

# Chapter 6

## FISHERIES

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### 6.1 INTRODUCTION

Two key aquatic environments that support fish in the Lake Tahoe Basin are lakes and streams. These dynamic ecosystems characteristically change in space and time. Combined, attributes of lakes and streams provide necessary elements such as water, cover, and spawning and nursery habitat to support fish and other aquatic organisms. Both environments play an important role in sustaining desirable fish populations and cannot be viewed independently because some fish species use both lake and stream environments to complete their life cycles. The combination of chemical, biological, temperature, and physical characteristics of lakes and streams influence the suitability of these environments to sustain different fish populations. Accordingly, degradation of the necessary characteristics of lakes or streams can reduce the sustainability of Tahoe's fishery.

The composition of Lake Tahoe's fish community has changed considerably since the arrival of Euro-Americans to the Lake Tahoe Basin. Prior to the influence of Euro-American activities, seven species of fish occurred in the lakes and streams of the Lake Tahoe Region (Murphy and Knopp 2000). Of the native fish species, Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) and the mountain whitefish (*Prosopium williamsoni*) were abundant and revered by Native Americans because they provided ample food for their people. Today, Lahontan cutthroat trout have been extirpated from Lake Tahoe, and the population of mountain whitefish is believed to occur in very low numbers (Murphy and Knopp 2000). Fisheries biologists have concluded that several factors have contributed to the decline or extinction of native fish and the degradation of fish habitat in the Lake Tahoe Region. Extensive logging, water diversions, intense grazing, commercial harvest, road building, and the introduction of non-native fish and other aquatic organisms are believed to have cumulatively contributed to the change in Lake Tahoe's fish composition and degradation of fish habitat (SNEP Sierra Nevada Ecosystem Project (SNEP) 1996; Murphy and Knopp 2000). Consequently, since the Comstock Era (circa 1860), 20 additional fish species have been introduced into Lake Tahoe's aquatic environment.

The goal of the threshold for the Tahoe Region fisheries resources is to ensure the existence of adequate aquatic habitat essential for the growth, reproduction, and perpetuation of existing and threatened fish resources in the Lake Tahoe Basin. To achieve this goal, four threshold standards and associated indicators have been adopted, including: Lake Habitat (or littoral substrate); Stream Habitat (miles of stream in different condition classes); In-Stream Flow (number of permitted activities allowed to reduce stream flow below a rate appropriate for sustaining fish life history activities); and Lahontan Cutthroat Trout (reestablish a population back into the Lake Tahoe region). This section reports on progress made towards achieving adopted Threshold Standards, evaluates the effectiveness of TRPA's

current Regional Plan for achieving Threshold Standards, and proposes a new approach to measure the condition of aquatic resources.

## 6.2 BACKGROUND

In recognition of the contribution of natural resources (including fish resources) to the environmental quality of the Lake Tahoe Basin, the Tahoe Regional Planning Compact established the framework from which the TRPA Regional Plan was created and environmental threshold carrying capacities (“thresholds” or “threshold standards”) were adopted for fish. The Regional Plan, including the Goals and Policies (TRPA 1986) and the Code of Ordinances and Rules of Procedure (TRPA 1987), provide relevant policy statements for the maintenance of habitat conditions for fisheries threshold standards.

According to the Goals and Policies, Fisheries Sub-Element, there is one goal and nine policies statements relative to maintaining fisheries resources. The goal is to improve aquatic habitat essential for the growth, reproduction and perpetuation of existing and threatened fish resources in the Lake Tahoe Basin. The nine policies are

1. TRPA must consider and mitigate project impacts to fish habitat in streams and lakes;
2. Prohibit the development of blockages and other impediment to fish movement in streams;
3. Develop an in-stream maintenance program to inventory and remove stream blockages;
4. Establish boating standards to reduce associated disturbance in the shallow zone of the lake;
5. Encourage habitat improvement projects in streams and lakes;
6. Maintain and enhance in-stream flows;
7. Transfer existing points of water diversion from streams to the lake, whenever feasible;
8. Support state and federal efforts to reintroduce Lahontan cutthroat trout; and
9. Control the level of Lake Tahoe to reflect seasonal weather and runoff patterns.

