

# APPENDIX D: Peer Review Response

## Peer Review Matrix

Reviewer	Introduction	Methodology	Air Quality	Water Quality	Soil Conservation	Vegetation Preservation	Fisheries	Wildlife	Scenic Resources	Noise	Recreation
Barber	X	X						X		X	
Beauchamp	X	X		X			X				
Booth	X	X			X						
Burns									X		X
Guildford	X	X		X							
Hall					X		X		X		X
Hunt	X	X	X							X	
Marion									X		X
Naiman	X	X				X	X				
Noon								X			
Rose				X							
Spak	X	X	X								
Wessman	X	X			X	X					

## **GENERAL RESPONSE**

As part of the charge to peer reviewers of the 2015 threshold evaluation report, reviewers were asked to consider if; 1) the data, analysis and findings were based on the best available science and 2) what additional information might be necessary to effectively report on and manage the environmental health of the Region. Where comments related directly to the methods, findings, layout or editorial style of the 2015 threshold evaluation report, TRPA has responded to those comments with inline responses that are the traditional format for responding to peer review comments in scientific journals. In those replies, TRPA indicates changes made in response to the comment and provides a rationale for the modifications.

TRPA is fortunate in that many of the comments of the peer review panel were of a more probative nature and focused not just on the analyses, conclusions or recommendations reached during the threshold evaluation reporting process, but questioned or provided suggestions that focused primarily on the content of the threshold standards themselves. Since there was substantial overlap both in the nature of these comments and in the response, TRPA felt it better to synthesize the sentiment of the comments and formulate a single response. This format afforded TRPA the opportunity to provide a more detailed response than is typical of the traditional inline response to comment format, and also reduces the redundancy in the reply.

### **1. Summary comment: Modify current standard, add new standards, modify monitoring programs**

The 2015 Threshold Evaluation Report focuses on the evaluation of environmental conditions relative to the 171 adopted standards. Many of the comments received during peer review focused on the content of the existing standards, rather than on the analysis of the current standards. While TRPA staff are not able to modify the existing report to accommodate these comments, TRPA is grateful for each recommendation. The many thoughtful recommendations will help inform how TRPA and partners review and update the standards.

The majority of threshold standards are now over 30 years old and the scientific evidence base for many standards dates back to the 1970s. Many reviewers expressed frustration that the standards had not been modified to integrate emerging science. This critique was not unexpected. There is a broad recognition that the threshold standards should be comprehensively reviewed and an initiative is currently underway to do so. In 2015, TRPA's Governing Board identified seven strategic initiatives for the agency to engage in over the next five years. This Threshold Evaluation Report and the recommendations contained in the peer review are a critical component of that process.

There is also a broad recognition that this review and will not happen overnight. The threshold standards establish the environmental quality goals for the restoration of the Tahoe Region. Updating the goals for a multi-billion-dollar restoration project that includes over 100 partners and many more stakeholders is a non-trivial exercise.

In 2015, the states of California and Nevada signed a memorandum of understanding establishing a Tahoe Science Advisory Council (Council). The Council is charged with providing decision makers in the Region with independent scientific guidance. At the August 2016 meeting of the Executive Committee of the Council, the Executive Committee endorsed the first work plan for the Council. That work plan identified the provision of scientific guidance to TRPA and partners as part of the strategic initiative to review the threshold standards as the primary task for the Council to engage in over the next two years. This is a significant opportunity for the partners in the Region that work to promote threshold attainment. It means that many of the questions and comments raised

during the peer review of the 2015 Threshold Evaluation Report will be benefit from being considered by a panel of 14 scientific experts from the leading academic and research institutions in the two states.

Both the executive summary and the recommendations and conclusions chapters recognize that much work remains to be done in this regard. TRPA is actively working the Council and other partners to ensure that the threshold review process is informed by the best possible science, is inclusive, and transparent. The recommendations section takes this one step further and details one component of the first phase in a multi-phased effort to comprehensively review the threshold standards. This component is a proposed assessment of the formulation of the standards against best practice. The proposed assessment has been peer reviewed by two experts in the field of monitoring and evaluation, and those reviews are including in the appendices of this report. The first task for the Council will be to review the proposed assessment and the comments of the peer reviewers on the chapter and provide feedback on the assessment itself and the appropriateness of the assessment as a building block for the initiative to review and update the threshold standards. The expectation is that the Council will provide that feedback to the TRPA Governing Board in the first quarter of 2017. That feedback will inform the development of the comprehensive review of the threshold standards.

*Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.*

Comments from: Jesse Barber (Boise State University)

**Introduction Chapter:** Page 1-5: The lack of inference from regression analysis is perhaps couched more accurately as a limitation in experimental design, not necessarily a limitation in the modeling technique chosen. For example, imagine an experiment where vehicles were not allowed to drive on some sections of road near sensitive wetland areas, during songbird dawn chorus, while other areas were open to vehicles at all times. A regression analysis of the variation in background sound levels created by these conditions and bird reproductive success might reveal a strong relationship. This hypothetical result would have much stronger inference than the description currently in the report attributed to this statistical technique. Thus, I propose, this section should be amended to state the correlational approach to data collection in the report, not necessarily the stats.

**TRPA RESPONSE:** The introduction and report are intended for a general audience and the description of time periods in the report, Ex: "From 1860 until after the turn of the century" was deemed appropriate for a general audience and has not been modified.

**Methods Chapter:** Overall, very nicely done. The clarity of the status/trends/confidence designation is commendable.

Page 2-10, Table 2-3: Surely there is an error here. Frequentist statistical convention is  $p < 0.05$  is 'statistically significant'. The R-squared cannot be interpreted if the test is not significant. Do you mean to use these categories: 0.01 and 0.01-0.04 and 0.04-0.05??

**TRPA RESPONSE:** While frequentist statistical convention is to use a value  $p < 0.05$  as 'statistically significant' the selection of 0.05 as a value is as the reviewer suggests a convention, rather than rule. Indeed, the use of  $p < 0.05$  in has been critiqued by numerous authors (see overview in (Murtaugh 2014)) and even suggested to have potentially "disastrous consequences for the environment (Field et al. 2004)." The selection of a p-value is balance between the likelihood of making a type I error – false positive, and type II error – false negative. Higher p-values, make false positives more likely or, it is more likely to report the presence of something that is really due to chance. Lower p values make false negatives more likely, e.g. overlooking an effect that is present. The use of the p-value in table 2-3 is as tool to communicate to a general audience the level of support or confidence TRPA has in the information presented. The extension of reporting of "results" that would not be considered "significant" by frequentist statistical convention is done in the interest of transparency in reporting. Here TRPA errs on the side of providing too much information, rather than too little. TRPA recognizes that there is a trade-off in this approach and commits to improve how it analyzes and presents information to the public.

**\*Wildlife Chapter:** In general, wildlife is well addressed in the 2015 Threshold Evaluation. However, the taxonomic focus, primarily on raptors is perhaps a skewed use of resources. Particularly in light of the fact that the laudable past monitoring efforts have revealed these species are in good shape. It is my opinion it is time for the team to turn their attention to other wildlife groups.

\*Songbirds and bats are the targets I suggest. Both groups are relatively easy to monitor and hold the potential to reveal ecological patterns of habitat quality broadly (Chapman and Reich 2007; Jones et al. 2009). Both groups strongly depend on insects, are critical biological insect control agents (Kalka et al. 2008; Bohm et al. 2011), and provide an indirect means of assessing insect populations.

\*As the famous evolutionary biologist, Edward O. Wilson said, 'It is the little things that run the world' (Wilson 1987).

\*The recent discovery of White-Nosed Syndrome in Washington State (<https://www.whitenosesyndrome.org/>) should place bats as a top priority for the Threshold Evaluation team. Understanding bat populations now, and the influence of disturbance on their populations, is critical in the short time left before White

\*Syndrome reaches the Tahoe Basin. Bats known to be impacted by this devastating disease are common in the Tahoe Basin (e.g., big brown, *Eptesicus fuscus* and little brown, *Myotis lucifugus*).

**TRPA RESPONSE:** TRPA agrees that such a strong focus on raptors may not be the correct approach to the current issues Tahoe wildlife face, and may not be the best measure of overall wildlife health anymore. However, because TRPA's current thresholds control, any changes to these thresholds need to go through an independent, stakeholder process. These comments will be brought to those stakeholders.

I have one comment regarding the management of disturbance free zones: if noise (sound levels) and light at night from human-made sources are not incorporated into what is considered a disturbance free zone the designation 'disturbance free' is inaccurate (Francis and Barber 2013; Gaston et al. 2013).

**TRPA RESPONSE:** TRPA recognizes the potential impact from noise, and regulates noise levels in wildlife areas. Noise levels in the Region are evaluated in the Noise Chapter of the Threshold Evaluation Report. Code Chapter 13.5.3.5 attempts to minimize light pollution in project design to minimize impacts while providing adequate lighting for public safety (TRPA 2012c).

Major Deficiency: The team needs to address the impacts of roads on wildlife in the Tahoe Basin. The impacts of roads on wildlife deaths from collisions, habitat degradation from noise pollution and, importantly, connectivity are critical gaps in this analysis (van der Ree et al. 2015).

**TRPA RESPONSE:** Noise effects on wildlife are monitored through the monitoring of noise levels in areas designated as "critical wildlife areas" and "wilderness and roadless areas". The potential modification of threshold standards to include assessment of habitat connectivity or vehicle collisions is better address in the global response to comments on threshold standard modification.

Major Deficiency: The team needs to address the impacts of roads on wildlife in the Tahoe Basin. The impacts of roads on wildlife deaths from collisions, habitat degradation from noise pollution and, importantly, connectivity are critical gaps in this analysis (van der Ree et al. 2015).

**TRPA RESPONSE:** The purpose of this report, however, is to assess compliance with previously adopted noise standards, other impacts of roads on wildlife will be considered as part of the threshold update initiative.

### **Noise Chapter**

#### *Introduction:*

Page 10-1: Noise influences far more than just wildlife behavior and has been documented to have negative impacts on community structure, distributions, habitat quality and reproductive success (Francis and Barber 2013; Ware et al. 2015).

**TRPA RESPONSE:** For the introductory purpose of the chapter, TRPA does not think it is necessary to include this information. The reference to wildlife behavior was removed and instead TRPA noted in the paragraph regarding general negative effects on wildlife.

Page 10-3: Instantaneous thresholds for single events can be useful to enforce and monitor compliance of mitigation measures but integrated sound values over long time periods are the most critical for wildlife and, arguably, for people.

**TRPA RESPONSE:** TRPA agrees with this assessment and has therefore moved away from monitoring single noise events and focused more on cumulative noise events.

CNEL is not necessarily the best metric to evaluate noise for wildlife, as the penalties are human-centric. However, the penalties of 4.77 dB between 7-10 PM and 10 dB between 10 PM and 7 AM do protect wildlife during biologically critical crepuscular (dawn and dusk) periods.

\*Further, A-weighting of sound levels is an acceptable metric for humans and birds but is not adequate for many wildlife species (Francis and Barber 2013). Flat, un-weighted decibel readings should be used instead.

**TRPA RESPONSE:** The current threshold standards specify that A-weighted decibels are to be used to assess TRPA noise standards and therefore your comment relates to changing of the thresholds themselves. \*

The Natural Sounds and Night Skies Division of the National Park Service has a defined protocol to monitor sound levels in natural areas, has the longest history of any land management group of monitoring sound levels and could be a valuable resource for the Threshold Evaluation team when addressing this ecological pollutant.

**TRPA RESPONSE:** TRPA will use this program to help inform updating noise thresholds going forward.

Thresholds: Critically, there is little to no evidence that the threshold of 45 CNEL is fully protective of the most critical wildlife habitat. Many animals have hearing abilities that are many orders of magnitude below our own, and many natural habitats experience low-term integrated sound levels far below 45 dBA, often near 0 dBA. I suggest that Critical Wildlife Habitat Areas and Wilderness and Roadless Land Uses designated land types be maintained at the average sound levels of areas that currently experience the least amount of anthropogenic noise exposure. Ideally, these critical areas would be maintained at their

natural ambient levels, however given the prevalence of airplane traffic it is unlikely that any habitat currently experiences its ancestral sound levels. It seems clear that any increase in background sound level beyond ambient from natural sounds is likely to change ecological functioning (Shannon et al. 2015). For the most important habitat, I suggest using the precautionary principle.

**TRPA RESPONSE:** The original TRPA community noise limit for remote wildlife areas (CNEL of 25 dB) is primarily designed to promote natural quiet, an important aesthetic resource for human visitors. While this level would clearly protect animals as well (it is close to the average noise floor in wilderness areas), it was deemed not attainable in most of the wildlife Threshold Sites around the Tahoe Basin. The suggestion to change the standard for wilderness and critical wildlife areas will be passed on to the group tasked with updating the threshold standards.

Page 10-18. Saying there is insufficient data to determine the trend seems pretty erroneous to me here. Levels are over threshold. Traffic has increased since 2013. The habitat is still over the threshold. It should be managed as such.

**TRPA RESPONSE:** As a standard protocol set out in the methodology section of this report, any indicator that has less than three periods of monitoring data is deemed “insufficient data to determined trend”. Because there are only two years of data collection, it is impossible to be confident about any meaningful trend, especially because 2011 and 2013 values are similar. Additionally, the two monitoring locations used for this indicator are far from roads and highways and are mainly impacted by boat noise. No management actions since 2013 have been taken that would impact boat noise. Without actual data, TRPA cannot say with the necessary degree of confidence that a trend can be established.

Methods: How was the sound level data collected (equipment, protocols, etc.)? If done according to best practices, all metrics (LEQ as opposed to weighted CNEL; dBF as opposed to dBA; time above metrics, etc.) should be able to be calculated. These details need to be included.

**TRPA RESPONSE:** Chapter 68.5 of the TRPA Code of Ordinances establishes noise monitoring protocol. Noise monitoring equipment used throughout the Threshold Evaluations included Larson Davis Laboratories (LDL) Model 831 precision integrating sound level meter. This meter meets ANSI S1.4 Type 1 and IEC 61672 Class 1 specifications, and consisted of a system that included a heavy duty security enclosure, a deep cycle 12 volt battery, and related accessories. Detailed set-up and retrieval procedures for the monitoring systems were followed, which included the acoustic calibration of the noise meters both immediately prior and post sampling periods. The noise meters were programmed to record noise levels generated within 24-hour sampling periods, which included unit-calculated 24-hour averaged noise values (CNEL). The analysis presented in the report focus on the information necessary to assess conditions against the TRPA threshold standards (dBA). Information such as dBF is not relevant to TRPA standards and is therefore not included in the report.

**References**

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Gaston KJ, Bennie J, Davies TW, Hopkins J (2013) The ecological impacts of nighttime light pollution: a mechanistic appraisal. *Biol Rev* 88(4):912–927.

Jones G, Jacobs DS, Kunz TH, Willig MR, Racey PA (2009) Carpe notem: the importance of bats as bioindicators. *Endangered Species Research* 8:93-115.

Kalka MB, Smith AR, Kalko EKV (2008) Bats limit arthropods and herbivory in a tropical forest. *Science* 320(5872):71.

Shannon G, McKenna MF, Angeloni LM, Crooks KR, Fristrup KM, Brown E, Warner KA, Nelson MD, White C, Briggs J, McFarland S, Wittemyer G (2015) A synthesis of two decades of research documenting the effects of noise on wildlife. *Biological Reviews*  
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Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

## **Review: Tahoe Threshold Evaluation 2016**

David A. Beauchamp, U.S. Geological Survey, Western Fisheries Research Center, Seattle, WA

### **Introduction**

In general, this section is clear and informative. Just a few specific comments follow.

#### History

P 1-1 Instead of simply referring to the Comstock era, please provide a range of dates to bracket the specific periods when timber and grazing impacts degraded habitat within the basin.

Similarly, provide the year(s) when forest management policy of fire prevention and vegetation preservation policies were endorsed.

**TRPA RESPONSE:** The introduction and report are intended for a general audience and the description of time periods in the report, Ex: “From 1860 until after the turn of the century” was deemed appropriate for a general audience and has not been modified.

P 1-24<sup>th</sup> paragraph: “Since the 1960s,...” Please provide the actual population figures during the 1970s.

**TRPA RESPONSE:** The text has been modified to provide greater detail on the population growth in the region. Additional references have all been added to support the detailed population estimates.

P 1-9 Indicator: replace “constituent” with a more meaningful term. Most indicators should be in the form of a “variable.” “Parameters” are highly mis-used terms in limnology and other fields, and are often variables that are mis-labeled as parameters.

**TRPA RESPONSE:** TRPA understands the confusion can result from inconsistent or incorrect application use of individual terms. The definitions used here and in the methodology section to ensure consistency have been modified to ensure consistency.

### **Methods**

I appreciated the thorough definitions and derivation of key calculations in this section. This section will pre-empt needs for further clarification throughout the documents that would have otherwise emerged.

P 2-1 “Environmental Threshold Carrying Capacity (Threshold Standard)” Delete “Carrying Capacity” and simply refer to “Threshold Standard” instead. The term “carrying capacity” has very specific meanings depending on context, and could lead to unintended interpretation.

**TRPA RESPONSE:** “Environmental Threshold Carrying Capacity” is the term used in the Bi-State Compact. TRPA recognizes that the use of the term “carrying capacities” can lead to misinterpretations, and thus uses “Threshold Standard” throughout the document.

P 2-10, paragraph below Table 2-3 beginning with “Where the data collected...” Something is missing or poorly phrased in the second line: “...and the test for statistical [... revealed both indicate]...”

**TRPA RESPONSE:** Text edited to clarify the description of the methods.

### **Fisheries**

P 7-1, 2<sup>nd</sup> paragraph: A Table of native and non-native fishes, relative abundance (extirpated, rare, common), population trends (increasing, declining, stable) and approximate dates of discovery or extirpation would be useful.

Including 3 key invertebrates in this table (Daphnia, Crayfish and Mysids) would be helpful as well.

**TRPA RESPONSE:** We have added a figure to the introduction that shows a timeline for introduction of the non-native species and associated impacts of native species.

P 7-2, Policy points:

2. Some stream blockages may be beneficial for inhibiting the spread of non-native species, so perhaps include some caveats to acknowledge the potential usefulness of some blockages as a conservation tool.

**TRPA RESPONSE:** As indicated in the comment, some barriers are beneficial and the Regional Plan recognizes this. The text has been modified to capture this nuance.

5. Encouraging [functional] habitat improvement projects in streams and lakes.

**TRPA RESPONSE:** Noted for potential future policy modifications.

7. Clarify by rephrasing (The intent of this point was initially confusing). Proposed edit: “Transferring existing water diversions from streams to lake withdrawals, whenever feasible.”

**TRPA RESPONSE:** Modified text accordingly.

P 7-3, Table 7-1 Lake Habitat:

The essential habitat paradigm developed in stream ecology is only partially effective in lake environments, especially in large lakes. Biotic interactions (food supply, predation, competition) become much more important processes regulating lake communities than simply physical habitat alone. Threshold standards should be expanded accordingly to ensure that appropriate monitoring metrics are tracked to evaluate status, trends, and key processes that underlie changes in health of fisheries resources.

**TRPA RESPONSE:** We recognize that the standard for lake fish “habitat” relates to only one aspect (physical qualities of the substrate in the nearshore) of the conditions and processes

that influence the abundance of fish species in the Lake. We have expanded the discussion in the recommendations section to further address these issues.

Pelagic habitats cannot be ignored. Pelagic habitats support native Lahontan reddsides, Tui chub, (and probably larval sculpins), and historically supported Lahontan Cutthroat trout. These habitats have been changed by non-native species (mysids, lake trout, etc.), loss of Daphnia, and warming thermal regime

**TRPA RESPONSE:** We recognize that the standard for lake fish “habitat” relates to only one aspect (physical qualities of the substrate in the nearshore) of the conditions and processes that influence the abundance of fish species in the Lake. We have expanded the discussion in the recommendations section to further address these issues.

The fisheries section should develop additional threshold standards to include:

- Pelagic habitat standards (density of adult crustacean zooplankton, timing of thermal stratification, and the depth and temperature of epilimnion during summer)
- Non-native spp standards (relative abundance, spatial distribution, size structure)

**TRPA RESPONSE:** Modified recommendations section accordingly.

Current lake habitat indicator (acres of nearshore habitat defined by substrate size): Does this account for seasonal hydrodynamics that would naturally sort and maintain different substrate size distributions along different shorelines? I worry about potential efforts to add or change substrate composition. These will not be sustainable unless they operate in concert with existing physical processes of wind, wave energy, water circulation, and sediment accretion or erosion zones.

**TRPA RESPONSE:** The current standard does not account for seasonal dynamics. The potential impact of seasonal hydrodynamics will be highlighted for consideration during the threshold review process.

Stream Habitat: Does this indicator factor in the need for connectivity among essential habitats that might support different life stages during different seasons? Some stream miles are more influential than others. Otherwise valuable habitat might not be useful if too fragmented or isolated from other reaches.

**TRPA RESPONSE:** The current standard and indicator identified to assess condition against that standard consider only habitat in aggregate. The recommendations section has been modified to include this recommendation in any review of the standards and to consider habitat connectivity as a factor when prioritizing stream restoration projects.

Instream Flow: The 2<sup>nd</sup> standard is confusing. Please clarify-is the intention to transfer water withdrawals from stream diversions to direct withdrawal from the lake? Phrasing for this in Table 7-2 is more informative: "Divert stream intakes to lake sources"

**TRPA RESPONSE:** No modification made, the text referenced is adopted in resolution 82-11.

Lahontan Cutthroat Trout: Adfluvial Lahontan cutthroat trout will require good pelagic conditions to support adequate growth and survival. This is more of a comment to highlight the need to increase the "Lake Habitat Standards" above.

**TRPA RESPONSE:** The limitations of the current standard are addressed both above and in indicator sheet.

### **Lake Habitat**

P 7-5: 1<sup>st</sup> paragraph. "Feed and cover habitats" It will be important to differentiate habitat needs of larval forms of minnows and suckers, which have more limited ability to move, feed, and deal with wave energy, from post-larval "fry."

I don't believe that enough is known about essential larval fish rearing habitat, but I suspect that the lower wave-energy sites with smaller substrate, might be very important for larval stages, but less important for fry and older juveniles.

**TRPA RESPONSE:** The recommendations section of the indicator sheet has been modified to specifically address concerns related to specific requirements at different life stages.

3<sup>rd</sup> paragraph: The decline in native fishes is likely more of a response to interactions with non-native species than change in littoral habitat alone. Reproduction, recruitment, growth and survival of fish species can be strongly influenced by seasonal food supply, thermal and other environmental conditions, interactions with native and non-native species; all of which can fundamentally change whether the existing physical habitat can adequately support these populations as they might have historically. Thus the need for additional threshold standards for lake habitat that relate to non-native spp, ecological and environmental conditions that affect survival and growth of native fishes.

**TRPA RESPONSE:** The impact of non-native species on native fish populations is directly referenced in the recommendations of the indicator sheet. The discussion of these impacts has and been expanded, as has the discussion of AIS control and prevention activities.

Direct monitoring of trends in native and non-native fishes (and key invertebrates like crayfish and mysids) should be included as indicators. For native minnows, quantitative, depth-stratified minnow trapping would be an effective low-cost approach for monitoring status and trends of these populations, and would benefit from existing time series data.

**TRPA RESPONSE:** Indicators and monitoring programs are tailored to the stated objectives of the individual threshold standard. The monitoring recommendations included above are much appreciated and will be taken into consideration during the threshold review process.

P 7-8 & 7-9 Indicator State:

Efforts to "restore 'prime' habitat" would be wasteful in the absence of evidence that habitat is the primary limiting factor responsible for suppressing fisheries resources.

Instead, improved information on which habitats support successful spawning-larval-fry transitions, monitoring non-native species and their effects on native fisheries resources are more pressing actions.

**TRPA RESPONSE:** This recommendation will be included in future planning efforts.

“...additional factors influence the quality of littoral fish habitat.”

YES-monitoring of native and non-native species (relative abundance, distribution, size structure) should be integrated into this threshold standards framework.

**TRPA RESPONSE:** Addressed in the recommendation section.

Trend: I agree that the methodological differences employed through time to assess littoral habitat represent a refinement in habitat mapping rather than a real change in habitat quality/quantity.

Again, directly measuring trends in fish distribution, relative abundance, and size structure should receive more attention rather than a sole focus on physical habitat.

**TRPA RESPONSE:** Addressed in the recommendation section.

Authors report High confidence in a meaningful trend (reduction in native minnows), yet this metric is not currently recognized as threshold standard for fisheries. This should be changed.

**TRPA RESPONSE:** Addressed in the recommendation section.

P 7-9 Implementation and Effectiveness: Does habitat mitigation occur at the site of disturbance, or can it be targeted for high-value restoration/mitigation actions elsewhere in the basin? Please clarify.

**TRPA RESPONSE:** Where disturbance cannot be avoided, mitigation actions are generally required in the general vicinity of the disturbance. This has been clarified in the text. The suggestion that consideration be given to where required mitigation can have the greatest impact for fish population has been added as an item for consideration in the recommendations to attain or maintain the threshold.

Effectiveness of Programs and Actions: While prevention of new invasive species introductions is unquestionably important, the more critical issue is whether some existing non-native species are expanding abundance, distribution, or impact on native species.

**TRPA RESPONSE:** We recognize the central role that preventing new and controlling existing AIS has on native fish populations. A more robust discussion of AIS prevention and control program is included in the water quality section. We have modified the actions implemented to include reference to accomplishments of the program and now include a note directing interested readers to that section of the report.

Recommendations:

Additional the additional of more direct threshold standards for status and trends of littoral fishes and pelagic habitat thresholds should be adopted as mentioned in sections above. These additions would then require additional monitoring and analysis beyond the current focus on littoral habitat.

**TRPA RESPONSE:** The suggested guidance to consider the adoption of standards for species rather than habitat is included in the recommendations section.

Modification of Threshold Standard or Indicators:

I agree that the 2016 map be adopted. Remote sensing technology and analytical capability will naturally continue to rapidly improve. So reduce concern about future quality of this metric-no need for aggressive efforts to improve.

**TRPA RESPONSE:** Support for the recommendation to adopt the 2016 map will be communicated as will the recommendation that further refinement of the map is not necessarily a high priority.

Adopting a formal monitoring program for assessing status and trends of native littoral species and non-natives is essential. As repeated from sections above Additional Threshold Standards and Indicators should include:

- Pelagic habitat standards (density of adult crustacean zooplankton, timing of thermal stratification, and the depth and temperature of epilimnion during summer)
- Non-native spp standards (relative abundance, spatial distribution, size structure).

**TRPA RESPONSE:** Recommendation on pelagic habitat standards now included in the recommendations section. Standards for non-native species are currently included in the water quality section. We agree that this siloed approach to management does not lend itself to effective communication or management and will incorporate the recommendation as we consider standard modification.

**Stream Habitat**

7-13 Devote a whole page to this map and label the tributaries. It's virtually useless at this small size and poor resolution.

**TRPA RESPONSE:** A higher resolution version of the map is now used and the size of the map is now nearly a page; major tributaries were labeled as well. The online reporting platform is in production and this concern will be directly addressed.

7-14 Monitoring and Analysis:

MMI-As a key metric for evaluating stream habitats, this index should be described in moderate detail in the Methods Chapter. Specifically, what measures of “ecological structure and function” are included, and at what temporal-spatial scales are they measured?

**TRPA RESPONSE:** A more detailed description of methods is now provided as well as text specifically directing interested readers to technical reference for CSCI scoring.

What I'm NOT seeing here is any direct correlation to fish production, growth, survival, size structure, etc.

Reliance on indirect measures of "stream health" doesn't necessarily translate to health of fish populations.

Because continuous temperature data, fish sampling data, etc. were not explicitly included in threshold standards for stream habitat condition, I'm concerned that this assessment will be misleading with regard to status and trend of fisheries

**TRPA RESPONSE:** We agree that the measure (and adopted threshold standard) is an indirect measure of stream health, and does not necessarily correlate to fish population health. The recommendations section has been modified to suggest addressing this concern in any modification or revision of the standard.

P 7-15. Top paragraph. Assigning a single rating to an entire stream is a real limitation, especially for the major drainages.

**TRPA RESPONSE:** The methodology uses a probabilistic sampling regime to assign a % of stream length in basin to individual categories. The score on an individual site on a stream does not serve as a score for the entire stream length. Instead, the percentage of randomly selected stream sites in different health categories (excellent, good, marginal) are reported.

P 7-16

22 degrees C is nearly an acute lethal temperature for most salmonids. A more reasonable threshold for chronic stressful exposure would be 18 degrees C. Cite some peer-reviewed literature here from Dan Isaak (USFS-Boise Experiment Station) and colleagues:

Wenger et al. 2011. Flow regime, temperature, and biotic interactions drive differential declines of trout species under climate change. Proceedings of the National Academy of Science [www.pnas.org/cgi/doi/10.1073/pnas.1103097108](http://www.pnas.org/cgi/doi/10.1073/pnas.1103097108)

Jager HI, Van Winkle W, Holcomb BD (1999) Would hydrologic climate changes in Sierra Nevada streams influence trout persistence? Trans Am Fish Soc 128:222–240.

McCullough DA, et al. (2009) Research in thermal biology: burning questions for coldwater stream fishes. Rev Fish Sci 17:90–115.

Sustained thermal tolerance is also strongly mediated by food supply: greater food supply enables greater tolerance to warmer conditions or longer periods of exposure.

**TRPA RESPONSE:** Additional discussion and references have been added that specifically address exposure to temperatures that can result in chronic stress and the likelihood that climate change may increase exposure to those elevated conditions.

A more explicit description of temperature monitoring (locations and whether continuous logging versus spot measures) is needed here.

**TRPA RESPONSE:** Continuous temperature and flow monitors were installed on five streams, which account for nearly 50% of tributary inflow, at or before 2015. Additionally, the temperature work conducted by Trout Unlimited in the Upper Truckee River is described in the report in more detail based on these comments.

Good physical habitat features won't support salmonids if temperatures are too high. Invertebrates do not necessarily share the same thermal tolerance or performance responses as fish, so BMI is also not a great correlate for stream habitat quality for fishes.

**TRPA RESPONSE:** As said before, TRPA understands that benthic macroinvertebrates don't necessarily correlate directly to fisheries health. This limitation will be addressed during the threshold review process. Additionally, a discussion of the potential impacts of climate change and warming stream temperatures has now been added to the conclusions and recommendations section.

Implementation and Effectiveness. Effectiveness of Programs and Actions:

P 7-18 Annual monitoring should be adapted to directly evaluate responses to restoration projects. What's effective and what isn't? Unless restoration projects can demonstrate TRPA

**TRPA RESPONSE:** We believe this comment applies more generally to the report and not just to the Fisheries threshold category. While the threshold evaluation report has historically focused on status and trend, we recognize that adaptive management requires more robust assessments of program and project effectiveness. The issue is now included as a general recommendation in the conclusions and recommendations chapter. Additionally, more stream monitoring sites that are the site of past or future restoration projects are now being included in the stream monitoring program to better assess restoration effectiveness based on these comments.

A bit more quantifiable statement here would help. The implication above that cumulative effects will eventually provide measurable benefits needs a comprehensive vision for how connectivity of quality habitat structure will improve the function and carrying capacity of stream habitat to support fisheries resources. What is the vision for achieving a meaningful "critical mass" of habitat restoration?

**TRPA RESPONSE:** We believe this comment also applies more generally to the report and not just to the Fisheries threshold category. TRPA and partners are actively addressing the issue of how we set interim targets and develop strategic plans that enable those goals to be realized. The issue is now included as a general recommendation in the conclusions and recommendations chapter.

P 7-19

Recommendations:

Without a more direct assessment of fish status, trends, or mechanistic examination of relevant limiting factors for native fishes, the monitoring and analytical approach are inadequate.

The current approach essentially tracks performance of benthic invertebrates and physical habitat features while ignoring or at least inadequately including more directly relevant metrics like diel-seasonal thermal regime and direct measures of size, condition, and relative abundance of fish. Not even presence/absence of fishes was mentioned here.

My apologies if I'm missing something here, but if so, then a bit more detailed description of how fish performance is measured or how fish performance connects directly to the metrics examined here would be very helpful.

**TRPA RESPONSE:** The observation is pointed and no apology is necessary. The current threshold standards, and thus the indicators identified to measure those standards relate to habitat condition, and not to populations. We recognize the potential shortcomings of this approach and in the recommendations section we recommend that standard review consider what the ultimate aims of the standard are. Additionally, the limited current fish sampling data that is available from the US Forest Service is included to show the low numbers of native fish and the low fish diversity currently in sampled Tahoe streams.

### **Instream Flow**

P 7-23 top of page: Related to Tracy & Rost's (2003) evaluation...establish minimum instream flow conditions."

Would be very helpful to link these findings and conclusions to criteria for selecting stream restoration projects, i.e., habitat restoration should only be emphasized in reaches with high probability that adequate flows and temperatures will be available.

**TRPA RESPONSE:** Restoration project prioritization has historically considered potential benefit for salmonid populations as a criterion when identifying sites. The recommendations section of the stream conditions indicator sheet has been modified to include the recommendation to more explicitly consider likely flow and temperature when prioritizing stream restoration projects.

### **Recommendations**

Regarding Modifications of the threshold standard or indicator:

Agreed, however, a stronger link between Tracy & Rost's conclusions and how these inform habitat restoration priorities would be valuable here.

**TRPA RESPONSE:** Addressed in the comment above.

### **Lahontan Cutthroat Trout**

Background:

Human & Environmental Drivers: Mysid shrimp should also be listed explicitly here.

**TRPA RESPONSE:** Modified text to include reference to the impact of mysid on the Lake's food web.

Implementation and Effectiveness:

"...continuing challenges include adverse interactions with non-native species..."

Mysis diluviana are a fundamental contributor to change in food web structure and competition for zooplankton, as well as a key energy source that supports lake trout production.

**TRPA RESPONSE:** Modified text to include Mysid in the discussion of food web alteration.

"...additional research is needed to improve understanding of reintroduced LCT population dynamics and their interactions with nonnative species (Al-Chokhachy et al. 2009)."

Understanding how LCT will seasonally utilize habitats and depths, grow, and withstand predation by lake trout are logical next steps in Lake Tahoe.

**TRPA RESPONSE:** Modified text to address additional information needs.

References:

Missing authors:

Al-Chokhachy, R., M. Peacock, L.G Heki, and G. Theide. 2009. "Evaluating the Reintroduction Potential of Lahontan Cutthroat Trout in Fallen Leaf Lake, California." *North American Journal of Fisheries Management* 29: 1296–1313.

**TRPA RESPONSE:** Reference added.

#### **Chapter 4 Water Quality**

In general, there was considerable redundancy throughout this chapter, because sections on nutrients and turbidity were divided into separate treatments of: 1) concentrations, and 2) total loading. Since total loading requires knowledge of daily concentrations x flow, combining these metrics into the same section(s) would provide more context for interpreting when high concentrations should be a real concern and could help identify and prioritize future restoration efforts. For instance, we should worry less about high concentrations of nutrients or turbidity when associated with relatively low flows or very short durations of high-concentration events than when associated with higher flows or more prolonged events. The highest total loading of both nutrients and turbidity typically come from watersheds with moderate concentrations, but higher total flows. So placing the concentration data in the context of total flows and thus total loading seems like a more meaningful way to present these data.

Unless this format is obligatory for some reason, I strongly recommend that the sections on concentrations and total loading be combined, then simply highlight the different implications and interpretations produced by these metrics. Some tables could simply add 1-2 more columns to combine the concentration and total loading data into a more synthetic and accessible form. Combining these sections would also reduce the length of this chapter significantly (perhaps by 30-40%).

**TRPA RESPONSE:** TRPA is in the process of migrating to an online reporting platform and reconsidering data organization and presentation to ensure it is accessible to the widest possible audience. The new reporting platform is designed to reduce much of the redundancy inherent in the current structure while still ensuring that readers have access to all the information necessary to understand the status and trend evaluation for each standard.

P4-2. Equally important is the exceedingly small areal extent of the watershed relative to the size of the lake.

Some acknowledgement of how the loss of *Daphnia* after the *Mysid* introduction affects lake transparency would be important. The much higher grazing capacity of *Daphnia* compared to copepods, etc. and vertical distribution patterns of *Daphnia* (primarily epi- and meta-limnetic) often combine to significantly increase transparency for lakes of similar trophic status. The loss of this relationship should also be highlighted in the Fisheries Chapter, because it was both a

more efficient link from primary production to fish production, but also as a process that can improve transparency.

**TRPA RESPONSE:** The impact the loss of *Daphnia* is likely to have had on lake clarity is now described in the clarity indicator sheet, and in the fisheries chapter.

Table 4-1. Are macrophytes covered in the Littoral Invasives section or elsewhere?

Macrophytes are an important concern for littoral dynamics and species composition and interactions. It would be helpful to explicitly list at least some of key groups of invasives intended here.

Table 4-2. Again, monitoring recent and existing aquatic invasives in both pelagic and littoral habitats should be assessed on a routine basis (e.g., during key month or months every 1-3 years) to facilitate early or rapid shifts in status that could generate detrimental impacts on water quality, food web stability, etc.

Too many table entries list insufficient data to even determine a trend!

**TRPA RESPONSE:** While TRPA wishes that it could provide status and trend determinations relative to the standard for all indicators, financial constraints (both past and present) of TRPA and partners agencies have always been a limiting factor. There are 178 threshold standard and the monitoring budget of TRPA and its partners have never been sufficient to consistently measure all indicators at a level we would like.

### Lake Tahoe Pelagic Waters

P 4-18: To clarify the definition of pelagic habitats in the 2<sup>nd</sup> sentence, please revise: "... all waters of the lake [with bottom depths] deeper than 30 feet or..."

**TRPA RESPONSE:** Text modified as suggested.

P 4-20-22. Trends in Secchi depth transparency are encouraging, even after accounting for potential bias from recent drought conditions.

P4-22. The 24,644 miles of street sweeping is presumably achieved by multiple sweeping over the same roads. Please clarify, e.g., sweeping on a regular cycle? Only where and when as needed?

**TRPA RESPONSE:** The miles of streets swept are reported annually by each jurisdiction, based on information from their internal operations tracking. The reported value includes single stretches of road that are swept more than one. Additional details are available at [ltinfo.org](http://ltinfo.org).

P4-25. Monitoring Approach. Presumably For practical reasons, the photic zone has been defined as some fixed range of depths (based on previous monitoring) from which depth-specific samples are drawn for estimating depth-integrated ppr, or are potentially different depths sampled every trip, depending on optical characteristics of that day? If a fixed depth is used, then please clarify by stating that:

“...water samples are collected from [the surface to xxx m at] 13 different depths spanning the photic zone [based on ???].”

Alternatively, if sampling depths are adapted to the photic zone estimated for that day, please explain the process

**TRPA RESPONSE:** The sampling depths are fixed based on previous analysis. Additional detail is now provided to clarify.

### **Tributary Water Quality**

Suspended sediment concentration threshold (60 mg/L).

P4-55. Midway through the monitoring Approach box, Please clarify that each stream averaged 28 sampling events per year: “For the last 10 years, the average number of samples collected [annually was N=28 for each stream]...”

**TRPA RESPONSE:** Text modified as suggested.

Note-The phrasing for the average number of samples taken annually per stream varied throughout the document. This particular example of phrasing was quite ambiguous whereas most others were better. It’d be useful to use clear consistent phrasing throughout.

P4-59. The recommended alternative analyses that would use time- and flow-weighted daily averaging for suspended sediment/turbidity and nutrients should be adopted wherever sufficient data are available.

The potential day-night sampling bias (“time-of-sampling bias”) is a legitimate concern and measures to address this should be prioritized.

P4-63. The different phosphorus standards used by Nevada (0.05 mg/L) and California (0.015 mg/L) should be consistently footnoted whenever status or trends are reported in Tables or figures.

**TRPA RESPONSE:** The standards are listed in the standard section of the indicator sheet.

Relevance—

-The regression of Total P versus turbidity would provide valuable quantitative support for the degree to which TP affects lake transparency

**TRPA RESPONSE:** TRPA will share the suggestion for additional analysis with our monitoring and management partners.

-I’d prefer that the value of algae to the aquatic food web be stated a bit more broadly (i.e., algae directly feeds primary consumers which are then consumed by invertebrates and vertebrates at higher trophic levels)

**TRPA RESPONSE:** Text modified as suggested.

Monitoring and Analytic Approaches: Again, combining the concentration and total loading sections would be very helpful here. When dealing with the concentration data in isolation, I started to be distracted by the concern that the mass-balance calculations for total loading would be compromised by how “average annual concentrations...” were computed, whereas if these sections were combined, the text would be significantly shorter, clearer, and much more informative.

P4-65 Another example of: “For the last 10 years, the average number of samples collected [annually was N=28 for each stream]...”

**TRPA RESPONSE:** Text modified as suggested.

P4-68. Analytic approach. Consider adopting the time- and flow-weighted averaging for TP. Again, this argues for combining the concentration and total loading sections together! Monitoring approach-if sufficient data are already available for some tribs, regression equations for TP versus turbidity would be valuable.

**TRPA RESPONSE:** The current presentation format is designed to balance accessibility to a general audience with providing enough detail on methods for parties interested in digging deeper. TRPA is in the process of migrating to an online reporting platform to provide users with access to raw data as well as files used to analyze that data.

### **Nitrogen Concentration**

Footnote the different TN concentration standards for Ward and General (0.15 mg/L) versus Blackwood, Trout, and Upper Truckee (0.19 mg/L) whenever referring to proportion of samples exceeding the standards, or for status and trend summaries.

P4-71. Again-please broaden the ecological contribution of primary producers to higher trophic levels in aquatic food webs (not just to primary consumers).

**TRPA RESPONSE:** Text recognizes the role in the entire food web of the lake.

P4-72. Great to have cross-calibrated 5.5 years of nitrate + nitrate data using old and new methods.

**TRPA RESPONSE:** An additional reference is now included for readers interested in learning more about the comparison between alternative methods for measuring nitrogen.

### **Tributaries Suspended Sediment Load**

P4-78 Adopted Standards-Please clarify standard 2) Littoral and pelagic Lake Tahoe: 3 NTU is quite a lot of turbidity for the pelagic zone. Please add more description as to whether this 3 NTU value pertains to individual measurements or some broader average across dates and/or locations.

**TRPA RESPONSE:** There was a typo in the draft that has now been corrected. The adopted standards section of the indicator sheet provides the text of the adopted standard for the reader.

P4-79. Analytical approach. Seems like many of the same analytical approaches were used for suspended sediments, phosphorus (TP) and nitrogen (TN). Can't these methods be combined in a much more efficient way for shared methodologies, then simply highlight differences specific to a particular constituent?

**TRPA RESPONSE:** Individual indicator sheets were designed to be stand-alone documents.

P4-83. Effectiveness of Programs and Actions. A recurring statement that the relative importance of specific factors cannot be dissected out because so many factors are co-mingled is not very satisfying. Improved analytical methods that can identify and quantify the relative contributions of various factors should be prioritized over the intervening period before the next Threshold Evaluation. Such an effort would produce tremendous benefits in terms of diagnosing the most problematic factors and would inform how to prioritize restoration efforts more effectively.

**TRPA RESPONSE:** The suggestion to focus more on effectiveness evaluation applies more broadly than just analysis of tributaries or the water quality chapter. The suggestion is now addressed in the conclusions and recommendations chapter.

Monitoring Approach-It's incredibly important to assess the effectiveness of restoration projects, yet very little effort has been allocated to such assessments historically. I applaud the authors' recognition this important issue. More thoughtful pre-post evaluation of restoration projects will be required to guide us to truly effective restoration practices.

**TRPA RESPONSE:** The recommendation has been retained.

Total Nitrogen Load.

The time series graph of Total N Load and Total Flow shows a phenomenal fit (nearly 1:1). Is this real? Earlier statements about how microbial action decoupled nitrogen availability from loading seems to be contradicted by this figure.

**TRPA RESPONSE:** The graph is correct. The annual total load closely tracks the annual total runoff. The apparent correlation is spurious, since load is the product of concentration and runoff. The availability of organic nitrogen (TON) to microbes is not related to the total annual TON load, though it explains why TON load is important.

\*P4-104. Modification of the threshold standard or indicator-

-Need to develop tributary load reduction targets in order to establish some benchmark for evaluating status, trends, and progress toward attainment. These targets can be modified adaptively as new information emerges, but in their absence the monitoring, evaluation, and restoration efforts will be unnecessarily open-ended and lack effective guidance.

### **Surface runoff**

P4-109. Effectiveness of programs and actions. With regard to the diminishing returns from increasing storm water retention beyond the 20-year 1-hr storm. While valuable to evaluate

potential cost-benefit ratios, stating just the average response curve seems overly simplistic here. I doubt that all locations behave so similarly. An incremental change in retention capacity at some locations could produce much greater (or lesser) benefits than others. Does the citation (2<sup>nd</sup> Nature & NHC 2011) show the variability in responses among locations or conditions? If so, are the responses similar enough to support the claim that a 20-yr 1-hr retention capacity is a good all-around standard? If not, then a bit more detail would be really valuable here.

**TRPA RESPONSE:** [Additional detail is provided in the referenced material.](#)

I

mplementation and Effectiveness-

P4-114. If only 186 BMP certificates have been issued out of 2441 parcel owners that were notified that maintenance was due, then doesn't that imply only 7-8% compliance? Sounds like an enforcement issue here.

**TRPA RESPONSE:** [Compliance activities are coordinated with our TMDL partners and the local jurisdictions to ensure that all TMDL load reduction targets are met.](#)

P4-125. Recommendations-Monitoring approach.

Some good points listed here. They reinforce the suggestion that monitoring and analysis for concentrations and Total annual loading should be combined from the sampling design through final analysis phases.

**TRPA RESPONSE:** [The recommendations have been retained.](#)

## Fisheries

P 7-1, 2<sup>nd</sup> paragraph: A Table of native and non-native fishes, relative abundance (extirpated, rare, common), population trends (increasing, declining, stable) and approximate dates of discovery or extirpation would be useful.

Including 3 key invertebrates in this table (Daphnia, Crayfish and Mysids) would be helpful as well.

**TRPA RESPONSE:** We have added a figure to the introduction that shows a timeline for introduction of the non-native species and associated impacts of native species.

P 7-2, Policy points:

2. Some stream blockages may be beneficial for inhibiting the spread of non-native species, so perhaps include some caveats to acknowledge the potential usefulness of some blockages as a conservation tool.

**TRPA RESPONSE:** As indicated in the comment, some barriers are beneficial and the Regional Plan recognizes this. The text has been modified to capture this nuance.

5. Encouraging [functional] habitat improvement projects in streams and lakes.

**TRPA RESPONSE:** Noted for potential future policy modifications.

7. Clarify by rephrasing (The intent of this point was initially confusing). Proposed edit: "Transferring existing water diversions from streams to lake withdrawals, whenever feasible."

