being assessed through an ongoing surveillance program. Based on the lack of direct findings no additional regulatory actions were imposed by the TMDL for this waste load allocation.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Implementation Plan Section] 4.7. Implementation for Livestock and Domestic Animals: Existing CCWB policies require owners and operators of lands with livestock or farm animals to control discharges of soil and sediment into water courses and must self-monitor their property to determine if erosion control management practices are needed to reduce waste discharges.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Implementation Plan Section] 4.8. Recommended Water Quality Monitoring: The CCWB concluded that the ongoing monitoring programs of the City of Watsonville and Santa Cruz county, as supported through research expertise of the Monterey Bay Analytical Services and Dr. Raphe Kudela, USCS are sufficient to document trends in nutrient loads and in-lake water quality conditions pursuant to the implementation of this TMDL. Future monitoring and data analysis will be a critical component of ensuring progress towards numeric water quality goals and evaluating the effectiveness of any management practices applied to reduce pollutant loading. Consideration should be given to spatial and temporal scales of the monitoring data, and consistency of methods, to ensure that appropriate statistical comparisons can be made across time. Sampling needs to be rigorous enough to account for differences arising in meteorological and hydrological influences across space and time.

***Staff responses to comments***
***Staff will add language to the implementation plan reflecting these suggestions.***

[TMDL Implementation Plan Section] 4.9. Timeline and Milestones for TMDL Implementation: The TMDL has documented serious water quality and beneficial use impairments of Pinto Lake stemming from the bio-stimulatory effects of excessive nitrogen and phosphorus inputs. As such the goal of the TMDL Implementation Strategy is to meet the TMDL allocations in the shortest time-frame feasible. However it is appropriately recognized that the implementation of all required management practices, or the achievement of expected load reductions resulting from these managements, will not happen immediately. Therefore the Implementation Strategy defines both an Interim and Final Load Allocation Goal as follows:

- Interim Goal is to achieve and maintain the toxicity water quality objectives for contact recreation in receiving waters designated REC, based on microcystin water quality guidelines within 2 years.
- Final Goal is to achieve the phosphorus waste load and load allocations within 10 years of the effective TMDL.

Based on current efforts and observations it seems possible to rely on in-lake alum treatments as a mechanism to meet the Interim water quality goals. Watershed load reductions will clearly take a longer period of time because of the physical scale to address, lack of definitive outcomes for certain management actions, number of parties involved, and costs of implementation.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Implementation Plan Section] 4.12. How We Will Evaluate TMDL Implementation Progress: The stated approach of the TMDL is to strive for pollutant load reduction while continuing to monitor receiving water concentrations. It is also

recognized there may not always be a direct correlative relationship between mass-based load reductions and pollutant concentrations in the grab samples of the receiving water. This understanding has led to the conclusion that other metrics should be used to help provide insight on interim progress including: 1) phosphorus mass-based load reductions; 2) improvements in flow-weighted concentrations; 3) estimates of the scope and extent of implemented management practices aimed at reducing loads; and 4) improvements in receiving water nutrient response indicators, independent of nutrient concentrations. The CCWB also holds open the option of recommending revision to the implementation plan should ongoing monitoring indicate that current efforts are insufficient to achieve the TMDL allocations and numeric targets.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Implementation Plan Section] 4.13. TMDL Achievement and Future Delisting Decisions: The ability to meet the TMDL load allocations and water quality objectives is subject to inherent uncertainty. It is recognized that any implementation strategy needs to allow for flexibility, adaptability and re-assessment when appropriate. Immediate success is not realistic and the CCWB proposed interim load allocation and benchmarks to be considered within two years and that TMDL and numeric water quality targets be reconsidered based on new research or information. Delisting decisions will be based on the criteria and methodologies set forth in the 303(d) Listing Policy of the State Water Board (2004).

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments.***

[TMDL Implementation Plan Section] 4.14. Success Stories, Case Studies & Existing Implementation Efforts: It is highly encouraging and critical to the likely success of this TMDL that pollutant loading control efforts are already underway and that there are specific examples that can help demonstrate and quantify effectiveness at reducing loading. Based on the magnitude of the input, the highly bioavailable forms of nutrient input, and the direct feedback to cyanobacteria within the lake itself no management plan will be more important to study and maintain than the in-lake alum treatment. The watershed based management practices to capture sediment and nutrient runoff will contribute to water quality protection but it is very uncertain whether established management practices can generate the targeted 75% reductions in TP loading.

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments. Concerning the comment on uncertainty about achieving targeted load reductions, we used conservative assumptions in the TP load reductions which, in part, resulted in relatively stringent load reduction estimates.***

We identified proxy indicators of water quality standards achievement will may be used to determine if adequate load reductions have been achieved, irrespective of whether or not 75 percent load reduction in total phosphorus loading are achieved.

For example, if microcystin, dissolved oxygen, and chlorophyll a levels consistently reach acceptable levels, this may be taken as a proxy indicator that adequate phosphorus load reductions have been achieved.

Concluding Remarks on the Draft Implementation Strategy Report:

I conclude that the technical basis of the proposed implementation strategy is fundamentally sound and scientifically defensible. I agree with the establishment of Interim timeline goals to achieve the loading capacity of Pinto Lake and that meeting all TMDL load allocations would take up to ten years. The Implementation Strategy appropriately defined the regulatory or non-regulatory actions needed to achieve waste load allocations and set reasonable schedules and milestones for the completion of actions to be taken using a combination of interim and final targets. Moreover, the plan recognizes the absolute need for continued watershed monitoring by the appropriate parties in order to determine progress towards achieving the objective water quality standards.

The one concern that I have with the Implementation strategy is the lack of identifying the potential requirement for future additional in-lake Alum treatments, and what specific criteria would be established to define when those applications are needed. The literature on the long-term effectiveness of Alum treatments shows a range in the duration of effectiveness ranging from a single year to almost twenty years (Welch and Cooke 1999; NALMS position paper, 2014).

***Staff responses to comments***
***Central Coast Water Board staff appreciates the reviewer's comments confirming the fundamental soundness of the Implementation Plan.***

***The City of Watsonville's alum application contractor has discussed strategies with City staff about future alum application strategies. We will add language to Implementation Plan addressing this topic.***

# 5. REFERENCES


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