The core of TRPA’s fisheries regulations that are designed to achieve threshold standards is detailed in TRPA Code Chapter 79; however, applicable regulations for the management of fish habitats can be found throughout the document (TRPA 1987). Chapter 79 includes provisions for the protection of fish habitat and the enhancement of degraded lake and stream habitat. For lake environments, all projects and activities conducted in the shorezone may be prohibited, limited, or otherwise regulated in prime habitat areas; or in situations that TRPA found to be vulnerable or critical to the needs of fish. Special conditions of project approval,

such as restoring physically altered substrate, limiting construction to designated periods, or implementing shoreline protective measures may be required for development in the shorezone in order to mitigate or avoid significant adverse impacts to habitat or normal fish activities. Certain activities, such as boat beaching may be restricted temporarily in areas where spawning activity occurs. To support the non-degradation standard that applies to lake fish habitat, TRPA's Code prohibits the alteration of substrate in areas of prime fish habitat (i.e., feed and cover boulder/cobble fields, and spawning gravels) unless approved by TRPA. The protection provision for in-stream habitats is similar: prohibit stream channel alterations, stream crossings shall be designed to facilitate fish movement, barriers to fish movement are permitted to be removed, development shall fully mitigate impacts to fish habitat, maintain in-stream flows, prevent sediment entry into streams, and provide vegetative cover.

## **6.2.1 MEASUREMENT AND MONITORING OF INDICATORS AND STANDARDS**

There are four threshold indicators used to measure the status of Lake Tahoe fisheries relative to establishment of threshold standards including: acres of "prime" lake habitat for fish, miles of stream habitat in various condition classes, human influenced degradation to in-stream flow characteristics, and TRPA Governing Board support for the reestablishment of Lahontan Cutthroat Trout. Over time, minor changes have been made to how either an indicator or a standard is articulated (see compliance form from previous Threshold Evaluations 1991, 1996, & 2001). Below are indicators and standards cited directly from the 2001 TRPA Threshold Evaluation (compliance forms).

### **F-1 Lake Habitat**

#### ***F1 - Lake Habitat Indicator***

Physical disturbance of rocky (spawning and feed/cover habitats) substrate (acres).

#### ***F1 - Lake Habitat Standard***

A non-degradation standard shall apply to fish habitat in Lake Tahoe. Achieve the equivalent of 5,948 total acres of excellent ('prime') habitat.

According to TRPA (1982a), "The quality of the lake can be evaluated and tested against the threshold using measures of habitat disturbance and substrate conditions." The indicator for the F-1 threshold standard was identified by TRPA (1996) as "Physical disturbance of rocky substrate (acres)" even though this indicator does not directly measure acres of "prime" habitat as stated in the threshold standard (see below). TRPA (1982a) considered moderate to heavy boat traffic as disturbance that significantly contributed to the decline of lake fish habitat quality, while TRPA (1996) further considered the rearrangement or clearing of near shore substrate to accommodate beach use during low lake levels as disturbance to fish habitat and thus a degradation to fish habitat conditions.

## **F-2 Stream Habitat**

### ***F2 - Stream Habitat Indicator***

Miles of stream habitat in the various categories based on field inspections of habitat.

### ***F2 - Stream Habitat Standard***

Maintain 75 miles of excellent, 105 miles of good, and 38 miles of marginal stream habitat as indicated by the map on page 76 of the EIS for the Establishment of Environmental Thresholds (TRPA 1982b).