**TRPA RESPONSE:** Modified text accordingly.

P 7-3, Table 7-1 Lake Habitat:

The essential habitat paradigm developed in stream ecology is only partially effective in lake environments, especially in large lakes. Biotic interactions (food supply, predation, competition) become much more important processes regulating lake communities than simply physical habitat alone. Threshold standards should be expanded accordingly to ensure that appropriate monitoring metrics are tracked to evaluate status, trends, and key processes that underlie changes in health of fisheries resources.

**TRPA RESPONSE:** We recognize that the standard for lake fish "habitat" relates to only one aspect (physical qualities of the substrate in the nearshore) of the conditions and processes that influence the abundance of fish species in the Lake. We have expanded the discussion in the recommendations section to further address these issues.

Pelagic habitats cannot be ignored. Pelagic habitats support native Lahontan reddsides, Tui chub, (and probably larval sculpins), and historically supported Lahontan Cutthroat trout.

These habitats have been changed by non-native species (mysids, lake trout, etc.), loss of Daphnia, and warming thermal regime

**TRPA RESPONSE:** We recognize that the standard for lake fish "habitat" relates to only one aspect (physical qualities of the substrate in the nearshore) of the conditions and processes that influence the abundance of fish species in the Lake. We have expanded the discussion in the recommendations section to further address these issues.

The fisheries section should develop additional threshold standards to include:

- Pelagic habitat standards (density of adult crustacean zooplankton, timing of thermal stratification, and the depth and temperature of epilimnion during summer)
- Non-native spp standards (relative abundance, spatial distribution, size structure)

**TRPA RESPONSE:** Modified recommendations section accordingly.

Current lake habitat indicator (acres of nearshore habitat defined by substrate size): Does this account for seasonal hydrodynamics that would naturally sort and maintain different substrate size distributions along different shorelines? I worry about potential efforts to add or change substrate composition. These will not be sustainable unless they operate in concert with existing physical processes of wind, wave energy, water circulation, and sediment accretion or erosion zones.

**TRPA RESPONSE:** The current standard does not account for seasonal dynamics. The potential impact of seasonal hydrodynamics will be highlighted for consideration during the threshold review process.

Stream Habitat: Does this indicator factor in the need for connectivity among essential habitats that might support different life stages during different seasons? Some stream miles are more influential than others. Otherwise valuable habitat might not be useful if too fragmented or isolated from other reaches.

**TRPA RESPONSE:** The current standard and indicator identified to assess condition against that standard consider only habitat in aggregate. The recommendations section has been modified to include this recommendation in any review of the standards and to consider habitat connectivity as a factor when prioritizing stream restoration projects.

Instream Flow: The 2<sup>nd</sup> standard is confusing. Please clarify-is the intention to transfer water withdrawals from stream diversions to direct withdrawal from the lake? Phrasing for this in Table 7-2 is more informative: "Divert stream intakes to lake sources"

**TRPA RESPONSE:** No modification made, the text referenced is adopted in resolution 82-11.

Lahontan Cutthroat Trout: Adfluvial Lahontan cutthroat trout will require good pelagic conditions to support adequate growth and survival. This is more of a comment to highlight the need to increase the "Lake Habitat Standards" above.

**TRPA RESPONSE:** The limitations of the current standard are addressed both above and in indicator sheet.

### **Lake Habitat**

P 7-5: 1<sup>st</sup> paragraph. "Feed and cover habitats" It will be important to differentiate habitat needs of larval forms of minnows and suckers, which have more limited ability to move, feed, and deal with wave energy, from post-larval "fry."

I don't believe that enough is known about essential larval fish rearing habitat, but I suspect that the lower wave-energy sites with smaller substrate, might be very important for larval stages, but less important for fry and older juveniles.

**TRPA RESPONSE:** The recommendations section of the indicator sheet has been modified to specifically address concerns related to specific requirements at different life stages.

3<sup>rd</sup> paragraph: The decline in native fishes is likely more of a response to interactions with non-native species than change in littoral habitat alone. Reproduction, recruitment, growth and survival of fish species can be strongly influenced by seasonal food supply, thermal and other environmental conditions, interactions with native and non-native species; all of which can fundamentally change whether the existing physical habitat can adequately support these populations as they might have historically. Thus the need for additional threshold standards for lake habitat that relate to non-native spp, ecological and environmental conditions that affect survival and growth of native fishes.

**TRPA RESPONSE:** The impact of non-native species on native fish populations is directly referenced in the recommendations of the indicator sheet. The discussion of these impacts has and been expanded, as has the discussion of AIS control and prevention activities.

Direct monitoring of trends in native and non-native fishes (and key invertebrates like crayfish and mysids) should be included as indicators. For native minnows, quantitative, depth-stratified minnow trapping would be an effective low-cost approach for monitoring status and trends of these populations, and would benefit from existing time series data.

**TRPA RESPONSE:** Indicators and monitoring programs are tailored to the stated objectives of the individual threshold standard. The monitoring recommendations included above are much appreciated and will be taken into consideration during the threshold review process.

P 7-8 & 7-9 Indicator State:

Efforts to "restore 'prime' habitat" would be wasteful in the absence of evidence that habitat is the primary limiting factor responsible for suppressing fisheries resources.

Instead, improved information on which habitats support successful spawning-larval-fry transitions, monitoring non-native species and their effects on native fisheries resources are more pressing actions.

**TRPA RESPONSE:** This recommendation will be included in future planning efforts.

“...additional factors influence the quality of littoral fish habitat.”

YES-monitoring of native and non-native species (relative abundance, distribution, size structure) should be integrated into this threshold standards framework.

**TRPA RESPONSE:** Addressed in the recommendation section.

Trend: I agree that the methodological differences employed through time to assess littoral habitat represent a refinement in habitat mapping rather than a real change in habitat quality/quantity.

Again, directly measuring trends in fish distribution, relative abundance, and size structure should receive more attention rather than a sole focus on physical habitat.

**TRPA RESPONSE:** Addressed in the recommendation section.

Authors report High confidence in a meaningful trend (reduction in native minnows), yet this metric is not currently recognized as threshold standard for fisheries. This should be changed.

**TRPA RESPONSE:** Addressed in the recommendation section.

P 7-9 Implementation and Effectiveness: Does habitat mitigation occur at the site of disturbance, or can it be targeted for high-value restoration/mitigation actions elsewhere in the basin? Please clarify.

**TRPA RESPONSE:** Where disturbance cannot be avoided, mitigation actions are generally required in the general vicinity of the disturbance. This has been clarified in the text. The suggestion that consideration be given to where required mitigation can have the greatest impact for fish population has been added as an item for consideration in the recommendations to attain or maintain the threshold.

Effectiveness of Programs and Actions: While prevention of new invasive species introductions is unquestionably important, the more critical issue is whether some existing non-native species are expanding abundance, distribution, or impact on native species.

**TRPA RESPONSE:** We recognize the central role that preventing new and controlling existing AIS has on native fish populations. A more robust discussion of AIS prevention and control program is included in the water quality section. We have modified the actions implemented to include reference to accomplishments of the program and now include a note directing interested readers to that section of the report.

Recommendations:

Additional the additional of more direct threshold standards for status and trends of littoral fishes and pelagic habitat thresholds should be adopted as mentioned in sections above. These additions would then require additional monitoring and analysis beyond the current focus on littoral habitat.

**TRPA RESPONSE:** The suggested guidance to consider the adoption of standards for species rather than habitat is included in the recommendations section.

Modification of Threshold Standard or Indicators:

I agree that the 2016 map be adopted. Remote sensing technology and analytical capability will naturally continue to rapidly improve. So reduce concern about future quality of this metric-no need for aggressive efforts to improve.

**TRPA RESPONSE:** Support for the recommendation to adopt the 2016 map will be communicated as will the recommendation that further refinement of the map is not necessarily a high priority.

Adopting a formal monitoring program for assessing status and trends of native littoral species and non-natives is essential. As repeated from sections above Additional Threshold Standards and Indicators should include:

-Pelagic habitat standards (density of adult crustacean zooplankton, timing of thermal stratification, and the depth and temperature of epilimnion during summer)

-Non-native spp standards (relative abundance, spatial distribution, size structure).

**TRPA RESPONSE:** Recommendation on pelagic habitat standards now included in the recommendations section. Standards for non-native species are currently included in the water quality section. We agree that this siloed approach to management does not lend itself to effective communication or management and will incorporate the recommendation as we consider standard modification.

### **Stream Habitat**

7-13 Devote a whole page to this map and label the tributaries. It's virtually useless at this small size and poor resolution.

**TRPA RESPONSE:** A higher resolution version of the map is now used and the size of the map is now nearly a page; major tributaries were labeled as well. The online reporting platform is in production and this concern will be directly addressed.

7-14 Monitoring and Analysis:

MMI-As a key metric for evaluating stream habitats, this index should be described in moderate detail in the Methods Chapter. Specifically, what measures of “ecological structure and function” are included, and at what temporal-spatial scales are they measured?

**TRPA RESPONSE:** A more detailed description of methods is now provided as well as text specifically directing interested readers to technical reference for CSCI scoring.

\*What I'm NOT seeing here is any direct correlation to fish production, growth, survival, size structure, etc.

\*Reliance on indirect measures of "stream health" doesn't necessarily translate to health of fish populations.

Because continuous temperature data, fish sampling data, etc. were not explicitly included in threshold standards for stream habitat condition, I'm concerned that this assessment will be misleading with regard to status and trend of fisheries

**TRPA RESPONSE:** We agree that the measure (and adopted threshold standard) is an indirect measure of stream health, and does not necessarily correlate to fish population health. The recommendations section has been modified to suggest addressing this concern in any modification or revision of the standard.

P 7-15. Top paragraph. Assigning a single rating to an entire stream is a real limitation, especially for the major drainages.

**TRPA RESPONSE:** The methodology uses a probabilistic sampling regime to assign a percentage of stream length in basin to individual categories. The score on an individual site on a stream does not serve as a score for the entire stream length. Instead, the percentage of randomly selected stream sites in different health categories (excellent, good, marginal) are reported.

P 7-16

22 degrees C is nearly an acute lethal temperature for most salmonids. A more reasonable threshold for chronic stressful exposure would be 18 degrees C. Cite some peer-reviewed literature here from Dan Isaak (USFS-Boise Experiment Station) and colleagues:

Wenger et al. 2011. Flow regime, temperature, and biotic interactions drive differential declines of trout species under climate change. Proceedings of the National Academy of Science [www.pnas.org/cgi/doi/10.1073/pnas.1103097108](http://www.pnas.org/cgi/doi/10.1073/pnas.1103097108)

Jager HI, Van Winkle W, Holcomb BD (1999) Would hydrologic climate changes in Sierra Nevada streams influence trout persistence? Trans Am Fish Soc 128:222–240.

McCullough DA, et al. (2009) Research in thermal biology: burning questions for coldwater stream fishes. Rev Fish Sci 17:90–115.

Sustained thermal tolerance is also strongly mediated by food supply: greater food supply enables greater tolerance to warmer conditions or longer periods of exposure.

**TRPA RESPONSE:** Additional discussion and references have been added that specifically address exposure to temperatures that can result in chronic stress and the likelihood that climate change may increase exposure to those elevated conditions.

A more explicit description of temperature monitoring (locations and whether continuous logging versus spot measures) is needed here.

**TRPA RESPONSE:** Continuous temperature and flow monitors were installed on five streams, which account for nearly 50% of tributary inflow, at or before 2015. Additionally, the temperature work conducted by Trout Unlimited in the Upper Truckee River is described in the report in more detail based on these comments.

Good physical habitat features won't support salmonids if temperatures are too high. Invertebrates do not necessarily share the same thermal tolerance or performance responses as fish, so BMI is also not a great correlate for stream habitat quality for fishes.

**TRPA RESPONSE:** TRPA understands that benthic macroinvertebrates do not necessarily correlate directly to fisheries health. This limitation will be addressed during the threshold review process. Additionally, a discussion of the potential impacts of climate change and warming stream temperatures has now been added to the conclusions and recommendations section.

Implementation and Effectiveness. Effectiveness of Programs and Actions:

P 7-18 Annual monitoring should be adapted to directly evaluate responses to restoration projects. What's effective and what isn't? Unless restoration projects can demonstrate TRPA

**TRPA RESPONSE:** We believe this comment applies more generally to the report and not just to the Fisheries threshold category. While the threshold evaluation report has historically focused

on status and trend, we recognize that adaptive management requires more robust assessments of program and project effectiveness. The issue is now included as a general recommendation in the conclusions and recommendations chapter. Additionally, more stream monitoring sites that are the site of past or future restoration projects are now being included in the stream monitoring program to better assess restoration effectiveness based on these comments.

A bit more quantifiable statement here would help. The implication above that cumulative effects will eventually provide measurable benefits needs a comprehensive vision for how connectivity of quality habitat structure will improve the function and carrying capacity of stream habitat to support fisheries resources. What is the vision for achieving a meaningful "critical mass" of habitat restoration?

**TRPA RESPONSE:** We believe this comment also applies more generally to the report and not just to the Fisheries threshold category. TRPA and partners are actively addressing the issue of how we set interim targets and develop strategic plans that enable those goals to be realized. The issue is now included as a general recommendation in the conclusions and recommendations chapter.

P 7-19

Recommendations:

Without a more direct assessment of fish status, trends, or mechanistic examination of relevant limiting factors for native fishes, the monitoring and analytical approach are inadequate. The current approach essentially tracks performance of benthic invertebrates and physical habitat features while ignoring or at least inadequately including more directly relevant metrics like diel-seasonal thermal regime and direct measures of size, condition, and relative abundance of fish. Not even presence/absence of fishes was mentioned here.

My apologies if I'm missing something here, but if so, then a bit more detailed description of how fish performance is measured or how fish performance connects directly to the metrics examined here would be very helpful.

**TRPA RESPONSE:** The observation is pointed and no apology is necessary. The current threshold standards, and thus the indicators identified to measure those standards relate to habitat condition, and not to populations. We recognize the potential shortcomings of this approach and in the recommendations section we recommend that standard review consider what the ultimate aims of the standard are. Additionally, the limited current fish sampling data that is available from the US Forest Service is included to show the low numbers of native fish and the low fish diversity currently in sampled Tahoe streams.

### **Instream Flow**

P 7-23 top of page: Related to Tracy & Rost's (2003) evaluation...establish minimum instream flow conditions."

Would be very helpful to link these findings and conclusions to criteria for selecting stream restoration projects, i.e., habitat restoration should only be emphasized in reaches with high probability that adequate flows and temperatures will be available.

**TRPA RESPONSE:** Restoration project prioritization has historically considered potential benefit for salmonid populations as a criterion when identifying sites. The recommendations section of the stream conditions indicator sheet has been modified to include the recommendation to more explicitly consider likely flow and temperature when prioritizing stream restoration projects.

#### Recommendations

Regarding Modifications of the threshold standard or indicator:

Agreed, however, a stronger link between Tracy & Rost's conclusions and how these inform habitat restoration priorities would be valuable here.

**TRPA RESPONSE:** Addressed in the comment above.

#### Lahontan Cutthroat Trout

Background:

Human & Environmental Drivers: Mysis shrimp should also be listed explicitly here.

**TRPA RESPONSE:** Modified text to include reference to the impact of mysid on the Lake's food web.

Implementation and Effectiveness:

"...continuing challenges include adverse interactions with non-native species..."

*Mysis diluviana* are a fundamental contributor to change in food web structure and competition for zooplankton, as well as a key energy source that supports lake trout production.

**TRPA RESPONSE:** Modified text to include Mysis in the discussion of food web alteration.

Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

**2015 Threshold Evaluation Report**  
**Review of Introduction, Methods, and Soil Conservation chapters**  
**Derek B. Booth**  
**July 7, 2016**

## Biographical Summary

**Derek B. Booth, Ph.D., P.E., P.G.**

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Dr. Booth is an Adjunct Professor with the Bren School of Environmental Science and Management at UC Santa Barbara and an Affiliate Professor at the University of Washington, and the co-Senior Editor of the international scientific journal *Quaternary Research*. His research focuses on the impacts of watershed disturbance and urbanization on hillslope erosion, stormwater runoff, and stream-channel geomorphology. He holds a B.A. in Geology from UC Berkeley, and M.S. in Geology from Stanford University, and a Ph.D. in Geological Sciences from the University of Washington.

## REVIEW OF INTRODUCTION AND METHODS

### INTRODUCTION

#### Overview

This is a clearly written overview of the Tahoe-area history and the overall approach being taken in the rest of the document. Its level of detail seems about right, and the introduction to the indicator icons is clear (although the distinction between “Threshold Category “ and “Threshold Indicator Reporting Category” seems unintuitive and possibly unnecessary). Including an evaluation of confidence, and an option for compiling recommended changes to the indicators, is a welcome acknowledgment of the need to embrace uncertainty and ongoing improvements in approach.

**TRPA RESPONSE:** TRPA now refers simply to threshold categories and reporting category.

#### Specific comments

Figure 1-1. This map has a date of 2012. It should be clear whether it is “active” or just a handy, available graphic. Note that elements are not legible at page scale and should probably be enlarged or omitted for clarity. The “Stream Restoration Plan Area” for South Lake Tahoe is particularly difficult to interpret; “Mixed-Use” in the legend should probably be “Mixed Use”.

**TRPA RESPONSE:** The map has been updated.

Page 1-3. “Threshold standards set environment quality targets to protect the unique natural values of the Tahoe Region while still providing for appropriate and orderly development.” This should probably be revised to read “Threshold standards set environment quality targets INTENDED to protect...” There’s nothing in this document to suggest that anyone has really evaluated whether these targets, set back in the 1980’s, can actually achieve their stated goals. Based on the response-to-comments in the 2011 Threshold Evaluation, that is *not* the task of these documents (“the primary purpose of the threshold evaluation report [is] evaluating status attainment...” [p. E-31 of that review]). This response to the comment raises an obvious question: if not part of the Threshold Evaluation Report, where is this being done?

**TRPA RESPONSE:** \*

Because of this apparent shortcoming, the following statement on p. 1-4 does not appear to be supported: “The periodic threshold evaluations reported on progress in achieving threshold standards and put forward Regional Plan course corrections in response to best available science and monitoring.” Perhaps greater emphasis should be placed on the stated purpose of the Threshold Evaluation, “Provide recommendations on additional actions to facilitate threshold standard attainment *or otherwise improve the effectiveness of the plan or applicable standards*” (emphasis added). In other words, this should not just be an evaluation of progress towards a pre-established target, but whether the target itself is appropriate. That’s what “best available science” is supposed to inform.

**TRPA RESPONSE:** The “best available science” informs both the design and selection of policies and programs and to achieve the adopted targets, as well as the selection of targets. The limitations of not comprehensively reviewing the targets is addressed in the report, and the strategic initiative referenced above is intended to ensure that the threshold standards continue to reflect the values of the Region and are grounded in the “best available science.”

Page 1-5. The limitations of a status-and-trends monitoring program to determine causality is much appreciated—it is a commonly forgotten truth.

Page 1-6. The definition of numerical standard is missing the words “intended to” or “assumed to” or “hoped to” somewhere in its text. Presenting these numerical standards as rock-solid, precise thresholds of certain scientific validity provides no service to the public or managers. Does anyone believe that the provided example (“the annual average deep water transparency as measured by Secchi disk shall not be decreased below 29.7 meters”) will protect the stated values at a qualitatively different level than, say, 29.6 meters? Or 29.8 meters? Although the selected value is not arbitrary, nor does it provide three-digit precision for assuring certainty of goal attainment once reached. After all, in some cases such thresholds are later found to be simply wrong.

**TRPA RESPONSE:** Text modified as suggested, in order to capture the underlying assumption that the standards, if achieved, will achieve the desired goal.

The text for management standards is more circumspect (“intended to”).

For a *policy* statement to provide “specific direction” to an agency (or anyone else) is an oxymoron—policies are normally broad, aspirational statements to frame an overarching intent or goal. Reading through the provided text that follows is a perfect example of what is *not* specific.

**TRPA RESPONSE:** Modified text to ensure that the reader understands that the direction provided by policy statements is generally broad in nature.

## METHODS

### Overview

Having a centralized text that provides common definitions and approaches, and that outlines the data sources for all subsequent chapters, is a useful structure that goes far to streamline the presentation of the chapters that follow. The risk, however, is that it requires a standardized framework that may not be equally suited to every topical evaluation. Some of this difficulty is suggested by the specific thresholds and boundaries that are used to define the status of attainment or the magnitude of a trend. Avoiding arbitrary or inconsistent definitions from one chapter to the next is certainly commendable, but as noted in the peer review of the 2011 Report not every fractionally equivalent numerical change has the same meaning, or the same consequences, across all resource indicators.

**TRPA RESPONSE:** The Report describes the common reporting framework for all standards. This framework does not translate to a common management response for dealing with change across all indicators. Context for interpretation of the status and trend determination is provided in the discussion of the trend determination and management recommendations and management does not ascribe the same meaning to fractional change across all indicators.

### Specific comments

Page 2-1. Trying to set threshold standards that will be necessary (and sufficient) "...for the maintenance of a significant scenic, recreational, educational, scientific or natural value of the Region, or to maintain public health and safety within the Region" is a daunting task, and there should be a high degree of scientific skepticism that the Tahoe Region (or anyplace else) can get them right on the first attempt. However, I see little effort in either the responses to the 2011 peer review or the 2015 chapters that I am reviewing that such an introspective evaluation has been accomplished. I see changes at the margin (e.g., substituting a more current soils map for the original data source) but no substantive critique of the topic of this paragraph, namely the threshold standards themselves.

**TRPA RESPONSE:** \*

I also don't see any mention of the balance between environmental quality and economic opportunity invoked on page 1-3 of this 2015 draft ("...while still providing for appropriate and orderly development"). This definition of Threshold Standards is all about natural attributes—have we decided to ignore the economy, or is that an inconvenient (yet inescapable) reality best acknowledged as infrequently as possible?

**TRPA RESPONSE:** \*

Page 2-8. I doubt that the "estimated attainment date" will have much meaning for most indicators. Unless they're tied to a concrete, funded plan or program, it's almost silly to use what I assume would be a linear extrapolation of prior trends to "calculate" a date. Absent firm legally and/or financially obligated commitments, just don't do it.

**TRPA RESPONSE:** The establishment of "estimated attainment date" or "interim target date" date has been a particularly challenging area for TRPA, and are presented with trepidation under the long-standing code provision to include such dates. TRPA acknowledges the limits of its approach but is constrained by available resources to bring additional rigor to this code requirement. In response to the comment here and similar comments from other peer reviewers, the estimated attainment date is being omitted unless, as suggested, it has a firm empirical or scientific foundation. This recommendation and the proposed approach to bring

additional rigor to establishing interim targets dates is addressed in the conclusions and recommendations chapter of the Report.

Page 2-9. I would trust professional judgment of confidence (“weight of evidence,” if you prefer) much more than a 2-out-of-3-is-good approach. For example, a poor protocol will yield useless (i.e., “low confidence”) data no matter how and well-located and frequently they have been collected. That bad (or the wrong) data are collected with high precision and frequency, and with a certainty of where they are located, will not improve their value in assessing status.

Similarly, a mechanical stratification of  $r^2$  values for trend confidence is very limited. P-values aren’t much better (see Head et al., 2015, The Extent and Consequences of P-Hacking in Science: PLoS Biol 13, e1002106). Plot (and display) the data, and draw whatever qualitative conclusions you believe are warranted from such a display. I suspect, however, that only rare settings will provide you with sufficient information to quantify an assignment of confidence with the precision implied by this approach (and  $r^2$  values almost certainly won’t provide much basis in any case).

In summary, I see no defensible value in either Table 2-3 or Table 2-4. Please discuss this matter in depth with statisticians before pressing forward in this fashion.

**TRPA RESPONSE:** As discussed above, the common reporting framework for all standards does not translate to a common management framework for dealing with change across all indicators. The intention is to quickly communicate information to a general audience. No management decision is blindly responsive to these classifications. However, TRPA recognizes the potential limitations and will consider as part of the review process.

## REVIEW OF CHAPTER 5, SOIL CONSERVATION

### Overview

The Soil Conservation chapter begins with a laudable affirmation of the importance of protecting soil resources throughout the basin. Articulated benefits include sustaining vegetation, maintaining water quality, providing habitat, and providing “a platform for development.” Evaluating the state of such a critical watershed and ecosystem component is based on two reporting categories: impervious cover as a function of soil/landscape position, and stream environment zones (SEZ's).

As noted by a prior reviewer of the 2011 Threshold Evaluation, restricting the scope of this chapter to just two categories of indicators (and, by inference, two sources) of soil erosion appeared rather limiting. The response to this comment by the chapter contributors (Appendix E, p. E-31) stated “The chapter focuses on the impervious cover and SEZ indicator reporting categories *to address the primary purpose of the threshold evaluation report in evaluating status attainment*” (emphasis added). Although administratively defensible, this points to a fundamental shortcoming of this review process—and, by association, this 2015 draft Threshold Evaluation. If the overarching task of the report is not to evaluate the status and trends of Lake Tahoe for present and future generations, but instead to check off a bureaucratic box of potentially questionable relevance or value (see below), then the need for a peer review such as this one is quite limited.

**TRPA RESPONSE:** It is important to distinguish between the two process referenced in the comment above. The first is the evaluation of environmental conditions relative to the existing threshold standards, this exercise is the subject of this report. The second is the review and updating of the threshold standards, which is a strategic initiative of the agency and is described in more detail the global response to peer review comments.

Many acknowledge that the threshold standards may not be perfect, but we should recognize they reflect the political will of the many stakeholders in the region at the time they were established. In recognition of that fact, the agency and its partners in the Region are committed to producing a technically credible, and scientifically rigorous evaluation of the current standards for the stakeholders of the Region. The peer review is intended to ensure the rigor of the report. The second process, that of reviewing and updating the threshold standards is discussed in greater detail in the global response to comments.

### Detailed comments

As explained in the 2015 text (p. 5-1), “Impervious cover is a primary indicator of land disturbance. Excessive impervious surface contributes to sediment and nutrient inputs to Lake Tahoe and its tributaries impairing water quality, altering surface hydrology and groundwater recharge regimes. The results are often negative impacts on soil health, fisheries, wildlife habitat and vegetation growth. SEZ's provide a variety of critical services in the basin...” Although related to some extent, these two classes of indicators will be considered separately in this review.

**TRPA RESPONSE:** Standards for SEZ and impervious cover are analyzed separately in this report. Additional analysis in the water quality chapter of the report directly addresses pollutant load (sediments and nutrients) and the fisheries chapter include and analysis of the stream health. The current siloed approach to reporting on the standards may result in some confusion here, and we are exploring options to break out the resources silos.

### Impervious surfaces

In every iteration of the Threshold Evaluation report readily available on the internet (2001, 2006, 2011, and now 2015), the use of impervious cover and the associated criteria and thresholds are

cloned from that of Bailey (1974, Land-Capability Classification of the Lake Tahoe Basin, California-Nevada, A Guide For Planning. USFS, USDA, TRPA, South Lake Tahoe, CA). Thus, any review of the Soil Conservation chapter of the Threshold Evaluation must begin with a review of this 1974 report. Although the 2011 peer reviewers apparently lacked access to this document, it was readily available as of 2016. It appears to have been produced as an agency report; no record of an externally peer-reviewed document (e.g., a scientific journal article) has been found, and a subsequent update of the data sources and acreage tallies (Loftus 2007) strongly suggest that even internal agency review prior to its publication was minimal.

**\*TRPA RESPONSE:** The observed focus on impervious cover criteria is a direct product of the Bailey criteria being written into the adopted standards.

\*Bailey (1974) is, as its title clearly states, primarily a “land-capability classification of the Lake Tahoe Basin.” It followed a well-described procedure for using map-based data on topography, soil type and texture, and geology and geomorphology to define three hazard “potentials” (Bailey 1974, Table 4; reproduced as TRPA 2015, Table 5-2):

- Slope potential (divided into gradient categories of 0-5%, 5-9%, 9-16%, 16-30%, >30%)
- Erosion potential (based on aggregate stability and soil permeability)
- Runoff potential (based on hydrologic soil group)

This conceptual approach is well-supported in the literature of the 1960’s and 1970’s, and it bears great similarity to other such efforts of similar vintage. For example, the “Universal Soil Loss Equation” (first released in 1965, updated in 1978) predicts the potential erodibility of a soil at particular location on the landscape by the following parameters:

- Typical rainfall intensity
- Hillslope gradient
- Length of contributing hillslope
- Aggregate stability and soil permeability
- Soil texture
- Vegetative cover

In Bailey (1974), the discrimination of soil and landscape types is followed by a less well-defined process that integrates these potentials into 7 “Capability levels” (actually, 9 such levels because Level 1 is further subdivided into 1a, 1b, and 1c on the basis of soil saturation and “fragile flora and fauna”). Bailey (1974, p. 18) states that “No absolute evaluation of hazard was attempted; only relative hazard within the area was considered. The land capabilities map combines the data presented on each of the other maps to provide a single hazard rating of the basin.” However, each hazard rating *is* ultimately quantified precisely, by assigning a discrete numerical threshold for “disturbance” as measured by the fractionally recommended maximum impervious area coverage. This quantification is summarized in a table (Bailey 1974, p. 24) that is reproduced as part of Table 5-1 of TRPA (2015).

The sources of the assigned “allowable percentage of impervious cover” values in Bailey (1974) are asserted to comprise recent local erosion-rate studies, field observations, conversations with others, and a host of studies published in the late 1960’s and early 1970’s on sediment yields and runoff quantities from urban and suburban areas around the country. No specific values of imperviousness drawn from these studies are cited as a basis for the allowable percentages, and having personal familiarity with most of the cited literature I suspect it is because they do not actually provide any.

\*As noted in the 2015 draft report, the original soils mapping used by Bailey was subsequently updated by Loftus (2007). Curiously, Loftus's update to Bailey's Table 4 (Loftus 2007, Table 4a) is not included in the 2015 draft, which instead reproduces Bailey's original Table 4 (TRPA 2015, Table 5-2). The 2007 update, however, only reconciles some prior inconsistencies and puts forward a more recent, higher resolution map on which to base the boundaries of different soil categories. It does not re-evaluate the basis for the capability levels, or the specific values chosen, at all.

**\*TRPA RESPONSE:** The Bailey table outlining the attributes of the individual land capability classes is included, because the standard being evaluated refers directly to those classes. The Loftus table referred to is a simplified version of the Bailey table that does not include some of the descriptive text (ex, Disturbance Hazard) that is included in the Bailey version of the table.

\*Although beyond the scope of this review to provide a full critique of this 42-year-old technical report, since transformed without substantive modification or critique into management policy for one of the greatest natural resources of the continent, several aspects of that foundational study bear specific comment:

- *Sediment sources and erosion processes in the Lake Tahoe watershed*

Three fundamental assumptions underlie both Bailey (1974) and all available iterations of the Threshold Evaluation:

1. There are only two significant sources of management-responsive sediment to Lake Tahoe: urban development and degraded riparian zones.
2. The primary mechanisms by which urban development results in sediment production and delivery are surface runoff production, which can result in sheetwash and gullyng, or channel erosion from increased discharge in downstream receiving waters.
3. Increased sediment production from degraded riparian zones is a consequence of bank erosion and/or channel incision.

\*These assumptions are plausible, but none appear to have been subject to even casual inspection, never mind rigorous evaluation, in the context of the Threshold Evaluation. Regardless of what studies have subsequently been conducted in the Lake Tahoe basin over the last 40+ years, their unmodified acceptance from Bailey (1974) suggest that any such evaluations that *have* occurred have not informed the acceptance of these assumptions in their original form.

Even a cursory review of recent published studies suggests that much progress has been made on these topics, even if not incorporated into present management approaches. For example, Rios et al. (2014) monitored small urban catchments in the Lake Tahoe Basin and concluded that "small, urbanized watersheds and intervening zones are disproportionately important contributors of nonpoint source pollution, including nutrients and suspended particles." This supports the first assumption listed above; however, they also recognized that impervious area explained only "35.7%" of the variance in suspended sediment yields in their data set, suggesting that this parameter is likely not the major (never mind the only) determinant of fine sediment delivery into the lake, even from the land uses most likely to show such a dependency.

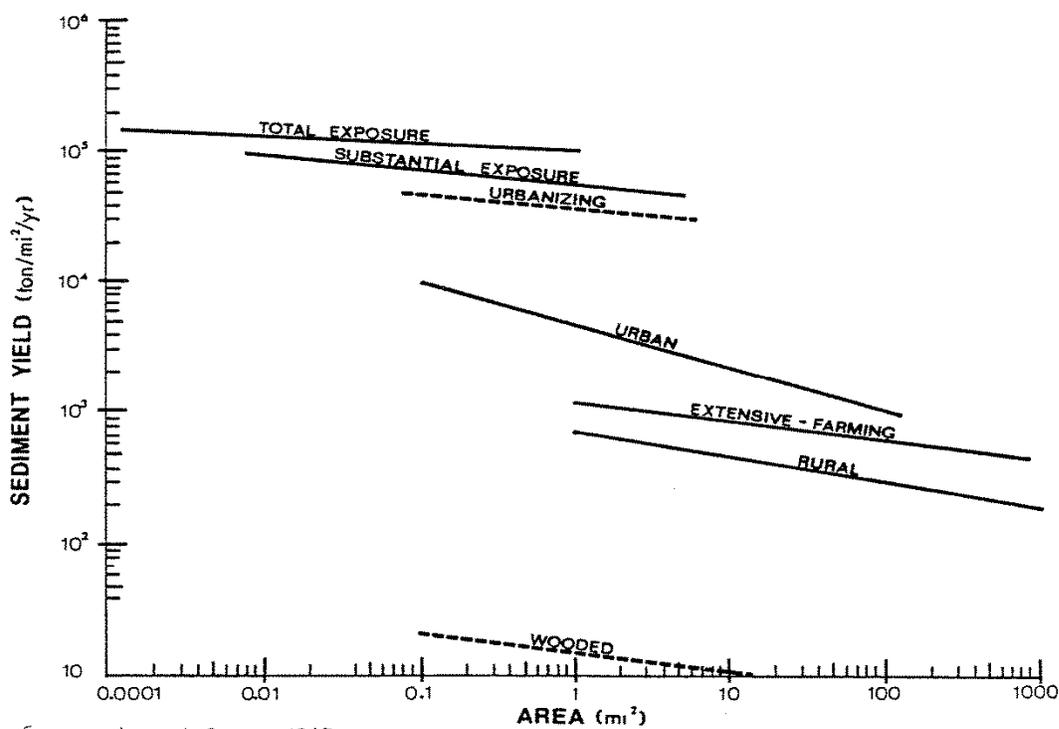
Simon (2008) made direct measurements of streambank erosion, extrapolated those results to the remaining unmonitored drainages across the basin, and compared the resulting totals of measured+inferred fine sediment delivery from bank erosion to prior estimates of total sediment delivery to the lake. He concluded that streambank erosion constitutes "25% of the average, annual fine-sediment load delivered to the lake from all sources." He also noted that the two largest contributors of fine sediment (the Upper Truckee River and Blackwood Creek) "account for slightly more than 80% of all fines emanating from streambanks." These findings suggest an

obvious geographic focus for management attention, but they do not necessarily support the wholesale aggradation of SEZ's regardless of location in the watershed, or any equivalency in the importance or value of their restoration.

Sediment budgets for non-urban catchments in the Tahoe basin (e.g., Stubblefield et al. 2009) suggest the types of information that would be needed to discriminate "urban" from "non-urban" sediment sources, but such information is not readily available in a compiled form. However, even localized case studies such as Stubblefield et al. emphasize the variability of sediment sources, and they stress the importance of understanding the nature, intensity, and location of the dominant processes (see assumptions 2 and 3 above). As they note (Stubblefield et al. 2009, p. 164), "Previous work in the Tahoe basin suggests three dominant erosional processes are prevalent: landslides; stream bank erosion from both tributaries and the main channel; and gully, rill and sheetwash occurring on steep denuded areas in headwaters, i.e. badlands." Not one of these processes has a particularly "urban" fingerprint, and only the first is likely to be improved by SEZ restoration.

**TRPA RESPONSE:** The 2011 TMDL provides detailed estimates of the pollutant loads and sources of those loads within the Tahoe Region (Lahontan & NDEP 2010a, 2010b). In the TMDL, fine suspended particles (FSP) are identified as the primary driver of declining clarity in Lake Tahoe. FSP are estimated to be responsible for about two-thirds of clarity loss and 72% of FSP originate from urban areas. The TMDL estimated that stream channel erosion accounted for 4% of FSP and that non-urban upland sources accounted for 9%.

These complexities notwithstanding, an influential body of literature has long-emphasized the potential for urban development to induce high rates of soil delivery to receiving waters (e.g., Wolman and Schick 1967). However, the very high rates of development-induced erosion that have gained management attention (such as the figure reproduced below from Wolman and Schick, 1967) are almost invariably associated with the land-clearing stage of urbanization (the "total exposure" [of the land surface] in the graph below). Less commonly appreciated is the subsequent reduction in sediment yields from the land surface once the ground is covered, an intuitive but often overlooked outcome of paving over exposed soil and stabilizing infrastructure-threatening landslides. In such settings, sediment loads that remain elevated above undisturbed levels are commonly due to the contribution of streambank erosion and incision from urban-increased runoff (e.g., Trimble 1997, Nelson and Booth 2002). Although this process is a consequence of increased impervious area, this is a useful indicator of such impacts only in the absence of effective stormwater management. Thus, avoiding or remediating such problems typically requires *runoff* control, not "erosion control." A lack of understanding the erosion-generating process(es) can therefore risk implementing mitigation that is not simply ineffectual but actually misguided.



**TRPA RESPONSE:** The focus in the basin is generally on pollutant load control, with the subsequent focus on understanding pollutant generating processes or pollutant sources in the basin. The current scientific basis for pollutant load management in the basin is detailed in the TMDL and associated documents (Lahontan & NDEP 2010a, 2010b, 2014).

- *Impervious cover*

Since Bailey's 1974 report, well over 4000 articles have been published in the scientific literature on urban development where "impervious" or "imperviousness" is mentioned in the title or abstract. Even the definition of the term has become more sophisticated, recognizing the critical differences between "connected" vs. "disconnected" (i.e., effective vs. ineffective) imperviousness that now underlies much of the recent technological and policy advances in stormwater management. There is no disagreement that impervious area is a key, landscape-scale indicator of urbanization and a host of associated disturbances, but any meaningful guidance for the 21<sup>st</sup> century should be using this metric, at most, as a starting point, not the sole criterion, for regulation and for tracking management success.

**TRPA RESPONSE:** As the comment suggests, impervious cover is just one of many indicators used to assess the effectiveness of programs and projects to reduce pollutant load the Lake. Confusion may arise because other indicators of management success are reported in other sections of the report. For example, the Water Quality section contains reporting on intermediate results such as load in tributaries and stormwater runoff and ultimate response in environmental conditions such as pelagic lake clarity and nearshore algal growth. Management action, such as pollutant load reduction accrediting for the TMDL program is coordinated by partners and specifically focuses on areas that are hydrologically connected to the Lake.

Degraded Stream Environment Zones (SEZ's)

\*As with imperviousness (as a broad indicator of “urban disturbance,” and so surely worth minimizing), so SEZ’s are valuable biotic and abiotic resources worthy of protection or restoration. Translating this recognized importance into effective and achievable management targets, however, requires something more than the blunt instrument offered by the guiding documents for the Threshold Evaluation. The discussion of the “Indicator status” beginning on page 5-13 of the 2015 draft exemplifies this critical shortcoming:

1. Preserve existing naturally functioning SEZ lands in their natural hydrologic condition:

Although asserted in the text to be “in attainment,” I see no basis to make such a conclusion. It’s apparently based on the presence of regulations for which “new coverage in SEZ lands has been prohibited unless it can be fully mitigated.” I appreciate the faith placed in such regulations, but as a staff scientist who helped enforce stream and wetland protection for a decade in a less far-flung watershed than that of Lake Tahoe, the apparent lack of field verification leaves this discussion somewhat unconvincing. Are there any data to support this assertion?

**TRPA RESPONSE:** The regulations referenced in the draft include and are supported by field verification. Field verification is the cornerstone of the permitting process and prevents degradation of SEZ in the Region. Additional detail is now included to clarify.

2. Restore 25 percent of the SEZ lands that have been identified as disturbed, developed or subdivided:

The 1+ page effort to “explain” this indicator gives ample testimony to its unworkability, and thus the broad irrelevance of any such evaluation. The discussion is almost Talmudic in its effort to justify making an evaluation (*any* evaluation) for purposes of the Threshold Evaluation; the authors should simply eschew their assigned task of “evaluating status attainment” and abandon any pretense of coherence in the present guidelines, in order to serve the greater good of maintaining an overall tone of credibility for the remainder of the chapter.

**TRPA RESPONSE:** The detailed explanation of the methods used to evaluate the standard provides transparency and contributes to the credibility of the evaluation. While the review suggests that the credibility of the evaluation is damaged by the transparent nature of the evaluation methods, this runs counter the guidance of most experts in the field and guidance of international institutions (Gerrard 2006; Mackay 2007; UNEG 2012, 2014; IUCN 2015).

That said, the goal of restoring riparian lands is a worthy one, and measures to track that progress are surely needed. Improving the current state of definition and evaluation would be a worthy task for the Threshold Evaluation. For example, is “disturbed” the same as “subdivided”? They are lumped together in this category, but presumably not *every* SEZ on subdivided property is been disturbed (and if it has been, they how can we have faith in the regulations touted in #1 above?). If an SEZ on subdivided land, presumed to be in the presently counted acreage of “disturbed, developed, or subdivided,” is subsequently found to be in a functioning condition, does it now count as “restored” and so contributing to attainment of the 25% target?

**TRPA RESPONSE:** While TRPA recognizes the difference between “Disturbed” and “Subdivided” the adopted standards that is the subject of this evaluation lumps the two together. This is critical to understand the target formulation (which is percentage based) and is discussed in detail in the status section of the indicator sheet. The clarification suggested in the review is included in the recommendations for “modification of the threshold standard or indicator” of the indicator sheet. The approach to evaluation is conservative in that only restoration projects contribute towards attainment of the restoration goal.

3. Restore all disturbed SEZ lands in undeveloped, un-subdivided lands:

This discussion on p. 5-18 of the 2015 report raises the obvious question of why *all* SEZ’s, regardless of location, are not targeted for ultimate restoration. As noted elsewhere (and as widely

appreciated in the broader scientific literature), riparian zones are perhaps the single most critical, “sensitive” parts of a landscape. Why would such a goal not be articulated for the entirety of the stream and river network of the basin? Indeed, why would the restoration effort not be greatest where the impacts from surrounding land uses are most intense and problematic?

**TRPA RESPONSE:** Additional information on the SEZ restoration target can be found the reports that led to the adoption of the SEZ standard (TRPA 1982a, 1982b). While beyond the scope of this document to address in detail, the earlier comments of this review suggested the need to address and find balance between environmental and economic concerns. There is some indication of why the standard was not established for indication that the standards framers had these concerns in mind when they established the standard. See text below from 1978 water quality management plan (TRPA 1978), “The cost of restoring all SEZ to their natural state would be cost prohibitive. This solution should only be applied in limited situations where benefits received would also be substantial.” This background information is now included in the report for readers wishing for additional background.

As noted above, in response to a peer review comment on the 2011 report—if the response to such comments is that the scope of this Threshold Evaluation is self-limited only to evaluating the criteria as previously administratively defined, then this is not a scientific peer review and the Threshold Report is not responsive to best available science—and it simply should not be represented as such.

**TRPA RESPONSE:** The charge to the peer reviewers of this report asked each peer review panelist to evaluate both 1) the credibility of the analysis presented and the findings and conclusions, and 2) what other information should be presented to improve management in Region. The hope is that by not limiting the peer reviews comments, the Agency and partners in the Region will receive constructive guidance that will ultimately lead to better management. This report, like nearly all reports on progress towards shared goals of a large group of stakeholders, is “self-limiting” in the extent that it focuses on what the stakeholders’ previously agreed the report would focus on. TRPA is a Bi-State Agency that is accountable to the citizens and their representative’s in the government of the two states. The content of this report is outlined in resolution 82-11 that established the threshold standards.

*\*4. Attain a 5 percent total increase in the area of naturally functioning SEZ lands:*

Given the uncertainties noted above in terms of both definition of terms and on-the-ground conditions, it is difficult to see how any defensible evaluation of this threshold can be made. It is equally unclear why “5%” is a meaningful, credible value. If there are underlying economic, social, or political drivers that require a target that falls somewhat short of full restoration of *all* SEZ lands, then in the interest of producing a transparent, scientifically defensible document those drivers should be shared. Otherwise, this indicator stands in direct contradiction to the prior discussion of these critical landscape features.

## SUMMARY AND RECOMMENDATIONS

\*Using a 40+ year old unreviewed report as the foundation for evaluation and management of soil-related resources in the Tahoe Basin is *not*, emphatically, “best available science.” That said, the framework provided by Bailey (1974) is a credible one, and the revision that is so urgently needed here need not abandon all prior work to constitute a credible replacement. Such an effort would likely follow steps similar to the following suggested sequence of activities:

1. Compile key pieces of watershed information and definition—topography (in particular, slope angle), geology and soils, hydrography (rivers, streams, wetlands). These are the “factors” of Bailey (1974).
2. Integrate these layers into relatively homogeneous landscape areas with respect to sediment-production susceptibility. These are equivalent to the “hazard classes” of Bailey (1974), although the manner of their integration requires greater transparency and objective criteria than is presented in that earlier document.
3. Evaluate the magnitude of soil erosion and delivery of each hazard class, distinguishing between natural production rates and those associated with land disturbance. This was accomplished in Bailey (1974) using somewhat intuitive and unquantified criteria, and without distinguishing “natural” from “disturbed” productivity in either relative or absolute terms. A “modern” approach would undoubtedly include some combination of prior (i.e., published) and new field measurements and observations.
4. Integrate the distribution and the magnitude of soil erosion into sediment budget for the watershed, at a level of accuracy and precision necessary to identify (1) major sources of sediment into the lake and (2) potential greatest increases in sediment delivery as a result of future development. This was done in only a rudimentary fashion in Bailey (1974), simply by identifying the “most susceptible” classes. Although a useful first step, this does not provide a basis for evaluating whether future development is likely to significantly impact sediment delivery to the lake. A good starting framework could be developed from texts such as Reid and Dunne’s book, *Rapid Evaluation of Sediment Budgets* (1996, Catena Verlag GMBH, 164 pp.) or any of the 144 published works that have since cited it.
5. Articulate the goal of watershed management with respect to sediment management: is it no net increase in sediment delivery? A net improvement? Degradation of SEZ’s that is no more than X%? Minimize degradation of SEZ’s while accommodating a Y% increase in developed land? Any such criterion is nowhere apparent, which makes any exercise in setting disturbance limits or restoration targets completely arbitrary.
6. Develop a suite of alternative management approaches that achieve the articulated goal of #5, based on the understanding of sediment-erosion and sediment-delivery processes developed in #4. This might include some combination of outright impervious-area limitations (the only strategy advanced in Bailey 1974), stormwater control from either new development and/or existing development, erosion control, and/or instream channel stabilization.

\*A somewhat parallel exercise is also needed with respect to the protection and restoration of SEZ’s. Without the sediment budgeting of #4 above, there is no way to know the degree to which degraded riparian zones are contributing to the sediment load of the lake, although recent studies (e.g., Simon 2008) suggest that these zones in general (even if not “degraded”) may be a significant source basin-wide. However, “restoration” of a SEZ should not necessarily be synonymous with “channel stabilization,” insofar as a naturally functioning river or stream may have significant, albeit localized, zones of bank erosion associated with channel migration. Channel erosion, of course, can be an entirely natural process that contributes to healthy stream ecosystems and the creation of

critical habitats, and so invoking a simple numerical target for restoration (particularly if the implementation is simply bank-hardening streambank stabilization) is unlikely to achieve broader ecological goals that ultimately will support a healthy lake condition as well.

\*Even prior to such a comprehensive evaluation, not all “degraded SEZ’s” have equivalent impact on sediment erosion and delivery, and not every locality is equal to every other with respect to net sediment contribution, broader opportunity for a broader range of benefits, or ease of achieving desired outcomes. Without some framework for stratification, never mind an understanding of actual importance to the stated goals, there’s really no point.

\*In summary, the present approach to evaluating the condition and the improvement in SEZ’s is an overly blunt instrument with no apparent scientific basis beyond “more is better.” The science has truly advanced in the last 40+ years; this Threshold Evaluation should, at minimum, acknowledge how much work remains to bring the protection of Lake Tahoe into the 21<sup>st</sup> century.

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Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

Robert C. Burns Evaluation.

### **Chapter 9—Scenic Resources.**

This chapter is an inventory and evaluation of the myriad of various scenic resources. The list is certainly exhaustive, and rates a majority of all scenic resources as “at or somewhat better.” This seems to be a very high proportion of scenic resources that are very good. If the management and stakeholders agree, than this method may be appropriate.

**TRPA RESPONSE:** At the time the scenic scoring and evaluation was done in 1982, approximately half of the roadway travel units and nearly 90 percent of the shoreline travel units were found to be in attainment. As summarized on pages 9-5 and 9-13, the ratings are calculated based on an evaluation of individual components of the visual environment, which are then aggregated to determine the composite scenic score. The 2010 “Status and Trend Monitoring Plan for Scenic Resources in the Lake Tahoe Basin” provides additional detail on the scenic monitoring approach, which is based on an objective method of evaluating visual quality using numerically-scaled definitions of certain landscape qualities, similar to the approach used by the U.S. Forest Service and Federal Highway Administration. While the report does identify a high proportion of units in attainment, the determination is based on an expert review of objective criteria, it is consistent with numerous previous evaluations, and it is generally consistent with recreation user satisfaction surveys, in which 98 and 96 percent of respondents reported satisfaction with the scenery in the Lake Tahoe Basin in 2005 and 2010, respectively (2011 Threshold Evaluation Chapter 11, Recreation).

The chapter is well written and uses a logical explanation process. However, I would suggest that the scenic resources should be evaluated by users of the area in addition to an inventory with manager-developed perceptions. If user surveys have been conducted, that information would support managers’ perceptions and would be another measure of quality assurance.

**\*TRPA RESPONSE:** User surveys to collect perception data outside of the formal field monitoring process conducted by the scenic evaluation team of experts could be done. This would be useful information, and could help calibrate or check the scenic monitoring if done with a large enough sample of users. However, review by trained scenic professionals is more comparable across years and would more objectively evaluate the specific components that comprise each scenic score.

As noted previously, the use of stakeholder, community and user group perceptions for Scenic Quality would be helpful for the managers to know that their opinions do not vary (or do vary) from those of the stakeholders. I would suggest the use of stakeholder data.

**TRPA RESPONSE:** See previous response.

## **Chapter 11. Recreation.**

The recreation survey section is rudimentary and, in reality, a loosely cobbled together set of data. As it exists I doubt the databases are valuable in management decision-making. The data should be analyzed more thoroughly and presented in the report in a way that is useful. The data should be segmented across various settings within the management area, and sociodemographic data should be analyzed as well.

I have concern that the data were collected by various different groups, and not by one agency. While this method can be perfectly fine if it is managed properly, the methods used should be outlined in the Methods chapter. The USFS NVUM process is referenced, but then quickly dismissed. There have been 3-4 rounds of data collected at the Lake Tahoe Management Unit. While the 2015 data may not yet be available, it would be useful to see the previous data analyzed and shown, at least for the high use sites.

**TRPA RESPONSE:** TRPA acknowledges the limitations in the recreation survey data. The available surveys were conducted for different purposes, do not address the full range of recreation opportunities in the region, and are not comparable to the surveys used in previous evaluations. The introductory section on page 11-1 and the monitoring approach section on page 11-4 were both revised to be explicit about the limitations of the user satisfaction survey data.

The NVUM data was used in previous threshold evaluations, however data was not available for the 2011 – 2015 evaluation period addressed by this report. The previous NVUM data has been analyzed and is available in the 2011 Threshold Evaluation Report. It was excluded from this evaluation to avoid comparisons between recreation surveys that were conducted using different approaches and focused on different geographic areas.

Page 11-9 includes a series of recommended changes to the monitoring and analytical approach that are intended to result in a more consistent and coherent planned monitoring approach, which would address the concerns expressed in this comment.

The PAOT data should be analyzed for this report, not simply referred to as being historically bad (page 13). This report should show trend data over time, and include the same types of graphs and arrows as seen in the methods section.

**TRPA RESPONSE:** The PAOT data is analyzed on pages 11-14 and 11-14. In response to this comment, a new figure 11.2 was added to present trends in PAOT allocations over time.

I am not confident that the satisfaction questions will answer what is needed for progressive park management. For example, satisfaction with recreation access and safety are lumped into one category. A quick look at previous research would show that these should not be grouped together, as they are very different questions. The lowest score is seen for this item. But is the problem with safety or access? And where does the problem exist? The data are presented at the end of this report in a confusing manner. I am concerned about the very low ratings of satisfaction for many of these items.

**TRPA RESPONSE:** In response to this comment, the access and safety category was divided into two separate categories in the figure on page 11-2, and in Appendix 1. Appendix 1 was revised to provide additional explanatory language and detail on survey methods. The recommended changes to the Threshold standard, analytic approach, and monitoring approach, described on page 11-9, are intended to address the concerns raised in this comment. Implementation of these recommendations would provide a more consistent planned monitoring approach that is specifically designed to provide the information needed to inform recreation policy and management.

## Review of the Tahoe Regional Planning Agency's 2015 Threshold Evaluation Report

Thank you very much for the opportunity to review this report. As a limnologist who has been concerned about eutrophication in large lakes around the world, I welcome the chance to learn more about iconic Lake Tahoe. The TRPA is to be commended for its extremely comprehensive work with such a large and varied number of groups of stakeholders. It is clear that in the overall sense Lake Tahoe is well protected and showing positive signs that the efforts to protect it and remediate it are working. I reviewed chapters 1, 2 and 4, the Water Quality chapter. My comments specific to each chapter are below.

Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

### Comments on Chapter 1 Introduction

#### History

The background and historical information is adequate and appropriately brief; however, it could be even briefer and more specific if it contained a simple table or diagram of the timeline of events impacting the Lake Tahoe ecosystem. This section should include a few statements addressing important environmental challenges faced by the TRPA that are imposed beyond the watershed boundary including climate change, atmospheric transport of nutrients and pollutants and invasive species.

**TRPA RESPONSE:** Discussion of important environmental challenges facing TRPA and Lake Tahoe has been included in the Executive Summary.

#### 2015 Threshold Evaluation Report

This introduction to this section acts as a reasonable guide to how to navigate the individual chapters for each of the nine threshold categories. I found the reference to Figure 1-2 confusing at the point when the reader is referred to "As can be seen in the right hand column..." – this is confusing and does not serve to illustrate the statement about types of standards.

**TRPA RESPONSE:** The paragraph has been written to improve clarity.

#### Description of Indicator Summaries

This section is in general straightforward; however, it becomes confusing at the heading "Implementation and effectiveness". It seems this subsection should be more logically entitled "Progress toward attainment of threshold standards".

**TRPA RESPONSE:** Change in conditions relative to the standard is reported in the status and trend section. The "Implementation and effectiveness" reports on the program and policies of TRPA and partners that contribute to attaining and maintaining standards.

#### Evaluation of Management Standards and Policy Statements

This section of the Introduction was confusing to me as it did not seem relevant to the Water Quality Chapter. Although some Standard Types listed as Management and Policy are listed in Table 4-1, few of these standard types had related indicator summaries in Chapter 4. This section of the introduction should be clarified as to what section or sections of the report these statements are applicable to.

**TRPA RESPONSE:** This section applies to management standards without numeric targets and policy statements. Text has been for clarity. Each indicator sheet details the type of standard being evaluated and the evaluation criteria.

## Comments on Chapter 2 Methodology

The introductory paragraph for this chapter is a bit misleading. Item 2 in the list on page 2-1 indicates this chapter includes an outline of the indicator summaries. This information is actually provided in Chapter 1.

**TRPA RESPONSE:** Item 2 has been moved from the introduction to the methods section as suggested.

Evaluation of numerical standards and management standards with numeric targets

Determination of indicator status

This section is problematic as it provides an example of how it may be inappropriate to express target attainment status as a percent calculation followed by a detailed example for Secchi disk depth which was the example previously provided. Light is absorbed and scattered logarithmically with depth and this makes it difficult to compare Secchi disk depths directly to variables that change in a linear fashion. In general the Secchi disk depth should be logged to perform calculations. It would be best to provide an example using a different type of indicator such as TP.

**TRPA RESPONSE:** The challenges of using a linear percent to target calculation are discussed in the text of the document.

Evaluation of indicator trend

The use of a simple linear regression on non transformed data may not be providing appropriate trends. As discussed above calculations involving Secchi disk measurements should be transformed. Other data, where the ranges of values are large, should also be transformed to avoid possible sensitivity to a few high or low numbers. Many researchers use the Sens slope rather than regression for this type of data.

**TRPA RESPONSE:** The section describes the general approach where more indicator specific analysis were not employed. The indicator sheets contain detailed descriptions of the analysis performed. For example, the Secchi disk trend is assessed by UC-Davis using a general additive model.

Confidence in status and trend determination

It is good to see that you provide assessment for the different components of the indicator assessment. While a measurement in itself might be very robust, the analyses of temporal and spatial data is much less likely to be statistically robust. This is a good reason to have more than one indicator to address a particular issue.

**TRPA RESPONSE:** Comment noted.

Evaluation of management standards and policy statements

This section of Chapter 2 was not really relevant to the water quality chapter; however, I did notice that this section appears to be a repeat of what was previously provided in Chapter 1 (the Introduction) on page 1-10.

**TRPA RESPONSE:** Descriptions of how management standards and policy statements were evaluated may not be relevant to the water quality chapter but it is relevant to many other chapters and is therefore kept in the methodology chapter.

Sources of status and trend data information

This information appears in the indicator summaries and could possibly be eliminated from this chapter.

**TRPA RESPONSE:** The information is compiled here for readers that do not delve into all the details of the individual indicator sheets.

### **Overall assessment of Chapters 1 and 2**

Adequate. Some duplication. It might flow more readily if the Introduction was briefer. The section on Description of Indicator summaries might fit more logically into Chapter 2 which I would entitle Guide to Indicator Summaries rather than methodology.

**TRPA RESPONSE:** The descriptions of indicator summaries has been moved from the introduction to the methods section as suggested. The name “methods” has been retained, because the section more broadly details the methods used.

### **Comments on Chapter 4 Water Quality**

#### **General issues**

1. The use of annual averages to analyze trends is problematic as many variables are driven by a few episodic events
2. Many references were missing or if cited not readily available.
3. Where does the primary productivity go?
4. Modelling efforts are needed to link these separate data sets in a meaningful way to water quality. For example, the Sparrow model or more detailed SWAT model and others used in the Great Lakes could be helpful

#### **Specific Comments**

##### **Introduction**

Page 1, 2<sup>nd</sup> paragraph lists the six threshold standard categories. This section requires clarification in two ways. The categories should be more clearly defined. Depth criteria for pelagic and littoral water should be included. Tributaries are generally considered to be the conduit of surface runoff so this leads to confusion when there is a category called “surface runoffs.” This category as reported on here is more accurately defined as storm water outflow. The ground water and “other lake” category are not defined and although they are listed in Table 4-1 they do not appear again in the report. This should be changed or explained.

**TRPA RESPONSE:** Category names are drawn from the text of the resolution 82-11 of the TRPA governing board, and definitions are provided for each where they exist. An explanation of why indicator sheets for these two reporting categories do not appear in the report is now included.

Several references here and throughout the chapter (and in chapters 1 and 2) were either not included in the list of references or not available online. This leads to the reader wasting time looking for citations and becoming frustrated.

**TRPA RESPONSE:** TRPA recognizes that some references were missing from the peer review draft and has gone through to ensure that all references are now included in the draft.

In the next TRPA Threshold evaluation report I strongly recommend including metric units wherever imperial units are used throughout the report. Although the public is more familiar with imperial units, scientists are used to thinking in metric units and it is distracting to have to convert from imperial to metric units.

**TRPA RESPONSE:** We are in the process of migrating to an online reporting platform and will include metric units after imperial units or the ability to convert between the two on the platform if possible to facilitate reading by scientific audiences.

Page 1 last paragraph, it would be helpful to include the date when the value statements were developed to provide context. If these are the value statements coined in 1982 they could be understood in that context. Are these value statements examined periodically to determine if they still reflect the views of the TRPA.

**TRPA RESPONSE:** The value statements were developed when the various thresholds were first established in 1982. This is now clarified in the text. The threshold update initiative, which is described in the global response to comment, may include examining the value statements.

Fine sediment should be quantitatively defined.

**TRPA RESPONSE:** Quantitative definition is now provided.

Page 2 paragraph 3. It would be informative to provide specific examples of some of the invasive species and changed nearshore conditions that are alluded to in this paragraph.

**TRPA RESPONSE:** Examples of invasive species are now included.

### **Lake Tahoe's pelagic waters**

The designation of greater than 10 m is too shallow. Other studies consider the littoral to be less than 20 m. The scientific definition for the littoral is the 1% light level. In Lake Tahoe this depth would be much deeper than 10 m. By classifying water that is deeper than 10 m but receiving adequate light to drive benthic algal photosynthesis important information pertaining to changes in the nearshore and littoral may be missed.

**TRPA RESPONSE:** Text modified to reflect the TRPA. The definition of the nearshore used by researchers for monitoring is the 31-year average August (maximum) thermocline depth in Lake Tahoe is 21 m (69 feet).

The number of indicators for the pelagic is surprisingly small and the fact that there are no indicators in common with the littoral, tributary and stormwater runoff data is unfortunate. It makes it difficult to track and understand the linkages between the land and the lake and, therefore, demonstrate the impact of changes on the land to the lake. I recommend the inclusion of TSS, FSP, TN, and TP for the Pelagic, Littoral, Tributary and Stormwater runoff indicator categories. I also recommend adding phytoplankton chlorophyll a as a measure of phytoplankton biomass in both the pelagic and littoral. In the pelagic the addition of particulate stoichiometry (particulate carbon, nitrogen and phosphorus) would provide much needed information about the nutrient status of the pelagic phytoplankton. It is possible that some of these measurements are already being made and could easily be included as indicators and importantly these would be "linking indicators" for the Threshold Evaluation Report.

**TRPA RESPONSE:** \*

There is inconsistency between information in Table 4-1 and the indicator summaries. Nitrogen Loading is listed in the Pelagic indicator category as a numerical standard, but there is no indicator summary. Pollutant loading is listed as a management standard type for N, P and Fe but no summaries were provided. A standard listed as "Record of threshold standard exceedance" is confusing with no explanation in Table 4-1 or in the indicator summaries. These inconsistencies should be explained.

**TRPA RESPONSE:** Text has been added to clarify.

## Pelagic Lake Tahoe Annual Average Secchi depth

### Human and environmental drivers

This is a good description of the factors that contribute to the Secchi disk depth value and of the anthropogenic and environmental drivers that affect the Secchi disk depth. A driver not considered here but important to the Secchi dynamics is climate change. Climate change may have overarching indirect impacts on the components of the Secchi disk depth and specific impacts such as drought creating dust, increased temperature modifying the depth of stratification and therefore the light environment for phytoplankton in and below the epilimnion.

**TRPA RESPONSE:** The potential consequences of climate change are referenced in the Executive Summary, and Conclusions and Recommendations chapter, and the recommendations section of the clarity indicator sheet. The omission in the discussion of the drivers was an oversight that has been addressed in the Report.

### Secchi trends

This discussion raises several questions. Where are the separate winter and summer data? What are the dates of winter data? Has the timing of the winter and summer data changed since 1967 as a result of climate change. Meteorological data might be helpful in understanding trends especially more recent trends. The statement about a decline in small algal cells needs documentation. The same statement is made in the State of the Lake report for 2015 with no other information or reference. It is necessary to explain how this could contribute to a change in Secchi depth, but not a change in total chlorophyll a concentration (as presented in the State of the Lake Report (SOL)). Similarly it is necessary to explain how the shallower mixing depth contributes to a decline in Secchi.

**TRPA RESPONSE:** A more detailed explanation of how mixing depth and algal cells influence the observed Secchi disk depth has been added. The winter secchi depth data is included in the State of the Lake report referenced in the indicator summary.

### Secchi confidence

I agree the Secchi disk depth is a very useful indicator and should be continued. It is as you point out impacted by several factors so it is important to convey that in any presentation of the data and in general avoid making much of year to year changes.

**TRPA RESPONSE:** comment noted.

### Programs and actions

TMDL reports. The 2014 handbook was not accessible online. The 2010 publication specifies phosphorus and fine sediment particles need to be reduced as well as nitrogen. It is important to be specific as different approaches and costs are associated with these three different pollutants.

**TRPA RESPONSE:** All TMDL related materials are available on the TMDL website referenced in the report at: <https://www.enviroaccounting.com/TahoeTMDL/Program/Home>

### Recommendations

Nutrient reduction as recommended in the Sahoo et al 2015 publication is an important recommendation. As above there should also be an effort to determine how the reduction of N and P using different approaches differ in cost and effectiveness.

**TRPA RESPONSE:** The recommendation has been retained.

### Other comments

Fine suspended sediment is not included as an indicator in offshore yet this is what makes the major contribution to scattering of light (Swift et al 2006). Swift demonstrated that inorganic particle scattering primarily due to the < 4 µm size inorganic particles is the major contributor to Secchi disk measurements in pelagic Lake Tahoe. Based on the Secchi disk measures and the chlorophyll concentrations available in the SOL 2015 report, one would have to conclude that the decrease in Secchi disk transparency since 1984 must be due to an increase in suspended sediment as chlorophyll has remained essentially constant. Clearly the measurement and reporting of fine suspended particles in the pelagic would be relevant in the TER. To be of the most use, I suggest reporting the changes in FSP < 4.0 µm in the tributaries, littoral and pelagic in order to make the connection between the source of particles and impact on the lakes clarity. As Swift et al (2006) state these data are needed to run a model that will provide a linkage between erosion control measures and the lake's response.

**TRPA RESPONSE: \***

The designated State standard of 29.7 m is based on the mean Secchi depth from 1967 to 1971 while the designated State standard for the Vertical Light Extinction coefficient (VEC) is not to exceed 0.08 (m<sup>-1</sup>). The state standard for VEC has already been achieved several times since 1985. There is a disconnect between these two standards. A general equation to predict VEC from Secchi depth in waters not highly influenced by colour is:

$$\text{VEC} = 1.7 / \text{Secchi Depth}$$

Using this equation to estimate VEC for Lake Tahoe would generate a VEC of 0.057 (m<sup>-1</sup>) to meet the Secchi standard. This is almost exactly the value for VEC measurements reported for Lake Tahoe in the years 1971 to 1977.

It seems that there should be a more similar standard (or at least a clear explanation for each standard) to avoid confusion and doubt by the general reader who sees the goal for VEC being met but the goal for Secchi depth seeming a long way off.

**TRPA RESPONSE: \***

### **Pelagic Lake Tahoe Phytoplankton Primary Productivity**

#### Relevance

The annual average areal rates of carbon fixation reported for Lake Tahoe have been increasing in a linear fashion since measurements began in 1967. This is an interesting and important trend for Lake Tahoe. Primary productivity is a very complex indicator, e.g. it integrates light availability, light absorbance by phytoplankton as well as nutrient availability and modification due to consumption of the carbon fixed, so that the trends observed in Lake Tahoe could be the result of several factors impacting PP individually or in combination. Without understanding the underlying factors it may be inappropriate to conclude that the increasing rates of PP necessarily represent a negative trend for the health of Lake Tahoe. Assuming the methodology has remained completely unchanged, the trend should be explainable by understanding the components of primary production. The biomass and photosynthetic efficiency of the organisms at a given irradiance comprise the areal rate of carbon uptake at any given time and location in the lake. Thus any changes in algal biomass, pigment composition, photosynthetic efficiency, and light quality and or quantity could result in a change in areal carbon fixation. It is difficult to know which if any of these factors have changed over the course of PP measurements in Lake Tahoe because although carbon uptake is measured routinely at several depths it is not clear if there are measurements of chlorophyll and photosynthetic efficiency at the same depths. These data would be

needed along with light data to understand what changing factor is driving the increase in PP. Data found in the primary literature report that there have been changes in the phytoplankton community composition since monitoring began including a shift to smaller centric diatoms which is similar to trends in other large lakes undergoing re-oligotrophication (Reavie et al. 2014, JGLR 40:3 pp 618-639). Unfortunately there is not much information on the pico phytoplankton in Lake Tahoe. These tiny algae may be becoming more important in Lake Tahoe and to understand if smaller diatoms and smaller algae in general may be the reason primary productivity has increased without a concomitant increase in chlorophyll a would require information about the photosynthetic efficiency of these smaller species. The fact that chlorophyll a is not increasing in the pelagic waters of Lake Tahoe suggests that the measure of PP in the pelagic is not a strong indicator of lake health without additional information on the components of PP and importantly on the fate of PP. The lack of change in chlorophyll a concentration could also be explained by changes in loss rates of PP to grazers and or sedimentation; however I was unable to locate any recent studies exploring these processes in Lake Tahoe.

**TRPA RESPONSE:** TRPA is aware that there are many factors affecting primary productivity in Lake Tahoe, some known and some unknown by researchers. TRPA will continue to work with scientific partners to better understand these processes and how they affect management decisions.

#### Human and Environmental Drivers

Goldman et al (1993) demonstrated using enrichment bioassays that historically Lake Tahoe phytoplankton were nitrogen limited. However, beginning in 1980 phytoplankton were much more likely to be limited by P. The primary literature and the grey literature on Lake Tahoe consistently state that N and P are limiting phytoplankton growth in Lake Tahoe. If phosphorus is currently the limiting nutrient then the focus should be on P reduction rather than both P and N. Enrichment bioassays can be quite useful and they are cost effective; but, they are not always a reliable indicator of the processes occurring in situ. Phytoplankton incubated in containers during enrichment bioassays are cut off from nutrients potentially obtained from atmospheric gases and from regeneration by grazers and as a result these enrichment experiment results could provide an incorrect assessment of the limiting nutrient in situ. There are several simple physiological and composition measurements that could be made on water from the epilimnion of the pelagic of Lake Tahoe to document the nutrient limiting phytoplankton growth at any given time of the year (Guildford and Hecky 2000 L&O 45: 1213-1245).

**TRPA RESPONSE:** The monitoring suggestions above will be passed on to the group tasked with updating thresholds and their associated monitoring programs. More information on this process can be found in the global response to comments.

The majority of P entering Lake Tahoe is most likely originating in the basin and thus can be much more readily controlled than N which can have a major atmospheric component. The Laurentian Great Lakes recovered from eutrophication primarily as a result of the Great Lakes Water Quality Agreement implemented in 1972 and most recently revised in 2012. This agreement sets phosphorus loading targets and limits on point source emission and detergent use that have been demonstrated to be effective in reducing algal biomass. The Great Lakes recovery occurred even as nitrogen concentrations in the lakes continued to rise as a result of agriculture and transportation emissions. This recovery was driven by regulating point sources of P. Unfortunately, the low hanging fruit of P control has been picked and the managers of the Great Lakes now face the daunting task of trying to control non-point sources P from intensive agricultural areas particularly in the lands riparian to the western basin on Lake Erie. Documented increases in soluble reactive phosphorus concentrations in combination with warming temperatures and more intense precipitation events are driving potentially toxic blooms of the cyanobacteria *Microcystis* (Michalak et al 2013 PNAS 110: 6448-6452; Scavia et al. JGLR 40: 226-246).

The P cycle in the Great Lakes has also been dramatically impacted by invader zebra and quagga mussels (see section on AIS below for more comments on AIS in Lake Tahoe).

**TRPA RESPONSE:** comment noted.

Confidence in PP as an indicator. (High). I agree that you can be confident in the trend; however, as stated above the complexity in PP makes it difficult to interpret and therefore to be a useful indicator.

**TRPA RESPONSE:** \*

It is telling that there are no applicable State and Federal standards for phytoplankton primary productivity. This is not a commonly used indicator for eutrophication. Chlorophyll a is more commonly measured and although problematic in some ways it is a much more direct measure of phytoplankton biomass, and related problems such as algal blooms and potential oxygen demand through decomposition, than primary productivity.

**TRPA RESPONSE:** \*

### **Pelagic Lake Tahoe Vertical Extinction Co-efficient**

I think that Vertical Extinction measurements should be continued. They provide a complimentary measurement to the Secchi with a different sensitivity to particulate matter, and can be quantitative and analyzed to provide more insight than Secchi alone. VEC can be used to calculate the depth of the euphotic zone, the mean water column light intensity both measures are useful in understanding and quantifying primary productivity. However see Section on Secchi depth above for concern regarding the State standard.

**TRPA RESPONSE:** \*

### **Littoral Lake Tahoe**

As stated previously the criteria for littoral (< 10 m) may mean important information is unavailable about the health of the nearshore areas of Lake Tahoe. I appreciate from the information in the introduction to this section that recognition of the importance of the nearshore in Lake Tahoe is a relatively recent phenomenon as it has been in many economically and environmentally important large lakes and that it will take time to develop an appropriate monitoring program and generate data to evaluate trends. For example, the Great Lakes Water Quality Agreement (revised in 2012 specifically calls for development of a Nearshore Framework for monitoring and managing the nearshore environment. I recommend including common indicators in the littoral that would permit LTRPA to assess the impact of land use changes in the watershed on littoral and pelagic waters. Vertical light extinction, TN, TP, phytoplankton chlorophyll a, TSS and FSP measurements in nearshore waters taken in waters with a depth of about 10 m would be appropriate as, at this depth, the effect of episodic resuspension would be minimized.

**TRPA RESPONSE:** TRPA and partners are currently in the process of reviewing how resources are allocated to monitor the nearshore. The suggestions above will be raised within the context of that discussion. In a 2013 review on nearshore monitoring, scientists in the Region suggested that focusing on algae rather than nutrients was desirable because, it “ is more reliable than simply measuring nutrients at the very low concentrations typical in this lake (Heyvaert et al. 2013). ”

As noted above for the pelagic waters indicator summaries, it was difficult to reconcile the information from Table 4-1 with the indicator summaries.

**TRPA RESPONSE:** Many of the standards are included multiple times in resolution 82-11 and the current reporting structure attempts to balance comprehensiveness while limiting redundancy. Indicator summaries attempt to deal with this by listing the multiple standards to which they apply to in the “adopted standards” section of the indicator sheet. TRPA is in the process of migrating to an online reporting platform and are reconsidering how we organize and present information to ensure it accessible to the widest possible audience.

### **Nearshore water clarity**

In Table 4-1 the indicator standard “Sediment Loading” is listed with units of NTU. In Table 4-2 the summary of status and trends lists the indicator “Turbidity” at and away from stream mouths. In the indicator summary the indicator is referred to as “Nearshore water clarity” While all these terms are related they are not at all equal. It is necessary to be more clear and consistent about what is being measured and assessed and reported on in the different tables and summaries. The detailed discussion in the Recommendations section for this indicator summary implies that this indicator standard is being re-evaluated with the idea of using beam transmission as an indicator or water clarity rather than NTU. I strongly support this recommendation.

**TRPA RESPONSE:** The indicator names on tables 4-1 and 4-2 have been revised to ensure consistency with the indicator sheet presented later in the standard. TRPA and partners are currently in the process reviewing the threshold standards and how we monitor and evaluate progress towards those goals. The suggestion above will be raised within the content of that discussion.

There is some confusion in understanding the data presented in this section on littoral water clarity. After reading and rereading I believe I now understand that the data presented as box plots in the first figure in this section are data collected at the 25 m depth and the data presented in Figure 1 on page 4-37-38 are from a pilot study at the 7 m depth. Data at the 7m depth would be expected to be more representative of the nearshore than the 25 m depth. Although the indicator summary Table 4-2 provides status and trends for turbidity at stream mouths and away from stream mouths, there is no information or data in the indicator summary about the spatial variability relative to stream mouths in either the long term data collected at the 25 m contour or in the pilot study done at the 7 m contour.

**TRPA RESPONSE:** The interpretation above is correct, but we have modified the textual description of the data presented to improve clarity. The recommendations section of the indicator sheet explains the challenge of spatially and temporally delineating areas influenced by stream zones and thus the challenges associated with presenting the analysis suggested above.

I recommend VEC measurements be included as a littoral indicator for nearshore waters that are deeper than 7 m but shallower than 20 m. These measurements would provide a linkage to the VEC measurements in the pelagic and would also be useful for modelling periphyton growth in the nearshore.

**TRPA RESPONSE: \***

There is a real need for a nearshore water clarity indicator that can be compared to tributary load data to explore patterns and determine factors that reduce transparency along the gradient from nearshore to the pelagic.

**TRPA RESPONSE: \***

### **Nearshore attached algae**

It is good to see that the TRPA has adopted attached algae as an indicator of littoral health for Lake Tahoe. The accepted light level cut off for when respiration exceeds photosynthesis is 1% and in Lake Tahoe, attached algae would be expected to exhibit positive growth at depths of 20 m and even deeper. It is surprising that the monitoring for attached algae in Lake Tahoe is done at 0.5 m. At this shallow depth attached algal growth and biomass accumulation is expected to be significantly impacted by physical processes such as light inhibition of photosynthesis, high ultraviolet light exposures and by wave action. I recommend that the standard for attached algae be re-evaluated.

**TRPA RESPONSE: \***

There is confusion in trying to reconcile Table 4-1, 4-2 and the indicator summary for attached algae. The table of data for attached algae in the indicator summary does not provide units or an explanation for the > and < 6225 feet or 1000 days. It is very confusing. Reporting a mean value for the whole lake sampling is not informative for this indicator as it is so heterogeneous in space and time. The literature referred to were not readily available. Attached algae is an important indicator however based on this section of the report it is not clear that the monitoring or analysis are adequate to provide useful information.

**TRPA RESPONSE:** Both the table and the text description have been modified to provide additional information. Results for individual sites are presented in the trend section of the indicator sheet, and full site level details are available in the UC-Davis analysis of periphyton trends, referenced in the report is now included as an appendix to the report.

### **Nearshore Aquatic invasive species**

It is good to see that Lake Tahoe has a boat inspection program as this must be one of the main vectors for introduced species. Although it is good to see a large overall effort to protect against AIS it might be helpful to be more specific and to identify and prioritize based on type of organism and potential threat based on what has been learned in other water bodies. In the Laurentian Great Lakes increased water clarity as a result of filtering by the aquatic invader dreissenid mussels has resulted in dramatic increases in attached algae (Higgins et al. 2005, JGLR 31:547-563).

**TRPA RESPONSE:** TRPA continually works with partner agencies (as well as partners in other areas of the country as suggested) and researchers to better understand and prioritize management of AIS in Lake Tahoe according to best available science.

### **Tributary water quality**

The indicators in the tributaries are the most thoroughly covered indicators in the report however the use of the annual averages even when plotted as loads does not provide important information about the extreme and episodic events that would be expected to be the most important factors influencing long term trends and nutrient and sediment delivery into the lake.

**TRPA RESPONSE:** The suggestion to pay more attention to monitoring of extreme events for nutrient and sediment delivery will be passed on to the group tasked with updated the thresholds and their monitoring plans. A more thorough discussion of this process can be found in the global response to comments.

### **Tributaries suspended sediment concentration**

The data are difficult to assess because of the problem of sample number and timing. There is a good discussion of this problem, and it appears that there has already been an effort to address this problem.

I agree that continuous and or automated monitoring for some parameters in some streams would be valuable and provide a more realistic representation of the problem and the trends. The programs and actions to remediate suspended sediment in tributaries was vague for the two most problematic tributaries Blackwood and Ward. It would be good to see what actions if any can be suggested to remediate these undeveloped areas.

**TRPA RESPONSE:** Through the Environmental Improvement Program (EIP), numerous restoration projects have been undertaken in the Blackwood and Ward Creek watersheds to address suspended sediment concentrations. These projects include but are not limited to: removal of failing/eroding culverts, projects that fix bank erosion/channel incision through re-connection to historic floodplains, BMP's installed on forest and ski area roads, and stormwater improvements in urbanized areas.

### **Tributaries total phosphorus concentration**

The graphs for five of the seven tributaries were missing. Similar to the suspended sediment data the TP data in tributaries are difficult to assess due to temporal variability in both number of samples and actual concentrations. The data generated from continuous and automated monitoring of some variables will provide a more realistic assessment of improving or worsening trends for TP. These continuous monitoring records should help target problem locations and times and aid in understanding what mitigation actions are likely to be helpful and possible to implement.

**TRPA RESPONSE:** The layout that caused the graphs to not be displayed has been resolved and these graphs are displayed in full now in the report. The suggestion for continuous monitoring has been addressed in previous comments.

### **Tributaries Total nitrogen concentration**

As for TP and TSS the use of annual means is problematic when it is clear that inputs are extremely sensitive to weather events. The continuous monitoring approach is clearly needed. It is evident that efforts are ongoing to reduce human impacts and this is to be commended, but the future monitoring should help these efforts to be targeted more efficiently. It should be noted that in the Great Lakes TP inputs have been reduced resulting in reduced chlorophyll while at the same time TN has increased due to anthropogenic activities. While high concentrations of nitrogen can impact water quality in terms of algal composition and at extremely high concentrations threaten fish and even humans, there is not evidence that over the course of monitoring of the Great Lakes that nitrogen inputs have resulted in elevated chlorophyll. The Lake Tahoe report frequently states the need to control both N and P to control algal productivity and biomass. This may be the general consensus in the Lake Tahoe literature but it is not in the wider freshwater literature. Economic costs of controlling both may impact the ability to address specific causes and mechanisms to improve and maintain water quality.

**TRPA RESPONSE:** The suggestion that TRPA should perhaps pay less attention to total nitrogen concentrations will be passed on to the group tasked with updating the threshold standards. A more detailed description of this process can be found in the global response to comments.

### **Tributaries suspended sediment load**

This calculation is helpful and is useful to evaluate large spatial and temporal scale changes. It will be much more powerful when continuous monitoring of turbidity is available in addition to stream flow. It is good to see that based on this data there has been considerable reduction in erosion.

**TRPA RESPONSE:** comment noted.

### **Tributaries fine sediment load**

These data show no trend although measurements have been made since 2002. It may be a problem of reporting one size range (< 40 µm) rather than specific bin sizes representing different classically defined particles such as silt, clay and colloidal size. I determined from the literature I was able to access that these different sizes are likely being measured as part of the FSP measurement and could be reported.

**TRPA RESPONSE:** The reporting size range included in the analysis is actually < 20 µm, not < 40 µm. The difference between this and the TMDL definition of FSP (< 16 µm) is identified as an area for potential improvement.

### **Total phosphorus load and Total nitrogen load**

These data are a helpful way to synthesize the TP and TN concentration data and gauge the impact of these changing TP or TN concentrations to the lake. These graphs demonstrate the importance of climate to the loading to the lake.

**TRPA RESPONSE:** comment noted.

### **Surface Runoff**

I agree that controlling storm water runoff from urban areas is an important part of protecting water bodies. As it stands this section is not entirely understandable. It is odd that there are no P, N or suspended sediment concentration data presented for this section, yet there are plots of TP, TN and FSP loads to the lake. There should be an explanation about why the concentrations are not shown. The loadings reported are a very small proportion of the loadings resulting from the tributaries. It would be helpful to develop a quantitative model to help understand how reductions in stormwater runoff nutrient concentrations would be expected to impact the lake.

**TRPA RESPONSE:** P, N and suspended sediment concentration data are presented in the report, following the data presented for loading. The suggested model is the foundation of the Lake Tahoe TMDL and the load reductions targets it establishes to restore the clarity of the lake.

The units for FSP are reported in weight units but the FSP loading data for the tributaries is reported as numbers of particles. This makes it impossible to compare the relative contributions to the lake.

**TRPA RESPONSE:** As indicated on the indicator sheet, after March 2017 the data will be more directly comparable.

### **Overall comments and conclusions**

The water quality of Lake Tahoe is being evaluated with an impressive number of indicators and the record of data for many of the indicators is long and robust. This information is very valuable in assessing trends and modelling future conditions. I can understand the challenge of synthesizing this large data base and distilling it down to a 5 year evaluation report. Although the report provides detailed summaries of many indicator standards for the various components (indicator categories) of the lake, the lack of consistent indicator standards across indicator categories made it a challenge to understand how changes in the watershed impact the pelagic, littoral, tributary and stormwater runoff. For example, while it is clear that changes in TP loading from tributaries would be expected to impact littoral and offshore waters with respect to phytoplankton biomass, transparency and primary productivity, it seems that reporting TP concentrations in the littoral and the offshore in addition to the tributaries and stormwater would provide the reader with a more tangible and transparent way to

assess improvements to erosion in the watershed. The flow of the report would benefit from a diagram to map the indicators and linkages in the watershed, littoral and pelagic of Lake Tahoe. Another challenge of presenting such a long and detailed record of historical data is that extreme events are often masked by reporting annual averages. Trends exhibited by plotting extreme events rather than annual averages could reveal important changes otherwise missed.

**TRPA RESPONSE:** TRPA is in the process of migrating to an online reporting platform and are further reconsidering how we organize and present the information to ensure it is accessible to the widest possible audience. TRPA is experimenting with an online organizational structure that includes the explicit linkages suggest above, and that link actions, with intermediate results and outcomes.

Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

**Tahoe Regional Planning Agency's 2015 Threshold Evaluation Report**  
**Additional comments from Sonia A. Hall, peer review chair and coordinator**

In addition to coordinating the review of each chapter by at least two reviewers with specific expertise in the topic each chapter deals with, I am providing comments on each chapter. It is important to note that my expertise in the chapter's topic is general rather than specific, so these comments should be taken as subservient and complementary to those comments provided by the topic-expert reviewers.

### **Chapter 3 – Air Quality**

July 5, 2016

**P 3-1:** Achievement of air quality threshold standards *suggests* – rather than provides partial evidence for – effectiveness of the TRPA Regional Plan, associated programs, and air quality regulations and programs. Actual causal analysis would be necessary (and even recommended) to provide actual evidence of this effectiveness, and lack of notable shifts in indicator values when certain actions were implemented suggests that other drivers may be overwhelming such effectiveness in some cases.

**TRPA RESPONSE-** In large part, the effectiveness of air quality regulations and programs can be attributed to the more stringent mobile source emission controls placed upon the vehicle fleet at the national level. The actual evidence of the effectiveness of these controls at the national level can be traced to the decreasing trends in the regional air quality indicators. However, TRPA and the Tahoe Metropolitan Planning Organization (TMPO) have specific plans through the Regional Plan and Regional Transportation Plan to further reduce vehicle emissions and improve air quality. TRPA believes that while current air quality monitoring may not be able to definitively differentiate between improving trends from sources outside the basin and those from sources within the basin, the policies and plans in place through TRPA and the TMPO are sufficient to continue improving trends in air quality.

In the Fisheries chapter I highlighted the value of including TRPA's goal in the introductory paragraphs. What is TRPA's goal for air quality? Is it compliance with federal and state standards? Adoption of more stringent thresholds for some of the indicators suggests it is more than that. The goal should be explicitly stated.

**TRPA RESPONSE-** Goals for all the individual Threshold Chapters will be presented in the Executive Summary. The Goal for Air Quality in the 2011 Threshold Evaluation reads as follows; "To improve and maintain air quality to protect human health, scenic values and environmental quality, and reduce vehicle traffic volume".

*Regional Air Quality Conditions as Measured by the EPA Air Quality Index:* This section provides useful information, as identified by Mr. Hunt in his review. It is also a good example of ancillary data and analyses that are valuable and informative to decision-makers that rely on these Threshold Evaluation Reports. There is much opportunity to strengthen such ancillary data and analyses, as Dr. Spak describes, throughout the Report. However, this particular section is confusing in this particular place. I would recommend shifting this section (and the reference to the EPA AQI on P 3-8) to the end of the introductory section of this chapter (after Table 3-3 and initial description of the indicators and their status and trends summary). I would further recommend some discussion of how to best use this information to complement the Thresholds Evaluation.

**TRPA RESPONSE-** The Final Draft will relocate the findings of Table 3-3 to be better aligned with the EPA-AQI narrative discussion. The use of existing ancillary data to complement existing data will be discussed during the threshold and monitoring review and update.

**P 3-11:** Add to Figure 3-1 a simplified version of Table 1-1, the management and policy reporting icons.

**TRPA RESPONSE:** A table outlining the key to the reporting icon used to characterize the implementation status of management and policy statements has been added.

**P 3-25:** Please describe why data do not meet regulatory requirements for completeness and validation. The implication of this statement is very different if not meeting such requirements is due to (a) data too new and not yet evaluated, (b) not evaluated, and will not be evaluated, or (c) evaluated and found lacking in quality.

**TRPA RESPONSE-** TRPA uses the strictest Federal Reference Methods for establishing accuracy of data. In cases where the data does not meet regulatory reporting requirements, it is due to one of the following reasons:

- The data used is meant to accompany existing “official” data sets (the CO monitor in Stateline was only installed after the EPA and NDEP recommended removal of the existing CO monitor in Stateline because the long term data set found CO levels to be far within standards). Data in these cases is still calibrated and maintained by qualified air quality specialists but has not gone through the lengthy process of becoming officially recognized data.
- The data is for three year averages and the monitor has not been running for three years yet.
- The data was not complete under the EPA’s rules for completeness.

In all these cases, data is only used to assess status and trends when it is officially recognized data.

**Overall:** This chapter would benefit from a Conclusions section at the end, that summarizes the status and trends for the whole threshold category. This would be a narrative discussing Table 3-3, which was a very useful, visual summary of all the indicators and their status and trends. This concluding section would address: what do the status and trends information on all these indicators say about the status and trends of Air Quality as a whole? And what are the overall recommendations for the Air Quality category?

**TRPA RESPONSE-** The Executive Summary will include a color coded summary page that includes the Status, Trend and Confidence of each threshold indicator as well as a summary discussion of air quality.

There are many air quality indicators that are influenced by prescribed burns and wildfire, and prescribed burning regulatory controls are identified as drivers and/or actions implemented to improve conditions. In Washington State (where I have greater experience) there is an active debate on the trade-offs between strict regulations of prescribed burning to maintain air quality standards in affected communities, and the limits these impose on agencies’ ability to restore forests, with consequences for wildfire occurrence and associated, more severe air quality issues in the summer. TRPA should consider supporting and/or funding efforts to understand such trade-offs in the Basin, or discussing them in this Report if they are already fully (or partially) understood.

As discussed by Dr. Spak in his review, there are many opportunities, and a distinct need, to provide additional information, data, and analyses that can inform whether actions are leading to changes in indicators. This is particularly the case where there is a clear hypothesis articulated, and data already exists that would allow some evaluation of that hypothesis.

**TRPA RESPONSE:** The suggestion to increase support and/or funding for better understanding of air quality impacts and tradeoffs of prescribed burns in the Tahoe Basin has now been included in the recommendations section. A 2014 study by the Desert Research Institute found that prescribed burns had the largest impact on PM 2.5 levels, but during the 2010-2011 sampling season, no regional exceedances for PM 2.5 were caused by prescribed burns. (see “Evaluation of Prescribed Burning Emissions and Impacts on Air Quality in the Lake Tahoe Basin”, Chen, et al, 2014). This report laid out recommendations for further research and actions to further mitigate air quality impacts. TRPA will continue to work with partners to implement best practices for prescribed burns based on best available science.

**P 3-35:** The distinction between “regional” and “sub-regional” visibility indicators was initially confusing. Please explain where this is first articulated why one monitoring site can provide a “regional” measure, while another site only provides a “sub-regional” measure. If both are individual sites, why do they provide information at different geographic scales?

**TRPA RESPONSE** – As stated in the introductory paragraph to visibility, there are two types of visibility problems that occur within the Lake Tahoe Region. Regional visibility is characterized by a uniform reduction in visual range in all directions, whereas sub-regional visibility is characterized by a layer of haze that often hangs over the more populated south shore and linked primarily to wood smoke and re-entrained dust. The monitoring site at DL Bliss State Park measures the regional visibility for basin-wide visibility while the South Lake Tahoe site monitors visibility at a smaller “sub-regional” scale that looks only at the South Lake Tahoe urbanized area.

**P 3-38 (and beyond):** Applying the same criteria for trend confidence to a trend of “little or no change” as are applied to “improvement” or “decline” trends is counter-intuitive. If the regression analysis suggests there is no trend, then of course the  $r^2$  will be low and the p-value will be high. These metrics reinforce the lack of trend, rather than undermining the confidence in the result that there is no change. I recommend consulting with a statistician to evaluate how the  $r^2$  and p-values should be interpreted to inform the confidence measures.

**TRPA RESPONSE:** Text has been updated to include discussion on why low  $R^2$  values do not always correlate to low confidence in a trend. The overall methodology has remained the same to ease consistency in reporting, but the confidence has been increased to “moderate” in recognition that low  $R^2$  values do not always correlate to low confidence in a trend.

The fact that TRPA has no ability to regulate or otherwise control factors such as wildfire outside of the basin does not necessarily mean TRPA is unable to affect those factors. The entities TRPA partners with on monitoring, its ability to inform and/or fund research on the impacts of those outside factors on Basin values, as well as TRPA’s relationship with regulatory agencies that can control some of those factors may be critical avenues for TRPA being able to influence what happens outside the Basin. As Dr. Spak identified, looking at that “bigger picture” may become increasingly important for TRPA to do, to maintain attainment of some of these indicators in the future.

**TRPA RESPONSE-** TRPA will continue to maintain positive relationships with California, Nevada, the USFS, and the local jurisdictions and counties in fire suppression efforts and education. Where appropriate, TRPA will work with these partners on issues outside the Basin that impact the thresholds and the Basin itself.