Past evaluations (1991 and 1996) of stream habitat quality used a list of subjective evaluation criteria (Table 6-1). Each threshold stream was scored according to criteria identified in the table to conclude the relative condition of each stream. The resulting score for a particular length of stream was then fitted into 1 of 3 classes, 'excellent', 'good', or 'marginal' and the overall mileage of that stream segment was calculated (Table 6-1). According to TRPA documents, it was unclear which fish species group the classification scheme was relevant to (e.g., suckers, trout, all). Consequently, an assumption was made that the classification scheme was most relevant to trout species, considering the criteria used in the classification scheme appears biased toward salmonid life histories. Past evaluations have used different criteria to draw conclusions on the conditions of different streams based on availability of data. For example, biological data were not available for the 1996 Threshold Evaluation and thus those criteria were dropped from the condition assessment of all threshold streams. For the 2001 Threshold Evaluation the professional opinions of Fisheries Technical Advisory Group (FTAG) members were used to report on the condition of stream habitat due to a lack of field effort since 1996. Likewise, the current Threshold Evaluation (2006) of stream habitat is hampered due to lack of field effort to assess fisheries conditions.

**Table 6-1: Original Stream Ranking Criteria Used to Rate the Condition of Threshold Streams**

<b>Criterion</b>	<b>Rating (score)</b>		
Seasonal Stream Flow	Prominently Dry	Intermittent	Continuous Flow
Resident	0	2	5
Migratory	0	2	5
Pool Abundance	Less Than 50%	More Than 50%	Close to 50%
Resident	2	2	5
Migratory	2	2	5
Aquatic Cover	Poor	Medium	Good
Resident	0	2	5
Migratory	0	2	5
Substrate	Poor	Fair	Good
Resident	0	2	5
Migratory	0	2	5
Shade Canopy	Poor	Medium	Good
Resident	0	2	5
Migratory	0	2	5
Aquatic Vegetation	Few	Common	Abundant
Resident	0	1	2

Criterion	Rating (score)		
Migratory	0	1	2
Benthic Fauna	Poor	Fair	Good
Resident	0	5	10
Migratory	0	5	10
Fish Abundance	Few	Common	Abundant
Resident	0	5	10
Migratory	0	5	10
Reproduction	Poor	Fair	Good
Resident	0	2	5
Migratory	0	5	10
Bank/Channel Stability	Poor	Fair	Good
Resident	0	2	5
Migratory	0	2	5
Stream Gradient	Steep	Slight	Moderate
Resident	0	1	2
Migratory	0	2	5
Barrier/Obstructions	More than one	One	None
Resident	0	1	2
Migratory	0	5	10
% Diversion	High	Moderate	None
Resident	0	5	10
Migratory	0	5	10
Maximum Resident <sup>a</sup>	2	31	71
Maximum Migratory <sup>a</sup>	2	40	87

Criteria were modified for the 1996 Threshold Evaluation (TRPA 1996) by removing biological criteria from stream condition assessment (C. Shade 2001, , pers. comm.)  
\*Stream Classification Scoring System  
<sup>a</sup> 1996 Threshold evaluation maximum scores for a residential or migratory stream was 70% of the maximum score reported in TRPA (1982b).

Source: (from Appendix D of TRPA 1982b)

**Table 6-2: Stream Score Classes Used in 1982 and 1996**

Stream Classification	Original Score Classes for <u>Migratory</u> Streams (1982b)	Original Score Classes for <u>Residential</u> Streams (1982b)	Revised* Score Classes for <u>Migratory</u> Streams (1996)	Revised* Score Classes for <u>Residential</u> Streams (1996)
Marginal	< 55 points	< 35	< 38.5	< 24.5
Good	55 – 68 points	35 - 50	38.5 – 47.5	24.5 - 35
Excellent	> 68 points	> 50	> 47.5	> 35

Refer to Appendix 3 in 2001 Threshold Evaluation for a summary of stream scores reported in TRPA, 1996  
\*The same stream ranking criteria in Table 6.2.1 were used in 1996, with the exception of biological indicators

### **F-3 Instream Flow**

#### ***F3 - Instream Flow Indicator***

Interim indicator – The number of permits issued that allow long-term reductions to stream flow and degradation to riparian community. Permits shall not be issued unless it is proven that the riparian community will not be impacted. Long-term

indicator – stream flows on basin streams shall not unnaturally drop below seasonal flow standards established by TRPA supported by research conducted by Desert Research Institute.