Is the frequency or occurrence of low visibility days not an important indicator, in terms of the frequency that such air quality concerns affect the scenic values of the Basin?

**TRPA RESPONSE:** The number of low visibility days that are the result of wildfire events that occur far from the basin are an important factor in the scenic values of the basin. However, at this time, TRPA cannot control fires outside the basin.

**P 3-47:** The connection between indicators is under-used and under-discussed. As an example, knowing (or at least providing hypotheses, to then be tested) why annual average PM10 values are considerably better than target while peak 24-hr concentrations are somewhat worse than target could well provide guidance as to where, when or why current programs and actions are insufficient for bringing the peak values into attainment.

**TRPA RESPONSE** - The differences between the peak 24 hour PM10 concentrations and annual PM10 averages are in fact known. Exceedances of the 24-hr maximum occur primarily in winter due to seasonal weather patterns (inversions), woodstoves, and entrapped roadway dust. TRPA is aware of these issues and is thus continuing programs such as woodstove rebate programs, as well as implementing street sweeping programs to minimize dust in the air and fine sediment into the lake.

**P 3-52:** Description is needed on how the annual mean concentrations are weighted to provide the 3-year average.

**TRPA RESPONSE** – The three-year average is calculated by the California Air Resources Board. Details of the calculation are available on their website.

**P 3-60:** The assumption that the VMT constant – which depends on factors such as the road network, residential housing units, income, occupancy, employment, etc – does not change across a 25-year window undermines the value of the trend. Cannot the TransCAD model be used to evaluate the sensitivity of that constant to changing assumptions for these different factors? Conclusions from a sensitivity analysis that at least quantify whether the values tend to be over- or under-estimated by considering it a constant would be very informative for interpreting this trend.

**TRPA RESPONSE-** the Tahoe Metropolitan Planning Organization (TMPO) uses their TransCAD model to weigh relative differences in growth against a VMT constant that was established in 1987. Since that time, the model has undergone a series of sensitivity analyses relative to the VMT Threshold and has been adjusted accordingly based off those analyses.

**P 3-61:** Given the statement under Confidence that VMT was estimated with progressively more sophisticated – and hopefully, more precise – models, the statement under Effectiveness that current programs and policies are mostly effective in reducing VMT is unsupported. Isn't it possible that the decreasing trend in VMT could simply be due to increasingly accurate or precise measures, rather than an actual improvement in the indicator?

**TRPA RESPONSE -** While the current model is more precise, the outside demographic factors which determine VMT growth (i.e. residential population, employment, sales tax and visitation) coupled with current TRPA regulatory programs to reduce VMT all substantiate the models decrease in VMT.

**P 3-63:** Why are Human and Environmental Drivers for Odor not applicable?

**TRPA RESPONSE:** Text corrected.

**P 3-66:** I support the recommendation for modifying this indicator, shifting from a policy statement to a numerical standard. I further recommend that this should be the approach that TRPA strives for in relation to all its management and policy statements. As information improves and/or opportunities arise to quantify these statements, TRPA should move to do so.

**TRPA RESPONSE -** As more numerical information becomes more readily available to substantiate quantifiable indicators, TRPA will transition to recommend these amendments.

#### Minor comments

**P 3-2:** Were the AQI values reported in the last paragraph calculated by TRPA based on EPA data, or provided directly by EPA?

**TRPA RESPONSE-** AQI is not the subject of a threshold standard and has been removed to avoid confusion.

**P 3-7:** The link to the TRPA Threshold Standards (goals document) is wrong.

**TRPA RESPONSE** – This link has been corrected.

**P 3-8:** Please briefly describe when and why annual summaries versus raw data were needed.

**TRPA RESPONSE** – Monitoring filters from the particulate samplers at Bliss State Park and Lake Tahoe Community College are sent directly to UC Davis where they are processed and distributed to specific laboratories for analysis, after which the data is compiled by NPS/CIRA (Colorado State Univ.), reviewed, and reported along with the quarterly data from the EPA/IMPROVE fine particle monitoring network. Annual summaries are often tabulated from the respective California Air Resources Board, Nevada Department of Environmental Protection, Washoe County and Placer County. Raw data is analyzed by partners and contractors, and then given to TRPA in the form of quarterly and annual reports to ease reporting tasks for TRPA.

**P 3-9:** The first paragraph on addressing data limitations should be integrated into the 2<sup>nd</sup> paragraph in the Data Limitations section on P 3-8.

**TRPA RESPONSE-** This paragraph has been integrated into the second paragraph in the Data Limitations sections as suggested.

Confidence in the icons of Table 3-3 are not distinguishable. Rather than shrinking the icon, shrink the size of the icon while leaving the formatting of the border unchanged.

**TRPA RESPONSE-** TRPA understands the icon design is not perfect and will take comments as yours into consideration for the future.

**P 3-12:** Provide the regression line equation,  $r^2$  and p-value for all trend lines in this and other graphs. Use consistent representation throughout.

**TRPA RESPONSE-** – Data was analyzed and regressions were done by the Desert Research Institute (DRI) using standard methodology for statistics in air quality. Rather than have DRI use the same methods that are used in the rest of the report, TRPA deemed it a better use of resources to have them use standard air quality methodology instead. Therefore, the  $r^2$  and p-value are not included. If this is a concern voiced throughout, TRPA will consider adding these values to future reports.

Cross-references to later sections where a point is discussed in further detail would avoid questions and concerns on the part of the reader. For example, the 2012 CO false reading statement on this page is unjustified. However, a simple pointer to see the section in the summary where this is discussed would avoid this being an issue.

**TRPA RESPONSE-** TRPA agrees and updated the text accordingly.

**P 3-17:** Who is Campbell? S/he provides critical “personal communications”, yet no information is provided that would lend credibility to such information.

**TRPA RESPONSE –** Most of the Campbell references are made to the annual air quality reports put out by TRPA contractor, Dave Campbell, with DRI. DRI maintains the operational protocols established and accepted by the EPA to provide scientifically defensible air quality data. The personal communication with Mr. Campbell are credible and are appropriately referenced.

**P 3-24:** The suggestion of alternative definitions that could be used was very useful, particularly in light of Mr. Hunt’s specific recommendations on which he found most reasonable. Note however that the alternatives identified on P 3-30 should be edited to total nitrogen oxide emissions.

**TRPA RESPONSE:** No text on page 3-30 could be found that references nitrogen oxide emissions. Alternatives presented do not list the type of standard being assessed.

**P 3-28:** In multiple trend graphs the legend includes symbols not plotted in that particular graph (e.g. in this graph, the open symbols are not plotted). Please “clean up” the legends to reflect those datasets plotted in that particular graph.

**TRPA RESPONSE:** These graphs were included in reports prepared by outside contractors for TRPA and are therefore not easily editable by TRPA.

**P 3-36:** Suggest not linking data points, as it obscures the trend lines, that are more important.

**TRPA RESPONSE:** These graphs were included in reports prepared by outside contractors for TRPA and are therefore not easily editable by TRPA.

**P 3-56:** Check the  $r^2$ , as  $r^2$  should not be a negative value.

**TRPA RESPONSE:** Corrected.

**P 3-60:** Type of standard is considered a visibility indicator, yet is not included under visibility in Table 3-3. Why?

**TRPA RESPONSE:** All indicators in the chapter are represented in Table 3-3.

**P 3-66:** Provide references for where the quoted text was copied from.

**TRPA RESPONSE:** Citation included.

**Missing reference:** Lahontan Water Quality Control Board 2010 (also referenced as Lahontan 2010 on P 3-55 – be consistent on formatting of references).

**TRPA RESPONSE:** updated.

## Chapter 5 – Soil Conservation

July 19, 2016

**P 5-1:** Is the goal to “protect the Region’s soil resources and provide their continued ability to filter and retain nutrients for a variety of purposes”? Articulating clear, SMART goals and how the standards relate to those goals, makes it easier to evaluate the standards themselves.

**TRPA RESPONSE:** \*

As the intent is for each chapter to be stand-alone, I’d recommend defining stream environment zones in this chapter.

**TRPA Response:** The definition of SEZ has been moved from the introduction of the SEZ section to the introduction of the soil conservation chapter to ensure that readers understand the goals of the soil conservation standards.

This chapter refers to “adopted soil conservation targets.” Why the change in terminology?

**TRPA RESPONSE:** The “adopted” qualifier has been removed to improve consistency with other chapters in the report.

References are needed to support the statements that excessive impervious surface contributes to sediment and nutrient inputs to Lake Tahoe, and to support the statement that this leads to negative impacts on soil health, fisheries, etc.

**TRPA RESPONSE:** Additional references are now included.

Recommend describing, at least in general terms, what the land capability classes are based on. This could be done, for example, as a footnote to Table 5-1.

**P 5-2:** Nice to see improvement in data since 2011 allowing the determination of trend.

**P 5-3:** As I have mentioned elsewhere, please include the key to management/policy icons in Figure 5-1.

**TRPA RESPONSE:** Table 1-1 is now included in all chapters.

**P 5-4:** The definitions of hard and soft cover appear somewhat too rigid and not inclusive. What about surfaces such as gravel, which is covered (i.e. hard) but allows infiltration (i.e. soft)? Are these types of surfaces not extensive enough to warrant inclusion in a class?

**TRPA RESPONSE:** The formal terms definitions of hard and soft coverage are included in the TRPA Code of Ordinances referenced in the chapter. The definitions focus on degree of compaction, because of the role physical compaction plays in preventing infiltration. Gravel surfaces, such as driveways, that are intended for year-round use were required to be paved by the BMP deadline in 2008.

**P 5-5:** Please clarify that LiDAR data were used to measure “actual” impervious cover in 2011. This was not immediately clear to me when I read it. It is also important to describe in this chapter with what frequency TRPA plans to re-use LiDAR to obtain updated impervious cover data.

**TRPA RESPONSE:** As point of practice and consistent with the 2011 threshold evaluation report, TRPA refers to the estimates of impervious cover based on LiDAR data to be “estimates” of the actual extent of impervious cover in the Region. The cost of acquiring LiDAR is significant (>200k) and thus future acquisition of LiDAR data for the Region will likely require financial support from a multiple partners in the Region. The benefits of acquiring the data towards for the many monitoring needs in the Region are being assessed to determine appropriate acquisition intervals.

**P 5-8:** Presenting the results for all land capability classes together was very useful to show where standards are attained and where they are not. TRPA might consider similar visuals for other chapters where there are a multitude of clearly similar and related standards (of course, this does not allow you to show trends, but could be complemented with trends graphs).

**TRPA RESPONSE:** The pie chart display utilized on page 5-8 is also utilized to communicate the attainment status of related standards in other chapters. See for example tributary load standards in the water quality chapter.

**P 5-9:** There is a reference to “unpermitted impervious cover.” What does that entail? Can you provide any anecdotal or other information on how important this unpermitted cover might be in the Basin?

**TRPA RESPONSE:** An additional explanation of what unpermitted cover is has been added and additional information on work to ensure unpermitted cover is not added.

**P 5-10:** Good to see that the category with the worst status (Class 1b) is the one showing improvement. I understand that there is high confidence in the accounting of acres of cover added. Are there no instances of decreases in cover? How confident are you that those data are accurate?

**TRPA RESPONSE:** Cover was removed from three land classes (1a,1b,2) as detailed in Table 5-3. Confidence in the accounting for coverage removed is also high and the text has been modified to clarify that point.

**P 5-11:** How effective is the physical removal of impervious cover? I realize that the removal is verifiable and contributes to the standard attainment, but would recommend discussion of how effective that removal is at allowing the site to improve the services it provides.

**TRPA RESPONSE:** Additional detail is now included on how TRPA verifies restoration of sites where coverage is removed. Standard TRPA permitting conditions for projects that remove cover, include the requirement the natural hydrologic function and services are restored after cover is removed. Site restoration is field verified as well prior to a project being determined complete.

At the rate set by the interim target for class 1b (10 acres over 4 years) means that it would take 264 years to attain the standard. This suggests that something needs to change. Either the feasibility is too low, so the standard should be re-evaluated, or programs need to be developed and implemented to significantly increase the rate of improvement. What *is* feasible should be discussed.

The interim target for class 2 is unclear.

**TRPA RESPONSE:** The issue of establishing interim targets and estimating attainment dates applies more generally to the report as a whole and not just to assessment of the impervious cover standard. Conservation in the Region is the result of the collaborative efforts of many partners in the Region, and setting of (or attainment of goals) requires input and extensive consultation with those partners. The issue is now addressed as a general recommendation in the conclusions and recommendations chapter.

From the recommendations for the monitoring approach, it appears that you are considering an approach with two methods (LiDAR every few years, and permit accounting in the interim, calibrated to the LiDAR measures when those are taken), and regular ways of calibrating them to each other. Is this correct? If so, I support it, and would recommend you describe this more explicitly in this section.

**TRPA RESPONSE:** The current approach which includes dual pronged approach described above, and we have refined the text to clarify this.

**P 5-13:** The report clearly articulates the challenges with evaluating the Stream Environment Zones standard, which is very helpful in interpreting the rest of the chapter. I recommend that the description of the challenges be complemented up front with either specific recommendations of how to achieve them, or the presentation of the alternative ways of addressing these challenges, to provide decision-makers with a clear understanding not only of the challenge and potential solutions, but also the implications of choosing one approach over another. I realize that much of this has been done in the report. However, structuring it in the indicator summary makes it hard to fully understand the implications.

**TRPA RESPONSE:** The design of the report makes trade-offs between and attempts to balance inclusion of the same information in multiple locations. Each indicator sheet is designed to be a standalone document, that provides the most detailed overview of the standard. The highest level issues with the SEZ standard are also highlighted in the executive summary.

**P 5-16:** The fact that the SEZ restoration targets are percentage based, and the baseline used in this report to translate those percentages to “acres of SEZs restored” should be described in the Monitoring and Analysis section, not left to the Indicator State section.

**TRPA RESPONSE:** A description of the basis for evaluation is now included in the analytic approach section of the monitoring and analysis as suggested.

The report states “the percentage targets are subject to change as the estimated extent of SEZ in the basin is revised based on new information.” This is true even beyond the adoption of a “uniformly accepted SEZ map.” Changes in hydrology driven by changing snowpack dynamics as temperatures warm, changes in water use patterns as population grows, and other factors will likely continue to lead to changes in SEZs that may need to be captured in the baseline rather than in the current status of “restored acres.” A significant investment in mapping and classifying SEZs in the Region may be needed to develop the “accepted baseline” for these standards. TRPA should carefully consider how to develop that baseline in a way that recognizes, accepts, and addresses the changes expected in the baseline as climate and other factors change. If the current opportunity to do so is missed, I would expect TRPA to face the same issue of a changing baseline in future reports.

**TRPA RESPONSE:** The points raised above are all extremely salient and will be considered in any review of the current standard.

**P 5-17:** How can new coverage in SEZ lands be “fully mitigated” when the standard is to preserve all existing naturally functioning SEZ lands? Or does the standard not imply that ALL naturally functioning SEZ lands should be preserved?

**TRPA RESPONSE:** This additional context is now provided in the explanation.

**P 5-20:** I fully support—and would like to highlight the importance—of the recommendation to develop a monitoring plan that enables assessment of SEZ condition. Given the use of EIP project tracking as the approach to monitoring the status and trend in SEZs, it will be important that the monitoring plan also determine what data EIP projects will need to report to allow TRPA to use these data to assess changes in condition over time.

**TRPA RESPONSE:** These recommendations have been retained in the final version of this report.

**Overall:** As mentioned for other chapters, this chapter would benefit from a Conclusions section at the end, that summarizes the status and trends for the whole threshold category: what do the status and trends information on all these indicators say about the status and trends of Soils as a whole? And what are the overall recommendations for the Soils category?

**TRPA RESPONSE:** A summary of the status and trends information has been included in the executive summary of this report.

**Minor comments**

**P 5-15:** Why is the map format different to the others in the report? Consistency helps the reader trace the linkages between different standards and chapters.

**TRPA RESPONSE:** TRPA is in the process of migrating the reporting to an online dashboard to ensure consistency across all components of the report.

**P 5-19:** Why is overall confidence Low, when both confidence in both status and trend are moderate?

**TRPA RESPONSE:** Typo corrected.

**P 5-20:** By when is the Taylor-Tallac area expected to restore 250-300 acres?

**TRPA RESPONSE:** At present there is no estimated start or completion date for the Taylor-Tallac restoration work.

**Chapter 7 – Fisheries**

June 30, 2016

**P 7-1:** Very valuable to have TRPA’s goal for the particular resources (fisheries in this case), as it provides much needed context for the thresholds selected. Though not specifically identified by Drs. Beauchamp and Naiman, their concern about the habitat-based standards not addressing the condition of the fish populations should lead TRPA to reconsider this goal: if the habitats being restored and monitored are not the main factors limiting fish populations, identifying those main limiting factors and revising the goal to target restoration and monitoring to improve those factors should be a priority for TRPA.

To help the reader track the relationships between indicators, it would be helpful to have a figure analogous to Figure 1-2, that details the full “tree” of categories, standards and indicators for the Fisheries category. This could be accompanied with a repeat Figure late in the chapter (see Overall comment at the end of this review) that also includes the reporting icon for each indicator.

**TRPA RESPONSE:** The relationship between standards and reporting categories is contained in the table 7-1 and 7-2. Tree were removed in favor of the pie charts presented in the executive summary, to more accurately communicate the status of the standards.

**P 7-4:** Add to Figure 7-1 a simplified version of Table 1-1, the management and policy reporting icons.

**TRPA RESPONSE:** Table 1-1 is now included in all chapters.

**P 7-6** (and all other maps in indicator summaries): Maps could be used more effectively to, for example, show the spatial relation between the location of fish habitat and the distribution of factors identified as Human and Environmental Drivers (e.g. urbanization along the shore zone); or is stream habitat in excellent condition adjacent to prime lake habitat? Additionally, *all* maps should be shown large enough to make information

presented clear, and at a consistent scale and extent across all maps of the Basin, to allow the reader to further relate locations from one map (e.g. Figure 1-1) to locations in another map (e.g. P 7-6).

**TRPA RESPONSE:** TRPA is in the process of migrating the reporting to an online dashboard which will ensure consistency across all components of the report and provide interested parties with access to higher resolution maps for all threshold indicators. The suggested analysis to explore stream condition (and change in condition) within the context of potential spatial drivers of condition is underway as part of the ongoing work to connect the results of the stream bio assessment with the project prioritization of the environmental improvement program.

**P 7-7:** Is there data to estimate the potential impact of lake level fluctuations on the availability of “prime” fish habitat, especially spawning habitat? More broadly, I’d recommend TRPA make an effort to summarize and share with leadership available and up-to-date information on the human and environmental drivers identified, that should inform decisions and recommendations for changes. For example, if data exist on lake level fluctuations, and the frequency with which low lake levels occur during spawning periods, that would provide useful contextual information for interpreting the “somewhat better than target” status of prime fish habitat.

**TRPA RESPONSE:** Work is underway to create more detailed maps that detail the amount of spawning habitat available at different lake levels.

**P 7-15:** Why are site scores averaged in one monitoring period first, and then the trend assessed based on how these averages change over time? Isn’t it possible that the condition of some of the sites is improving while at others it is declining? Such differences would be averaged out with this method. If there is a robust rationale for averaging site scores in one monitoring period first, please explain it clearly. If that rationale is not clear, consider assessing the trend over time at each site first, and then summarizing that information across sites. Averaging may not be the most informative way to do that, as the range and distribution of sites across that range is very useful information.

**TRPA RESPONSE:** The primary objective is to provide an overall assessment of the health of streams in the Region, not to assess the health or change in health in any one stream in the basin. The statistical “trend” design was set up to look at the basin’s streams as a whole as well, not necessarily at the individual stream level. Moreover, with only 5-6 years of data available, no meaningful trends were detected at the individual stream level, as stream health is a longer-term process than 5-6 years of data would likely pick up on. The individual stream site scores are used for prioritization of projects and focus areas for the EIP. The text has been modified to clarify how the data is used.

However, in recognition of the desire for partner agencies and the public to see results of stream restoration and other water quality improvement projects, TRPA has added “trend” stream sites on stream segments that have planned stream restoration or large area-wide BMP projects to help show the effects of EIP projects on individual streams.

*Related to the comment on P 7-7 on drivers:* Another factor that would seem highly relevant in this context is occurrence of drought (identified as a driver on P 7-13 and P 7-15). On P 7-15 you state that low water levels are likely the largest contributor to poor condition in 4 of the 24 marginal sites, at least. Though it is true that if sampling occurred during wet years that proportion would decrease (as stated), it is also true that if droughts become more frequent in the future, then monitoring during wet years would be meaningless for determining condition for fish. I recommend including a summary of expected changes in drought frequency or intensity under a changing climate, to inform how this monitoring should be targeted.

**TRPA RESPONSE:** A more robust discussion of likely climate change impacts and the potential management implications with regard to stream habitat is now included in the recommendations section.

**P 7-16:** Reference is made to the importance of projects to reduce stream temperatures. How is this dealt with? Recommendations for attaining or maintaining the threshold do not discuss this at all. Is it in the Recommendations chapter itself (not available at this time)?

**TRPA RESPONSE:** Restoration of riparian vegetation that increases shading is encouraged in project design.

**P 7-19:** The interim target attainment date paragraph concludes with two scenarios: persisting or worsening drought, or return of wetter conditions. Is there no information available on how likely these two scenarios are, especially as the climate changes? Understanding this is critical to interpreting this attainment date.

**TRPA RESPONSE:** The establishment of interim targets is a persistent challenge for the organization, and the limitations of the current and past approach have been acknowledged in past threshold evaluations and by the peer reviewers of this evaluation. The two scenarios reference relate to regional weather, rather than forecasts of longer term climatic change in the region.

*Stream Habitat Category:* There is no reference or discussion of the effects of severe fires on sedimentation, riparian condition, etc. The Introduction chapter briefly discusses the legacy of fire suppression on forests in the Lake Tahoe Basin. Evidence is growing of the impacts of climate change on fire occurrence across western US forests. This context should be discussed in this report, to inform interpretation of stream habitat indicators, as well as considered for future monitoring, analysis and/or discussion.

**TRPA RESPONSE:** A more detailed discussion of the influence of both forest stand dynamics and wildfire on flow and water quality in Regions tributaries has been included.

**P 7-20/23:** What about the implications of climate change to stream flow? Given the importance of precipitation on stream flow, and the impact of increasing temperatures on snowmelt and the relative amount of snow and rain, what's known on climate change impacts on stream flows should be summarized, and the implications for future flows should be discussed.

**TRPA RESPONSE:** A more robust discussion of likely climate change impacts and the potential management implications with regard to stream habitat is now included in the recommendations section.

**P 7-22:** About half way down the page: should "option" be "optimal"?

**TRPA RESPONSE:** Text modified as suggested.

**Overall:** This chapter would benefit from a Conclusions section at the end, that summarizes the status and trends for the whole threshold category: what do the status and trends information on all these indicators say about the status and trends of Fisheries as a whole? And what are the overall recommendations for the Fisheries category?

**TRPA RESPONSE:** Overall conclusions are highlighted in the executive summary and in the conclusions and recommendations chapter. TRPA recognizes that the existing reporting structure already contains significant redundancy and adding additional conclusions and recommendations at the end of each chapter would exacerbate this further.

**Missing reference:**

Byron et al. 1989

**TRPA RESPONSE:** Reference added.

Chapter 9 – Scenic Quality

July 27, 2016

This chapter clearly articulated how the scenic quality values across the Lake Tahoe Basin were defined, and that they had each been identified and rated for quality in 1982. This comprehensive definition of what values are being maintained and enhanced provided a solid foundation for the most recent rating of those same values, and the evaluation of trends. Therefore, my comments on this chapter are generally minor.

**Minor comments**

The three appendices should be referenced in the chapter. In addition, the order the information is provided in Appendix 2 should be consistent with the order it is given in the chapter – roadway travel units first, followed by shoreline travel units.

**TRPA RESPONSE:** the information in Appendix 2 has been reordered as suggested with the roadway scenic resources first followed by the shoreline scenic resources.

Given that the ratings of the different scenic quality indicators are subjective, a brief description of how and why the approach is credible and repeatable would be valuable.

**TRPA RESPONSE:** An outline of criteria for evaluating views from roadways and views from the lake has been added to the Travel Route Ratings appendix. It describes and visually shows what a 1, 3, and 5 rating are for each of the criteria.

**P 9-1:** How do you define “the vast majority of views” referenced in the first goal?

**TRPA RESPONSE:** The 1982 inventory looked at all views from the major roadways in the Basin and assigned ratings that reflected various landscape conditions. It was found that the vast majority of views and lands had a dominant natural appearance. Going forward, the goal has been to maintain and enhance these conditions wherever they exist.

**P 9-2:** The first row in Table 9-1 refers to Tables in the Draft Study Report, but the full reference of this Draft Study Report is not available. Similarly, the second row refers to the 1993 Lake Tahoe Basin Scenic Resource Evaluation. I recommend using a standard format for references, as you have done in other chapters, and include a References section at the end of the chapter.

**TRPA RESPONSE:** A “Reference” section has been added at the end of this chapter.

**P 9-4 (and pages summarizing status and trend determinations for the other standards):** I felt it would be clearer for the reader to organize this summary with the different status categories across different columns, and the different trends categories in different rows. This would visually convey how many units were in and out of attainment, and whether there is a relationship between those out of attainment and the direction and magnitude of change. For later tables, each cell in the body of the table could have the icon plus the number of units that fell in that combination of status and trends. Such an approach could also be applied to other chapters, such as the Soil Conservation chapter, that has a set of related standards (impervious cover in different land capability classes) analogous to those for the different travel units in this chapter.

**TRPA RESPONSE:** TRPA is in the process of migrating to an online reporting platform and reconsidering data organization and presentation to ensure it is accessible to the widest possible audience. The new reporting platform is designed to reduce much of the redundancy inherent in the current structure while still ensuring that readers have access to all the information necessary to understand the status and trend evaluation for each standard.

**P 9-7:** I was left wondering why a 0.17% per year increase was considered a “marked improvement”, particularly since later in the chapter (**P 9-17**) a 0.19% per year decrease was described as “statistically insignificant.” The language used in a number of the trend summaries implies that the authors consider the changes to be more important than the standard methodology of this report reflects. If that is indeed the case, I would recommend you state that, and explain why.

**TRPA RESPONSE:** The text was not intended to imply that the authors consider the changes more important than the standard methodology reflects. The sentence has been edited to read as follows: “While this is an improvement, it would be considered little to no change using the methodology described in Chapter Two of this report”.

**P 9-8 (also repeated under the other standards):** I fully support the approach described under Attain or Maintain Threshold, of using these data to update the Scenic Quality Improvement Program, and encourage the TRPA to prioritize their efforts and investments guided by these data.

**P 9-11:** The messages conveyed by the pie chart and the map are visually contradictory. I realize that the travel units are not of standard lengths, and there is a good reasoning for that. However, this has implications in terms of the absolute progress needed to reach full attainment, especially if the 31% of units out of attainment are significantly longer than those in attainment. Given that how the travel units are defined is clear and consistently applied, I do not recommend changing the indicators or approaches in any way, rather I recommend discussing the implications of the different unit lengths, especially in light of the low rates of improvement observed so far.

**TRPA RESPONSE:** TRPA did an analysis in response to this comment and found the following for the scenic roadway and shoreline units:

Shoreline Travel Units

Total Shoreline Length = 73.39 miles

Length in Scenic Attainment = 44.67 miles (60.87%)

Length in Non-Attainment = 28.72 miles (39.13%)

Roadway Travel Units

Total Roadway Length = 114.22 miles

Length in Attainment = 82.49 miles (72.22%)

Length in Non-Attainment = 31.73 miles (27.78%)

A sentence has been added to both the roadway and shoreline travel route ratings section under the maps which states: “Different travel routes have different lengths. Therefore, approximately 61 percent of the shoreline is within travel units that are in attainment of the adopted standards” and “Different travel routes have different lengths. Therefore, approximately 72 percent of scenic roadways are within travel units that are in attainment.”

**P 9-13:** In line 4 you refer to a table. Should this be “the graph below”?

**TRPA RESPONSE:** This has been corrected to reference the graph below.

**P 9-15:** Provide a couple of key references included in “characteristics are well documented in the academic and professional literature...”

Give a brief definition of the characteristics measured – unity, vividness, variety, intactness. Level of detail should be analogous to that provided for coherence, condition, compatibility and design quality on **P 9-25**.

**TRPA RESPONSE:** An explanation of what these four measures are is now provided.

It would be helpful to the reader if you provide some examples of what are the “scenic resources” identified in the 1982 inventory.

**TRPA RESPONSE:** Text added that outlines what scenic resources as viewed from roadway and of the shoreline.

**P 9-16:** Why do you provide regression lines and equations for some of the Trend graphs, and not others? Recommend consistency, and given that you discuss the trends in each indicator summary, I support including the regression information in each.

**TRPA RESPONSE:** The graph has been updated to show regression lines and equations.

**P 9-23:** Why is there a single regression shown, rather than a split regression (before and after 2001), as is discussed in the last paragraph on **P 9-22**?

**TRPA RESPONSE:** The graph has been modified to show a split regression.

**P 9-25:** What are class I and class II bicycle trails? Briefly describe.

**TRPA RESPONSE:** A description of class I and class II bike lanes has been added to this section.

This summary explicitly describes how the baseline condition was established for scenic resources added later than 1982. I did not see that described for the earlier indicators, so would recommend including that.

**TRPA RESPONSE:** Paragraph two of the chapter outlines that the standards were adopted in 1982.

Why is the Other Areas indicator reporting category only compared to the baseline, rather than also having a minimum score? Is it because baseline in all cases was well above 50% of the maximum score? I would recommend describing why it is different (unless there isn't a robust rationale).

**TRPA RESPONSE:** The "Other Areas" refers to scenic resources related to public recreation areas and bike trails. These scenic resources, and the other scenic resources that are associated with roadways or the shoreline, are fundamentally different from the travel unit scores and are based on a different set of evaluation characteristics. The scenic resources related to public recreation areas and bike trails were first inventoried in 1993, not 1982 as were scenic resources associated with roadways and the shoreline. Like the 1982 inventory, the scores established during the 1993 inventory were adopted as the threshold standard for those scenic resources (the minimum score required for attainment). The report therefore compares the 2015 scores to the baseline scores, which the report could have referred to as the threshold standard or the minimum score required to be in attainment.

All of the "scenic resources" have a non-degradation standard that is equal to the original score that was assigned at the time the first inventory was done. The travel unit composite scores, in contrast, include both a numeric and a non-degradation standard. Travel units must attain the numeric "threshold" (15.5 for roadway units, 7.5 for shoreline units) and be equal to or greater than their original scores to be in attainment, while the scenic resource composite scores must simply be equal to or greater than their original score.

**P 9-31:** There is no reference to number of buildings. I realize that this policy is focused on design elements of buildings that are being built, but the accumulation of buildings will also affect scenic quality, and therefore may need to be considered. Is that sufficiently covered under other indicator categories, such as travel route ratings? If that is the case, it would be worth stating that.

**TRPA RESPONSE:** No scenic threshold gauges the absolute number of buildings. However, the visual impact of built structures or the visual mass of individual or aggregate buildings is considered in most scenic categories. For example, under the travel route categories, scenic roadway units are divided into three visual environments: urban, transition, and natural. The number of buildings seen from a travel route is limited by the travel route's visual environment. For example, too many buildings in transition visual environment can cause it to go to non-attainment. An explanation of these roadway units has been added to the chapter.

**P 9-34:** Last line appears incomplete: "... modifications that could clearly community character."

**TRPA RESPONSE:** Change made to sentence.

## Chapter 11 – Recreation

July 28, 2016

It was interesting that this is the only category that has only policy statements as standards. It was clear from the chapter and indicator summaries the challenges posed by the lack of numerical standards. This both reinforces the need for the TRPA to consider how to move from policy and management statements to numerical standards, and highlights the particular importance for doing this around Recreation.

**TRPA RESPONSE:** This comment is consistent with the recommendations to modify the threshold standard or indicator to "improve the evaluability of the standard and the information it provides for management."

**P 11-1:** Very valuable to have TRPA's goal articulated. The language used ("to achieve the recreation threshold standard") presents the standards as the end itself, rather than as a means of quantifying and tracking progress towards the ultimate end of "ensur[ing] equilibrium between the region's natural endowment and its manmade environment."

Briefly describe where the "best available information" was obtained.

**TRPA RESPONSE:** The introductory text was revised to clarify that the goal of the recreation element of the Regional Plan is to promote and manage recreation consistent with the policy direction provided in the adopted recreation threshold policy statements to "ensure equilibrium between the region's natural endowment and its manmade environment." Because the threshold standards are policy statements rather than numerical targets, they provide broad policy direction rather than a specific means of quantifying and tracking progress. The clarification is intended to convey the role of the policy statements in providing direction on the approach to achieve equilibrium between the region's natural endowment and its manmade environment.

A brief description of the best available information was added to page 11-1.

**P 11-2:** The graph showing the results of the satisfaction survey suggests that a framework already exists among monitoring partners to set numerical targets for recreation. Why has it not been done?

**TRPA RESPONSE:** As described under the monitoring approach section on page 11-3, the monitoring results shown in the graph represent a summary of surveys conducted by various recreation provider in different portions of the Region, rather than a cohesive monitoring framework. These surveys were conducted for different purposes, do not address the full range of recreation opportunities in the Region, and are not comparable to the NVUM survey results used in previous evaluations. Therefore, these monitoring results are not appropriate to set numerical targets for the region. Several recommendations are included on page 11-10, which call for revisions to the monitoring and analytical approach, and modification of the threshold standard to improve the evaluability of the standard and the information it provides for management.

**P 11-3:** Why isn't one of the evaluation criteria a question such as in the Scenic Quality chapter: "Is there evidence to suggest these actions are achieving the intent of the policy statement?" I realize that the evaluation of surveys and review of land acquisitions and development of public access amenities may be addressing that, but it is valuable to make that explicit.

**TRPA RESPONSE:** The comment is correct that the second and third criteria evaluate whether there is evidence to suggest actions taken by TRPA are achieving the intent of the policy statement. In response to this comment, page 11-4 was revised to make the intent of the evaluation criteria explicit.

**P 11-4:** Somewhere in this indicator summary there needs to be a clear discussion of the uncertainty and limitations to the conclusions drawn from the surveys because they are incomplete, opportunistic, and have such different objectives that their aggregation is questionable. The way the information is organized, there is recognition that the data is not the best, but the results are then presented as “truth”, without discussion of the impact of data quality for this purpose, or their ability to effectively function as “evidence that actions are achieving the intent of the policy statement.”

**TRPA RESPONSE:** In response to this comment, both the introduction on page 11-1 and the description of the monitoring approach on page 11-3 were revised to include a discussion of the uncertainty and limitations of the use of this survey data.

Why aren't values provided on percent of total land area held in public ownership under Status?

**TRPA RESPONSE:** In response to this comment, the status summary was revised to include the percent of total land area held in public ownership.

Overall, having policy statements with no numerical targets means that status doesn't provide much information about what is happening with the resource of interest, rather it informs whether action is being taken. Trend in the values reported here would be much more valuable in informing whether those actions are leading to positive change, or whether the actions are not being effective. Therefore, assessing trend should be a priority for quantifying evidence of effectiveness of policy statements.

**TRPA RESPONSE:** While TRPA agrees that showing the trend in the values reported here would be more valuable in informing whether those actions are leading to positive change, comparable long-term data is not available for much of the information presented in this report. Where long-term comparable data is available, it was added to this report. This included the addition of historic rates of PAOT utilization on page 11-14, and the addition of a longer-term data set showing the rate of recreation facilities improved or created on page 11-11.

The existing recommendations on page 11-9 calls for “consistent and repeatable surveys of recreation users”, to allow comparisons over time. These recommendations were revised in response to this comment to clearly call for “closely tracking public land acquisitions and recreation facility projects to allow for an evaluation of trends over time”. The recommendations have also been revised to call for an evaluation of changes in user satisfaction and the rate of recreation facility development over time, once recommended monitoring improvements have been implemented.

**P 11-6:** If data such as those presented in Figure 11.1 were available for 1982 or other earlier date, it would be possible to establish a baseline for these resources against which to compare the current status (analogous to the baseline developed for scenic quality resources – subjective, but standardized and consistent across space and time). Is this possible? If not, I recommend evaluating whether the 2012 values could provide such a baseline, against which to compare these and future status.

**TRPA RESPONSE:** Historic data similar to that presented in figure 11.1 is not available to support an analysis of trends in these resources. This information is now being tracked through the Environmental Improvement Program tracker website, and it should be available to assess trends in facility development in the future.

A recommendation on page 11-9, recommends a more coherent and consistently planned monitoring approach, which would allow for comparisons of consistent data over time. In response to this comment, the recommendation related to the monitoring approach on page 11-9 was expanded to include an additional recommendation to continue to closely track public land acquisitions and facility projects over time, which would allow for an evaluation of trends. In addition, a new recommendation related to the analytical approach was added to page 11-9. This new recommendation calls for the analytical approach to include an evaluation of

changes in user satisfaction and the rate of recreation facility development over time, after implementation of monitoring recommendations that would provide consistent data.

**P 11-7:** I was encouraged to see the recommendations to the monitoring approach, and fully support all three, especially the third one, coordinating and combining the recreation monitoring with the scenic quality monitoring.

**TRPA RESPONSE:** These recommendations have been retained in the final version of this report.

In contrast to my last comment, I was surprised that no changes are recommended for the standard itself. As you have mentioned in other chapters, and as I highlighted at the beginning of this chapter's review, not having numerical targets makes monitoring very challenging. And in this case, you have at least some data suggesting what numerical targets would allow you to assess effectiveness of actions taken in response to this policy statement.

**TRPA RESPONSE:** In response to this comment, a new recommendation to revise the Threshold Standard was added to page 11-9 that, in part, calls for the standard to be "amended as necessary to improve the evaluability of the standard and the information it provides for management."

It is encouraging to see the recognition that climate change may have impacts that affect the amount, quality, and distribution of recreational opportunities, as well as the patterns of recreational use. I encourage the TRPA to further evaluate existing information on climate change and climate change impacts, and further develop and plan for such changes.

**TRPA RESPONSE:** This comment is consistent with the discussion and recommendations in the report. These portions of the report have been retained in the final version.

**P 11-9:** The distinction between improvement and creation of recreation facilities should be discussed. Given that the majority of progress is in improvement rather than creation, how much impact does that have on recreational opportunities and/or the quality of the recreational experience?

**TRPA RESPONSE:** A brief discussion of the differences between improved and new trail facilities was added to page 11-8, as follows: "While substantial trail improvements have been documented, it should be noted that the majority of recent trail projects consisted of trail improvements rather than the development of new trails. While trail improvement projects provide public benefits, they often do not provide new recreational or access opportunities, as would occur with the development of a new trail."

The definition of "Improved" facilities was added to the text of the figure referenced in the comment. The definition is as follows: "Facilities are considered improved when an action is taken to enhance an existing facility for the benefit of public use. Improvements do not include routine maintenance. A facility is considered improved with the inclusion or improvement of one or more new amenities that are conducive to the comfort, convenience or enjoyment of facilities. Amenities include but are not limited to fences, lighting systems, drinking water fountains, picnic tables, benches, refuse containers, bike racks, trellises, educational displays, playgrounds, parking lots with less than 8 spaces and restrooms under 500 square feet." The addition of this definition would allow the reader to consider and understand the degree to which recreation improvements affect recreational opportunities and/or the quality of the recreational experience.

**P 11-10:** The TRPA should consider a two-method monitoring approach, analogous to what is started (and proposed for the future) in the Soil Conservation chapter: combine the annual tracking of permitted projects with an independent measure of what is occurring across the Basin. This may not be as straightforward as the use of LiDAR to measure actual impervious cover across the Basin, but is nonetheless important to include.

**TRPA RESPONSE:** This comment is consistent with the recommendations included in the report, which call for revisions to the monitoring and analytical approach. Improved annual tracking of recreational facility development and public land acquisitions could be combined with a consistent and comprehensive recreation user survey, which would provide an independent measure of what is occurring related to recreation in the region.

**P 11-11:** The PAOT system was unclear. Granted this is not a system I have experience with, though I would argue that the same might be the case for interested stakeholders looking to better understand the progress the TRPA is making.

**TRPA RESPONSE:** In response to this and other peer-review comments, the discussion of the PAOT system on page 11-17 was edited for clarity. The recommendations related to modification or replacement of the PAOT system were also expanded. The limitations of the PAOT system are described in this report and have been noted in previous Threshold Evaluations. While PAOTs are a management concept used elsewhere, the specific PAOT system used here is unique to the Tahoe Region. Replacement or modification of the system would likely allow interested stakeholders to better understand the progress being made related to recreation resources.

Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

**Independent Peer Review**

**Prepared by Gary T Hunt, QEP  
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**Tahoe Regional Planning Agency (TRPA)-Threshold Evaluation Report**

**June 30, 2016**

**Introduction-Chapter 1**

Sufficient information is presented to allow for the reader to understand the purpose and objectives of the Threshold Evaluation. Data on the types and numbers of businesses by industrial sector would have been especially valuable as related to the air quality portion of the peer review. It would have been helpful also knowing which of these industries (and how many) had permits related to discharges into the Lake Tahoe environment. For example, water discharge permits, air emissions permits etc. If not provided in this section then it is recommended that this information be provided in the media specific sections of the report as appropriate. It would be helpful if the total number of primary and secondary residences located in the study region were also listed.

**TRPA RESPONSE** –Appendix A of this report outlines the socioeconomic setting of the Lake Tahoe Region and contains information about jobs by industry as well as information on second home ownership rates.

As related to the air quality portion of the Threshold Evaluation it is also recommended that the numbers of wood stoves in place in residential and commercial properties and the numbers of vehicles owned and operated by these residents be also provided. Again this data can be provided in the Introduction section or the Air Quality section (Chapter 3) of the report.

**TRPA RESPONSE** – No data exists on the number of existing wood stoves in the Tahoe Basin. Pursuant to Chapter 65 of the TRPA Code of Ordinances, TRPA regulates non-compliant woodstoves through the woodstove retrofit program, which provides that “Prior to any sale, transfer or conveyance of any building, all existing wood heaters in the building, excluding legally existing open fireplaces that are not primary heat sources, shall be in conformance with the emission standards contained in subparagraph 65.1.4.B.1.” In addition to the provisions of Chapter 65, TRPA partners with other jurisdictions to provide a rebate program that allows homeowners to purchase newer clean-burning woodstoves. The total number of local cars cannot be calculated in time for this report and will be included in the next evaluation but the total number is not necessary for the air quality status and trend.

Some portions of the Introduction chapter (commencing with the section entitled threshold standards) actually relate more to methodology employed in preparation of the 2015 TRPA Report. This information on pages 1-5 to 1-11 is somewhat redundant to information currently contained in Chapter 2 entitled Methodology. It is recommended that this material currently presented in Chapter 1 Introduction be incorporated into Chapter 2 Methodology.

**TRPA RESPONSE** – The section of the introduction related to indicator sheet content has been moved to the methodology chapter.

## **Methodology-Chapter 2**

Methodology employed was well described and clearly presented. Often times example calculations were provided. This was true for the Determination of Indicator Status and Evaluation of Indicator Trend sections. This chapter reflects revisions made by the report authors in response to the peer review of the 2011 TRPA report. For example, status scores were used in calculation of indicator status even when available data were insufficient. Confidence scores, as well as, indicator status and trend scores, however, were not artificially biased high due to insufficient data or lack of standards as was the practice in preparation of the 2011 TRPA report.

(Note: Readers should view only color versions of the report (hard copy or electronic on screen) to fully appreciate report contents. The methodology used and the actual results for each threshold category are hard to follow when viewed in black and white).

**TRPA RESPONSE:** Full color versions will be put on TRPA's website and when printed copies are used, TRPA will ensure that these are in color,

## **Noise-Chapter 10**

The noise chapter represents an improvement to what was presented in the 2011 TRPA report. Responses to comments on the 2011 TRPA report offered by this peer reviewer are reflected in the 2015 report. Based upon the 2011 peer review "many of the noise monitoring thresholds, especially those related to single noise events were not analyzed for this (2015) evaluation and therefore received a status of unknown". In addition the TRPA instituted a more rigorous monitoring program in the majority of the noise areas commencing in 2011 and continuing through calendar year 2015. This included monitoring at more sites for at least seven (7) days during the critical calendar period of May 15 to October 1. This reviewer endorses this practice over time as these data will allow for a more reliable evaluation of indicator status versus thresholds, data trends, confidence and threshold attainment status.

**TRPA RESPONSE:** TRPA will continue to monitor noise thresholds based on the monitoring updates recommended in 2011. Thank you for your comments.

## **General Comments and Recommendations**

1] The noise program remains too complex and resource intensive. There are too many indicators, land use categories and numerical thresholds that need to be monitored to evaluate data trends and attainment status.

**TRPA RESPONSE:** \*

2] It appears that current programs and corrective actions are not effective in reducing noise levels on those highways with a 55 dBA standard. Review and evaluation of noise standard values is recommended. For example, if trends indicate future attainment is not likely numerical standards may need to be increased. In the case of highways standards range from 55 dBA to 65 dBA for cumulative noise events (CNEL). Attainment with the 55 dBA standard has been a challenge while attainment with the 60 dBA and 65 dBA standards has been less of a challenge. Consider adopting a 60 dBA standard for all highways.

**TRPA RESPONSE:** \*

3] The TRPA hired a noise consultant in 2011. As a result dramatic improvements were made to the noise monitoring program. These included but were not limited to the following: 1) instrument calibration. 2) increased frequency of monitoring (# days and # sites). These measures, also recommended by this peer reviewer in 2011, resulted in more reliable and representative noise measurements across the study region.

**TRPA RESPONSE:** TRPA will continue to monitor noise thresholds based on the monitoring updates recommended in 2011. Thank you for your comments.

- 4] Recommendations for additional actions, findings and conclusions are frequently contained within the individual data evaluation and interpretation reports for each indicator category. These need to be consolidated to remove redundancy and should appear as appropriate in the report summary and conclusions chapter.

**TRPA RESPONSE:** TRPA has updated the entire report to summarize findings and recommendations to improve communication and reduce redundancy.

#### **Comments and Recommendations- Single Noise Event Categories**

- 1] Threshold standards for the majority of the single noise event categories could not be evaluated due to insufficient field data. A severe lack of data does not allow for adequate evaluation of many of the single noise event indicators. As a result, the effectiveness of existing regulations cannot be characterized. There are, again, too many single noise event standards. These need to be reduced or consolidated in order to avoid insufficient data determinations in future years.

**TRPA RESPONSE:** \*

- 2] The current criteria of “zero exceedances of the threshold standards” for a single noise event is unrealistic. Attainment in the future seems unlikely, as a result. An alternative threshold attainment measure should be sought. Non-attainment should not be based upon a single exceedance of a standard but rather make use of all data collected. The data set should include all compliant measurements, as well as, all exceedance data. In this manner attainment can be defined as a % value (total compliance values/total # measurements). Statistical analyses of data for each category should also be applied. This approach is especially important to those noise standards characterized as single noise events (eg motorized water craft).

**TRPA RESPONSE:** \*

**ADDITIONAL TRPA RESPONSE:** For single noise events caused by watercraft in the shorezone, TRPA did analyze the number of single noise event exceedances out of the total number of boats on the water as suggested in this comment. This method will continue to be used in analyzing single noise events.

#### **Comments and Recommendations- Cumulative Noise Event Level (CNEL) Categories**

- 1] The CNEL data base is much improved since 2011 when the enhanced monitoring program began. Indicator status, data trends, confidence determinations, threshold attainment, and overall program effectiveness can now be evaluated with the availability of more reliable and representative data sets for many of the CNEL noise categories.

**TRPA RESPONSE:** TRPA will continue to monitor noise thresholds based on the monitoring updates recommended in 2011. Thank you for your comments.

- 2] This reviewer agrees with the current practice of establishing data trends by using annual mean CNEL values. Attainment status should also be based on the same annual mean CNEL values representing all monitoring locations within a given land use category. The current practice of using the maximum 24 hour CNEL value to determine indicator and attainment status is overly conservative.

**TRPA RESPONSE:** Attainment status was based on the maximum 24 hour CNEL value to remain consistent with past evaluations. However, the suggestion to base indicator status attainment on all annual mean CNEL within a current land use category has been moved to the recommendations section and will be considered for future use.

- 3] This reviewer endorses the following statement found in the recommendations section (Modification of the Threshold Standards or Indicator Section) for many of the CNEL land use categories in the noise chapter. (pgs. 10-17, 10-20, 10-26, 10-32, 10-35, 10-38, 10-41)  
*“Outside Peer review for both the 2011 and 2015 Noise Threshold Evaluations have suggested that the attainment of CNEL should be based on the percentage of events that exceed the threshold rather than being based on a single exceedance and that TRPA should report on the number of locations that exceed the CNEL standard rather than the magnitude of the exceedance (TRPA 2012; Kerr et al. 2016).”*  
**TRPA RESPONSE:** Two suggestions have been put forward by the reviewer to analyze threshold attainment for CNEL. 1) Status determination for CNEL should be based on annual mean CNEL at all monitoring locations within a given land use category. 2) Status determination should be based on the percentage of events that exceed the threshold. These two recommendations have been included in the recommendations section to consider for future changes.
- 4] Statements made regarding the effectiveness of the noise control program, threshold attainment and attainment dates are not supported by data presented for four of six of the highway categories. These statements are found in the Implementation and Effectiveness sections for these highways (pgs. 10-41, 10-47, 10-56 and 10-59). Revisions are warranted.  
**TRPA RESPONSE:** Errors are noted and have been corrected accordingly.
- 5] There are too many indicator categories for CNEL noise. Consolidation/combination of existing land use categories should be considered if this can be justified. There are currently five (5) separate numerical values used as noise standards (See Table page 10-3). Can this number be reduced to three (3)? (For example 45, 55 and 65 dBA).  
**TRPA RESPONSE:** In this Threshold Evaluation, the decision was made to separate the land use categories into individual Indicator Sheets, instead of combining them into one Indicator Sheet. In past evaluations the land use categories that share similar dBA threshold levels were combined into one Indicator Sheet, yet still analyzed separately for status and trends. TRPA determined this method to be more confusing to the reader and therefore separated each land use category into individual Indicator Sheets. TRPA appreciates the feedback and will consider ways to make the chapter easier to read and understand in the future.

### **Air Quality-Chapter 3**

#### **General Comments**

- 1] In general the majority of the air quality indicators were found to be in attainment with the associated standards or indicator threshold values. Trends in most cases indicated moderate improvement. Air quality in the Lake Tahoe Region is well defined and the measures in place to improve air quality moving forward are working  
**TRPA RESPONSE:** comment noted.
- 2] Recommendations for additional actions, findings and conclusions are frequently found within the individual data evaluation and interpretation reports for each indicator category. These should be consolidated to remove redundancy and placed as needed in the summary and conclusions section of the report. (Note: This reviewer was not assigned to peer review the report summary and conclusions section).  
**TRPA RESPONSE-** A summary of recommendations and conclusions is included in the Conclusions chapter of the report.
- 3] Only emissions from California vehicles are accounted for in the air quality indicator categories. CARB emissions estimates are used, for example, to develop daily and annual emissions for NOx.

These data, in turn, have been used historically to monitor attainment with the NO<sub>x</sub> threshold standard. It appears that emissions from vehicles registered in the state of Nevada that operate within the Lake Tahoe region are not accounted for in any of these emissions estimates. Further, if Nevada vehicle emissions standards are not equivalent to California vehicle emission standards then continuous improvement in air quality may not be achievable. It is recommended that the revised TRPA report address the impacts associated with tailpipe emissions from vehicles registered in Nevada. For example, should Nevada consider adopting California vehicle emissions standards?

**TRPA RESPONSE** - Information for the Nevada emissions were only made available as a part of the 2015 supplement to the NDEP second 10-year Lake Tahoe Basin Limited Maintenance Plan and are accounted for in the estimates. However, CARB sponsored fleet mix-speed survey was utilized in the new emissions inventory contained in the CARB EMFAC modeling for the Lake Tahoe Region which included vehicles registered in Nevada. The county level emissions are apportioned to the Basin based on the ratio of AVMT or population in the Basin versus the totals from the three Nevada counties.

### **Carbon Monoxide (CO)**

1] CO data indicate that concentrations for this indicator are well below the strictest applicable standards. This is true for both the 1-hour and 8-hour CO standards. TRPA has concluded that the overall status is considerably better than the target, that the trend shows moderate improvement with a moderate degree of confidence. This reviewer agrees with this assessment.  
**TRPA RESPONSE:** comment noted.

2] No interim target or target attainment date is offered as the Lake Tahoe Region is currently in attainment with the strictest standard. TRPA has also concluded that current regulatory programs, policies and actions directed at reductions in carbon monoxide emissions especially from motor vehicles have been effective. Existing programs and actions will remain in place for continued control of carbon monoxide emissions. This reviewer agrees with these findings and the recommended course of action.  
**TRPA RESPONSE:** comment noted.

### **Ozone- (O<sub>3</sub>)**

1] TRPA maintains a 1-hour standard for ozone of 0.08 ppm (v/v). This standard is more stringent than the corresponding standards for both California (0.09 ppm) and Nevada (0.10 ppm). TRPA recommends that the current standard of 0.08 ppm remain in place. This reviewer agrees with this recommendation.  
**TRPA RESPONSE:** comment noted.

2] Ozone data presented for the 3-year average of the 4<sup>th</sup> highest 8-hour concentration indicates that the Lake Tahoe Region has never violated the historical Federal Standard of 0.080 ppm or the revised standard of 0.075 ppm adopted in 2008. Despite conditions that TRPA defines as “at or somewhat better than target” the long term trend shows moderate improvement over the calendar period 1986, when monitoring began, until 2014, the most recent year where monitoring data are available. The data and statistical analyses show a decrease of 0.53% (or 0.0004ppm) per year. This peer reviewer is in agreement with these findings.  
**TRPA RESPONSE:** comment noted.

3] Ozone data presented for the 1-hour average supports an indicator or threshold status of “at or somewhat better than target” and a long term trend that show “moderate improvement”. Based upon current 2012 to 2015 results current regulatory programs and actions are successful

in reducing maximum ozone concentrations as 1-hour average data. This peer reviewer is in agreement with these findings.

**TRPA RESPONSE:** comment noted.

- 4] TRPA has characterized compliance with the 8-hour ozone standard as “somewhat worse than target” with a trend that reflects “moderate improvement”. The monitoring data for the period 1975 to 2014 supports the TRPA findings. A statistically significant downward trend is in place showing a 0.57% (0.0004 ppm)/year decrease in O<sub>3</sub> concentrations versus the 0.070 ppm California standard. This reviewer is in agreement with TRPA findings and conclusions.

**TRPA RESPONSE:** comment noted.

### **Nitrogen Oxides-(NO<sub>x</sub>)**

- 1] This indicator currently relies on modeled emissions estimates of NO<sub>x</sub> from automobiles. Data are based solely on the California portion of the basin on what appears to be traffic count data collected in the Lake Tahoe Region (contributions from Nevada vehicles are not included). Results are reported in units of tons per day of NO<sub>x</sub> (average summer day) and are compared against a 5.6 ton/day threshold standard. These data have been trending downward since 1990 and are characterized in the report with “moderate improvement”. Indicator status has been classified as “considerably better than target” based upon the following: 1) CARB (2015) estimated an average of 4 tons per day of NO<sub>x</sub> or 71% of the 5.6 tons/day threshold. 2) 2014 annual average NO<sub>x</sub> concentrations in ambient air 4.1 ppb or 14% of the strictest California standard. 3) 2014 highest 1 hour NO<sub>x</sub> concentration of 27.9 ppb or 15.5% of strictest California standards. Confidence is classified as moderate. The latter applies to both indicator status as well as trends. This reviewer agrees with this assessment and the conclusions offered.

**TRPA RESPONSE:** comment noted.

- 2] TRPA claims that existing federal, state and regional programs and actions are effective in controlling NO<sub>x</sub> emissions and ultimately NO<sub>x</sub> levels in ambient air. These claims on the effectiveness of existing programs and actions are based upon declining trends in CARB emissions estimates in combination with TRPA ambient monitoring data. This reviewer agrees with this assessment and the conclusions offered.

**TRPA RESPONSE:** comment noted.

- 3] TRPA has made a recommendation to amend the threshold standard for NO<sub>x</sub> and favor adoption of a numerical standard consistent with state and federal concentration standards. Measurement of NO<sub>x</sub> concentrations in ambient air more accurately represents contributions from all sources and not just vehicle associated emissions as is the case with the current modeled NO<sub>x</sub> values. Monitoring and modeling approaches will continue for a period of 5 years (Note: this latter recommendation made by this peer reviewer in 2011). This peer reviewer endorses this proposed approach for monitoring the status and trends of nitrogen oxides in the future.

**TRPA RESPONSE:** comment noted.

### **Visibility - Regional and Sub Regional Visibility Specific Comments**

- 1] The visibility indicator program was revised based upon peer review comments offered for the 2011 TRPA report. The visibility threshold standard was comprised of nine (9) individual indicators in 2011. This has been reduced to four (4) indicators in 2015.

**TRPA RESPONSE:** comment noted.

2] Regional visibility is characterized as “at or somewhat better than target” based upon the 3 year average data base 2012-2014. The regional visibility trend shows “little or no change”. The long term trend over the period 1991 to 2014 suggests that programs and actions have been effective at maintaining and improving visibility. The only exception to this is negative influences on visibility in the Lake Tahoe Region directly attributable to wildfires outside the basin. Control of wildfires outside the basin is beyond the jurisdiction of TRPA. This reviewer agrees with these findings and conclusions.

**TRPA RESPONSE:** comment noted.

3] The sub regional visibility monitoring program was restructured based upon the 2011 peer review and the DRI Chen 2011 report. A second sub regional monitoring site was established at Lake Tahoe Community College in 2014. Insufficient data currently exists to determine indicator status and trends. Sufficient data should be available from this new site in 2017.

**TRPA RESPONSE-** The Lake Tahoe Community College (LTCC) Monitoring Site, which is now used to characterize the sub regional visibility indicator, has been in operation for the past two years. Three years of continuous data are necessary to determine compliance with the indicator and as noted, data will be available beginning in 2017.

### **PM<sub>10</sub> Respirable Particulate**

1] The annual average respirable particulate (PM<sub>10</sub>) concentration indicator status was reported as “considerable better than target” with a moderately improving trend. Data have been collected since 1989 at numerous sites in the Tahoe Region. Data are compared to the annual National Ambient Air Quality Standard (NAAQS) of 50 ug/m<sup>3</sup> and a stricter California standard of 20 ug/m<sup>3</sup>. The highest annual average PM<sub>10</sub> concentration of 14.3 ug/m<sup>3</sup> was measured at the South Lake Tahoe site in 2014. This represents 71% of the stricter 20 ug/m<sup>3</sup> California standard. The trend line shows a decrease of 0.5 ug/m<sup>3</sup> or 2.5% per year relative to the same California standard. This improving long term trend suggests that programs and actions currently in place are effective at controlling PM<sub>10</sub> concentrations. This reviewer agrees with this assessment and the conclusions offered.

**TRPA RESPONSE:** comment noted.

2] TRPA offers a number of options for defining how the respirable particulate indicator will be evaluated in the future. The current method consists of use of the highest reading from the most recent monitoring period for comparison to the strictest California standard of 20 ug/m<sup>3</sup>. This reviewer regards this approach as overly conservative since only the highest annual average concentration is used to compare to perhaps the strictest PM<sub>10</sub> standard in the nation. Based upon review of the options offered by TRPA this reviewer recommends that the following be considered for evaluation of indicator status in the future:

- Average of all monitoring stations during the most recent monitoring period for comparison to 20 ug/m<sup>3</sup> standard.
- Number of exceedances during the current monitoring period.

**TRPA RESPONSE:** TRPA will consider the two methods for measuring threshold attainment listed above during the threshold review and update process.

3] The highest 24-hour average PM<sub>10</sub> concentration indicator status was reported as “somewhat worse than target” with a trend characterized as “not changing”. Data are compared to the stricter California standard of 50 ug/m<sup>3</sup>. The highest 24 hour average of 50.8 ug/m<sup>3</sup> was measured at the South Lake Tahoe site in 2014. This represents a value 102 percent of the California standard. The trend line shows an increase of 0.1 ug/m<sup>3</sup> pre year (or 0.2%). This trend

characterized as reflecting “little or no change” suggests that existing programs and actions could have been more effectively implemented. This reviewer does not necessarily agree with these findings as they result from application of an overly conservative approach. The single highest 24 hour PM<sub>10</sub> concentration measured in the most recent monitoring year at any site is compared to a very strict California standard of 50 ug/m<sup>3</sup>. The latter is 3 times less than the PM<sub>10</sub> NAAQS of 150 ug/m<sup>3</sup>. This approach needs to be evaluated and an alternative more realistic approach selected. TRPA, in fact, offers a series of options for evaluation of this indicator in the future. (pg. 3-45 Analytic Approach). This reviewer recommends that the following be considered for evaluation of indicator status in the future:

- Average of all monitoring stations during the most recent monitoring period for comparison to 50 ug/m<sup>3</sup> standard.
  - Number of exceedance of 50 ug/m<sup>3</sup> standard during the current monitoring period.
- TRPA RESPONSE:** TRPA will consider the two methods for measuring threshold attainment listed above during the threshold review and update process.

### PM<sub>2.5</sub> Specific Comments

1] 24 hour and annual average PM<sub>2.5</sub> concentrations are lower than threshold standard concentrations. The highest annual average PM<sub>2.5</sub> concentration for 2014 was 8 ug/m<sup>3</sup> measured at Tahoe City (67% of the stricter California standard of 12 ug/m<sup>3</sup>). The highest 3 year average of the 98<sup>th</sup> percentile 24 hour PM<sub>2.5</sub> concentration for 2014 was 31 ug/m<sup>3</sup>, also at Tahoe City (88% of the NAAQS of 35 ug/m<sup>3</sup>). PM<sub>2.5</sub> data for the Bliss Site is much lower than Tahoe City. The highest average concentration at the Bliss Site was 40% of the 35 ug/m<sup>3</sup> target value during the 2012-2015 monitoring period. The trend based upon Bliss Site data indicates “little or no change”. This based upon an increase in the 98<sup>th</sup> percentile 24 hour PM<sub>2.5</sub> concentration of 0.1 ug/m<sup>3</sup> (0.3% increase) annually. TRPA claims that programs and actions in place are effective at maintaining PM<sub>2.5</sub> concentrations below standards. The trend line, however, warrants continued attention and further corrective action if the trend continues to increase above the current annual value of 0.1 ug/m<sup>3</sup> (0.3 % increase). This reviewer is in agreement with these findings, conclusions and proposed course of action.

**TRPA RESPONSE:** comment noted.

2] TRPA recommends that the specific definition for the PM<sub>2.5</sub> annual average indicator be reevaluated. Several potential options are offered. This reviewer agrees with this recommendation. Options recommended by this reviewer can be found in the PM<sub>10</sub> section of this review (Comment 2).

**TRPA RESPONSE:** TRPA will consider the two methods for measuring threshold attainment listed above during the threshold review and update process.

### Nitrate Deposition

1] A new nitrate deposition indicator has been introduced in the management standard category. The status of this newly implemented indicator could not be evaluated due to lack of relevant information. The TRPA has identified two (2) management standards to address nitrate deposition one under the air quality threshold standard and a second under the water quality threshold category. Available information regarding nutrient deposition suggested that there has been little or no statistical change in the amount of dissolved inorganic nitrogen deposited into the lake annually. These data suggest that the TRPA regional plan and stricter vehicle emission standards have not been effective.

**TRPA RESPONSE:** Utilizing traffic counts from both Caltrans and NDOT, the Average Daily Traffic has decreased by 21 percent from the recorded values in 1990. Coupled with the cleaner

mobile source emissions suggest that nitrate deposition levels from in-basin sources should be dropping. TRPA believes additional monitoring of nitrate deposition should be considered to strengthen any conclusions about the status and trends of nitrate deposition.

- 2] Nitrogen deposition in Lake Tahoe is currently based upon water quality monitoring at a single location on the lake. TRPA recommends that the representativeness of this location be assessed. This reviewer agrees with this recommendation. In addition, multiple locations on the lake should be identified for nitrogen deposition monitoring on a routine basis. Water quality monitoring is the most effective means of evaluating nitrate deposition into the lake. **TRPA RESPONSE:** The recommendation to include multiple locations for monitoring nitrate deposition into the lake has been included in the recommendations section of this indicator sheet.
- 3] Control of NO<sub>x</sub> emissions sources within the TRPA air shed alone may not be effective in the further reductions of nitrogen deposition to the lake. Long range transport of nitrogen/nitrates from outside the Lake Tahoe air shed may also be a factor. The indicator status and downward trends for VMT (see Comment 4) supports this, for example. **TRPA RESPONSE-** Two schools of thought exist with respect to the local contribution of nitrogen emissions: 1) Metrological conditions do not favor retention of locally produced nitrogen dioxide. 2) Despite the unfavorable metrological conditions a significant percentage of nitrogen dioxide captured within the region converts to particulate nitrate and upon the failure of natural processes to scavenge the nutrient, is subsequently transported into the lake. TRPA will continue to work with partners to use best available science to answer these questions and adjust actions accordingly.
- 4] Vehicle miles traveled, which is used by TRPA as a surrogate for both NO<sub>x</sub> emissions and nitrogen deposition, have been trending downward since data capture began in 1981. TRPA has characterized this trend as representing “moderate improvement” as a consistent downward trend has been observed since 2009. Indicator status is characterized as “at or somewhat better than target”. (VMT estimated at 95% of 20,000,000 miles target). “The status and trends for VMT suggest that current programs and policies are mostly effective in reducing VMT”. This reviewer agrees with this assessment and the conclusions offered. **TRPA RESPONSE:** comment noted.

#### Odor Specific Comments

- 1] TRPA’s stated position in the TRPA 2011 Threshold Evaluation report was that policy statements that addressed diesel exhaust from vehicles be removed from the list of Threshold Standards. This reviewer at the time did not endorse the removal of these policies. In response to this the TRPA has retained policies, ordinances and programs and expanded the text in the 2015 Threshold Evaluation Report. This reviewer supports these actions. **TRPA RESPONSE:** comment noted.
- 2] This reviewer again recommends that a numerical Threshold Standard be put in place to allow for direct monitoring of the attainment status of the odor indicator, as well as, trends moving forward. TRPA, in fact, recommends that “applicable ambient air quality standards for NO<sub>x</sub>, SO<sub>2</sub>, CO and PM that are directly applicable to diesel engine emissions be used to measure attainment with the diesel odor standard”. This reviewer endorses this proposed approach. **TRPA RESPONSE:** comment noted.
- 3] The odor indicator is restricted to vehicle emissions (e.g. diesel fueled) at present. Use of numerical ambient air quality standards for compounds associated with vehicle emissions such as NO<sub>x</sub>, SO<sub>2</sub>, CO and PM is appropriate. As ambient concentrations for these parameters trend

downward odor incidents attributable to vehicle emissions should “track” accordingly. This reviewer endorses use of these standards as surrogates for odors attributable to vehicle emissions.

**TRPA RESPONSE:** comment noted.

- 4] The TRPA report states that “it appears that state and federal measures and programs have been effective in reducing odor. In addition, state and federal actions in conjunction with adopted TRPA policies, appear to be sufficient in lieu of TRPA program support”. (Effectiveness of Programs and Actions pg. 3-66). While these statements may be true there is no data in the odor indicator section to support these statements. As a result, the existence of odor programs, policies and ordinances alone do not serve as useful measures for monitoring odor indicator status and trends. Numerical standards such as those suggested in Comments 2 and 3 above should also be in place and applied in combination with policy statements for evaluating odor indicator status and trends in the future.

**TRPA RESPONSE:** The section that evaluates the effectiveness of programs in reducing odor was updated to reflect the fact that while we have policies in place to reduce odor, TRPA cannot make a definitive scientific judgment on how effective the policies are in reducing odor.

- 5] Odors attributable to sources other than motor vehicles and diesel emissions are not addressed in the odor section. The TRPA should consider a process to monitor and record odor complaints including use of an Odor Hotline. Odor events could be monitored and used to evaluate attainment with an actual numerical standard (eg goal equals a reduction in the number of complaints and/or violations from year to year). This could be accomplished through development of a complaint data base. Goals for attainment could be established moving forward consisting of net reductions in complaints and/or violations (actual number or %) from the prior reporting period. Complaint and violation trends could be monitored and used to evaluate the effectiveness of all existing odor regulations and policy statements. Enforcement responsibilities could be delegated to local law enforcement agencies such that additional TRPA resources would be limited. In a similar manner to the proposed approach for noise odor violations could result in warnings and fines levied against the offender.

**TRPA RESPONSE:** The above suggestion has been added to the list of recommendations.

## Lake Tahoe Review for Chapter 9: Scenic Resources

By Dr. Jeffrey L. Marion, Recreation Ecologist  
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### General Comments

I've completed my review of Chapter 9 on Scenic Resources. In general, I found this chapter to be a professional review of the scenic resources within the Lake Tahoe Basin. In contrast to the Recreation Chapter, the guiding statements for scenic resources do permit the development of effective evaluation indicators and standards and provide a sharp contrast to the deficiencies noted in the Recreation chapter. The indicators, monitoring methods, and analyses for this chapter are substantially better and provide an example of what the recreation section could look like with improved guiding statements. In particular, this chapter incorporated the kind of longitudinal (time-based) analyses, graphics, and statistical testing that are possible and necessary to inform management decision-making.

**TRPA RESPONSE:** Scenic monitoring provides a good example of how a topic that seems subjective can be evaluated in an objective and consistent way to track progress and inform management decisions. These comments provide additional support for the recommendations in the Recreation Chapter, to develop and implement a proactive and coordinated monitoring system, and revise the Recreation Threshold Policy Statements. On a related note, the Recreation Chapter includes a recommendation to integrate the current scenic monitoring of recreation sites with the recreation monitoring of the same sites to support the recreation threshold evaluation. This recommendation has also been added to the scenic chapter in the "Other Areas: Public Recreation Areas and Bike Trails" indicator sheet in the recommendations sections under monitoring approach to further support this recommendation.

Some possible improvements include incorporation of discrete examples of ongoing scenic resource problems with photos to convey the most common challenges to readers. Similarly, a description of corrective actions with before and after photos would also be helpful. Without these readers don't gain a complete understanding of the challenges associated with the management of scenic resources. I note that the section on the Built Environment (pgs. 9-32 to 9-40) does include some of this type of material, which was very informative. Inclusion of photos showing new construction adjacent to the scenic evaluation critiques promotes dialogue and development of a shared norm or consensus on what the Lake Tahoe Basin community desires. These examples also clarify the management direction for building owners, architects, and the public.

**TRPA RESPONSE:** Before and after photos showing scenic improvements have been added to the chapter to give readers a sense of the type of conditions that detract from scores ("before" photos), and changes that are causing the improvements in scores ("after" photos).

### Specific Comments

Pg. 9-2, Table 9.1: In contrast to Recreation, the Scenic Resources indicators and standards are indeed described to facilitate management decision-making and evaluation.

Pg. 9-3, last line of 2<sup>nd</sup> paragraph: The third word should be "route."

**TRPA RESPONSE:** Change made.

Table 9-2: Excellent table, particularly the division into the five Status & Trend classes. The Figures and map on the following page are also excellent – *particularly* the ratings by year in lower left showing the improving trend with statistical testing. This information is very helpful for interpreting the findings and a substantial improvement as compared to the Recreation chapter. I am a bit

confused by comparison of this figure to the figure and data on page 9-7. One is % of units in attainment and the other is average travel rating – which is the “official” metric? Use of methods consistent with the U.S. Forest Service, which were developed by scientific research, is very helpful and lends credence to this section.

**TRPA RESPONSE:** For roadway travel units, each travel unit is evaluated individually against the adopted standard for that unit. Thus, there are 54 separate metrics for the 54 travel units. Table 9-2 summarizes the status of the 54 travel units relative to the adopted standard or “official” metric for each unit. The two figures referenced in the comment provide different ways of aggregating and reporting on the status of the 54 separate standards, but they do not replace the individual scores for the 54 travel units, which are the adopted standards. The figure showing percent of units in attainment is included to show changes in the number of units that meet the adopted standards over time. The figure showing the average travel route rating had not been included in previous threshold evaluations, but was added to this report as another way to present changes in scenic conditions over time. This average travel route rating figure can reflect changes in scenic quality that do not change the attainment status of an individual unit (e.g., increases in scores for units that are already in attainment, or decreases in units that are already not in attainment).

I was left wondering what the problems were for the units that did not attain an acceptable rating. Could that information be summarized and presented so that readers are more aware of the problems and possible solutions?

**TRPA RESPONSE:** A summary of the identified problems from the 2015 scenic monitoring has been added to each indicator sheets under “Effectiveness of Programs and Actions.”

Table 9-2 and pg 9-11: Also excellent. Great to see the change in direction with improvements in shoreline travel route ratings beginning in 2002 following the Scenic Shoreland Ordinances (only possible by presenting the date by year). Excellent example of “adaptive management.”

**TRPA RESPONSE:** The table number in the draft that was peer reviewed incorrectly labeled this table as 9-2. It should be Table 9-3 and has been corrected.

It would be helpful to know what some of the problems were, how they were resolved, and what some of the remaining problems are. Readers are left in the dark regarding “what’s really going on.” Some photos might also help characterize the conditions of concern or show the improvements through side-by-side before-and-after comparisons. Given the subjectivity of scenic quality assessments I’m surprised that some photos are not included here for illustration purposes.

**TRPA RESPONSE:** Field notes have been summarized in the effectiveness of programs and actions indicator sheet to summarize some of the issues that are still outstanding that if addressed will allow these units to be in attainment.

Pg. 9-18 & 9-21: Same comments for the “Roadway Scenic Quality” and “Shoreline Scenic Quality” Ratings – could use some explicit examples and photos. I’m curious as to why they include both segment and point assessments and data. Might there be some comments to describe the advantages/disadvantages of both methods? Are both methods necessary or is one clearly better?

**TRPA RESPONSE:** The 1982 Threshold Study Report recommended the use of two separate systems to evaluate scenic quality: travel route ratings and scenic quality ratings. Travel route ratings evaluate the entire travel experience along a shoreline or roadway unit to evaluate cumulative impacts. The 1982 Report noted that the travel route rating system was not sensitive enough to reflect changes in scenic quality resulting from small-scale changes. A second system was recommended (scenic quality ratings) to focus on the scenic quality of individual scenic resources that could be seen from the same roadway and shoreline travel routes. An outline of the two systems for evaluating scenic conditions has been added to the chapter.

Pg. 9-23: It would be useful to describe some of the challenges or problems specifically, as well as some of the solutions that have been applied. Before and after photos would also be good to include as examples.

**TRPA RESPONSE:** Before and after photos showing scenic improvements have been added to the chapter to give readers a sense of the type of conditions that detract from scores (“before” photos), and changes that are causing the improvements in scores (“after” photos).

### **Lake Tahoe Review for Chapter 11: Recreation**

By Dr. Jeffrey L. Marion, Recreation Ecologist

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#### **General Comments**

I’ve completed my review of Chapter 11 on Recreation. In general, I found this chapter to be a professional review of the recreational facilities and their development and management within the Lake Tahoe Basin. However, the guiding policy statements for the Tahoe Regional Planning Agency make their task rather challenging as described in my comments below. Until more clarity is established it will be difficult to make visitor and recreation management decisions and professionally manage increasing visitation. Reviewing the success of the various organizations that provide recreation facilities is equally difficult due to this guidance. I suggest refinements that specify the provision of optimal levels of appropriate recreational activities, high quality experiences, and the protection of Lake Tahoe’s natural, cultural and historic resources. Further, I suggest incorporation of zoning so that some areas can be managed with substantial developments that can accommodate large numbers of visitor with limited resource impact, while other areas are managed with less development and visitation. Employing the ROS and VUM frameworks briefly described and included below can assist managers in the professional management of their lands and recreational infrastructure, activities, and capacities (PAOT). Such frameworks are particularly beneficial when difficult and publicly salient management decisions must be made and justified.

**TRPA RESPONSE:** In 2015, the TRPA Governing Board directed the agency to consider the question posed above as one of seven strategic initiatives for the agency to engage in over the next five years. This threshold evaluation report and the recommendations contained in the peer review are critical first parts of that process. In response to this comment and others, a recommendation to modify the threshold standards was added to page 11-9. Additional details on TRPA’s proposed approach to review the threshold standards as part of the strategic initiative are detailed in the conclusions and recommendations section of this report.

Some improvements to this report could be undertaken currently or for the next report to include the element of time in the various tables and figures that would allow an improved understanding of long-term trends and management success. The report does include recommendations, which I support, to adopt improved standardized surveys of visitor satisfaction (e.g., the U.S. Forest Service Natl. Visitor Use Monitoring system surveys). Finally, I also suggest incorporation of monitoring to assess the resource conditions on and adjacent to the existing recreation facilities (recreation sites and trails).

**TRPA RESPONSE:** While TRPA agrees that including the element of time would improve the understanding of long-term trends and management success, comparable long-term data is not available for much of the information presented in the tables and figures in this report. Where long-term comparable data is available, it was added to this report. This included the addition of historic rates of PAOT utilization on page 11-14, and the addition of a longer-term data set showing the rate of recreation facilities improved or created on page 11-11. The existing recommendations on page 11-9 call for “consistent and repeatable surveys of recreation users”, to allow comparisons over time. These recommendations were revised in response to this comment

to clearly call for “closely tracking public land acquisitions and recreation facility projects to allow for an evaluation of trends over time”. The recommendations have also been revised to call for “an evaluation of changes in user satisfaction and the rate of access facility development over time”, once recommended monitoring improvements have been implemented.

The commenter’s support for the recommendation to adopt improved standardized surveys is noted, and those recommendations are maintained in the final version of the report. TRPA supports the suggestion to monitor resource conditions on and adjacent to recreation facilities, in concept. Monitoring of resource conditions is addressed by other Threshold categories, including Soil Conservation, Vegetation, and Wildlife. Resource condition monitoring is also addressed within land management plans and through project approvals. Therefore, it may not be necessary to incorporate monitoring of resource conditions into the Recreation Threshold Evaluation. However, a recommendation to modify the threshold standards was added to page 11-9. The process to modify the threshold standard could consider the appropriateness of including resource conditions as an element of the recreation threshold standard. Additional details on TRPA’s proposed approach to review the threshold standards as part of the strategic initiative are detailed in the conclusions and recommendations section of this report.

### **Specific comments**

The adopted threshold standards for recreation are statements of policy rather than numerical standards. 1) “...preserve and enhance high quality recreational experiences and provide additional access to the shore zone and other areas for dispersed recreational uses,” and 2) “...establish and ensure a fair share of the total basin capacity for outdoor recreation is available to the general public.” (TRPA 1982).

So TRPA recreation management is guided by these two statements? I’m not sure you are inviting my comment on those (they are likely beyond the scope of this report) but I do have some concerns. First there is no mention of natural, cultural, and historic resource protection from recreational visitation in either statement. Shouldn’t there be? Second, statement 1 appears to call for perpetual recreational development of the shore zone, which is quite sensitive to visitor use impacts when compared to traditional “on-water” activities, or to recreational developments set back from shorelines. Statement 2 seems to address an equity issue but it’s unclear to me who, other than the general public, is competing for a share of that capacity. More importantly, these statements are not written in a manner that allows a clear empirical evaluation of management success. The assessment asserts that “the Region remains in attainment with adopted recreation threshold standards,” but the policy statements were not written to allow a clear evaluation of “attainment of standards.”

**TRPA RESPONSE:** In 2015, the TRPA governing board directed the agency to consider the question posed above as one of seven strategic initiatives for the agency to engage in over the next five years. This threshold evaluation report and the recommendations contained in the peer review are critical first parts of that process. In response to this comment, a recommendation to modify the threshold standards was added to page 11-9. Additional details on TRPA’s proposed approach to review the threshold standards as part of the strategic initiative are detailed in the conclusions and recommendations section of this report.

The table on page 11-2 provides a good example and illustration. Surveys of recreation satisfaction in National Park Service units (where I generally work) are notoriously “favorable” – the great majority of visitors are highly satisfied. To be useful an evaluation would need to develop a sensitive and reliable assessment tool and apply the same tool through a qualified sampling process to yield comparable data that could be examined periodically to evaluate changes in visitor satisfaction over

time. This table does not include survey data from earlier time periods so changes in satisfaction are unknown. I could not find any source information for these data in Appendix 1.

**TRPA RESPONSE:** This evaluation is the first time the agency used this data and it does not have comparable historic data that would allow an evaluation of changes over time. In the past TRPA used U.S. Forest Service NVUM survey data. However, no NVUM survey data is available for the current evaluation period. Because comparable data was not available, TRPA could not show changes over time. A recommendation on page 11-9, recommends a more coherent and consistent planned monitoring approach, which would allow for comparisons of consistent data over time. In response to this comment, an additional recommendation related to the analytical approach was added to page 11-9. This new recommendation calls for the analytical approach to include an evaluation of changes in user satisfaction and the rate at which access to recreation facilities are developed over time, after implementation of monitoring recommendations. Source information for the user satisfaction surveys was added to Appendix 1.

“The recreation element contains goals and policies that are intended “to achieve the intent of the thresholds over the life of the Plan by ensuring that recreational opportunities keep pace with public demand, that recreational facilities remain high on the development priority list, and that the quality of the outdoor recreational experience will be maintained.” (TRPA 2012e)”

The statement above from the bottom of page 11-2, taken from the Regional Plan actually provides better and more measurable objectives. I still suggest inclusion of objectives related to the protection of natural, cultural, and historic resources. Now on page 11-3 I see reference to resource protection under Adopted Standards but it’s not clear where this guidance is derived from.

**TRPA RESPONSE:** The statement from page 11-2 is an interpretation of the threshold standard excerpted from the Regional Plan. This Regional Plan language would be considered as part of a process to revise the Threshold standards.

Objectives related to resource conditions are addressed by other Threshold categories, including Soil Conservation, Vegetation, and Wildlife. Therefore, it may not be necessary to incorporate monitoring of resource conditions into the Recreation Threshold Evaluation. However, a recommendation to modify the threshold standards was added to page 11-9. The process to modify the threshold standard could consider the appropriateness of including resource conditions as an element of the recreation threshold standard. Additional details on TRPA’s proposed approach to review the threshold standards as part of the strategic initiative are detailed in the conclusions and recommendations section of this report.

Visitor surveys – I’m familiar with the U.S. Forest Service Natl. Visitor Use Monitoring system surveys. They are professionally developed, employ consistent sampling, and should provide good comparable information. It’s unfortunate that their data was not yet available for inclusion. I recommend employing their data, extending them to non-USFS sites, and including statistical comparisons between consecutive surveys for future comparisons.

**TRPA RESPONSE:** The recommended monitoring approach on page 11-9 is consistent with this comment. In response to this comment, an additional recommendation related to the analytical approach was also added to page 11-9.

The data presented are from a range of sources and no information is included in Appendices allowing an evaluation of the survey methods, research design/methods, sample sizes and response rates, etc. in the future I suggest inclusion of such material in an Appendix. As noted, the best evaluation of attainment would include a comparison of findings from two or more identical surveys conducted several years apart – none of these include such comparisons. Having said that, visitor

satisfaction does appear to be high for the south shore but is substantially lower for the north shore, and quite low for the S. Lake Tahoe and El Dorado County facilities (page 11-20 for the latter). Additional data on page 11-21 indicate that visitors desire more county parks, facilities, and trails and improves in the “ease of travel” for trails. Values in the 50’s and 60’s would not be suggestive of “in attainment” as indicated in the report.

**TRPA RESPONSE:** In response to this comment, a summary of survey methods and sample size for each survey were added as footnotes at the bottom of Appendix 1. The survey results have also been made available on the Lake Tahoe Info website at: <https://laketahoeinfo.org/MonitoringProgram/Summary/1> . TRPA agrees that it would be preferable to include a comparison of findings from two or more identical surveys conducted several years apart, and this concept is reflected in the recommendations related to the monitoring and analytical approach on page 11-9.

The report has been edited throughout to clarify that the threshold evaluation determined that TRPA has “implemented” policies and programs consistent with the adopted policy statement. The term “attainment” has been removed to clarify that the report does not evaluate the attainment of adopted numerical standards.

The comments related to visitor satisfaction are addressed in the recommendations section on pages 11-9 and 11-10. As noted by the reviewer, an evaluation of user satisfaction should be based on consistent survey criteria implemented over several years. For this reason, the recommendation to attain and maintain the threshold focuses on those areas where multiple previous surveys have also identified low satisfaction levels (i.e., access to recreation sites, trail connectivity, and the availability of parking at recreation sites). The recommendations do not address differences in user satisfaction within different geographic areas of the Tahoe Region because this data was generated from surveys that did not use comparable methods.

While there is data documenting a trend in the acquisition of public lands it seems haphazard – a table revealing the various public land owners and their acreage by year with aggregate sums at the base would be helpful.

**TRPA RESPONSE:** Information on public land acquisition per year by agency was not historically tracked in a centralized location, and is not available for inclusion in this report. This information is now being tracked through the Environmental Improvement Program tracker website, and it should be available to assess trends in land acquisition in the future. In response to this comment, the recommendation related to the monitoring approach on page 11-9 was expanded to include an additional recommendation to continue to closely track public land acquisitions and facility projects over time, to allow for an evaluation of trends.

Figure 11.1 does provide useful information for gauging the number of trail miles developed or improved trails by year – this is excellent though there should be a definition of what “improved” means or it should be omitted. Table 11.2 is also useful but data across time is needed. For example, how is the number of miles of roads with bicycle lanes and sidewalks expanding over time? Same for number of miles of street and mtn. bike trails and hiking trails by year. Improvements over time can’t be evaluated without the incorporation of change over time. Table 11.3 does contain some time-based data by describing new projects but an evaluation of long-term changes is not possible.

**TRPA RESPONSE:** The definition of “improved” trails was added to the text for Figure 11-1 as follows: “Trails are considered improved when an action is taken to enhance an existing trail for the benefit of outdoor recreation. Action to improve trails include constructing bridges, improving stormwater drainage, and trail grooming. Adding new amenities like signage, kiosks, and interpretive displays also qualifies as an improvement action.”

Detailed information on trail accomplishments per year was not historically tracked in a centralized location, and is not available for inclusion in this report. This information is now being tracked through the Environmental Improvement Program tracker website, and it should be available to assess trends in trail improvements and construction in the future. In response to this comment, the recommendation related to the monitoring approach on page 11-9 was expanded to include an additional recommendation to continue to closely track public land acquisitions and facility projects over time, to allow for an evaluation of trends. In addition, the figure on page 11-11 that shows recreation facilities improved or created was expanded to include prior years, where data was available.

Page 11-8, top: I see the recommendation I previously made regarding the use of the USFS surveys – good! If the timing of their survey is poor I suspect that some other entity could apply their same survey if you requested permission.

**TRPA RESPONSE:** This comment is consistent with the recommendations on page 11-9 and 11-10.

Pg 11-8, bottom: Great to see these 5 suggested strategies; they are excellent. In particular, the informational component is important. During my visit I did not realize that there was limited parking over at Emerald Bay and when we visited on a busy day we were unable to park there. I had examined the South Shore Bus service but discovered that it did not reach Emerald Bay. I did not discover the Emerald Bay Trolley service until just now when I did a Google search.

**TRPA RESPONSE:** This comment is consistent with the recommendations on page 11-9 and 11-10.

Pg 11-9: Would like to see a definition of “Improved” recreation facilities or have it omitted unless the improvements are truly substantial.

**TRPA RESPONSE:** The definition of “Improved” facilities was added to the text of the figure referenced in the comment. The definition is as follows: “Facilities are considered improved when an action is taken to enhance an existing facility for the benefit of public use. Improvements do not include routine maintenance. A facility is considered improved with the inclusion or improvement of one or more new amenities that are conducive to the comfort, convenience or enjoyment of facilities. Amenities include but are not limited to fences, lighting systems, drinking water fountains, picnic tables, benches, refuse containers, bike racks, trellises, educational displays, playgrounds, parking lots with less than 8 spaces and restrooms under 500 square feet.”

“The PAOT measure is an estimate of the number of individuals that a recreation facility or area can support at any given time. The PAOT allocations are used as both a target for desired recreation capacity, and a maximum limit to the recreational use that can be supported in an area.”

Pg 11-11: The above statement seems like an entirely ineffective process. We use PAOT determinations to identify the maximum number of visitors at various destination spots within National Park Service units. Almost always the number of visitors at those maximum capacities allow a degree of crowding and “less than desirable” experiential conditions. They should not be used as “a target for desired recreation capacity” in the sense that you are actively managing to increase use to that “target.” Did I misread this?

**TRPA RESPONSE:** It is correct that the PAOTs are used as both a maximum limit and a target for recreation capacity for those recreation facilities that are subject to PAOT allocations. The limitations of the PAOT system are described on page 11-16, and recommendations to revise or replace the system are also included on pages 11-16. In response to this comment, the recommendation related to the analytical approach was expanded to include a recommendation

that: “The PAOT system and analytical approach should be revised to allow for separate consideration of the desired and maximum recreation capacities”.

I’ve tried to understand how the PAOT system is being applied but the report is confusing on this topic. For example, it discusses the Eagle Falls trailhead and its 36 parking spaces. However, if a bus drops visitors here the design capacity of the parking lot becomes irrelevant when determining PAOT. I suggest application of a Recreational Opportunity Spectrum (ROS) system for planning and management purposes, and of a Visitor Use Management (VUM) framework for making decisions regarding the management of visitor use and carrying capacity. These are briefly described below. The ROS system allows land managers to develop and manage different zones to achieve differing resource protection and recreational objectives.

**Recreation Opportunity Spectrum (ROS)** is a system for classifying and managing recreation opportunities based on the following criteria: physical setting, social setting, and managerial setting. The combination of the three criteria results in six different ROS classes: Primitive, semi-primitive non-motorized, semi-primitive motorized, roaded natural, rural, modern urban. It recognizes that a common activity like hiking can provide very different experiential outcomes depending on where that activity occurs, e.g., in a suburban setting vs. a wilderness setting.

Websites:

[http://www.fs.fed.us/cdt/carrying\\_capacity/rosfieldguide/ros\\_primer\\_and\\_field\\_guide.htm](http://www.fs.fed.us/cdt/carrying_capacity/rosfieldguide/ros_primer_and_field_guide.htm)

[http://www.fs.fed.us/cdt/carrying\\_capacity/qtr098.pdf](http://www.fs.fed.us/cdt/carrying_capacity/qtr098.pdf)

**Visitor Use Management (VUM)** is the proactive and adaptive process for managing characteristics of visitor use and the natural and managerial setting using a variety of strategies and tools to achieve and maintain desired resource conditions and visitor experiences. Developed and just released this week by a federal Interagency Council, it provides improvements over prior frameworks used by the U.S. Forest Service (Limits of Acceptable Change, LAC) and the National Park Service (Visitor Experience & Resource Protection VERP) that it will likely replace.

Websites: <http://visitorusemanagement.nps.gov/Home/About>,

[http://visitorusemanagement.nps.gov/Content/documents/Position\\_Paper\\_Volume\\_One.pdf](http://visitorusemanagement.nps.gov/Content/documents/Position_Paper_Volume_One.pdf)

**TRPA RESPONSE:** In response to this comment, the description of the PAOT system was edited to clarify the text and remove the reference to the number of parking spaces, which, as the comment notes, does not necessarily limit capacity. The recommendations on page 11-16 regarding the replacement or modification of the PAOT system were revised to recommend that a new or revised recreation management system “build upon best practices used elsewhere, such as the Recreation Opportunity Spectrum and Visitor Use Management approaches used by federal agencies”.

Pg 11-13, under Monitoring Approach: I concur with the report statements about the need to improve the PAOT system to account for a wider range of criteria. I’m a scientist who specializes in recreation ecology, a small field of study that examines the environmental impacts of recreational activities, and works with managers to avoid or minimize these effects. Our studies routinely find that the same amount and type of visitor use can have widely different impacts depending on an array of different factors. For example, hiking traffic on a paved trail is basically inconsequential (no measurable impact) but that same number of visitors hiking along an undeveloped shoreline lacking a trail could have significant impact.

I don’t see any condition assessment monitoring of recreation sites or trails. For example, is this infrastructure sustainably designed and managed and what condition is it in? Poorly designed or overused trails and recreation sites could have soil loss or visitor activities and resource impacts extending outside the designed “footprint” of intended use. I suggest adding future assessments

and monitoring to include such monitoring and I can be of assistance in recommending appropriate methodologies.

**TRPA RESPONSE:** The first part of this comment is consistent with the recommendations on page 11-16.

Monitoring of the condition of recreation sites and trails has not been conducted at a regional scale in the past for the Recreation Threshold Evaluation. The condition of some recreation sites and trails are evaluated to support the scenic threshold evaluation. Implementation of the recommendation on page 11-9 to “Coordinat[e] and combin[e] the scenic threshold monitoring system’s regular assessment of recreation sites with recreation quality data collection”, would allow for an assessment of the condition of recreation sites.

Monitoring related to natural resource conditions are addressed by other Threshold categories, including Soil Conservation, Vegetation, and Wildlife. Therefore, it may not be necessary to incorporate monitoring of resource conditions into the Recreation Threshold Evaluation. However, a recommendation to modify the threshold standards was added to page 11-9. The process to modify the threshold standard could consider the appropriateness of including resource conditions as an element of the recreation threshold standard. Additional details on TRPA’s proposed approach to review the threshold standards as part of the strategic initiative are detailed in the conclusions and recommendations section of this report.