### ***F3 - Instream Flow Standard***

Until instream flow standards are established in the Regional Plan to protect fishery values, a non-degradation standard shall apply to instream flows. The original evaluation criterion for the in-stream flow threshold standard is found in TRPA (1982a), which states, “*It can be evaluated for compliance by monitoring the number of new diversions and changes in points of diversion.*” TRPA (1996) states that the indicator of in-stream flows is “*...evaluated by use of an in-stream beneficial use assessment, such as the type established by Title 23, Section 670.6 of the California Administrative Code.*” An interim indicator and standard was adopted in the 2001 TRPA Threshold Evaluation, since TRPA staff has not had the technical ability or the staffing capacity to generate in-stream beneficial use assessments for each threshold stream. The interim indicator and standard is consistent to TRPA (1982b) to ensure TRPA reviewed and permitted projects/activities did not jeopardize stream flows for fish. Thus, this evaluation quantifies the number of applications for diversions and lake transfers filed with TRPA as an indicator of maintenance of stream flow conditions in the Region. Additionally, a summary of research completed by Desert Research Institute (Tracy and Rost 2003) on stream flow condition is provided in this evaluation.

## **F-4 Lahontan Cutthroat Trout**

### ***F4 - Lahontan Cutthroat Trout Indicator***

The successful establishment of a Lahontan cutthroat trout population in the Lake Tahoe Region.

### ***F4 - Lahontan Cutthroat Trout Standard***

It shall be the policy of the TRPA Governing Board to support, in response to justifiable evidence, state and federal efforts to reintroduce Lahontan cutthroat trout.

An evaluation criterion for Lahontan cutthroat trout (LCT) is found in TRPA (1982a), which states, “The threshold would be achieved with the successful establishment of a Lahontan population.” Agencies responsible for the recovery of this species were queried and relevant reports were reviewed to assess the status of this threshold.

## **6.3 THRESHOLD STATUS**

Overall, 2 indicators suggest attainment of regional threshold standards (instream flow and Lahontan Cutthroat trout), the status of one indicator is unknown due to lack of field effort (stream habitat), and one indicator, lake habitat, is not in attainment with the established threshold standard.

### 6.3.1 F-1 LAKE (LITTORAL HABITAT)

#### Status of Indicators

#### Non Attainment, but Near Attainment

The 2001 Threshold Evaluation indicated that the region was not in attainment with this standard based on the opinion of the TRPA Fisheries Technical Advisory Group (FTAG) that efforts to restore littoral habitat were insufficient. The FTAG based their determination on professional opinion and on data collected during drought years of the early 1990s which suggested that a significant proportion of 'prime' fish habitat had been disturbed (Table 6-3). Restoration of littoral habitat primarily involves the redistribution of rocky substrates at areas that had been manipulated by property owners in order to expand/enhance sandy beach characteristics during drought years (i.e., low lake levels). Since the 2001 Threshold Evaluation, little additional direct effort to restore littoral habitats has occurred other than to mitigate shore development projects. For example, a sewer line replacement project in Tahoe City required that littoral habitat be restored in-kind at a 1.5 to 1 ratio.