Pg 11-13, under Modification of the Threshold Standard or Indicator: I also concur with the report statements here about the need to clarify guiding objective terms (as previously noted). I still do not understand who other than the “public” is competing for the Lake Tahoe Basin resources. Does it mean the public traveling with a commercial party (on a ferry, renting a commercial boat) vs. unaffiliated visitors or private land owners? This needs to be clarified.

**TRPA RESPONSE:** This comment is consistent with the recommendations on pages 11-16 and 11-17. The Threshold Policy statement has been interpreted to refer to a balance of recreation resources that are available to the general public with private development, land ownership, and infrastructure use. For example, on page 11-14 the number of PAOT allocations, which represent public recreation capacity, are compared to the number of commercial, tourist, and residential development rights that have been used, which represent private use of resource capacity.

Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

## Review Comments on the Tahoe Regional Planning Agency (TRPA) 2015 Threshold Evaluation Report

Robert J Naiman  
26 July 2016

Summarized below are evaluations and comments on the information, analyses, results and recommendations contained in the 2015 TRPA Threshold Evaluation Report for the general Introduction, the general Methodology, and the Fisheries and the Vegetation chapters. As requested, the documents were evaluated relative to my expertise of the subject matter, publicly available information, and commonly accepted scientific methods and practices. I provide critical evaluations that identify deficiencies and errors, as well as point out positive aspects. Where appropriate I have made suggestions for objectively addressing most of the identified deficiencies or errors.

**General Introduction** - *Does the Introduction Section provide sufficient background information necessary to understand the purpose and scope of the Threshold Evaluation Report?*

The Introduction contains considerable information but does not present a compelling rationale for the importance of the Tahoe Regional Planning Agency (TRPA) program. The first page needs a concise paragraph giving the purpose, objectives and rationale for this report. In other words, provide a compelling paragraph to tell the readers why this report – and the program – is vitally important. As well, on Page 5, inform readers about the mechanisms or processes driving the observed status and trends. The activities are not convincing if the document is limited because analyses of causes and effects of observed status and trends were often not possible because the *"Investigation and presentation of the mechanisms and processes driving observed status and trends is beyond the charge given to the four-year threshold evaluation"*. This may be true but it is not what readers want to hear. The Introduction could be improved by crafting this difficult truth in a more positive light. How is the program going to identify the long term status and trends, and more importantly, what does the program plan to do about them, if anything? Likewise (also P. 5), if regression is not adequate, why not use the appropriate statistical/experimental procedures? Statement like this one leave readers wondering about the reliability of information presented.

Another general issue with the Introduction is that key words related to standards and confidences are not quantitatively defined. For instance, vague words such as *high quality, natural, moderate, and low* all have different connotations, depending on how they are used and perceived by individual readers. While this is a common problem in general reports it has been adequately addressed by several groups, notably the Millennium Ecosystem Assessment (<http://www.millenniumassessment.org/en/index.html>). The authors may want to review the approach they adopted.

Specific Comments:

P. 9: Under Monitoring and Analysis provide general information on data storage, determination of quality, and the general availability of data.

**TRPA RESPONSE:** The storage and availability of data was an issue identified during the peer review of the last threshold evaluation report, and since that time TRPA and partners have (and continue) to make significant investments in sharing and distribution of the data. Much of this data is now publicly available through the laketahoeinfo.org web platform, and TRPA will continue to add to platform and build out more robust functionality.

P. 9: Inform readers about how an "*indicator*" can be "*out of attainment*". Otherwise, this is a confusing statement.

**TRPA RESPONSE:** Text clarified to ensure that it is clear that indicator status is relative to the adopted standard.

P. 10: The recommendations seem to address mostly scientific approaches. If the recommendations are to fully engage readers and the public there will need to be recommendations that also address land use or other human-driven activities. Are there general recommendations of this type that can be added to the Introduction?

**TRPA RESPONSE:** The recommendations section of the introduction is intended to explain the contents of the report to reader and align expectations of what they can expect in the report. It does not contain specific recommendations for action. The recommendations referred to in the comment above can be found in the recommendations to "Attain or Maintain Thresholds" of the individual indicator sheets.

P. 10: Here is an opportunity to improve the overall program. What will it take to have management standards that are quantifiable? This seems essential for a fully functioning program.

**TRPA RESPONSE:** \*

There are a few additional comments and suggestions on a marked copy of the Introduction, which is attached.

**TRPA RESPONSE:** Edits made in accordance with suggestions.

*Are statements of fact presented in the Introduction Section sufficiently supported with appropriate references or original data and analysis?*

In general, yes. The Introduction provides references to published articles and reports as well as websites. Nevertheless, a link to a comprehensive database of reports, articles, websites and other resources would be highly beneficial.

**TRPA RESPONSE:** Many of the documents we reference are available through the TRPA website. We are moving more towards online reporting and attempt to provide access the referenced materials where doing so does not infringe on copyrighted materials.

**General Methodology** - *Are prescribed approaches for determining the status and trend of indicators relative to adopted standards clearly presented and appropriate?*

While the program is admittedly complex and evolving, this chapter raised many fundamental questions in my mind as to the veracity of the overall approach. The general Methodology perhaps requires a more in-depth discussion (and resolution) among the project leadership as to what the program is truly trying to attain, and whether or not the approaches employed will allow the program to reach the ultimate objectives. For instance (P. 1), it will be important for readers to understand what scientific or policy mechanisms are used to determine the Threshold Standards, and if they are ecologically or socially meaningful and defensible.

**TRPA RESPONSE:** \*The methodology described here relate only to the assessment of progress towards the threshold standards. Review and revision of the threshold standards was identified as a priority initiative by the TRPA governing board in 2015. Additional details on TRPA's proposed approach to make progress on the initiative is detailed in the conclusions and recommendations section.

The chapter, in several places, suffers from poor sentence construction. I recommend that it be carefully edited for clarity. Specific comments (and some questions) can be found on the attached document.

**TRPA RESPONSE:** The chapter has been re- reviewed thoroughly and the text revised as needed to improve clarity and readability.

*Is the prescribed approach for determining the level of confidence in status and trend determinations clearly presented and appropriate?*

While environmental characteristics vary over space, time and land use, using the current year's value can be misleading depending on that variation. I suggest reporting SD's and ranges, where appropriate. Further, are the evaluations of trends statistically significant (P. 6)? If not, then how is a trend determined?

**TRPA RESPONSE:** The report is intended to provide an overview of environmental health for a general audience. Because the target audience is lay audience, we attempt to simplify the presentation of information to facilitate communication. Additional information, such as variance in the indicators are considered when formulating recommendations and presented to decision makers. Additional information is also often reported in the confidence in the status and trend determinations. The details of the methodology for reporting status and trend are contained in the methodology section. Each indicator sheet provides a description of the specific methods used to assess status and trend, including criteria used for assessing the significance of a trend.

On P. 7 there is a detailed explanation of regression analysis. More importantly, it appears that PCA's and other more advanced statistical analyses are not being used. Why? The approach being used here (regression analysis) is a good start but may not be the best approach for determining complex trends and causalities. A defensible explanation is needed as to why other statistical approaches are not used.

**TRPA RESPONSE:** TRPA agrees that other more complex approach to data analysis are often appropriate and are used for many of the variables. In many parts of the report more complex statistical analysis are used, see for example, the majority of water quality indicators and many wildlife indicators. Limited time and resources in relation to the number of standards and indicators preclude more detailed analysis of causality and trend. In addition, many of the indicators only have limited years of data collected, or data has been collected in varying ways through the years, precluding more advanced statistical analysis.

P. 8: What is the scientific rationale for using 2.5% and other percentages?

**TRPA RESPONSE:** The methods describe a standardized approach to categorizing change across all 171 standards that vary between air quality to scenic quality and recreational experience. Assessing magnitude of change is subjective by nature and there is no "correct" value that could be used across all categories. Where there is no single "correct" answer, best practice in reporting is full transparency of the report methods, which are include in the report. The selected value is consistent with how change was categorized in the last threshold evaluation report, and thus ensures stakeholders can readily interpret and compare the results.

Using the intersection of the horizontal line with the y-axis to estimate an interim target for a specific indicator may not be always a good idea from an ecological perspective (P. 8). For instance, consider water quality (e.g., N, P) and its influence on fish carrying capacity. While it may be a good idea to reduce N & P in culturally eutrophic situations, it may not be a good idea in other situations to reduce them to zero (or very low levels). Nutrients are required to sustain healthy populations. Perhaps something needs to be said here about attainment of standards. Additionally, how is a quantifiable target set in a situation where the objective is to slow the rate of change away from attainment? Readers will want to understand this process.

**TRPA RESPONSE:** \*

The section on confidence in trend determination (P. 9 and 10) raises a number of questions. First, it is important to define "*Trustworthy Data*". Second, what is the scientific rationale for using the values and cut-off points (e.g., >0.75, and others), especially when data are sparse? It seems misleading without strong ecological and social rationales.

**TRPA RESPONSE:** A definition of what constitutes trustworthy data has been added to the methods section. The issue of bin selection for data presentation is addressed in the above comment. Where data are sparse and the outlined methods are unsuitable this is indicated in the details of the analysis of the individual indicator sheets.

For the overall confidence determinations (P. 10, Table 2-4), I recommend that it would be prudent to err on the side of environmental caution and use the lowest rating, especially when one is high and the other low (or could not be determined). Is this a philosophy adopted by the program?

**TRPA RESPONSE:** TRPA recognizes the potential benefit of erring on the side of caution and as an agency we err on the side of caution when making decisions and formulating policy in response to the findings of the report. The intention of the icons is to provide a quick snapshot of the status and trend relative to a standard for a general audience. We trust the interested readers and decision makers will dig deeper than the icon and read the descriptions that accompany the determinations.

The Management Standards and Policy Statements (P. 11) do not include assessments of trends or confidence, which is understandable. However, do they include recommendations on what needs to be done to attain the management standards and policy statements? The statements should at least provide explicit examples of what needs to be done, especially if readers are to have confidence that the program has thoughtful and committed leadership.

**TRPA RESPONSE:** As suggested, recommendations for program modification are included for management and policy statements.

*Are the approaches prescribed to determine an interim target and attainment date for an indicator reasonable, given data and funding limitations?*

See comments above. No specific information was provided on data and funding limitations in this chapter; therefore, it is not possible to answer the question.

**In evaluating the chapters on Fisheries and Vegetation, I used guidelines provided to reviewers by the Program coordinators:**

**Introduction** - Does the Introduction Section provide sufficient background information necessary to understand the purpose and scope of the Threshold Evaluation Report? Are statements of fact presented in the Introduction Section sufficiently supported with appropriate references or original data and analysis?

**Methodology** - Are prescribed approaches for determining the status and trend of indicators relative to adopted standards clearly presented and appropriate? Is the prescribed approach for determining the level of confidence in status and trend determinations clearly presented and appropriate? Are the approaches prescribed to determine an interim target and attainment date for an indicator reasonable, given data and funding limitations? Do the authors clearly articulate the sources of uncertainty in the analysis?

**Indicator and Indicator Reporting Category Evaluations** – Is the write-up associated with each indicator evaluation clear and complete? Are the analytical methods appropriately applied in the determination of an indicator’s status, trend, and confidence? Are there other or different analyses you would recommend to evaluate indicator status or trend? Are statements of fact or conclusions supported by appropriate references or original data and analysis?

**Recommendations** - Are recommendations appropriately supported by report findings and conclusions? Are proposed recommendations related to policy and on-the-ground project implementation supported by best available science? Are remaining uncertainties clearly articulated?

## Fisheries

The title of this chapter is misleading. There is little factual information on the status of fish populations and none on the commercial/recreational fisheries. Instead, the chapter is focused on a set of the more important aquatic habitats potentially available to fish. The TRPA should note that Fisheries (the plural form of “Fishery”) is defined as 1. a place where fish are bred; such as a fish hatchery. 2. A place where fish or shellfish are caught. 3. The occupation or industry of catching, processing, or selling fish or shellfish. 4. *Law*: the right to fish in certain waters or at certain times. This chapter should be re-titled to reflect actual contents.

**TRPA RESPONSE:** The chapter titles are drawn from the TRPA board resolution (82-11) in which the threshold standards were adopted.

While the chapter contains useful information that, for the most part is adequately acquired, the “Fisheries” program was a disappointment overall. This assessment relates to the emphasis on coarse habitat changes rather than fish population characteristics, the lack of clarity (quantitative definitions) in evaluation categories, the limited or non-existent (e.g., in-stream flow) monitoring, and the limited amount of restoration attempted. The chapter raised many basic questions and concerns, and I’ve listed the more important ones here and in the attached mark-up of the chapter.

**TRPA RESPONSE:** TRPA recognizes many of the concerns addressed above and the recommendations section of the indicator sheets contain the recommendation that the above concerns should be considered in any review of the standards. The assessment is focused on the adopted standard, which are detailed in TRPA board resolution (82-11).

P.1: It should be made clear to the readers as to why the fish and fisheries are ecologically and socially important. What do they tell one about the state of the Tahoe ecosystem? Do they have recreational or commercial significance?

**TRPA RESPONSE:** Additional information on the importance of fish and fisheries has been added.

P.1: The second paragraph could be moved to a section on "*History*". Its present position detracts from the overall flow of the text; the rationale and goals of the chapter should occupy the lead paragraphs.

**TRPA RESPONSE:** Paragraph moved as suggested.

P.4: How are *excellent, good, and marginal conditions* defined? Ideally, it should be by the responses of fish population characteristics over time.

**TRPA RESPONSE:** The full details of the methods are contained in the indicator sheet for stream habitat indicator.

P.5: Lake Habitat is, in reality, littoral habitat of undetermined depth (30m, 50m?). Are the pelagic or deeper (profundal) habitats considered in the status and trends evaluations? If not, why not? Are there valid ecological reasons for not considering them?

**TRPA RESPONSE:** The existing standard covers nearshore habitat to a depth of No standards have been adopted relative to deeper habitat. The concern expressed is not addressed in both the main text as well as the recommendations section.

P.5: How was the management target of 5,958 acres determined? [Note: 5,948 acres are used elsewhere in the report] Are there ecological or social rationales for fixing a very precise acreage? How many acres are potentially available for restoration or management? The indicator for lake habitat does not seem to have established a depth. Is there a "*cutoff*" depth for the acreage?

**TRPA RESPONSE:** The management standard is 5,948, the text has been reviewed to ensure the standard is correctly referenced through the document. A more detailed explanation of how the standard is beyond the scope of this document.

P.7: Provide an ecological rationale for establishing the "*prime*" size categories for substrates.

**TRPA RESPONSE:** The rationale for the standard is provided in the documents associated with the establishment of the standard. A more detailed explanation of how the standard is beyond the scope of this document.

P.8: Are invasive plants an issue in the littoral zone? If so, are they detected by remote sensing?

**TRPA RESPONSE:** Invasive plants are in issue in some parts of the littoral zone of Lake Tahoe and the monitoring and management of AIS is detailed in the water quality section of this report. There is currently a pilot effort underway to map invasive plants through the use of remotely sensed imagery.

P.8: If aerial mapping techniques and approaches continue to change, how will one determine if there are valid trends in littoral habitat? This issue needs to be given high priority by researchers.

**TRPA RESPONSE:** Scientists and managers are currently working together to assess the most effective ways to monitor and manage AIS in the Region.

P.9: Since "*there is insufficient data available to assess the effectiveness of individual programs or actions in maintaining lake fish habitat*" shouldn't the program implement research or monitoring to directly link them? Otherwise how does one know that the programs and actions - operated at

great effort and expense - are effective with respect to habitat carrying capacity and fish population responses?

**TRPA RESPONSE:** TRPA believes this comment applies more generally to the report and not just to the Fisheries threshold category. While the threshold evaluation report has historically focused on status and trend, we recognize that adaptive management requires more robust assessments of program and project effectiveness. The issue is now included as a general recommendation in the conclusions and recommendations chapter.

P.9: The recommendations for lake littoral habitat monitoring are reasonable and should be given serious consideration for adoption.

**TRPA RESPONSE:** \*

P.11: Scientific defensible, quantitative definitions of *excellent, good and marginal streams* are needed.

**TRPA RESPONSE:** Stream classification into one of the three categories is related to the CSCI score for the stream and the classification suggested by state of California. The definitions are quantitative and detailed description is included in the methods section.

P.14: Only eight reference sites have been established. I doubt that this is analytically sufficient. Are the reference sites established on various physical types of streams considered to be in "*excellent*" condition in order to measure departures from natural conditions? Having a scientifically defensible comprehensive strategy is essential if changes (or no changes) are to be detected in a reasonable period of time.

**TRPA RESPONSE:** When the stream bio assessment monitoring program began, there was no large data set of "reference" stream sites in CA/NV to compare Tahoe streams against; therefore eight local Tahoe streams were selected as "reference" sites. The reference sites were chosen to represent all the different Tahoe stream environmental gradients including; low elevation to high elevation sites, naturally rocky to naturally sandy substrates, as well as forested to meadow streams. In 2015, the State of California's Aquatic Bioassessment Laboratory finished their "reference" stream network, establishing what reference biotic conditions look like based on over 600 stream sites across the State. This reference network is now used by TRPA to calculate CSCI scores on streams in the Tahoe Basin, based on departure from what would be expected at these 600+ reference sites. The eight reference sites that TRPA originally established are still used to assess changes in Tahoe stream health on sites outside of most human influences.

P.15: Provide ecological rationales for using the numerical ratings and their thresholds for streams in the TRPA program. Otherwise they have no meaning.

**TRPA RESPONSE:** Stream classification into one of the three categories is determined by the CSCI score for the stream, and the classification suggested by the State of California Aquatic Bioassessment Laboratory. A further description of the categories is beyond the scope of this report. Interested parties are directed to the references included in the report.

P.16: Evidence needs to be provided to demonstrate that physical habitat characteristics (which are not identified) and "*break points*" established for streams elsewhere in California are applicable to streams in the Tahoe Basin.

**TRPA RESPONSE:** The "break points" used for this evaluation, which are based on the work of the State of California's Aquatic Bioassessment Laboratory, are based on streams only in the Sierra Nevada and North Coast regions of California, not the whole state. While it would be preferable to only use "break points" based on Tahoe stream data, there is not yet robust enough data available for this area to make statistically strong relationships between these "breakpoints" and physical

habitat characteristics. Therefore, we chose to use the more robust data set that includes a larger geographic area that is still somewhat similar to the geology of the Tahoe area.

As pointed out later in this section of the report, additional physical characteristics and climate play important roles in stream "health". Were they included in establishing the category designations for the Tahoe streams?

**TRPA RESPONSE:** This approach used in this report is consistent with the approach used by EPA's National Rivers and Streams Assessment and the State of California's Perennial Streams Assessment. Physical stream habitat characteristics are used to explain the BMI results, but do not directly contribute to measure of stream health. For example, if a stream shows a high amount of erosion and fine sediment, the stream will not be automatically given a "marginal" rating, unless the corresponding BMI's also show that it is in degraded biotic condition. BMI's have shown to respond reliably to a wide variety of stressors, from point source pollution to excess sedimentation, and were therefore chosen over physical habitat characteristics to rate stream quality. We understand the limits of this approach, and therefore included a discussion of physical habitat characteristics and their relation to BMI scores. While not used for scoring streams in this report, physical habitat characteristics are used to prioritize streams for restoration and to show restoration effectiveness when applicable.

P.16: The statement about categorization being mislabeled based on "*traditional*" assessments requires considerably more explanation. What does this mean in terms of scientific conclusions as well as management and policy decisions?

**TRPA RESPONSE:** The text has been modified to clarify that the comparison being made is assessment based only on physical parameters vs. physical and biological parameters. The reference to assessment based only on physical characteristics as "traditional" has been removed. The five sentences that follow the statement explain the difference between assessment focused only on physical criteria vs. assessment that also considers biological characteristics of the stream.

P.17: It is hard to accept the "*high*" confidence in the status of streams (and their fish populations) in the Basin. A very large percentage are rated as excellent - implying the fish populations are in good condition - but there are many culverts blocking movement, few native fishes, and the population dynamics are poorly monitored. Biotic integrity, as measured by the techniques used, may be high but there is little evidence that fish populations are in good or excellent condition.

**TRPA RESPONSE:** As both reviews of the fish habitat assessment suggest, the status rating relates to the threshold standard which relates directly to fish habitat, and does not actually measure the presence or health of fish populations. We understand the limitations of this approach and will work the threshold review team to ensure current threshold standards are modified to more accurately reflect TRPA's goals where appropriate.

P.18: The statement that streams and fish habitat have been substantially restored or enhanced through the Environmental Improvement Program, is hardly true with only 5 miles treated. This is a gross over-statement and should be modified to reflect improvements that can be documented. Later it is admitted that "*the positive effects of these projects on overall stream health have not yet shown up.*" The reasons provided for not seeing positive effects are valid.

**TRPA RESPONSE:** Only the length and number of projects is reported, no subjective determination of the relative magnitude of the impact of those projects is included.

Additionally, it is disappointing to see that fish passage improvement over 5 years resulted in only an additional 7.66 miles of available habitat (1.53 miles/yr). This is a very low rate of improvement

and attempts should be made to greatly accelerate restoration in future years, especially since the blockage points are known.

**TRPA RESPONSE:** Removing fish blockages, where appropriate, will continue to be a focal point of the Environmental Improvement Program (EIP) and your comments will help further the commitment to this work.

P.19: A recommendation is needed that addresses the slow rates of habitat restoration and removal of passage barriers.

**TRPA RESPONSE:** Fish passage removal in the Region is complicated by re-introduction efforts for LCT. As the other reviewer suggests, there are benefits to maintaining barriers that must be considered. The isolated populations these barriers create may provide opportunities for reintroduction of LCT in streams where they do not need to compete with introduced salmonids.

P.19: The recommendation that the threshold standard or indicator should clarify its intent to reflect the overall biotic integrity of the stream, rather than just fish habitat alone, is a good one – and should be seriously considered by the TRPA.

**TRPA RESPONSE:** \*

P.21: How are in-stream flow targets related to fish and other aquatic/riparian characteristics and ecological needs? This is a vitally important relationship and needs to be addressed directly via research and experimentation.

**TRPA RESPONSE:** The threshold standard is for a non-degradation of instream flows. Regulations are in place that prevent any additional stream withdrawals. The establishment of instream flow targets in relation to the needs of fish and other aquatic species will likely be considered as part of the initiative to review the threshold standards.

P.21: Without monitoring it is impossible to determine if in-stream flows are being provided. It, therefore, is premature to state that "*the threshold standards are determined to be implemented and in attainment*". The lack of monitoring for compliance is a major oversight.

**TRPA RESPONSE:** The threshold standard is for a non-degradation of instream flows. No diversions of stream flow have been allowed since the standard was adopted in 1982. Additionally, numerous studies, including Tracy and Rost 2003, found that stream withdrawals have little to no effect on base flows in the Tahoe Basin.

P.22: How do groundwater (GW) extractions affect stream flows? I would suspect that large GW extractions in a limited basin would have significant impacts on in-stream flows, especially during periods of drought.

**TRPA RESPONSE:** Instream flow in the Tahoe Region are primarily driven by climatological factors and thus the extent to which standards may benefit the species is limited because flow is not driven by release from dams or diversion. The South Lake Tahoe Area is the most densely populated area in the Basin and groundwater extractions account for 95 percent of the areas water supply. The most extensive study of groundwater in the area found that recharge exceeds extraction from groundwater by 18 percent annual and concluded that "*The overall trend of the groundwater elevation data indicates that groundwater pumping is not causing any long-term declines in groundwater levels, or overdraft, in the TVS Basin.*" The study suggests that the "*TVS Basin, the regulatory policies restricting growth throughout the Lake Tahoe Basin, will help to ensure that overdraft conditions do not develop in the future.*" Many of the public wells in the Region, which account for the majority of groundwater extraction, are separated from surface water by a confining layer that mitigates the impact of groundwater extraction on surface water flow. No diversions have been permitted since the Tracy and Rost 2003 study and the resident

population of the Region has decreased from 62,894 in 2000 to 54,380 in 2013. However, TRPA recognizes the age and potential limitations of the Tracy and Rost study and have flagged the issue for potential future review.

P.22: While it is laudable to have a statistical model for trout in-stream flow needs, other species have different flow requirements. The effort would be more robust if contrasting ecological water needs were considered (e.g., riparian plants, amphibians). As well, winter flow and ice conditions are extremely important in influencing biotic components. No information was provided on winter conditions.

**TRPA RESPONSE:** While TRPA recognizes that different species have different in stream flow needs and that a more robust approach would consider the needs of multiple species. The relevant standard reads, "Until instream flow standards are established in the Regional Plan to protect fishery values, a nondegradation standard shall apply to instream flows." No specific guidance is provided as to which fish species should be considered. The standard that is the subject of this evaluation relates to non-degradation of instream flow conditions.

Further, the Tracy and Rost investigation is 13 yrs old (and a non-peered reviewed internal report). How have conditions changed since then? Would the recommendations be the same in 2016? As a non-peered reviewed report, a lot of emphasis is being placed on its veracity; it may be time to re-evaluate the issue.

**TRPA RESPONSE:** No diversions have been permitted since the Tracy and Rost and the resident population of the Region has decreased from 62,894 in 2000 to 54,380 in 2013. However, TRPA recognizes the age and potential limitations of the Tracy and Rost study and have flagged the issue for potential future review.

P.23: The suggestion that "*... the need to establish minimum flow standards for individual streams may not be feasible or warranted and should be re-considered.*" is not warranted, especially with the apparently widespread pumping of GW.

**TRPA RESPONSE:** A more detailed response is included above.

P.23: The recommendation for monitoring needs to be modified, especially since there is no monitoring to determine if in-stream flow criteria are being attained. Further, it has not been demonstrated that the existing flow regimes are fully beneficial to native fishes or other important community components (e.g., riparian plants). This is a serious programmatic oversight that needs to be rectified.

**TRPA RESPONSE:** The recommendation will be communicated to the group charged with reviewing the threshold standards and the monitoring and evaluation plan that supports those standards. TRPA now includes a more report discussion of the surface groundwater interaction and additional explanation for why streamflow monitoring has not historically been considered a priority. Instream flow in the Tahoe Region are primarily driven by climatological factors and thus the extent to which standards may benefit the species is limited because flow is not driven by release from dams or diversion. The South Lake Tahoe Area is the most densely populated area in the Basin and groundwater extractions account for 95 percent of the areas water supply. The most extensive study of groundwater in the area found that recharge exceeds extraction from groundwater by 18 percent annual and concluded that "*The overall trend of the groundwater elevation data indicates that groundwater pumping is not causing any long-term declines in groundwater levels, or overdraft, in the TVS Basin.*" The study suggests that the "*TVS Basin, the regulatory policies restricting growth throughout the Lake Tahoe Basin, will help to ensure that overdraft conditions do not develop in the future.*" Many of the Region's public wells, which

account for the majority of groundwater extraction are separated from surface water by a confining layer that mitigates the impact of groundwater extraction on surface water flow.

P.25: It is hard to reconcile the determination that so many of the streams are being rated as "*excellent*" habitat when restoration of LCT populations appears to be limited by stream habitat, blockages, and non-native competition. The authors should reconsider this conclusion.

**TRPA RESPONSE:** The methodology used to assess stream habitat is detailed in the associated indicators sheets, and the limitations are noted there as well. The threshold standard for instream habitat does not directly reference LCT. As referenced in the indicator sheet, LCT were extirpated the Lake Tahoe Basin in 1930s, 50 years before the habitat quality of the streams in the Region were rated.

P.26: It has been 4 yrs since LCT were introduced into Lake Tahoe. Has it been successful? What are the results in terms of recreational fisheries?

**TRPA RESPONSE:** The standard that is subject of this evaluation is TRPA support for partners' efforts to reintroduce the species. The U.S. Fish and Wildlife is leading the restoration effort and many of the details of the reintroduction effort are included in the implementation and effectiveness section.

P.26: An additional recommendation might be to expand the number of sites being restored for LCT.

**TRPA RESPONSE:** The recommendation will be passed on to our partners who are leading the restoration effort.

## Vegetation

There is a substantial amount of information provided in this chapter spanning a broad range of spatial scales (from individual communities to the basin scale and, at times, beyond the Tahoe catchment). As such, the chapter has the potential to eventually become a "go to" source for future investigations. However, in order to perform that function or service, it will need to identify the data sources and ownership, evaluate the validity of data sets, and provide instructions on how data sets can be accessed.

**TRPA RESPONSE:** TRPA is currently moving the entire Threshold Evaluation Report into an online reporting platform where data sets, ownership, etc. can easily be accessed increasing the usefulness and applicability of the data and the chapter.

The chapter could benefit from having a section (or summary) on lessons learned as well as a section on plant communities that have been overlooked or ignored for various reasons. In the case of the latter, it is surprising that phytoplankton are not considered, especially with the emphasis on lake clarity, and that non-native species and understory species seem to have been relegated to the back shelf. As well, the understory vegetation is vitally important in terms of biodiversity and ecological processes. Has it been quantified for species, non-natives, and other important ecological characteristics in the riparian and upland forests? These plant categories help underpin the long-term ecological vitality of the Tahoe basin and should be receiving appropriate attention.

**\*TRPA RESPONSE:** Phytoplankton primary productivity is considered in the water quality chapter of the report. Summaries of lessons learned, etc. have been added to the Executive Summary of the report.

It was pleasing to see that so many of the recommendations addressed the need for establishing quantifiable objectives, including timelines for attainment of objectives. For many plant communities, it will take decades to achieve the objectives but it is vitally important to have quantifiable targets along the way, as well as an Adaptive Management (AM) framework to guide management actions. My sense, from reading the chapter, is that the program has not yet attained a working integrated system that would allow quantifiable monitoring to inform a viable AM framework, but progress is being made. Perhaps it is covered elsewhere in the report but a section on the AM framework would have been greatly appreciated. I hope that programmatic progress is fast enough to keep up with the ever-emerging environmental issues and land changes.

**\*TRPA RESPONSE:** TRPA agrees with the concerns regarding the program's ability to respond to emerging environmental and land use issues and these concerns are being addressed through the threshold update and review process.

In addition, I have quite a few concerns and comments about the chapter contents. While I found the individual sub-sections to be organized and at times informative, I also found many of them to be frustratingly limited in their temporal coverages and levels of monitoring. Here are some important comments, reactions and suggestions:

The current Introduction is largely "Background" information that could be moved to a new section. An Introduction should address the environmental issues - in this case, those associated with the vegetation - and provide clear objectives for the vegetative section of the TRPA report.

**TRPA RESPONSE:** The objective of each section of the report is to evaluate current conditions against the desired state as specified in the standard. The comment to remove background information in the introduction and to provide more clear objectives will be used in revising future versions of this report.

In the Table (P. 6-5 and 6-6, as well as elsewhere in the chapter), how were the percentages for relative abundance and other categories determined to be ecologically important and viable for the long term? As well, is there an Adaptive Management (AM) process in place to provide timely adjustments to specific program objectives? If not, there needs to be one.

**TRPA RESPONSE:** \*

I'm very surprised that suitable aerial photos do not exist before 2009 (see P. 6-13), at least for portions of the Basin. These would be highly valuable in determining trends, at least for some vegetative categories. What are the reasons why earlier photos cannot be used? In my experience, this is a very unusual development (see comment below on riparian vegetation).

**TRPA RESPONSE:** TRPA and partners recognize the potential value of review and analysis of older aerial images in the Region. Investing the time and resources to do so is dependent on resource availability and relative priority to other potentially beneficial analysis.

The discussion of disturbed vs. undisturbed wetland/meadow vegetation in proportion to the total undisturbed vegetation for the Basin (P. 6-18) is very informative. It provides a strong overview that readers will appreciate.

**TRPA RESPONSE:** Comment noted.

P. 6-19: I agree that the indicator does not measure the relative condition of meadows and wetlands or their ability to support various ecosystem services or attributes. As stated, the standard should be assessed against best practice for the establishment of standards and indicators for monitoring and evaluation, and amended as necessary to improve the evaluability of the standard and the information it provides for management.

**TRPA RESPONSE: \***

P. 6-20: If data for riparian vegetation are not reliable then they should not be shown. I'm surprised that calibrations between sets of techniques, photos, and so forth are not available (or were not done). Usually, as a matter of course, the calibrations are done and are well documented.

**TRPA RESPONSE:** The reported extent of vegetation types in earlier years reflects the values reported in those years, and are included in the report in the interest of transparency. Additional text has been added to clarify why older values are reported. Validation and map accuracy are discussed in detail in the USFS documents referenced in the text.

Riparian Vegetation: It is not clear how the TRPA arrived at a 4% target as being ecologically important for the riparian vegetation cover. It seems that there are better criteria that could be derived from aerial photos, such as the continuous distribution along streams, riparian widths, tree age distribution (or height), and other parameters that give an indication as to whether the riparian zone is structurally sound.

**TRPA RESPONSE: \***

P. 6-22: Quantifying changes in condition are paramount for an effective monitoring program, and I agree with this recommendation for riparian vegetation (as well as for all vegetative categories).

**TRPA RESPONSE:** TRPA and partners recognize the importance of information on vegetative condition and are actively exploring options to obtain condition data to support future evaluations.

Recommendations for the Shrub Vegetation Type: I do not agree with the recommendation for the Analytic Approach (P. 6-26). Having multiple estimates over relatively short (5 year) periods eventually provides some confidence that data are realistic (or not). It is also easier to establish trends, if they exist, with multiple points over several decades. Otherwise, changes can be interpreted as due to chance or other perceived drivers.

**TRPA RESPONSE:** A major evaluation interval specifies a time period at which a status determination relative to the adopted standard is made. Monitoring that feeds into that status determination occurs throughout the major evaluation interval. The suggestion is not to discontinue regular mapping of vegetation of the region, but rather to better align status determination with expected change in the phenomena being measured. If we expect it to take 200 years for a tree to reach maturity, an annual reporting exercise focused on answering the question "is the tree mature yet?" is likely to be irrelevant for management for at least the first 150 years. Other parameters are likely to be far more meaningful in assess interim progress and thus for useful for informing management decisions.

Nevertheless, the recommendation for Monitoring is excellent, as well as the recommendation for modifying the Threshold Standard or Indicator. I support their adoption by the TRPA.

**\*TRPA RESPONSE:** Comment noted.

There are a number of concerns about the section on yellow pine and red fir forest (P 6-28):

1. Why the change in diameter reporting?

**TRPA RESPONSE:** The previous definition (2006 and earlier) of Red Fir and Yellow Pine forest in stages "other than mature" as a DBH of twenty inches and under did not accurately represent "other than mature" stages; twenty inches DBH is simply too large of a threshold for Yellow Pine and Red Fir in "other than mature" stages. 10.9 inches DBH and under was used from 2011 on because it more accurately represents the size classes of early

successional Red Fir and Yellow Pine forests, and is an established forest habitat type in the California Wildlife Habitat Relations Types (CWHR. 2011. "California Wildlife Habitat Relationship System." [http://www.dfg.ca.gov/biogeodata/cwhr/wildlife\\_habitats.asp](http://www.dfg.ca.gov/biogeodata/cwhr/wildlife_habitats.asp)).

2. It is hard to keep believing this argument (changing mapping techniques/resolution) for why data are not reliable. A good remote sensing team would have made sure that, despite different techniques being used, the vegetation data would have been comparable.

**TRPA RESPONSE:** The remote sensing work used to inform the evaluation of the standard was completed by the Forest Service Region 5 Remote Sensing Laboratory, whom TRPA has high confidence in their use of best available science. The mapping of forest structure (not simply type) through the use of remotely sensed data is complicated and there are reasons sufficiently documented on why the remotely sensed vegetation data is not always comparable.

3. Map is too small to read.

**TRPA RESPONSE:** Map size has been increased.

4. Once again, what is the ecological rationale for setting the percentages (P 6-29) for Adopted Standards?

**TRPA RESPONSE:** \*

5. Is active planting being considered to meet the Target Attainment Date for yellow pine and red fir (P 6-30)?

**TRPA RESPONSE:** Forest health treatments in the Region focus on promoting multiple benefits including decreasing wildfire risk and promoting forest resiliency in the face of multiple threats. In addition, post fire rehabilitation includes planting.

6. Why is "*The less than 10.9-inch dbh definition of small trees ... thought to better represent the intent of the threshold standard (TRPA 2012b)*" (p 6-30)? As stated, it seems highly arbitrary.

**\*TRPA RESPONSE:** TRPA agrees with the reviewer that a size class definition needs to be clearly defined with strong scientific rationale. This may be addressed through the threshold review and update process which is addressed in the global response to comments.

7. Under recommendations, I do not agree with the proposed change in Analytic Approach; see previous comment on this topic.

**TRPA RESPONSE:** Addressed in a previous response to comment.

On the other hand, the revised monitoring approach and the modification of the threshold standard for yellow pine and red fir are good suggestions and should be adopted (P 6-31).

**TRPA RESPONSE:** \*

I was pleased to see a section in the vegetative report on the juxtaposition of vegetative communities and age classes (P 6-32). This speaks to a well-coordinated effort, besides being a highly functional activity as well. Nevertheless, a couple comments:

1. The map does not illustrate trends. Are there trends? Also, it shows fuel reduction treatments; not juxtaposition of vegetative communities or age classes.

**TRPA RESPONSE:** Modified header to convey to the reader that it is distribution of activities not trend that is being depicted.

2. The photos (P 6-32) do not illustrate vegetative juxtaposition. As well, they are repeated in the section on fuel reduction.

**TRPA RESPONSE:** The juxtaposition standard relates to the size of openings created during forest management activities. The pictures are of forest management activities. The photos for fuel reduction have been modified.

Bailey Land Capability System: The report requires a list (or a link to a website) giving the dominant vegetation or water types for each land capability classification (P 6-36). Further, how does the program address the proliferation of non-native species? How ecologically important are they in the Tahoe region?

**TRPA RESPONSE:** The Bailey land capability system focuses on placement of impervious cover. A link to the report has been added to ensure readers interested in more information can access it. The other questions raised in the comment are beyond the scope of this report, but are highly relevant to the review of the threshold standards referenced in the global response to comments.

Stream Environment Zones (SEZ): It appears that the SEZ program is structured around relatively recent environmental conditions (P 6-39). I suspect that recent conditions and perhaps spatial extent (especially near the lake) are significantly different from those before the arrival of Europeans. Early land activities most likely resulted in substantial sediment routing and deposition near the lake, local channel downcutting, removal of natural wood jams, and other environmental changes of long duration. Will the program attempt to restore the overall environmental conditions similar to those in a natural setting?

**TRPA RESPONSE:** \*

1. Why are there no monitoring partners and no monitoring as there is for upland vegetation? It seems that these would be essential.

**TRPA RESPONSE:** To this point, SEZ monitoring has been scattered and mostly project-specific. TRPA understands the limitations of the current assessment method for SEZ, and is currently implementing an SEZ monitoring program to better assess this standard with scientific rigor.

2. The removal of conifers from SEZs seems counter-productive as many riparian areas have conifers. They eventually supply large wood to streams/wetlands that provides habitat for centuries.

**TRPA RESPONSE:** Conifer encroachment is a well-documented management issue in the Sierra Nevada (Jones et al. 2005; Knapp et al. 2013; Krasnow & Stephens 2015), and does not remove all conifers in all SEZ. Natural wood recruitment for in-stream fish habitat is still allowed under conifer encroachment programs.

3. How are the "improved" conditions determined SEZs determined if there is no long term monitoring (P 6-41)? This does not make sense. However, later on the same page the author's note that monitoring and modification recommendations are needed; these should be adopted.

**TRPA RESPONSE:** Post implementation monitoring varies by project implementer. TRPA has initiated an SEZ monitoring program in 2016 to address the wider issue of SEZ condition and consistency of monitoring in the Region.

Appropriate Management Practices (P 6-42): Identify the specific management practices. Otherwise one cannot judge if they are appropriate (or relevant) for the management objective.  
**TRPA RESPONSE:** The management practices are discussed in both the monitoring and analysis section and in the implementation and effectiveness sections.

1. Where would one find the evidence supporting this statement/determination on the status of implementing appropriate management practices (P 6-43)? Who made the determination? This topic requires more substance than is currently presented.

**TRPA RESPONSE:** The science of forestry has evolved over the last hundred years, and so has the appropriateness of individual management practices. Within the Region, forest management is governed by the TRPA Code, Lahontan Basin Plan, California Forest Practice Rules, and the LTBMU Forest Plan. Each of which provides guidance, limitations, and best management practices that guide the determination of the appropriateness of forest management. The text has been modified to increase clarity and augment the description of management practices.

2. The recommendation for modifying the Indicator for Appropriate Management Practices is needed (P 6-44); it is one that should be adopted. Is there a way that this could become a quantitative objective with measurable outcomes?

**TRPA RESPONSE:** \*

Uncommon Plant Communities (P 6-45): Many of these appear to be places rather than plant communities. Mixing places and communities causes problems in conservation/restoration and, above all, retards learning from conservation/restoration actions and the development of conservation/restoration principles.

**TRPA RESPONSE:** \*

Deep-water plants (P 6-49): The authors provide a much needed recommendation for monitoring.

**TRPA RESPONSE:** Comment noted.

For the Upper Truckee Marsh (P 6-51) it is important to say why the condition is degraded; many readers will not recognize the degraded conditions from the photos because they have become such a common sight – many people see these as natural features.

**TRPA Response:**Text updated accordingly.

Upper Truckee Marsh: Here and elsewhere in the program, a qualitative assessment of a plant community has little value for evaluating the ecological condition (P 6-52). I strongly suggest that this indicator become quantitative.

**TRPA RESPONSE:** \*

Upper Truckee Marsh: Should there be a recommendation that addresses non-native species (P 6-56)?

**\*TRPA RESPONSE:** This comment may be addressed in the threshold review and update process. More details on this process can be found in the global response to comments.

The report should provide an Introduction and rationale as to why the individual marshes are addressed separately. Could the earlier section on marshes and wetlands act as an Introduction (overview) to these individual sections by giving the overall trends? As presented, these seem to be appendices to the main report. To follow on, after reading several of the following sections on individual sites it is clear that there is a lot of redundancy by not combining the marshes/wetlands

into one category. I suggest that the salient points be summarized in a Table, if only to make the document more readily comprehensible.

**TRPA RESPONSE:** The organization of this section follows the organization of other section in the report, where individual threshold standards are afforded individual indicator sheets. The summary of the status and trend appears in table 6-2 at the beginning of the chapter. TRPA is in the process of migrating to an online reporting platform and reconsidering data organization and presentation to ensure it is accessible to the widest possible audience. The new reporting platform is designed to reduce much of the redundancy inherent in the current structure while still ensuring that readers have access to all the information necessary to understand the status and trend evaluation for each standard.

Freel Peak Community: The recommendation to attain

P. 6-67: Part of the conservation significance score was confusing. If burrowing rodents and beaver are native species, then why they should detract from the conservation significance score. It seems as though the scoring is being done by researchers biased toward plants ...

**TRPA RESPONSE:** The standard relates to the status of the plant communities, which is why the evaluation focuses on the status of those communities.

Freel Peak Community: The recommendation to attain or maintain a threshold is a good one (P 6-83); it seems that it may be the best action since the drivers of change in this community are global.

**TRPA RESPONSE:** \*

Rorippa (P 6-85): Provide the correlation coefficient of the relation between sites occupied and lake level in the Figure caption. It may be informative, and very useful.

**TRPA RESPONSE:** The graph on page 88, not the one on 85, is more informative in terms of showing the relationship between lake levels and occupied sites. The correlation coefficient for the graph on page 88 is shown in the caption below the graph.

P. 6-91: Where is the AM framework described for TYC?

**TRPA RESPONSE:** The management framework for TYC is described in the management document referenced in the indicator sheet.

Draba (P 6-92): This is a well written section. The authors make a strong case for the need to protect populations of Tahoe draba. Similar ecological rationales should be crafted for other species and habitat types.

**TRPA RESPONSE:** Comment noted.

Galena Creek Rockcress (P 6-103): Remove lines in the figures; with so few data they are misleading, especially without statistical significance.

**TRPA RESPONSE:** Reporting convention for threshold evaluation is to include trend analysis when three data points are available, but to report that there is low confidence trend given the sparsity of the data. That convention is followed here to maintain consistency throughout the report.

Galena Creek Rockcress (P 6-105): The authors provide an important monitoring recommendation. As well, if there are only 2 verified populations, I agree that the target should be modified (P 6-106).

**TRPA RESPONSE:** \*

The section on Late Seral and Old Growth Forest Ecosystems (P 6-107) is important and probably should appear earlier in the chapter. As well, there should be a similar section on riparian forests.

Why are riparian forests not receiving equal consideration? While they are not as spatially extensive they perform vital ecological functions well out of proportion to their land cover. Other concerns with this sub-section:

**TRPA RESPONSE:** The order of the indicator sheets and section in the Report follows the order the standards appear in the TRPA Governing Board Resolution 82-11. The order in which they appear does not imply relative value of the individual standards.

1. (P 6-109): Explain how 55% was determined to be the target and, as well, why that percentage is ecologically meaningful. Also, the same needs to be explained for the zonal distribution of percentages.

**TRPA RESPONSE:** A reference has been added to the work that preceded standard adoption, a full discussion is beyond the scope of this document. Any changes to the thresholds will be addressed through the threshold update and review process which is discussed in more details in the global response to comments.

2. (P 6-110): The analytic approach does not seem to consider mortality as the stands undergo natural thinning. How are mortality rates, by species, incorporated into projections? As well, rather than use a single growth rate, it would be prudent to use a conservative range of observed growth rates to show the natural variability in transitions to "old growth" stands.

**TRPA RESPONSE:** The standard relates to area as classified by the dominate cover type. A reference has been added to the work the preceded standard adoption, a full discussion is beyond the scope of this document.

3. (P 6-112): The recommendation on monitoring does not address changes needed in monitoring. In fact, the paragraph does not address monitoring.

**TRPA RESPONSE:** The paragraph pertained to recommendations for modification of analysis conducted and has been moved accordingly.

4. (P 6-112): The authors provide a logical recommendation for the subalpine zone that should be seriously considered.

**TRPA RESPONSE:** \*

### Editorial Suggestions on the Vegetation Chapter

The key (Fig. 6.1) should appear before the symbols are used in the report (i.e., before the previous Table).

**TRPA RESPONSE:** The key for what each symbol means is displayed in the opening chapters before any of the data is presented.

Define or spell out SEZ (P 6-22).

**TRPA RESPONSE:** The text referenced is the adopted standard in TRPA Governing Board Resolution 82-11, and has not been modified. The acronym is defined and spelled out both in the chapter and on the indicator sheet.

P. 6-46: Not sure what this means: "... two cycles of monitoring data." Also, on the same page, define "deep-water".

**TRPA RESPONSE:** Text has been updated to improve clarity.

Deep-water Plants (P 6-47): The contour lines cannot be seen on the map.