**Table 6-3: 2001 Threshold Evaluation Estimate of Substrate Acreage by Habitat Type and 'Disturbance' in Lake Tahoe's Shorezone (Shoreline to 30 Feet Deep). Habitat Acreage Estimated by Byron et al. (1989).**

Habitat Type/Disturbance	Acres
Spawning (gravel 2 to 64mm diameter)	2,041
Not Disturbed	1,482
Disturbed <sup>a</sup>	559
Feed and/or Cover (>64mm diameter, interspersed boulders w/ gravel, sand and/or silt)	3,917
Not Disturbed	2,806
Disturbed <sup>a</sup>	1,111
<b>Subtotal Prime Habitat - not disturbed</b>	<b>4,288</b>
<b>Subtotal Prime Habitat – disturbed</b>	<b>1,670</b>
<b>Subtotal Prime Habitat</b>	<b>5,958</b>
Marginal (sand/silt bed, < 2mm diameter)	3,670
Not Disturbed	3,670
Disturbed <sup>a</sup>	0
<b>Total Habitat</b>	<b>9,628</b>
<b>Total Disturbed</b>	<b>1,670</b>
<b>Total Not Disturbed</b>	<b>7,958</b>
Source: TRPA GIS 2001 [layer name = 'fishhab_trpa8'].	
<sup>a</sup> Disturbance is defined as substrate redistributed or cleared by people (i.e. beach clearing) during drought years or areas potentially impacted by static shoreline revetments. Acreage for disturbed area is likely to be less than values reported in this table based on FTAG and Byron et al. (1989), Beauchamp et al. (1990, 1991), Allen and Reuter (1996), which stated that it was unknown if the redistribution of lakebed substrates had a negative impact on fish habitat.	

Since 2001, TRPA has sponsored research efforts to better understand the distribution and abundance of different littoral substrate (shallow fish habitat). Metz and Herold (2004) used remote sensing data (IKONOS satellite imagery collected in 2002) to evaluate littoral habitat conditions. This unique effort utilized new

technologies and analytical techniques to efficiently map littoral substrates and shorezone structures (such as piers). The results of the mapping exercise were then used to predict fish use of different littoral habitats.

Metz and Harold (2004) found substantial differences in the total amount of littoral zone habitat and different habitat type acreage (Table 6-4). For example, they revealed that there are approximately 4,900 more total acres of habitat available to fish and there is substantially less pure spawning habitat (-1,951 acres) available the previously reported by Byron et al. (1989). Metz and Herold (2004) attributed difference between their research and Byron et al. (1989) to different mapping approaches, availability of new mapping products (e.g., USGS SHOALS bathymetry data), habitat generalizations made by Byron et al. (1989), and the fine spatial resolution of their approach. Metz and Herold's (2004) results indicated that there are approximately 5,602 acres of "prime" fish habitat in Lake Tahoe's littoral zone, or about 357 acres less than identified as the threshold standard for lake habitat.

**Table 6-4: Comparison of Acreage and Percent Cover of Different Littoral Fish Habitat in Lake Tahoe, CA, NV.**

Habitat	Byron et al. 1989 – Values Used to Establish Existing Threshold Standard for Lake Tahoe		Metz and Herold 2004 – Revised Habitat Calculations (IKONOS 2002)		Difference in Acreage Estimates	
	Acres	Percent Cover	Acres	Percent Cover	Acres	Percent Cover
Marginal	3,670	38.1	8,913	61.4	+5,243	+23.3
Feed & Cover	3,918	40.7	5,506	37.9	+1,588	-2.8
Spawning	2,047	21.2	96	0.7	-1,951	-20.5
Total	9,629	100.0	14,515	100.0	+4,886	-
Life Cycle ("prime") Habitat	5,959	61.9	5,602	38.6	-357	-23.3

Because of differences in mapping approaches, Metz and Harold (2004) identified cross-walking procedures to better understand the status of littoral substrate (habitat). In the process of doing this, they discovered that the original boundaries of the lake fish habitat map (Byron et al. 1989) extended onshore for approximately 50 m, resulting in a systematic error in total habitat cover (acreage) which over estimated the total habitat area. To assess the distribution of lake habitat between 1989 and 2002, Metz and Harold (2004) reclassified habitats they identified (a process that coarsened the substrate resolution), clipped out upland areas and compared the proportion of different habitat types (Table 6-4). Their analysis indicated that there was a small proportional reduction in the prime (spawning and feed/cover) habitat and an increase in marginal habitat from 1989 to 2002 (Table 6-4). These results indicate that the region has not retained prime habitat at the level originally identified as the desired condition. However, after habitats were cross-walked, differences in the proportion of area covered by different habitat types was small and may be a function of different mapping approaches used.