**TRPA RESPONSE:** Contour lines removed from map. TRPA is in the process of migrating to an online reporting platform that will provide access to higher resolution maps.

Do you mean Grass Lake rather than Hell Hole (P 6-77)? See also last sentence on this page.

**TRPA RESPONSE:** Typo corrected.

P. 6-99: Define SWE and  $SWE = 0$ .

**TRPA RESPONSE:** Acronym defined at point of first use.

Old Growth Ecosystems (P 6-108): The color key for the figure is missing two categories.

**TRPA RESPONSE:** Key modified to ensure all are visible.

Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

June 23, 2016

TO: Dr. Sonia Hall, Conservation Science Partners  
FROM: Dr. Barry R. Noon  
RE: Review comments on 2015 Thresholds Evaluation Report, Lake Tahoe Regional Planning Agency (with a specific focus on Introduction, Methods and Wildlife Chapters)

I have thoroughly read the required chapters to enable me to provide an informed review of the wildlife monitoring program. The Lake Tahoe Regional Planning Agency (TRPA) is to be commended for providing some assessment of the status of wildlife with the Basin and to have established thresholds—that is, target values—for the monitoring state variables. However, my overall evaluation of the wildlife monitoring program is not favorable. Very few of the essential ecological and design components required of an environmental monitoring program are apparent in the wildlife program. I fully recognize that these limitations may be a consequence of severe funding constraints.

**TRPA RESPONSE:** TRPA recognizes there are opportunities to improve how we monitor species in the Region. While funding limitations are not referenced in the report, the existing monitoring is a function of available resources. TRPA monitors only osprey, nesting bald eagle, and waterfowl. TRPA relies on partners to monitor the status of the additional species included in this report.

In order to make my comments as useful as possible to the TRPA, I have structured my review to address: 1) what I perceive to be a deficiency in the existing program; and 2) what I see as a possible remedy.

#### Fundamental Deficiencies of the TRPA Wildlife Monitoring Program

The goals of the monitoring program and the target area to which these goals apply must be clearly stated. I interpreted the first few paragraphs of Chapter 8 Wildlife to have an implicit goal of sustaining all wildlife (vertebrates?) within the Lake Tahoe Basin. I believe this to be an appropriate **target population** (the vertebrate species assemblage) and **sample frame** (Lake Tahoe Basin).

#### **TRPA RESPONSE: \***

Monitoring any complex system, such as an assemblage of wildlife species that may exceed 300 vertebrate species (i.e., Lake Tahoe Basin), requires a surrogate-based approach. That is, all species of interest cannot be directly measured. This is driven in large part by the pragmatic reality of limited budgets. However, if the goal is to make inference to the status and trend of the full wildlife assemblage within the Basin (which I believe should be the goal of the TRPA), then the small number of species selected for monitoring should possess a number of key properties including:

- Knowledge of their status and trend should tell you something beyond their own measurement
- They should have sampling properties such as adequate abundance and broad spatial distribution in order to estimate change in their status and trend with sufficient statistical power
- In combination with the other species in the surrogate set, the species should be **complementary** in information content with species already in the surrogate set and add to

the **comprehensive** nature of the surrogate set (optimally, the surrogate set should span the domain of the species assemblage).

By meeting these properties, insights into the status and trends of the surrogate set allows indirect inference to these same properties for all the unmeasured species (see Noon et al. 2009).

Guidance to selection of the surrogate species set, and identifying the environmental and management factors that drive their dynamics, is aided by developing a conceptual model of the system being monitored (see Manley et al. 2000, Noon 2003 for examples).

In contrast to this approach, the TRPA selected what I would call a “flagship” species approach. That is, they chose to measure high profile species recognized and valued by the public. There is nothing wrong with this approach unless the TRPA is legally mandated, to the extent possible, to sustain all wildlife species within the Basin. Status and trend of many flagship species are unlikely to tell you much beyond their own measurement. A flagship species may be a member of an optimal surrogate set but other species with contrasting ecologies, life histories and spatial and temporal domains would also be needed.

**TRPA RESPONSE:** The special status wildlife species that are the subject of this report were selected in 1982 and generally reflect species of concern at the time. The use of the species as surrogates for the broader assemblage of vertebrates in the region, while sensible, was never a stated goal of the adopted standards. There is a broad recognition that the threshold standards may need to be reviewed and updated. Additional detail on that process is provided in the general response to comments that relate to modification of the standards.

Given the surrogate set, the next decision is what should be measured on these species. Monitoring state variables could include abundance, density, survival rate, or occupancy, for example. The TRPA primarily used count (abundance) data as the state variable. Once the state variables are selected, the sample unit—size, shape and number—for accurate state variable estimation must be described. Collectively, the species selected for measurement, their associated state variables, and sample unit properties constitute the **response design** of the monitoring program.

Next for consideration is the **sample design**. In addition to sample unit properties, a monitoring program needs to specify how the units will be selected for measurement. Typically, in order to make unbiased inference to the target population, sample units must be selected probabilistically so that all possible sample units with the sample frame have a non-zero probability of inclusion within the sample. It is important to remember that statistical inference flows from the analysis (i.e., simple linear regression in this case) to the sample to the sample frame to the target population. All these components must be appropriately integrated.

In my review of these chapters, I was unable to identify the response and sample designs used by the TRPA. It actually seems as if no sample units were designated, at least not in a probabilistic fashion. Reference is made to “population sites” but nowhere did I see this term clearly defined, nor do they seem equivalent to sample units in a traditional survey design.

**TRPA RESPONSE:** The lack of a commonly accepted definition for the term “population site” is an acknowledged issue and rectification of it is included in the recommendations section of the indicator sheet.

**It is my understanding that the TRPA wildlife monitoring program consists of a single sample site, the entire Lake Tahoe Basin.**

Within this single site, over multiple years, monitoring state variables (e.g., number of active osprey nests) are estimated. Inferences to population trend are then made after regressing the state variable on time (year) and determining if the model suggest a significant slope parameter. Below, I will outline several alternative statistical models for analysis of these time series data.

**TRPA RESPONSE:** Consideration of dual frame monitoring approach is now included as a recommendation for modification of the monitoring program.

### Thresholds

An **ecological threshold** is the point at which a relatively small change or disturbance in an environmental driver causes a rapid change in vital ecosystem state variable. Thresholds in ecological systems represent strongly non-linear changes in one or more vital state variables given a relatively small, marginal change in an environmental driver (i.e., a natural or anthropogenic process, event or activity). Even though the TRPA uses the term threshold, I believe they are really talking about monitoring trigger points—the value of a monitoring state variable that is unacceptable and will trigger some sort of management response. Trigger points are an essential component of an environmental monitoring program. However, they must be accompanied by an explicit statement of the management actions to be implemented once the trigger has been “pulled”. I found no discussion in the chapters I reviewed of what actions would take place if the threshold target was not met.

**TRPA RESPONSE:** As stated in the introduction, the TRPA definition of the “environmental threshold carrying capacity” is; “...an environmental standard necessary to maintain a significant scenic, recreational, educational, scientific or natural value of the region or to maintain public health and safety within the region.” As suggested this definition is more closely related to the goal for environmental quality or a trigger point at which corrective action will be taken, rather than a point at which ecosystem change is likely to occur. Ecological thresholds themselves are notoriously difficult to identify (Groffman et al. 2006; Lindenmayer et al. 2007).

TRPA is committed to adaptive management in the Region, the plan > do > check > adjust framework. The threshold evaluation report is part of the check portion of the cycle, intended to assess progress towards the Regions shared goal. The actions taken when individual standards are out of attainment are specific to the individual standards, but generally begin with two questions; 1) Did TRPA expect the indicator to be in attainment? Many of the threshold standards relate to long term goals that are not expected to be in attainment for many years. As such, simply being out of attainment may not trigger an alteration of management strategy. If, the expectation was that the standard would be in attainment, then a second question is asked; 2) What is the driver that caused the standard to fall out of attainment? Understanding the driver that caused the standard to fall out of attainment and the trajectory of that driver is critical to identifying the levers the agency and its partners can “adjust” in the system. Adjustments can include both policy mechanisms (e.g. Regional Plan or Code of Ordinance amendments) or infrastructure investments (through increased focus by EIP partners). For example, after the 2011 Threshold Evaluation Report identified the pace of environmentally friendly redevelopment was lagging, TRPA and partners identified and enacted a set of policy incentives to encourage redevelopment.

Review of management options to address issues identified during the threshold evaluation process begins with what TRPA defines compliance measures and supplemental compliance measures, which are defined in the TRPA Code as (16.3.2 & 16.3.8):

Compliance measures- A program, regulation, or measure including, but not limited to, capital improvements, operational improvements, or controls on additional development

to reduce, avoid, or remedy an environmental impact of activities within the Tahoe region or to promote attainment or maintenance of any threshold or standard.

Supplemental compliance measure - A compliance measure that is not being implemented at a given time but that TRPA may employ to attain or maintain a threshold or standard at a later date.

TRPA maintains a list of all compliance and supplemental compliance measures and the threshold standards they contribute to attaining or maintaining. That list can be found in the appendices of this report.

#### Concerns About "Population Sites"

Each of the major indicators (goshawk, osprey, bald eagle, etc.,) is referenced by population sites. I will use active osprey nest sites as an example because this seems to be the most easily understood indicator. It is my understanding that each year all previously active nest sites are visited in year  $t$  and if the nest is "active" it contributes a "1" to the count of the **total** number of active nests (the monitoring state variable) in year  $t$ . The survey process is continued through the list of all previously active nest sites until a total count of active nests in year  $t$  is estimated. The total count for year  $t$  ( $N_t$ ) is the response variable in subsequent regression modeling.

Several issues concern me in this "design". For example, what sampling effort is put into finding new nest locations not observed in previous years? Is there a probability-based design to survey other locations within the Basin that may not have a history of containing nest sites? Further, if a historic nest site is lost, say to development, is that site permanently removed from any subsequent trend analysis samples (a big mistake)? The bottom line is that reliable estimates of trend in the number of active osprey nests requires both the possibility of loss and additions to the most recent list of nests in year  $t-1$ .

**TRPA RESPONSE:** The protocol for monitoring osprey nests includes boat and walking surveys on Lake Tahoe and on other Tahoe area lakes in May and June to search for any new nests. These surveys include search of the entire shorelines of these lakes looking for any new nests. From the shoreline, almost all upland areas can be seen, and therefore confidence is high that a vast majority of new nests would be found using this method. Osprey and osprey nests are highly visible and readily identifiable in the Region. The few upland areas that are not visible from the shoreline are surveyed in a similar manner. Historic nesting sites are protected from development. TRPA and partners recognize the potential detection error and now include consideration of the dual-frame approach in the monitoring program recommendations. The analysis the reviewer presents below suggests that variation in year to year osprey counts is likely due to "process noise" rather than "observation error," but TRPA will continue to work with partners to minimize the influence of observation error on our estimates.

As an aside: The USFWS, as part of the Bald Eagle Recovery Plan, adopted a survey design exactly tailored to osprey nest monitoring in the Basin. It is called "dual frame sampling" and has been applied to trend analysis for multiple wildlife species (see Haines and Pollock 1998). The two sampling frames are the **list frame** and an **area frame**. The list frame contains information on all previously located active nests. The area frame is used to describe the geographical boundaries of the region of interest (i.e., the Tahoe Basin). If this method is of interest to the TRPA, I could provide additional details.

### Components of Variance in Monitoring Programs

In order to design efficient monitoring programs with high statistical power, it is necessary to understand the sources of uncertainty in data collection and analysis. Continuing with the osprey nest example, the TRPA wants to be able to understand temporal trends in the ecological processes that give rise to the true number of active nests in year  $t$  (let's call the total number of active nest in year  $t$ ,  $N_t$ ). However, we know that there are two key sources of uncertainty associated with our estimate of  $N_t$ . One is **measurement error**—perhaps the nest was active but we incorrectly concluded it was inactive. The second is **sampling variation**. If the true number of potentially active nest sites in the Basin is unknown, and we sample only a proportion of them, then a hypothetical different sample (of exactly the same size  $n$ ), would provide a different estimate of  $N_t$ . Uncertainties due to measurement error can be reduced in many ways, most commonly by making multiple visit to each potentially active nest to increase the likelihood of observing the true state. However, sampling variation can only be reduced by increasing sampling effort. The goal of a monitoring program is to minimize bias in the **observation process** so as to accurately estimate the **ecological process** (changes in  $N_t$  over time). Stochastic environmental variation directly affecting numbers in count data over time is called **process variance**.

### Estimation of Trend—Statistical Issues

TRPA estimated trend by regressing count data (e.g., number of active osprey nests) on time. Let count at time  $t$  be  $N_t$  (response variable) and year be indexed by  $t$  (independent variable). The fitted model was:  $\hat{N}_t = \hat{\beta}_0 + \hat{\beta}_1 t$ . Note that this model is linear and additive—that is, it models arithmetic population change involving adding or subtracting a fixed amount each year. However, this not the way biological populations change over time. Assuming no density-dependence, biological populations change by a **fixed rate** each year so that the expected numerical change among years depends on both the **rate** and the **current population size**.

Population trend in most vertebrate wildlife populations is defined as the average change in log abundance per unit time (Dennis et al. 1991). As a result, the appropriate model is **discrete geometric population growth**:  $N_{t+1} = N_t \lambda$ , where  $\lambda$  = the geometric growth rate. The model for osprey, and for most vertebrate species, is discrete because these species breed once per year, not continuously. Note:  $\lambda$  is easily understood as the logical growth parameter by solving for  $\lambda$  :

$\lambda = \frac{N_{t+1}}{N_t}$  Generally, this model is written as:  $N_t = N_0 \lambda^t$  where  $N_0$  is the initial population size.

Historically in wildlife ecology, the parameters of this model were estimated by a log-linear regression of counts against time (using simple linear regression, SLR) after transforming the geometric model by the natural log function (ln):  $\ln[N_t] = \ln[N_0] + \ln[\lambda]t$ . After fitting the SLR model, parameters estimates are interpreted as:  $\hat{\beta}_0 = \ln[N_0]$ ;  $\hat{\beta}_1 = \ln[\lambda]$ . Estimates of the population rate of change are given by:  $\hat{\lambda} = \exp(\hat{\beta}_1)$ . If  $\lambda > 1$  the population is increasing; if  $\lambda < 1$  the population is declining. In general, this is the model traditionally fit to wildlife count data (Eberhardt and Simmons 1992). However, better trend models have recently been developed (which I will discuss, below).

Better ways to estimate population trend from a time series of abundance data are now available (Humbert et al. 2009). Humbert et al. (2009) develop analytical methods to rigorously estimate exponential population trend and its variance from time series of count data thus allowing reliable

inference to whether a population is increasing, declining or remaining stationary. Estimation of trend from time series data depends critically on assumptions regarding whether process variance, sampling variation, or both are affecting the variance in growth rates over time (Humbert et al. 2009; Mills 2013).

Exponential growth with observation error: The first model discussed in Humbert et al. (2009) is the discrete geometric population growth model outlined above. When this model is log transformed, the growth rate can be estimated by SLR with  $\hat{\lambda} = \exp(\hat{\beta}_1)$ . This model assumes that the only source of variance in the time series of counts is due to sampling variation or observation error. The dynamics of the population are assumed to be governed by deterministic exponential growth.

Exponential growth with process variation only: The second model assumes exponential growth with process noise only—that is, no uncertainty exists in the count data due to sampling variation or observation errors. This would be the case if the entire population of interest was censused and observed without error. This model is equivalent to the density-independent diffusion approximation model developed a number of years ago (Dennis et al. 1991, Morris and Doak 2002). This model can be easily implemented in Excel based on a SLR of transformed time and count data. Specifically, the response variable  $y_i$  and independent variable  $x_i$  defined in terms of the original data are:

$$y_i = \left( \ln \left[ N_{i+1} / N_i \right] \right) / x_i$$

$$x_i = \sqrt{t_{i+1} - t_i}$$

The slope of the linear regression of  $y_i$  on  $x_i$ , forcing the intercept to be 0, is an estimate of the population growth rate,  $\hat{\lambda} = \exp(\hat{\beta}_1)$ . Because of the nature of the  $x_i$  transformation of the time variable, this model easily accommodates missing data.

Exponential growth with process variation and observation error: For most wildlife species, their abundance estimates vary due to environmental stochasticity (process variation), observation errors and sampling variation. In addition, many abundance time series are subject to autocorrelation due to correlated process variation—that is, a series of good years is often followed by a series of bad years. Autocorrelation in the response variable is thoroughly addressed in this model. This model, referred to as a **state space** model, is fit with a linear model including both random and fixed effects. In my opinion, this model (Humbert et al. 2009) is the most appropriate statistical algorithm to use to estimate trend from the wildlife count data collected in the Tahoe Basin.

Using the number of active osprey nests as an example, I have fit the original TRPA regression model, the observation error model, and the process variance only model using Excel. This spreadsheet is included with my review comments. The preferred trend model incorporating both sampling and process variation, however, cannot be easily programmed in Excel. Fortunately, Humbert et al. (2009) have made available a user friendly R script to fit this model to abundance time series data. This R algorithm estimates growth rates, observation error and process variation for all three models. This script is also attached to my review.

### Example Results: Trends in Number of Active Osprey Nests

Summary results of fitting the three models of Humbert et al. (2009) to the time series of the count of active osprey nests over time are shown below (Table 1).

Table1. Model results: Temporal trend in number of active osprey nests, Lake Tahoe Basin, 1997-2015. LCI = lower 95% confidence interval; UCI = upper 95% confidence interval.  $\sigma^2$  is the process variance,  $\tau^2$  is the observation error.

Model	$\mu = \ln[\lambda]$	$\sigma^2$	$\tau^2$	Var( $\mu$ )	LCI( $\mu$ )	UCI( $\mu$ )
Observation Error	0.0288	NA	0.0232	NA	0.0163	0.0413
Process Variance	0.0509	0.0218	NA	NA	-0.0173	0.1191
State Space	0.0509	0.0218	~0.0	0.0012	-0.0173	0.01191

Below, I have plotted the observed and predicted values of the count for the Observation Error Model (Fig. 1) and the Process Variance Model (Fig. 2) to show how well the estimated models fit the observed data. As is clear from Figure 1, the Observation Error Model is a poor fit to the data.

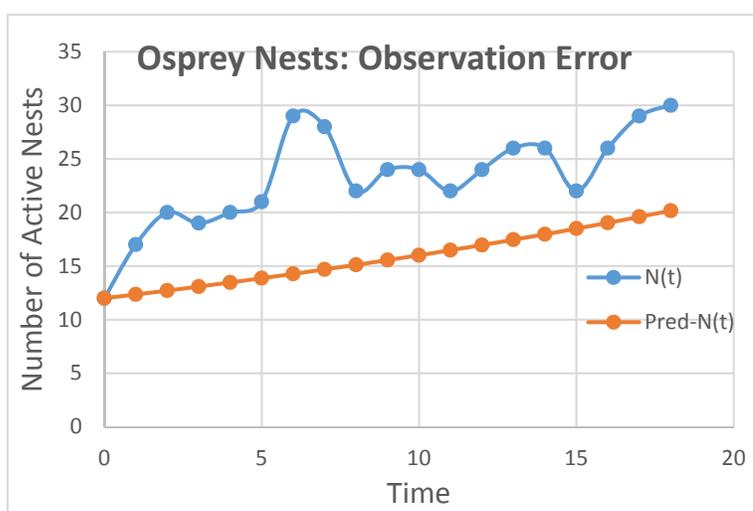


Figure 1: Fit of observation error model to active osprey nest count data.

In contrast, the fit of the process variance model to the data is much better (Figure 2). This is confirmed by the components of variance analysis which shows almost all the variability in the count data to be attributable to process noise and not observation error (Table 1). I have not graphed the state space model because the estimate of the growth rate from that model is equal (to four decimal points) to the process variance model.

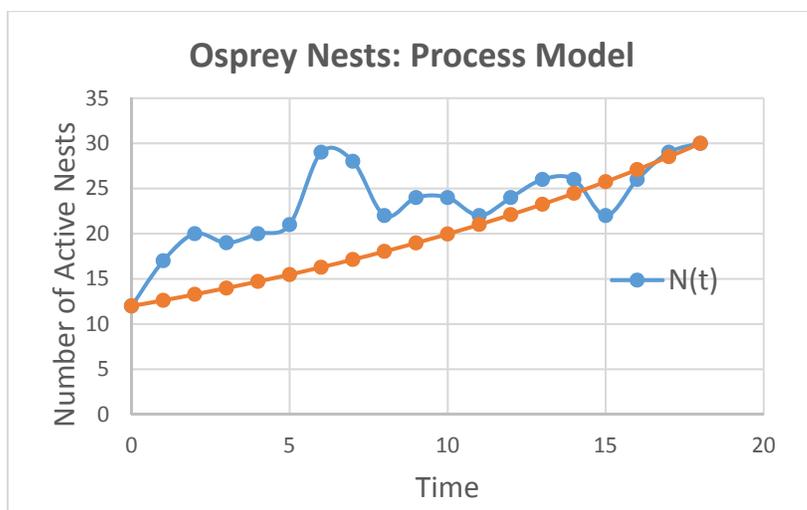


Figure 2: Fit of process variance model to active osprey nest count data.

Based on the point estimate of  $\ln[\lambda]$  from the state space model, I would cautiously infer that the number of active osprey nests appears to have increased over time at a rate of approximately 5%/year ( $= 1 - \exp[0.0509] * 100\%$ ). I emphasize caution because the confidence interval on  $\ln[\lambda]$  includes 0—that is, estimated annual rates of change based on the confidence intervals vary from a decline of 2%/year to an increase of 5%/year.

**TRPA RESPONSE:** TRPA staff are extremely grateful for the detailed explanation and time taken to reanalyze the osprey nesting data. State-space models are now used to present population trends for Osprey, nesting bald eagle, and peregrine falcon. The re-analysis has been incorporated into the report.

#### Brief Comments on Deficiencies Associated with Individual Species

For the most part, the Report (Chapter 8), honestly points survey design and data limitations.

- Goshawk: lack of standardized survey effort or any attempt to adjust the count for variable survey effort; high year-to-year variation in the count undermines reliable estimates of trend unless the length of the time series is long; a probabilistic survey should be designed for this rare and relatively cryptic species.

**TRPA RESPONSE:** The TRPA staff recommendation, included in the indicator sheet, is to consider implementation of a probabilistic survey.

- Active Osprey Nests: evaluated in detail, above. Dual frame sampling should be considered.

**TRPA RESPONSE:** As discussed above, the suggested state-space model is now used to analyze population trend, and the recommendation to consider the use of the dual frame sampling is included in the recommendations section.

- Winter Bald Eagle Count: methods I used to estimate trend for osprey nests are applicable to these data; how is survey effort standardized across years?; are the counts adjusted for varying survey effort and observer error? consider dual frame sampling.

**TRPA RESPONSE:** The suggested state-space model is now used in the report and the recommendations section includes the suggestion that dual frame sampling be considered.

The Tahoe Institute for Natural Sciences (TINS) leads winter bald eagle surveys in the Region and recognizes the limitations of the current survey methods.

- Nesting Bald Eagle: data too sparse for trend analysis.  
**TRPA RESPONSE:** TRPA assessment of the data was also that it was too limited to make any meaningful conclusions.
- Golden Eagle: data too sparse for trend analysis.  
**TRPA RESPONSE:** TRPA assessment of the data was also that it was too limited to make any meaningful conclusions.
- Active Peregrine Falcon Nests: methods I used to estimate trend for osprey nests are applicable to these data; consider dual frame sampling.  
**TRPA RESPONSE:** The suggested state-space model is now used in the report and the recommendations section includes the suggestion that dual frame sampling be considered.
- Waterfowl Population Sites: This indicator is very poorly defined and its ecological information content appears to be highly uncertain; consider dropping the indicator.  
**TRPA RESPONSE:** \*
- \*Disturbance-free Zones: This “indicator” is amenable to trend analysis based on periodic updates derived from remotely sensed data that provide estimates of extent, and spatial pattern (multiple landscape/fragmentation metrics could be considered).  
**TRPA RESPONSE:** \*
- Riparian Habitats: This “indicator” is amenable to trend analysis based on periodic updates derived from remotely sensed data that provide estimates of extent, and spatial pattern (multiple landscape/fragmentation metrics could be considered).  
**TRPA RESPONSE:** Exploratory work is underway in the Region to use remotely sensed data to assess health and recovery of Riparian habitats in the Region.

#### Literature Cited and Recommended

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Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

**Overall comments:**

There are a wide array of indicators of water quality that are reported, and the chapter presents both a rigorous scientific review of each indicator as well as a more holistic summary of trends and status for each indicator, which can be of value to a broader audience. General weaknesses perceived throughout sections included: (1) making sure appropriate and consistent time-series statistical approaches are used (e.g., Mann-Kendall or Sen's slope), and (2) considering whether "Insufficient Data to Determine a Trend" is the same as no trend observed. The authors may wish to consider a threshold time period or minimum of recorded samples be used to determine whether there is insufficient data to determine a trend, rather than the presence of a significant long-term trend. Often, no trend is a good thing, rather than an indicator of insufficient data.

**TRPA RESPONSE:** TRPA has gone through report to ensure "no trend" is not confused with "insufficient data". As laid out in the methodology section, three years or more of quality monitoring data is needed before a trend assessment will be made.

In many sections, the authors refer to substances that absorb and scatter light. In general, inorganic particles such as suspended sediments from runoff are highly scattering but weakly absorbing. In contrast, organic particles are generally substantially more absorbing and less scattering. So changes in substances such as primary productivity altering organic particles are likely to affect absorbance far more than scattering. The authors may wish to review J.Kirk's Light and Photosynthesis in Aquatic Ecosystems for a summary. The differential processes of absorbing and scattering will determine how changes in different substances (and substance particle size) influence clarity and color, and the effects of changes in particular response indicators will not necessarily impact both absorbance and scattering equally.

**TRPA RESPONSE:** The above comments will be passed along to the group tasked with updating thresholds and their monitoring programs. A more detailed description of this process can be found in the global response to comments.

It would be helpful to introduce discussion of limiting nutrients in Lake Tahoe because there is discussion in many sections on the influence of P and N. Not all forms of these nutrients will influence primary production, and it is likely that one nutrient is more important than the other - although this can vary based on time of year and depth, etc.

**TRPA RESPONSE:** Nutrient limitation is discussed in the work referenced in the document.

Early in the manuscript, perhaps in one of the summary tables, it would be useful to describe the statistical test used for each indicator. Sometimes descriptions of the test method is very detailed, while other times (for the same statistical test) the description is absent. Instead of repeating it, it would be useful to have a summary of the tests and why they were selected and to what indicators they were applied. Additionally, for many indicators, trends are assessed using both a statistical test as well as "visual inspection (i.e., qualitative)". Qualitative inspections should be avoided when at all possible to reduce subjectivity. Finally, some indicators have error bars (typically representing intra-annual standard deviations) while others do not, despite having the available data to

calculate these error bars. It would be nice to see a consistent approach of either including or excluding error bars depending on the type and volume of underlying data.

**TRPA RESPONSE:** TRPA is in the process of migrating to an online reporting platform and will consider the recommendations above to improve the presentation of information.

\* Finally, predictions of future values for response indicators often does not include referencing how response indicators will respond to climate induced changes in air temperature and precipitation, including impacts via changes in stratification and mixing and changes in the timing, duration, and magnitude of precipitation. It would be helpful to include projections, especially when changes in climate are likely to substantially impact the response indicator (e.g., Sahoo et al. 2016). Tahoe is a gem and meeting the various regulations and standards may not in some cases be sufficient in order to improve water quality conditions to targets given non-stationary climate conditions.

**Specific comments:**

Page 4-1: "Fine suspended sediment and nutrients that support algal growth (nitrogen and phosphorus) are the primary pollutants of concern in the Region because of the negative impact on transparency (Lahontan & NDEP 2010b) and blueness (Watanabe et al. 2016) of the lake...". Also, the header has the text, "Chapter Contributors" but no names are listed.

**TRPA RESPONSE:** Typo corrected. Chapter contributors were omitted from the peer review draft so that the reviewers were 'blind' to the authors, and thus reduce the potential for bias introduced by reviewer preconceived opinions of the authors.

Watanabe et al. 2016 show that blueness is correlated with chlorophyll fluorescence (an indicator of primary production, and often related to nutrient quantity and quality) but was not related to fine suspended sediments. Therefore, this sentence should be revised, as it implies that fine suspended sediment impacts blueness.

**TRPA RESPONSE:** Text modified accordingly.

Page 4-1: In this same sentence the authors write, "adversely affected by these pollutants (Reuter et al. 2009)." Are nutrients pollutants? Perhaps this is a philosophical question. I would prefer to see "substances" rather than "pollutants" used.

**TRPA RESPONSE:** The TMDL refers to both nutrients and FSP as pollutants, and this report follows that convention.

Page 4-2, line 2, pollutant should be plural.

**TRPA RESPONSE:** Text modified accordingly.

Page 4-2, the authors suggest that compact town centers well serviced by transit, pedestrian, and bike infrastructure will result in less pollutant load. In theory this would reduce the local N output, but two questions remain: first, earlier in the paragraph the authors state that fine sediment is the pollutant known to impact lake clarity. Are the authors trying to say that compact development will reduce fine sediment flux into the lake? If so, how?

**TRPA RESPONSE:** As said in the TRPA Regional Plan, compact development will help reduce fine sediment into the lake in many ways. Among these include removal of development on sensitive lands outside town centers, placing development where there are stormwater treatment facilities

in place, and reducing the use of private automobiles through better transit, etc. A more detailed discussion of why compact development will reduce pollution to the lake is out of the scope of this report and instead can be found in both the TRPA Regional Plan and the Lake Tahoe TMDL report.

Secondly, if the authors are trying to say that compact development will reduce N output and thereby reduce phytoplankton: 1) how much of the N budget comes from local sources? (It is unclear whether the authors are saying that local automobile usage contributes half the total N budget, or if automobile use anywhere contributes half the total N budget) and 2) are the phytoplankton N limited? (Overall, this paragraph needs some clarity - no pun intended :-))

**TRPA RESPONSE:** Paragraph has been modified to improve clarity. A detailed discussion on pollutant sources can be found in the Lake Tahoe TMDL referenced in the text.

Table 4-1: Is the vertical extinction coefficient what is often referred to as the diffuse attenuation coefficient ( $K_d$ ) or beam attenuation coefficient, otherwise known as beam- $c$ ? If it is the former, the unit of measure description is wrong - scattering not directly contribute to light loss if the light scatters directly back to the surface and out of the system; scattering mostly contributes to increasing photon pathlength, which thereby increases its chance of being absorbed). It would also be helpful to describe what wavelengths are studied. The extinction coefficient is very wavelength dependent and the fact that a minimum of 0.08 is set as the standard suggests that a specific wavelength or waveband is focused on.

**TRPA RESPONSE:** VEC is measured using a Photosynthetically Available Radiation (PAR) sensor which measures irradiance in the range from 400 to 700nm.

\*Table 4-1: Note that to achieve a turbidity load of  $<1$  NTU, you don't necessarily have to change the sediment load per se. Nephelometric turbidity is a measure of scattering, which is influenced by particle size, shape, and chemistry/particle make up.

It would be helpful to present Figure 4-1 before Table 4-2.

**TRPA RESPONSE:** To maintain consistency within the report, the placing of tables and figures has remained the same.

Table 4-2: I don't understand the pie charts for response indicators of "concentration of total phosphorus in tributary waters" and "concentration of total nitrogen in tributary waters". Do the different colors map onto different tributaries?

**TRPA RESPONSE:** The different colors in the pie chart signify the levels in or out of attainment of each tributary matching the symbol colors used to assess status in the rest of the report. Additional text added to clarify.

Table 4-3: The arrows indicate change in each indicator, but change relative to what? The earliest sample?

**TRPA RESPONSE:** Arrows reflect trend in an indicator relative to the target. This is discussed in detail in the methods section.

Page 4-21: Why has winter average Secchi ceased being used as a response metric? It seems like winter average Secchi is where the improvement has been. The analytical approach sounds reasonable except for this piece, "The GAM permits a nonlinear relationship by fitting a smoothing function which allows the trend analysis of recent years to be controlled more by recent

measurements.” How would a trend of ONLY recent years be controlled by another other than recent measurements? Furthermore, the authors may wish to consider alternative analytical approaches. Specifically the seasonal Sen’s slope may be more appropriate to use. The approach doesn’t assume independence of sample points and is able to account for seasonality in data, and is frequently applied to time series ecological data (e.g., O’Reily et al., 2015 in GRL).

**TRPA RESPONSE:** Winter Secchi depth was removed as a threshold standard in 2012 and replaced with annual average Secchi depth to promote alignment with the TMDL.

Page 4-24: In the relevance section it would be good to refer to reader to the Watanabe reference on chlorophyll influencing blueness. Additionally, phytoplankton contribute very little to scattering, so I suggest removing this phrase from this same section. Most scattering is via inorganic particles (e.g., sediments from the watershed).

**TRPA RESPONSE:** The TMDL estimated that FSP were responsible for two-thirds of scattering and organic matter was responsible for a third of scattering.

Page 4-25: It would be helpful to discuss experiments that test for which nutrients are most limiting, and if co-limited, how this varies annually. The report currently states that both nitrogen and phosphorus inputs are increasing primary production - does this mean the lake is co-limited? Also, while Secchi has intra-annual error bars (standard deviations), primary production measurements do not. Why not? Finally, the methods on this page state that simple linear regression was used for analysis. The data do look very linear (impressively linear, really), but least squares linear regression assumes the data points are independent - can you assume that here? Perhaps a more appropriate statistical test would be Sen’s slope. Its very likely that the results (e.g., estimated slope, significance, etc) will be essentially the same as linear regression, but the test is more appropriate for time-series.

**TRPA RESPONSE:** The experiments on nutrient limitation are discussed in the work referenced in the document. The suggestion for trend analysis of primary productivity will be passed on to our monitoring partner, UC-Davis TERC.

Page 4-26: “For the period of record (1968 to 2014) phytoplankton PPr has increased by 3.3 percent annually.” Is this the average of differences for every pair of consecutive years? “compliments” should be “complements”.

**TRPA RESPONSE:** The 3.3% is the rate of change for PPR. Compliments has been changed to complements.

27: “Interim Target – Reduce the rate of increase in PPr”. Annual rate? As the results on the previous page show, the calculated rate depends on the analytical method used.

**TRPA RESPONSE:** Establishment of interim targets is a larger issue in the report and is now addressed in the conclusions and recommendations.

Page 4-28: “Trend – Insufficient Data to Determine Trend”. Does this mean that there is no trend? The dataset looks sufficiently long to determine a trend. How was insufficiency determined? To me it just looks like there isn’t a strong trend, especially since the early 1980s. Note: comments above on Table 42 on the vertical extinction coefficient also apply here. The wavelengths used as especially useful because the coefficient is wavelength specific.

**TRPA RESPONSE:** TREND analysis is now included.

4-28: "The below average stream inflows and stormwater runoff due to the continuing drought, are substantial contributing factors in the recent improvement of lake transparency (UC Davis - TERC 2015)." Only the last two years look decent, and this is only relative to the preceding year. Is this the "recent improvement"? It doesn't look like an improvement relative to the long term mean.

**TRPA RESPONSE:** The long term declining trend for lake clarity slowed beginning around 2000, and in the last few years, clarity has increased. The five-year average clarity has improved for five consecutive years.

Page 4-33: Like some other indicators, what does it mean if there is insufficient data to determine a trend? The absence of a trend does not mean that there is insufficient data - and it is possible to collect data for centuries and not have a significant trend. It would be good if the authors describe the minimum duration (consecutive and/or total number of years) needed before a trend is estimated.

**TRPA RESPONSE:** As discussed in the trend section of this indicator, trend was not analyzed because the lack of consistency in a monitoring program and how data was collected. The minimum duration of data to analyze trend is discussed in the methodology section.

Page 4-33 and 4-34: Turbidity (especially when measured via nephelometry) is not the same thing as clarity. While littoral areas are too shallow to use a Secchi disk, there are other methods to estimate clarity. For example, see Gall et al. 2013 in L&O: <http://onlinelibrary.wiley.com/doi/10.4319/lo.2013.58.2.0443/full>. It would be better to rename this indicator, "Nearshore turbidity".

**TRPA RESPONSE:** The indicator has been renamed nearshore turbidity.

Page 4-35: According to the methods, "the nearshore extends from the existing shoreline to the average thermocline depth in mid-summer, or a minimum lateral distance of 350 feet from the shoreline, whichever is greater." Does this mean that the nearshore range varies year to year? Or is a particular depth used (e.g., the long term summer mean thermocline depth), in which case it would be useful to just state this value in this section. If the nearshore ranges year to year, you are not comparing measurements over the same spatial area, leading to data interpretation problems.

**TRPA RESPONSE:** Clarified text to ensure readers understand that monitoring was completed at a depth of seven meters.

Page 4-36, and 4-37: Are tables labeled sequentially in this chapter or by indicator?

**TRPA RESPONSE:** Each "indicator sheet" is designed to be a standalone document and numbering is sequential within an indicator sheet.

Page 4-39: Analytic Approach: Based on the results from nearshore turbidity, work needs to be done to decide on the temporal window over which a mean (or peak?) turbidity value will be selected in order to determine compliance with regulation. More work (as stated) is needed on transmissivity, and as suggested above, other approaches to assessing near shore clarity should be considered.

**TRPA RESPONSE:** \*

Page 4-45: Some of the species mentioned as introduced unintentionally were likely introduced intentionally, but not by a government agency but rather by individuals. For example, Blue Gill and Large Mouth Bass in the Tahoe Keys area were likely introduced intentionally for fishing.

**TRPA RESPONSE:** Text has been added to clarify “unintentional”.

47: Is there “little to no change” or insufficient data in this case? It seems like there is insufficient data to determine a trend here. Sampling hasn’t been going on for that long, and it is by necessity species specific. Perhaps it would be better to describe trends in indicator AIS rather than all AIS.

**TRPA RESPONSE:** Modified text to ensure readers understand that only the introduction standard was assessed as little to no change and all other standards were assessed as insufficient data to assess trend.

Page 4-48: How do you know that, “The prevention program has successfully prevented the introduction of new AIS into the lake.” No new introductions is not necessarily evidence of program efficacy, just as new introductions would also not mean that the program isn’t working.

**TRPA RESPONSE:** Text has been modified so as only to report the fact that no new AIS have been detected in the Lake since the program began. For now, the number of new AIS introduced will continue to be used as the indicator to assess. If there are other indicators that should be used, this will be discussed in the threshold review process described in more detail in the global response to comments.

Page 4-52 and 4-53: It would be useful to put a n= to indicate the sample size for each stream.

**TRPA RESPONSE:** TRPA is in the process of migrating the reporting to an online dashboard which will ensure consistency across all components of the report and provide interested parties with access to additional data and information. The continuous turbidity and temperatures data are available to the public through the USGS website NWISweb (<http://waterdata.usgs.gov/nv/nwis/current/?type=flow>).

Page 4-59: The authors may wish to consider moving toward a high frequency sensor based approach to assessing suspended sediments, using a nephelometric turbidity sensor. This would remove any potential bias due to sampling dates.

**TRPA RESPONSE:** The use of a nephelometric turbidity sensor for future sampling will be considered based on best available science and resources.

Page 4-61: the pie chart legend is missing the description for the color red.

**TRPA RESPONSE:** Layout modified to ensure all legend parts are visible.

Page 4-62 and 4-63: the graphs were missing in my pdf version. Only the axis labels showed up.

**TRPA RESPONSE:** Layout modified to graphs are visible.

Page 4-63: The authors state that algae support the food web, but that persistently high algae would be undesirable. This is true, but Tahoe manages to minimize algae/primary productivity and therefore wording in this section might be reworded to avoid the connotation that algae are a “good” thing, given that the management goals are to minimize it. Thus, perhaps it is best to keep this section written in terms of clarity and blueness. Speaking of which, blueness was mentioned early in the report but has not been referred to in any later sections on primary productivity or algae.

**TRPA RESPONSE:** The text has been revised to place persistently high algae in the context of the management objectives of the lake.

Page 4-69 and 4-70: It would be useful to have error bars for the nutrients.

**TRPA RESPONSE:** Error bars have now been added for nutrients.

Page 4-72: How closely did the two methods compare? Some statistics on the regression would provide the reader confidence that you can convert measurements of dissolved nitrate plus nitrite between the old and new method.

**TRPA RESPONSE:** An additional reference is now included for readers interested in learning more about the comparison between alternative methods for measuring nitrogen.

Page 4-82: Word here is confusing: "Status – Low. Where insufficient data exists to determine status, confidence in the status determination is low. High. The confidence in an estimate of total annual suspended sediment load depends on the number of samples, and on the variance of the daily loads that are sampled to derive the annual load." Also, generally if the p value is very low, you can just write  $p < 0.01$  or similar.

**TRPA RESPONSE:** Modified text as suggested.

Page 4-85: Why is the annual used, when the data are sampled at a much higher frequency? And what does the "No" text mean on the graph? This question on data reporting vs. sample frequency also applies to the next couple of response indicators. Plots of precipitation amount versus response load (e.g., suspended sediments, P, or N) would be useful and could be placed in the context of long-term trends in extreme precipitation events. That is, given what the relationship between flow and inputs is, what will future inputs look like given future climate scenarios and trends in extreme precipitation events?

**TRPA RESPONSE:** Annual data is reported here because the standard relates to load reaching the Lake on an annual basis. Removed the inadvertent text from the graph. Considerations of climate impacts are included in the executive summary and will be considered when revising standards.

92, "The total phosphorus load for each day at each stream was estimated from multiple regression of measured values." What was regressed on what in this instance?

**TRPA RESPONSE:** TRPA Response: The independent variable used in the regression estimates of TP (and SS) may be different for different water years. Five alternative regression models for the log of concentration were fit to each combination of station and water year, and the best model was chosen automatically on the basis of Gilroy's Mean Square Error (GRMSE; Gilroy et al., 1990). GRMSE is computationally intensive but utilizes information in the prediction data set as well as goodness-of-fit to the sample data to assess the error of the estimated flux. The five regression models that we compared are:

- $\log(c) \sim \log(q)$
- $\log(c) \sim \log(q) + \log(\text{MDQ}/\text{MDQ1})$
- $\log(c) \sim \log(q) + \log(\text{MDQ}/\text{MDQ1}) + D$
- $\log(c) \sim \log(q) + \log(\text{MDQ1})$
- $\log(c) \sim \log(q) + D$

where  $c$  = concentration,  $q$  = instantaneous discharge, MDQ = mean daily discharge, MDQ1 = mean daily discharge on the day before the measurement, and  $D$  = day number since start of the water year (Oct 1). Instantaneous discharge data were available only at sampling times, so MDQ had to be substituted for  $q$  during the prediction step for estimating loads. MDQ1 helps characterize a sample as belonging to the rising or falling side of a snowmelt cycle or rainfall event.  $D$  was included to index seasonal depletion of available sediment.

Page 4-121 (and 4-126, 4-131): For just about every other indicator, trends through time are shown as the primary graphic, but not for N concentration. Suggest changing this so it is consistent. Also, in many sections the text, "Because Lake Tahoe is an ultraoligotrophic lake, it is desirable to maintain primary productivity at low levels." is written. Just because a lake is ultraoligotrophic doesn't mean it is desirable to maintain low primary productivity. The justification of why depends on the value associated with different trophic statuses. It would be more accurate to say "Lake Tahoe is an ultraoligotrophic lake and management goals include maintaining this status due to its historic, cultural, economic, and aesthetic value." Or something similar.

**TRPA RESPONSE:** Modified text as suggested. The N concentration you are referring to is for the "surface runoff" indicators, not the "tributaries" indicators. Tributaries have been monitored consistently for a large number of years and thus trend is shown. Surface runoff has been measured only very recently and therefore no trend is shown.

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## Tahoe Regional Planning Agency 2015 Threshold Evaluation Report

Review comments by Scott N. Spak, prepared 23 June 2016

### Biosketch: Scott N. Spak, PhD

Dr. Spak is an Assistant Professor of Urban & Regional Planning at the University of Iowa. His research uses coupled environmental and human systems models to inform and study local and regional environmental policy. He holds a BA in Engineering Sciences from Dartmouth College and PhD in Atmospheric & Oceanic Sciences from the University of Wisconsin-Madison.

### Introduction

Considering the Threshold Evaluation Report as a routine planning update, the Introduction provides sufficient background to understand the purpose and scope of the Threshold Evaluation Report. For other purposes and stakeholders, the Introduction lacks an update on recent events or trends that have affected the basin's environment and its human inhabitants, and could contextualize the changes in the indicators studied. The scope is focused by omitting brief consideration of "big picture" changes in the basin.

Statements of fact in the Introduction are generally not supported by references. There are two sources cited other than TRPA and state agency documents. The history section is almost entirely without references. As the report is intended to "summarize and not repeat information already contained in other citable documents," the limited references are of low concern.

### Methodology

Prescribed approaches for determining the status and trend of indicators relative to adopted standards are clearly presented and generally appropriate. Assessment of trends over the entire monitoring record or in one or more shorter time series on a case-by-case basis is warranted, but not as codified as the other analytical parameters. "In some cases, with a long-term dataset, the trend arrow depicted in the reporting icon represents examination of the most recent data thereby characterizing the near-term trend." This differentiation is important and valuable. The analysis would provide maximum value to decision support by assessing trends over the adopted TRPA and state planning time horizon(s) for to the projects and plans that address the indicator.

The prescribed approach for determining the level of confidence in status and trend determinations is clearly presented. The selection of  $r^2$  as the primary determinant of confidence in the trend is ideal. Adjusting confidence in trends through t-test p value for such small datasets raises several concerns. The small datasets and high p values used to make determinations are less important than these limitations:

1. First, determine that detrended anomalies in Indicators are random, or quantify observed signals. The analysis assumes that year to year variability not explained by the trend is normally distributed due to observational detection limits, randomness in the underlying data, or both. However, inter-annual variability in most Indicators reflects a combination of management, climate, and socioeconomic signals. Long-term monitoring may be sufficient to support such a multiple linear regression analysis now or in the future after more monitoring at the same sites with identical methods. Results of that analysis would inspire confidence in management effectiveness, quantify the influences of climate and regional socioeconomic trends, and support a comparison of the role of each. Until then, the analysis should technically first confirm that detrended data are normally distributed before applying p value, select an alternative statistic for confidence that applies to non-Gaussian data, or use  $r^2$  alone.

2. Apply alternative approaches when Indicator extremes are not normally distributed. Many of the air quality Indicators quantify the highest hourly or daily concentrations in a one- to three-year period—the extreme highs of the dataset, which rarely follow a normal distribution. In these cases, extreme value theorem provides alternative means for determining confidence, or  $r^2$  alone may suffice.

The approaches prescribed to determine an interim target and attainment date for an indicator are well reasoned, and consider the relevant sources of uncertainty.

Minor edit: the link to Nevada Administrative Code - 445B.22097 is now <https://ndep.nv.gov/baqp/monitoring/aaqstd.html>

### Chapter 3. Air Quality

The air quality section addresses criteria air pollutants for which national and California standards have been long established, supplemented by deposition standards for water quality and management standards that reflect local emissions and emissions proxies. This consistency in regulatory standards and monitoring supports the quality and comprehensiveness of the indicators, monitoring, and analytical methods. As a result, the write-up associated with each indicator evaluation is correspondingly clear and complete, and reflects refinement in the 2006 and 2011 Threshold Reports. While not a formal Indicator in air quality management, the summary analysis of daily AQI is highly informative for trends assessment for a wide range of stakeholders.

#### Updates

The draft report misses a few recent regulatory and monitoring updates since the 2011 report:

1. The National Ambient Air Quality Standard for annual average PM<sub>2.5</sub> was revised in 2012 to 12  $\mu\text{g}/\text{m}^3$ , so the federal, Nevada, and California standard are now the same. The Nevada DEQ (<https://ndep.nv.gov/baqp/monitoring/aaqstd.html>) and US EPA (<https://www.epa.gov/criteria-air-pollutants/naaqs-table>) reflect this change. While the California standard is annual, the chart and write-up (page 3-52) might be revised to reflect this synchronization.

**TRPA RESPONSE:** A revised notation was made to denote the consistent standard.

2. The Tahoe City FRM PM<sub>2.5</sub> monitor conforms to NAAQS reporting requirements. While not yet used in trends analysis, the Monitoring approach for 24-hour (and annual average PM<sub>2.5</sub> (page 3-53) should be revised accordingly.

**TRPA RESPONSE:** Comment noted and the text was updated to reflect the changes at the monitoring site.

3. Management decisions based on the 2015 report should also consider the role California's 2016 Mobile Source Strategy (<http://www.arb.ca.gov/planning/sip/2016sip/2016mobsrsrc.htm>), which is expected to influence many air quality indicators.

**TRPA RESPONSE:** The Tahoe Metropolitan Planning Organization (TMPO) has been following the California Mobile Source Strategy and the proposed mobile source GHG reductions that are currently being proposed. In 2011, the TMPO established mobile source GHG targets of five and seven percent for the years 2020 and 2035 respectively and have most recently been working with CARB and other MPOs in establishing new GHG targets.

#### Omissions

The report should state that the IMPROVE network does not sample every day, and therefore may not observe the highest 24-hour concentration or accurately resolve the complete annual average on which standards are based. This difference, along with the distance between monitor locations,

may also contribute to the higher concentrations observed at Tahoe City.

**TRPA RESPONSE:** While the IMPROVE monitoring network only collects particulate samples one day a week, continuous particulate sampling is conducted at the California Air Resources Board (CARB) monitoring station in South Lake Tahoe (Sandy Way) which monitors hourly average PM<sub>10</sub>, wind speed, and wind direction. Additional PM<sub>2.5</sub> hourly data was collected from the Placer County APCD in Tahoe City.

### Analytical Methods

In nearly all cases, the analytical methods are appropriately applied in the determination of an indicator's status, trend, and confidence. A few minor exceptions:

- The NO<sub>x</sub> total emissions chart includes a trend line from 1975. A 25-year trend from 1990 clearly fits the data more closely, and may be warranted.

**TRPA RESPONSE-** While TRPA agrees that a trend line would better fit the data from 1990 onward; it is not best practice on the part of TRPA to ignore earlier information. This type of action may result in accusations of TRPA "cherry-picking" the data. Instead, the positive trend line since 1990 will be noted in the text.

- Recent high observations of highest PM<sub>10</sub> 24-hour average at all monitoring sites (3-43) may challenge the "little to no change" trend determination. A more conservative approach would be "insufficient data to determine" and lower confidence in the trend.

**TRPA RESPONSE:** While TRPA agrees that this may be the case, TRPA chose to apply the standard rules of methodology laid out in this report to ensure consistency across reporting categories.

- VMT (3-59) exhibits several trends, and the trend determination is not based on the one long-term trend from 1981 shown. The recent time series employed for trend assessment should be added to the chart.

**TRPA RESPONSE:** The trend determination used is based on the long-term trend from 1981 shown on the chart.

The 1-hour and 8-hour CO Recommendations for analytical approach request clarification on whether to assess the indicator based on the most current year of data available or on a multi-year average. Considering the discontinuity in monitoring sites, the sensitivity to inter-annual variability in meteorology, and the annual metric in the NAAQS, this reviewer suggests the use of the most recent year rather than a multi-year average.

**TRPA RESPONSE-** This suggestion will be taken into account for future analysis. Additionally, based off of EPA guidance, the NDEP discontinued CO monitoring at the Stateline site June 30, 2012. EPA and NDEP both concluded that after 33 years of clean data, all of it under 80 percent of the NAAQS and with an on-going downward trend met the EPA criteria for discontinuance. In order to maintain CO monitoring in light of the TRPA thresholds, TRPA has maintained a CO monitor located in a different spot from the previous NDEP site and will utilize this site for future reporting.

The 3-year average 4<sup>th</sup> highest 8-hour ozone Recommendations for analytical approach requests clarification on how to evaluate the indicator. The reviewer supports the reporting of the 3-year average 4<sup>th</sup> highest 8-hour ozone.

**TRPA RESPONSE -** TRPA Staff will continue to analyze the 2000 to present 3-year average 4<sup>th</sup> highest Ozone parameter and retain the 1975 to present indicator for future references-trend information.

Status and trends analyses

Supplemental datasets, even for Indicator proxies, can help address the limitations of sparse monitors, discontinuities in monitor siting, and differences in observational approaches and frequency between monitors. As the region maintains long-term attainment for each Indicator at state and national monitoring networks, supplemental data becomes less important. The few Indicators with monitoring discontinuities, uncertain or deteriorating trends, or status above threshold would benefit from additional modeling and remote sensing results from routine state and federal agencies to supplement local monitoring. These datasets represent very inexpensive and powerful additions to the information base.

**TRPA RESPONSE** - TRPA staff will initiate a prioritization process to identify those indicators where supplemental information ( i.e. modeling, remote sensing) could supplement the local monitoring currently being conducted.

The report notes insufficient monitoring data to assess for sub-regional visibility, an important factor for enjoyment of scenic amenities and currently very close to the TRPA standard on average days. High resolution daily remote sensing retrievals of aerosol optical depth and simulated near-surface extinction and column or surface AOD in regional chemical transport modeling can provide spatial information across the basin that resolve spatial scales (1-4 km) relevant to sub-regional variability and emissions source. The gridded National Emissions Inventory for each primary pollutant and source sector can also serve as an additional proxy. Modeling conducted for regulatory analyses by CARB and US EPA and forecasts from the National Air Quality Forecasting Capability may provide alternative data to support proxy analysis covering the entire basin for every hour. Modeling can simulate Indicator concentrations, trends, and deposition, and attribute them to source sectors.

**TRPA RESPONSE-** The variability in the sub-regional visibility standard is largely the result of the south shore monitoring station being out-of- commission and then moved to its current location at Lake Tahoe Community College. Now that the College site has collected two years of data, TRPA and other(s) will be readily able to assess the standard in the future.

The visibility Threshold Standard and its discussion should, at minimum, estimate natural visibility conditions (from observations and modeling) and reflect that the US EPA Clean Air Visibility Rule requires Class I visibility areas (including much of the Lake Tahoe Basin) to demonstrate reasonable progress toward natural visibility conditions by 2065. It is also recommended that the agency amend the regional visibility Threshold Standard by including the baseline and adding natural visibility conditions and target trend rates to support the use of the Indicator as a management tool coincident the federal Clean Air Visibility Rule.

**TRPA RESPONSE** – The current regional visibility standards (50 percent and 90 percent values) were established in the 1980s when visibility was poorer than today. The federal Clean Air Visibility Rule finalized in 2005 requires that natural areas such as the Lake Tahoe Basin demonstrate reasonable progress toward natural visibility conditions by 2065. This means that using baseline conditions established for the Lake Tahoe Basin between 2000 and 2004, the Region will need to continually demonstrate improvement in visibility over time rather than demonstrate compliance with a static standard value as is reflected in the current Threshold Standard. We agree with the recommendation that TRPA consider amending the regional visibility Threshold Standard to improve consistency with the federal Clean Air Visibility Rule.

Data Support

Statements of fact and conclusions are supported by appropriate references and generally by original data and analysis. Air quality in the Lake Tahoe basin has been studied extensively by

CARB and its grantees in recent years (<http://www.arb.ca.gov/research/research-results.php>). It is recommended that the Threshold Indicator Report update the information base with key applied findings about air pollution in the basin from peer-reviewed and regulatory science studies since the last report.

**TRPA RESPONSE** – Following are a listing of air quality references and analysis that could be incorporated into this information base;

**Publications:**

[www.fs.fed.us/PSW/partnerships/tahoescience](http://www.fs.fed.us/PSW/partnerships/tahoescience)

- **Examination of dust and air-borne sediment control demonstration projects.** Dr. Hampden Kuhns, Dr. Dongzi Zhu, Dr. John Gillies, Dr. Alan Gertler, Dr. Steven Cliff, Dr. Yongjing Zhao, Mr. Scott Brown, Ms. Domi Fellers, Mr. Michael Pook
- **Lake Tahoe Source Attribution Study (LTSAS): Receptor Modeling Study to Determine the Sources of Observed Ambient Particulate Matter in the Lake Tahoe Basin.** Dr. Johann Engelbrecht, Dr. Alan Gertler, Dr. Tony VanCuren
- **Impacts of vehicle activity on airborne particle deposition to Lake Tahoe.** Dr. Dongzi Zhu, Dr. Hampden Kuhns, Dr. John Gillies, Dr. Alan Gertler, Ms. Jacqueline Mason.
- **Visibility monitoring and standards for Lake Tahoe Basin: assessment of current and alternative approaches.** L.-W. Antony Chen, John G. Watson, Xiaoliang Wang.
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- **The Tahoe Climate Information Management System (TahoeClim).** Kelly Redmond
- **Improving meteorological data and forecasts for prescribed fire burn day decisions in the Lake Tahoe Basin.** Timothy J. Brown, Narasimhan K. Larkin, and Miriam Rorig.
- **Secondary pollutant formation in the Lake Tahoe Basin.** Barbara Zielinska, Alan Gertler, Andrzej Bytnerowicz, Wendy Goliff, and Chad Praul.
- **Evaluation of Prescribed Burning Emissions and Impacts on Air Quality in the Lake Tahoe Basin.** L.-W. Antony Chen, Tom Malamakal, Xiaoliang Wang, Mark G. Green, Judith C. Chow, and John G. Watson.
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- **Nutrient emissions from prescribed fire in the Lake Tahoe Basin: Implications from field and laboratory observations.** P. Verburg, A. Shackelford, L.-W. A. Chen, D. Zhu, R. Susfalk, B. Fitzgerald.
- **Analysis of 15 Years of Data From the California State Parks Prescribed Fire Effects Monitoring Program.** Alison E. Stanton and Bruce M. Pavlik

- **Lake Tahoe Upland Fuels Research Project: Investigating the effects of fuels reduction treatments on forest structure, fire risk, and wildlife.** Patricia N. Manley, Dennis D. Murphy, Bruce M. Pavlik
- **Developing fuels treatments for balancing fuel reduction, soil exposure, and potential for erosion in the Tahoe Basin.** Dr. Andrew P. Stubblefield, Dr. J. Morgan Varner<sup>1</sup>, Dr. Eric E. Knapp, Nick Harrison, Erin Banwell
- **Identifying spatially explicit reference conditions for forest landscapes in the Lake Tahoe Basin, USA.** Alan H. Taylor, R. Stockton Maxwell, Carl Skinner, Hugh Safford.
- **Evaluating alternative fuel treatments in the South Shore wildland urban interface area.** Morris Johnson and Roger Ottmar.
- **Assessment of Particle Size Analysis in the Lake Tahoe Basin.** Alan C. Heyvaert, Daniel M. Nover, Todd G. Caldwell, Wendy B. Trowbridge, S. Geoffrey Schladow, John E. Reuter.

#### Minor edits

The 1-hour and 8-hour CO Status discussions (3-13 and 3-16) might report the 2<sup>nd</sup> and 3<sup>rd</sup> highest observations from 2012 at the discontinued monitoring site for context in support of the decision to that they were due to a false/faulty reading.

**TRPA RESPONSE-** Based off of EPA guidance, the NDEP discontinued CO monitoring at the Stateline site June 30, 2012. Since that time, the NDEP has solicited the EPA to approve the following measures as part of their Limited Maintenance Plan;

- 1) Because the potential for high CO is typically in the winter months, the NDEP will use monthly average daily traffic (MADT) counts in its surrogate method. The season for MADT will run from October 1 to March 31 of the next year. To use MADT as a surrogate method for tracking CO levels, the NDEP will conduct an annual review of the seasonal traffic volumes in the Basin using the data from the Nevada Department of Transportation's permanent automatic traffic recorders in Stateline and Incline Village.
- 2) The NDEP will compare the latest rolling 3-year average of the MADT volumes against the baseline MADT average established by the traffic volume data collected during the 2008-09, 2009-10 and 2010-11 seasons.

As part of the EPA and NDEP both concluded that after 33 years of clean data, all of it under 80 percent of the NAAQS and with an on-going downward trend met the EPA criteria for discontinuance. In order to maintain CO monitoring in light of the TRPA Thresholds, TRPA has maintained a CO monitor that varies from the previous NDEP site and will utilize this site for future reporting.

The NO<sub>x</sub> concentration chart (3-31) should also include the federal standards.

**TRPA RESPONSE –** Comment noted. Federal Standard will be added.

The Nitrate Deposition figure in the 2011 report is contextualized by precipitation data, and its inclusion would help reinforce the 2015 analysis.

**TRPA RESPONSE –** Precipitation data will be added to the figure.

Global comment: locations of monitoring sites are difficult to identify on indicator status maps. Larger symbols, please.

**TRPA RESPONSE –** Comment noted

#### **Overall Report**

In the opinion of this reviewer, the report contains observations of (nearly) all of the environmental indicators *necessary* to make informed decisions about environmental management in the Lake Tahoe Basin. The report also clearly and comprehensively addresses uncertainties and spatial and temporal representativeness of the observations made in providing complete documentation for those indicators. As a traditional environmental planning assessment, the report provides the comprehensive management “dashboard” and “rear-view mirror” required to inform decisions. The agency is commended for this clear and extensive approach to indicators of local environmental change, at the leading edge of a regional planning indicator set relative to best practices. The large set of carefully selected, monitored, and analyzed indicators is both commensurate with and tailored to the unique and uniquely stringent environmental management and protection needs of the basin.

From a contemporary environmental planning perspective, environmental observations alone are not entirely *sufficient* as “the information base to inform modification of the regional regulatory framework, alter mitigation requirements for proposed projects, and target projects to improve the environmental health of the basin.” In the car analogy, there’s a very limited “windshield view” for each Threshold Indicator. Several additional information bases are required for rational planning to inform decisions on changes to regulations and new projects:

1. Similar indicators assessing the drivers that cause local environmental changes in these indicators between assessment reports and over time scales relevant to regional planning are required to understand why indicators have changed beyond the expected response to local management.

The most obvious of these are changes to the basin’s climate and socioeconomic activities:

a) Local climate in the basin and Sierra Nevada range—especially temperature, snowfall, snowpack depth, and precipitation frequency/magnitude/timing—has a direct influence on most indicators eight of the nine threshold categories: water quality, soil conservation, air quality, vegetation preservation, wildlife, fisheries recreation, scenic resources, and recreational opportunities. These influences are responsible for much of the inter-annual variability in the indicators that isn’t explained by the quantified trends. While some of these influences are *described* in the current report, they are not *quantified* as distinct indicators, and the planning process would benefit from their inclusion. From an ontological perspective, many of these climate signals also have obvious “thresholds” relevant to the indicators they impact, and could thus be incorporated consistent with the existing framework.

**TRPA RESPONSE- Comment Noted.**

b) Now that land use/land cover change and resource extraction have slowed dramatically, changes to the region’s economy are driven primarily by exogenous forces:

skiing/gaming/recreational activities elsewhere in the region and in the world relative to those in the basin; skiing conditions during the season; and the regional/national/international trends in demographics, employment, transportation costs, and disposable income that lead to local visits, in/out migration and corresponding changes to local demographics, and management indicators like VMT. Again, these are currently partially described, but not quantified as indicators.

Understanding trends in these drivers and corresponding local socioeconomic changes, even if anecdotally obvious, are essential for management that balances and affirms both environmental health and the local economy. High quality indicators for these external drivers of local change are readily available from state and federal agencies and TRPA partners without additional investment. Indicators for local skiing and tourism relative competitors are likely available, too.

**TRPA RESPONSE- TRPA supports the efforts of the Tahoe Prosperity Center by coordinating data collection efforts and tracking socioeconomic information for transportation modeling purposes.**

## 2. Process knowledge that connects indicator status and trends to driving forces.

It is recommended that the Threshold Indicator Report update the information base with key applied findings about air pollution in the basin from peer-reviewed and regulatory studies since the last report.

**TRPA RESPONSE** – Following is an abbreviated listing of pertinent air quality research with most of the research being found at the following USFS website;

### **Publications:**

[www.fs.fed.us/PSW/partnerships/tahoescience](http://www.fs.fed.us/PSW/partnerships/tahoescience)

- **Examination of dust and air-borne sediment control demonstration projects.** Dr. Hampden Kuhns, Dr. Dongzi Zhu, Dr. John Gillies, Dr. Alan Gertler, Dr. Steven Cliff, Dr. Yongjing Zhao, Mr. Scott Brown, Ms. Domi Fellers, Mr. Michael Pook
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- **Assessment of Particle Size Analysis in the Lake Tahoe Basin.** Alan C. Heyvaert, Daniel M. Nover, Todd G. Caldwell, Wendy B. Trowbridge, S. Geoffrey Schladow, John E. Reuter.
- **Effects of Pile Burning in the LTB on Soil and Water Quality.** Ken Hubbert, Matt Busse, Steve Overby

#### Limitations in indicators monitored

One issue with planning by indicators is that the planning scope evolves to primarily consider monitored changes, and responds to unmonitored issues only when they cross a threshold of visibility and impact that demands an immediate triage response. From a SWOT perspective, Threshold Indicators designed around monitoring Strengths and Weaknesses miss the unexpected Threats.

In the case of the Tahoe basin, there are a few important issues that have been studied recently and may eventually warrant preliminary assessment or formal Threshold Indicators:

1. Invasive species and vector-borne diseases impact the integrity of the ecosystem and can impact fisheries, wildlife, habitat, and soil and vegetation conservation directly, with indirect impacts on scenic amenities, water quality, and air quality through downstream effects from forest fires and other ecosystem disturbances. Since the impact threshold is the mere presence of these species, management indicators would be an effective start. As with existing indicators, invasives and their impacts can increase due to climate change.
2. Microplastics and persistent organic pollutants bioaccumulate and can magnify in the food web, impacting fisheries and wildlife for hundreds of years. The lake's long residence time makes it a closed system for them on planning time horizons. Neither are effectively controlled by wastewater treatment, and both can deposit in the ecosystem from local use: microplastics from synthetic fleece clothing, personal care products, and litter; POPs from volatilization and spills. POPs can also arrive through atmospheric transport and deposition. Plastic fibers have also been confirmed to concentrate POPs from water, and POPs can have synergistic effects, especially in endocrine disruption. Studies have confirmed the presence of microplastics in Lake Tahoe and POPs, including polychlorinated biphenyls, dioxins, and polybrominated flame retardants, in its fish. Since these pollutants cannot be remediated as quickly or easily as the criteria air and water pollutants for which indicators have been established, a precautionary approach may be warranted. For these pollutants, monitoring is often more expensive than proactive management, so pairing management indicators with monitoring once per reporting cycle may be an effective approach, with prior studies serving as the first monitoring results.

Comments marked with a \* pertain primarily to the content of the threshold standards and the response is included in the global response to comments.

## Review: 2015 Threshold Evaluation Report for the Lake Tahoe watershed

### Introduction, Methods, Soil Conservation

#### Chapter 1 Introduction

The introduction provides sufficient background information for understanding the purpose and scope of the Threshold Evaluation Report. The history is useful and gives important management background and perspectives. It appears to be supported well, with appropriate references and original data. I have a few comments and some minor edits.

- It's useful to see the statement regarding the insufficiency of regulation alone, and that guided growth through wiser resource management and infrastructure were eventually emphasized in the Tahoe watershed. I especially appreciate that TRPA recognizes the importance of scale for effective management of environmental and socioeconomic conditions.
- The term "threshold" is fundamental to the evaluation of Lake Tahoe watershed condition and yet I have never seen it well defined in any document. In the ecological literature, threshold means a point of dramatic change. This is not necessarily a desired thing. However, this Threshold Evaluation Report speaks to "progress toward attainment of adopted environmental threshold carrying capacities ...". I find this usage of "threshold carrying capacities" confusing. As this terminology is embedded in the whole evaluation process, I think it's very important to be much more clear in your definition of "threshold" and "threshold carrying capacities".

I acknowledge that "Threshold standards" are defined on page 1-5, and this helps in understanding the usage of "threshold". However, the relationship between the "threshold standard" and "threshold carrying capacity" is not clear and needs to be clarified.

**TRPA RESPONSE:** TRPA recognizes that understanding the term "threshold standard" or "environmental threshold carrying capacity" is central to understanding the report. We first define the terms on page 1-3 of the introduction, and then provide the formal definition on page 1-5. "Environmental Threshold Carrying Capacity" is the term used in the Bi-State Compact. We recognize that the use of the term "carrying capacities" could lead to misinterpretation, and therefore use "Threshold Standard" throughout the document.

#### Minor edits

- "Comstock-era mining" : should have hyphen between Comstock and era.  
**TRPA RESPONSE:** Modified text accordingly.
- Pg 1-3, second paragraph, second line: "scientific knowledge about the lake and its surrounding ecosystem ..."  
**TRPA RESPONSE:** Modified text accordingly.

- Pg 1-4, 1<sup>st</sup> line under “2015 Threshold Evaluation Report” – “This report presents the results of TRPA’s sixth comprehensive review of progress against threshold standards....”
  - “against” is not the best word; better would be “based on” --> “progress based on threshold standards”  
**TRPA RESPONSE:** The sentence has been entirely rewritten to improve clarity.
- Pg 1-6, Under “Numerical Standard”. Phrase “...shall not be decreased below 29.7 meters.” Can this be reworded? Perhaps “reduced” instead of decreased? Confusing.  
**TRPA RESPONSE:** The referenced text is the adopted text of the TRPA standard.

## Chapter 2 Methodology

The methods for determining the status and trend of indicators relative to adopted standards are clearly presented and sufficient for the data at hand. The determination of confidence levels is well described, and continuous attention to this process is very important to maintain and/or improve monitoring procedures. Sources of uncertainty should be addressed in the context of confidence levels, but are not discussed in this chapter. Determination of interim targets and estimation of attainment dates are adequately reviewed and appear appropriate for all indicators.

### Minor edits

- Page 2-1, last paragraph under “Indicator”. “...has a direct relationship to the status of attainment or maintenance of one or more threshold or standards.” “Threshold standard” is typically used together in this report. Why the separation here with “or”?  
**TRPA RESPONSE:** The sentence has been entirely rewritten to improve clarity.
- Page 2-3, the link for Nevada (<http://www.leg.state.nv.us/nac/nac-445b.html>) is missing.  
**TRPA RESPONSE:** No action taken. The link for Nevada standards is correct.
- Page 2-7, Figure 2.2 is redundant with information in Figure 2.3. Not necessary.  
**TRPA RESPONSE:** The figure was redundant and has been removed.
- Page 2-10, paragraph under Table 2-3. Text is missing: “...and both visual inspection of the plotted data and the test for statistical revealed ...”  
**TRPA RESPONSE:** The sentence has been entirely rewritten to improve clarity.

## Chapter 5 Soil Conservation

The soil conservation threshold is determined using two indicator reporting categories: impervious cover and stream environment zones. The descriptions of these categories are complete and clearly written. With the exception of a few points of clarification (see minor edits below) the approaches to determine impervious cover are appropriate and useful to track status and trends. The update from Bailey’s 1974 classification to the more recent 2007 NRCS surveys is described well and appropriately applied to determine status, trend and confidence. Similarly, the SEZ indicator category is detailed well and clearly argued as a useful indicator of the condition and functionality of stream environments. However, the text describing the Indicator State #4 (Attain a 5% total increase in the area of naturally functioning SEZ lands) is difficult to follow and should be clarified; i.e. Should the target of 5% increase be determined from the overall acres of SEZ in the region, or be considered an

increase to the acres of functioning SEZ at the start of the monitoring period?

**TRPA RESPONSE:** The text of indicator state 4 has been modified to clarify the basis used to assess the standard.

The discussion concerning the three factors complicating objective and consistent evaluations of status are useful and address recommendations well. For example, the *ambiguous objectives* section suggests ambiguity in terms such as “disturbed” and “naturally functioning” may be vegetation-type specific and require different metrics to characterize the functioning of the SEZ. Absolutely. Under the 3<sup>rd</sup> factor (“*Presence of multiple clauses...*”), the Roby 2015 SEZ review project is introduced. Its estimates of substantially higher SEZ area in the basin (29,391 versus 21,944 in the Tahoe 2001 plan) should give rise to a serious comparison and revisit of field delineation protocols. Why are these estimates so different? Can they (or should they?) be “calibrated” to one another to keep the valuable time series? It is important that the standards for delineating SEZ are the best available, given the reliance on change-of-area is an indicator of condition.

**TRPA RESPONSE:** A detailed discussion of the differences between the Roby SEZ mapping effort and previous efforts is included in the Roby report, but beyond the scope of this analysis. The questions raised in the peer review comment above are all salient and will likely be the subject of robust discussion in any effort to review or revise the standard.

#### Minor edits

- “Comstock era logging” should have a hyphen --> Comstock-era
- Pg 5-1, 4<sup>th</sup> para. “Excessive impervious surface contributes ...and its tributaries **by** impairing water quality, ...”  
**TRPA RESPONSE:** The sentence has been entirely rewritten to improve clarity.
- Pg 5-4, 1<sup>st</sup> para. “...contributes to sediment and nutrient inputs to Lake Tahoe and its tributaries **by** imparting water quality, alter surface hydrology...” *Or use appropriate punctuation.*  
**TRPA RESPONSE:** The sentence has been entirely rewritten to improve clarity.
- Pg 5-6, 1<sup>st</sup> para. Use of “nearly doubled” for the change in resolution from 2007 to 1974 is confusing, and could be considered as the 2007 resolution between twice as coarse as 1974. Needs rewording.  
**TRPA RESPONSE:** As map resolution increases the ability to depict the location of features in the map increase. The current text is consistent with the ESRI definition of resolution, see: <http://support.esri.com/other-resources/gis-dictionary/term/resolution>.
- Pg 5-6, 2<sup>nd</sup> para. This paragraph needs a concluding sentence that refers back to the 2007 classification. The goal of the paragraph is to distinguish the 2007 classification from the 1974 Bailey classification, and half of the paragraph describes the Bailey’s approach. Conclude with a statement on how the 2007 handled these issues.  
**TRPA RESPONSE:** Sentence added to clarify how the areas were treated in the 2007 soil survey.
- Table 5-3 caption. “Land capability class 1b ...by 657 acres.” Should be 659.6 acres.
- “All other land capability data classes indicate that current cover is above the allowable level.” Should be *below* allowable cover.  
**TRPA RESPONSE:** Modified text accordingly.
- Pg 5-17, 1<sup>st</sup> para, 4<sup>th</sup> line. “....commonly defined, preservation is interpreted to mean....”  
**TRPA RESPONSE:** Modified text accordingly.

- Pg 15-17, 2<sup>nd</sup> para, 16<sup>th</sup> line. "...of a strict location criteria where restoration of 25 percent of the SEZ must occur." Delete "for".  
**TRPA RESPONSE:** Modified text accordingly.
- Pg 5-20, under *Ambiguous objectives*. "Prior to the 2006 report, no location-based criteria were used in defining the set of SEZ ...."  
**TRPA RESPONSE:** Modified text accordingly.
- Pg 5-21, under *Presence of multiple clauses with the standard*. "Numerous clauses in the standard make interpretation consistent and objective evaluation of the standard challenging." Delete *and*.  
**TRPA RESPONSE:** Modified text accordingly.

**Review: 2015 Threshold Evaluation Report for the Lake Tahoe watershed Chapter 6  
Vegetation Preservation  
Reviewer: Carol Wessman, University of Colorado**

The long view of this planning process is greatly appreciated and will be valuable for the preservation of the ecological health and integrity of the Lake Tahoe Region. Overall, I find the report to be well written and each indicator evaluation clear and complete. Generally, the analytical methods are appropriately applied to determine status, trend and confidence of the indicators. It may not be in the scope of this evaluation, but more incorporation of landscape metrics in the analyses would quantify aspects of pattern (e.g. patch size, connectivity) that would be very valuable in determining indicator status or trends. In their current form, the TRPA evaluation approaches will capture coarse changes in vegetation presence and abundance, but will not always be able to identify critical thresholds in pattern that may lead to decline (or suggest improvement) in certain vegetation types.

**TRPA RESPONSE: \***

*Introduction*

The introduction to this chapter is well written and presents a useful foundation for diversity of ecosystems in this region. The history is useful for the context of the indicator categories and definitions are usually provided for less commonly-used terms.

- Table 6-1: Why isn't the Subalpine Forest considered in the Relative Abundance standard? All other forests are listed, as well as most other vegetation types. I understand that the 6 indicators, described further down on pg 6-10, are community richness and the 5 veg types identified under Relative Abundance. But a better link between Table 6-1 and the text under Common Vegetation is needed to make that connection. *A relevant note here: Text throughout the report could be referencing tables and figures much more (and thus requiring they be numbered).*

**TRPA RESPONSE:** The standards evaluated are those currently adopted in resolution 82-11. No specific target for extent of subalpine forest has been adopted. In 2015, the TRPA Governing Board directed the agency to consider reviewing the content of the threshold standards as seven strategic initiatives for the agency to engage in over the next five years. This threshold evaluation report and the recommendations contained in the peer review are critical first parts of that process. Additional details on TRPA's proposed approach to review the threshold standards as part of the strategic initiative are detailed in the conclusions and recommendations section of this report. The text has been modified in accordance with the editorial suggestions at the beginning of the comment. TRPA is in the process of migrating to an online reporting platform that will provide stakeholders with greater access to data and will facilitate a more continuous reporting. Additionally, all tables and figures are now numbered.

- I would find a discussion/overview on the concept of the *major evaluation intervals* useful upfront, in the introduction. Is that possible? It is defined on page 6-14, but it's an important aspect of this whole process. Each category brings in the monitoring intervals, and often in not-so-clear terms. An upfront definition could include either a general table with individualized tables in each of the category evaluations, or clearer presentation in each category, such as a table.

**TRPA RESPONSE:** TRPA recognizes the importance of the term and has modified the methods section to include a definition of the term.

- A discussion of disturbance would be useful in the introduction. This evaluation process equates disturbance with impervious surfaces. That definition needs to be upfront. A more refined definition would include acreage due to other disturbance types, including land use (not just impervious), fire, beetle kill, and fragmentation (e.g. density of trails; patch size), but that is, understandably, a more time-consuming analysis. Ultimately, these analyses are encouraged.  
**TRPA RESPONSE:** Variance in the definition of disturbance as it applies to the basis for determining status of many of the standards is detailed in the recommendations' section of many of the indicator sheets. The report recommends addressing this concern in the section on Modification of the Threshold Standard or Indicators.
- Table 6-2. The "I" symbol is not defined in Fig. 6-1, and I found no definition until pg 6-32.  
**TRPA RESPONSE:** Table 6-3 is now included that provides a definition of the symbol.

#### *Common Vegetation*

- Page 6-10, 4<sup>th</sup> paragraph. Include the time period in the discussion of the prolonged drought. When did it start; i.e. to present, how many years is "prolonged"? When did the bark beetle epidemic start, how long has it been active?  
**TRPA RESPONSE:** Text updated.

#### *Common Vegetation: Vegetation Community Richness*

- Page 6-14. *Modification of the Threshold Standard or Indicator*
  - o A four-year evaluation period is too short to assess trend by itself. This is the sampling interval for long-term monitoring. Make that distinction clear. Are you saying that evaluation every 4 years (assuming in perpetuity) is too long? I would suggest that that is not too long, given the time frame of human activity, and if you are to capture response to climate change, it is *as* likely to be a drawn out decline as it is to be a "rapid" failure.  
**TRPA RESPONSE:** The text has been modified to increase clarity and to better articulate suggested changes to evaluation intervals, especially considering "rapid" failures in vegetation communities.

#### *Common Vegetation: Relative Abundance of Meadows and Wetland*

- Page 6-17. *Effectiveness of Programs and Actions*
  - o In discussion of natural succession wetland and meadows – don't use the term "converted" ("converted to a forest type"). While I see its usage in context, it still brings in the sense of human activity. Use "succeeded to" to keep consistent with the natural process.  
**TRPA RESPONSE:** Text modified as suggested.

#### *Common Vegetation: Relative Abundance of Deciduous Riparian Vegetation Type*

- Page 6-21. *Monitoring and Analysis*
  - o Under *Analytic Approach* – I gather from this text and in other places in the document, disturbance is defined as impervious surfaces. This should be defined upfront, perhaps in the introduction.  
**TRPA RESPONSE:** Variance in the definition of disturbance as it applies to the basis for determining status of many of the standards is detailed in the recommendations' section of many of the indicator sheets. The report

recommends addressing this concern in the section on Modification of the Threshold Standard or Indicators.

*\*Common Vegetation: Relative Abundance of Shrub Vegetation Type.*

- Page 6-26. *Recommendations: Modification of the Threshold Standard or Indicator.*
  - o The target for land occupied by shrub vegetation is less than or equal to 25%. I agree that this may be problematic – should a minimum be set for attainment or is no shrub cover a reasonable target in some regions?
  - o The third point (top of page 6-27) states that a “simple accounting of the spatial extent” does not provide managers with an understanding of the relative condition of this vegetation type. This is true for percent cover of any of the vegetation types. However it is the first step in landscape assessment, and is a very useful metric in conjunction with other landscape metrics.

**TRPA RESPONSE:** \*

*Common Vegetation: Relative Abundance of Yellow Pine and Red Fir Forest in Seral Stages other than Mature*

- Pg 6-28. The 2001 and 2006 data (<20” dbh) are not comparable to the 2011 and 2015 data (<10.9 dbh). The color schemes (i.e. yellow – yellow pine; red – red fir) suggest that all years are comparable. These should be two separate graphs, or distinguished in some way from one another.

**TRPA RESPONSE:** A note has been added to the graph to make it clearer that the years are not comparable.

- Pg 6-30. *Indicator State*

- o Status. Immature red fir forest covers 3.3%, not 3.9%, of the Region.

**TRPA RESPONSE:** Text has been modified accordingly.

*Common Vegetation (Pattern): Juxtaposition of Vegetation Communities and Age Class*

- First place that the *Status: Implemented* is used (and defined)
- Pg 6-33. *Adopted Standards.* “Adjacent openings” – are these actual openings in the canopy or would it be more descriptive to call them adjacent patches?

**TRPA RESPONSE:** Table 6-3 is now included that provides a definition of the symbol. The text on the page 6-33 is the adopted text of the standard.

*Common Vegetation: Consistency with Bailey Land Capability System*

- Line 2. “...flow regulation...” Unclear. Are you referring to water flow? Perhaps hydrology?

**TRPA RESPONSE:** Text modified to clarify that it is surface water flow.

*Common Vegetation: Non-degradation of Stream Environment Zones*

- *Monitoring and Analysis.* Having the *Analytical Approach* in the form of a question is inconsistent with the rest of the indicators. The approach should be defined by how the question is answered.

**TRPA RESPONSE:** Text has been modified accordingly.

*Uncommon Plant Communities*

- Pg 6-56. Remote sensing is mentioned as a cost-effective way to assess trends in plant communities. I agree. Remote sensing could be used to monitor greenness,

connectivity, and interannual trends in these traits. Some inference of community composition based on patterns might be possible.

- Pg 6-77. Point 3 is misplaced (cut and pasted from previous Indicator). This paragraph is not customized to Grass Lake.

**TRPA RESPONSE:** Type corrected.

Pg 6-80. *Human & Environmental Drivers*, line 13. "...species likely to be replaced by species with wider ecological amplitude." What do you mean by amplitude?

**TRPA RESPONSE:** Amplitude has been changed to "range" for easier understanding.

### *Sensitive Plants*

- I don't understand the last sentence on this page: "*Galena Creek rockcress, determined to be considerably worse than target, is unlikely to be attainable because the target number of populations have been observed in the Region.*" The number of populations have reached the target, but are considered *worse* than the target?

**TRPA RESPONSE:** Corrected. The sentence should have read, "the target number of populations have *never* been observed in the region.

- Page 6-93. I find the text under *Monitoring Approach (Draba asterophora var. asterophora)* to be very confusing. I can't figure out how many subpopulation sites we've ended up with, and what the monitoring protocol is for those populations.

**TRPA RESPONSE:** The text has been modified to increase clarity.

- Page 6-94. *Indicator State, Status*. Unclear language. First, 4 main populations in LTBMU in 3 locations, at which 41 subpopulation sites are monitored. Then it's mentioned that demographic trends and drivers are monitored in 5 populations with 10 subpopulation sites with permanent plots in the LTBMU and the Humboldt-Yoiyabe National Forest. How do these two sets of populations relate? (4 vs 5? 4 + 5? 4 of 5??) Is an additional one in the Humboldt-Yoiyabe NF? How are "monitoring" at the 4 and "demographic trends and drivers" at the 5 sites different??

**TRPA RESPONSE:** The "status" description has been simplified to only provide information relative to the status of the species.

- o And *then*, under *Trends*, there is mention of 34 population sites – as those part of the Putnam PhD dissertation – are these overlapped with the 41 subpopulations mentioned under *Status*?
- o Please rewrite these sections for clarity.

**TRPA RESPONSE:** The "trend" description has been simplified.

- *Long-Petaled Lewisia*

- o Page 6-97, *Analytic Approach*, "...as the maintenance of two population sites can be demonstrated...." Why say two populations here, when your monitoring includes more? Are you implying "at least" two?

**TRPA RESPONSE:** "at least two" was implied and has been updated accordingly.

- o Page 6-98, 3<sup>rd</sup> line, spell out SWE à "snow water equivalent"

**TRPA RESPONSE:** text updated.

- *Cup Lake Draba*
  - Page 6-101, *Monitoring Approach*. Start this paragraph with the total number of monitored subpopulations (10), then give the history. Try not to bury the important numbers.  
**TRPA RESPONSE:** text updated accordingly and simplified
  - “Monitoring occurred every two years ...” Is this monitoring different than the census of every 5 years by LTBMU staff? (6<sup>th</sup> line)  
**TRPA RESPONSE:** text has been updated to better reflect actual monitoring. Monitoring occurred two years after plot establishment and afterwards every 3-5 years until the plant is delisted.
  - *Status*, 1<sup>st</sup> line, “11 subpopulation sites in the Region” – But only 10 are monitored? (*Monitoring Approach*) What’s the difference?  
**TRPA RESPONSE:** 11 sub-population sites was an error and has been corrected to 10.
- Page 6-104
  - 11<sup>th</sup> line, “... with 41 element occurrences reported ...” What are element occurrences?  
**TRPA RESPONSE:** “An **element occurrence** is NatureServe’s basic unit of record for documenting and delimiting the presence and extent of a species on the landscape. **Element occurrences**, or “EOs,” are defined as an area of land and/or water where a species is, or was, present, and which has practical conservation value.”  
(<https://surveyor.natureserve.org/elementOccurrences>)
  - 15<sup>th</sup> line, there is a reference to the “figure, part a”. Here it would be useful to have a figure number.  
**TRPA RESPONSE:** All figures and tables have now been numbered.

#### *Late Seral and Old Growth Ecosystems*

- Bar graph (again, it would be useful to have figures numbered!!) ð the legend needs to define the other two bars; only the 2006 and 2011 estimates are labeled.  
**TRPA RESPONSE:** All figures and tables have now been numbered.
- Page 6-112. *Modification of the Threshold Standard or Indicator*, last line. “.... standard for that zone should be considered to more accurately reflect the mature state of species occurring in that zone.” Be more transparent with the language. Here “mature state” isn’t clarifying the question. Use “age” of species.  
**TRPA RESPONSE:** \*
- The discussion around old growth is not clear, and the definitions by LTBMU given to early, mid and late seral stages as ranges of quadratic mean diameters will not be consistent across zones. Given that growing conditions at each of the elevational zones are different, size class for old growth will vary. In other words, it’s inappropriate and inaccurate to use the same size class for old growth across elevation zones.

**TRPA RESPONSE: \***

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*Minor edits (clarity and grammar)*

- The term “data” is plural. Its usage is mixed between plural and singular throughout the report. Despite popular usage in the singular, this is a scientific document and data should be used in the plural.  
**TRPA RESPONSE:** The term “data” used in this report is often used in its colloquial form and thus is often used in the plural and singular form. TRPA understands the reviewers concerns but must make this report readable to the public and science professionals and therefore has decided to keep using “data” in its current form.
- In several places in the document, temperatures are spelled out (e.g. nine- degree Fahrenheit; a two- to four-degree Fahrenheit). This is rather annoying. Using single digit numbers and the degree symbol is fine and far more readable. (e.g. 9° Fahrenheit; a 2° to 4° Fahrenheit, or even 9°F and 2° to 4°F)  
**TRPA RESPONSE:** Numbers less than 10 are now spelled and temperatures are presented consistently throughout the report.
- Page 6-2
  - Line 5. Add “was”. “Sheep grazing was ubiquitous in the Region’s forests and shrublands, and **was** so intensive that the understory was often denuded...”  
**TRPA RESPONSE:** text updated
  - Line 8. Please clarify sentence beginning with “A grazing allotment system was put in place ....” Is this saying one permittee at a time is allowed for certain areas?  
**TRPA RESPONSE:** text updated
  - 2nd para, 3rd line: “managers” to “manages” “...today the Forest Service **manages** 78 percent of the Region.”  
**TRPA RESPONSE:** text updated
  - 4th para, 1st line: Add “the” à “...poses a threat to the integrity of **the** Region’s vegetation communities...”  
**TRPA RESPONSE:** text updated
- Page 6-10
  - 3rd para, line 10. “...these communities and encourage **management** practices **that** promote healthy forests.”  
**TRPA RESPONSE:** text updated
- Page 6-13
  - Under Analytic Approach: “Proportion of the Region covered by individual vegetation types is **calculated** by dividing the area of the **vegetation** type ....”  
**TRPA RESPONSE:** text updated

- Page 6-16
  - o Under *Indicator State*: “Based on this target, the Region is at 93% of the objective of the management target.”  
vegetation type ....”  
TRPA RESPONSE: text updated
- Page 6-33
  - o Under *Human & Environmental Drivers*
- Page 6-37
- § 2<sup>nd</sup> line. Delete “A.H.” in citation of Nagel and Taylor.  
TRPA RESPONSE: TRPA used a standardized system for inserting references and this follows the standardized protocol.
- § 7<sup>th</sup> line. Hyphenate “.... Fire suppression-focused forest management....”  
TRPA RESPONSE: Text updated
- o Under *Human & Environmental Drivers*. 1<sup>st</sup> line, “The structure and distribution of vegetation in the Tahoe Region is influenced by ....”  
vegetation type ....”  
TRPA RESPONSE: text updated
- o Under *Effectiveness of Programs and Actions*. 5<sup>th</sup> line, “....soil conservation chapter of this evaluation which found that more than 10 acres of impervious ....”  
TRPA RESPONSE: text updated
- Page 6-45
  - o 4<sup>th</sup> para, 3<sup>rd</sup> line, “.... Which affects their ability to function properly...” (not “property”)  
TRPA RESPONSE: text updated
- Page 6-49
  - o *Indicator State: Trend*
    - § line 5, “.... The spatial extent of community decline suggests....”  
TRPA RESPONSE: text updated
- Page 6-54
  - o *Monitoring Approach*, 2<sup>nd</sup> line. “.... Assess the effectiveness of restoration work, ....”  
TRPA RESPONSE: text updated
- Page 6-55
  - *Interim Target* It is not possible to set a numerical target until additional monitoring data are available to gauge the status and trend of the site.  
TRPA RESPONSE: text updated
- Page 6-56
  - o *Attain or Maintain Threshold* – “The Conservancy-led project will restore....”  
TRPA RESPONSE: text updated

- Page 6-60
  - *Programs and Actions*, 5<sup>th</sup> line, "... designed to prevent new **invasives** from being introduced to the Lake ...."  
**TRPA RESPONSE:** text updated
- Page 6-63
  - *Adopted Standards*, last line, "...Freel Peak Cushion **Plant** Community, ...."  
**TRPA RESPONSE:** text updated
- Page 6-65
  - 1<sup>st</sup> line, "TRPA and **partners** implement regulations ..."  
**TRPA RESPONSE:** text updated
- Page 6-73
  - "3. Long-term monitoring of *Sphagnum* spp and ...." First sentence is a phrase and is inconsistent with points 1 and 2.  
**TRPA RESPONSE:** text updated
- Page 6-83
  - Line 1, "Consideration should be given to the use of a mixed effects model to ...."  
**TRPA RESPONSE:** text updated
  - *Modification of the Threshold Standard or Indicator*, line 6, "Standard revision should also give consideration **of** the likely impacts of ..."  
**TRPA RESPONSE:** text updated
- Page 6-87
  - *Indicator State. Status.* Line 4, "Figure 2 of this indicator sheet." No figures are numbered. As I mentioned above, numbered figures and tables, and more reference to them in the text is desirable to help in the interpretation of the data.  
**TRPA Response:** all figures have now been numbered
- Page 6-92
  - Under the Trend figure, what is the sentence "The observed increases in population two are likely due to ..." referring to? The Heavenly Ski Resort? Please refer to by name, not population number.  
**TRPA RESPONSE:** observed population increases due to increased monitoring was not limited to just one population and therefore the sentence was changed to reflect this.
- Page 6-98
  - *Analytic Approach*, 4<sup>th</sup> line, "... the following analysis to **assess** trends ..."  
**TRPA RESPONSE:** text updated
- Page 6-109
  - *Human & Environmental Drivers*, 3<sup>rd</sup> line. Use consistent format on citations. No first names, initials.  
**TRPA RESPONSE:** all citations have been updated accordingly.
- Page 6-110

- o *Analytic Approach*, line 6. Incomplete sentence? "... based on (Keyser and Dixon 2015)." Based on what? On Keyser and Dixon (2015).
- o Line 8, "... dbh, the size of "old growth" forest."  
TRPA RESPONSE: text updated

- Page 6-111

- o *Programs and Actions*, 2<sup>nd</sup> to last line, "... Projects are expect to enhance...."  
TRPA RESPONSE: text updated