For the 2001 Threshold Evaluation, the FTAG used data collected during early 1990s drought years to estimate the amount of habitat disturbed. Based on this assessment, TRPA estimated that about 28% of prime fish habitat was disturbed (or converted to marginal habitat) (Table 6-5). Metz and Harold (2004)

demonstrate that there is about 5.5% less prime fish habitat than previously estimated, which suggests that the total extent of degraded habitat is less significant than previously projected.

**Table 6-5: A Comparison of Acreage and Percent of Lake Fish Habitat Type Between Reclassified and Corrected Data from 2002 (Metz and Harold 2004) and 1989 (Byron et al. 1989), Lake Tahoe, CA, NV. Metz and Harold (2004) used a cross-walking procedure to improve comparability of mapping efforts.**

Fish Habitat Type	Metz and Harold (2004) Reclassified Habitat (acres)	Percent (%) of Total Habitat	Byron (1989) Original Fish Habitat (acres)	Percent (%) of Total Habitat	Difference (Acres)	Difference (%)
Spawning	1,502	19.6	2,042	21.2	-540	-1.6
Feed/Cover	2,821	36.8	3,918	40.7	-1,097	-3.9
Marginal	3,344	43.6	3,671	38.1	-327	5.5
TOTAL	7,667	100.0	9,631	100.0	-1,964	0

Given these results, a few conclusions can be made: 1) Previous mapping efforts (Byron et al. 1989) over-generalized the extent and distribution of different littoral habitats and systematic mapping errors were introduced resulting in an over-estimation of all fish habitats as upland areas were included in habitat acreage calculations; 2) the extent of disturbance to littoral habitat has been overestimated by about 22%; and 3) only 95 acres of pure spawning habitat (i.e., gravels not commingled with cobbles and boulders) exist in the lake and at low lake levels (<6,224.7 feet) pure spawning habitat may be largely unavailable for littoral fish spawning.

### **2006 Status evaluation relative to threshold attainment schedules**

The contribution of compliance measures to threshold attainment and the achievement of interim targets are summarized in the Compliance Forms at the end of this chapter and Appendix A.

#### ***Threshold interim target status***

The 2001 Threshold Evaluation set the following interim targets with respect to the lake habitat threshold: survey and map lake habitat by 2005 and recalculate the extent and distribution of different shorezone substrates, reassess the threshold standard and indicator for lake fishery by 2005, and achieve 5,948 acres of 'prime' fish habitat (spawning and feed/cover) by 2006 following an assessment of activities that degrade fish habitat. The mapping conducted by Metz and Harold (2004) completed lake habitat mapping target. This new mapping revealed that there are approximately 5,602 acres of prime nearshore fish habitat, roughly 346 acres less than the interim target.

The recommended interim target for completion by 2011 is the development and adoption of a new approach to measure biological condition in Lake Tahoe based on direct measures of the aquatic community, as proposed by the Pathway 2007 process, rather than the existing physical substrate indicator

### ***Threshold Target Dates***

As indicated above opportunity exists for meeting the threshold of 5,948 acres of 'prime' fish habitat through mitigation and restoration connected to projects within the shorezone, and through EIP projects that restore disturbed spawning and feed and cover substrate. It is feasible that this threshold may be met by 2011.

## **6.3.2 F-2 STREAM HABITAT**

### **Status of Indicators**

#### **Unknown**

No data has been collected since the 1996 Threshold Evaluation to specifically assess the condition of streams as originally envisioned at threshold adoption in 1986 (Table 6-1). No data were collected for the 2001 threshold evaluation, because it was determined that the likelihood of change since the 1996 assessment did not justify the large outlay of resources to collect these data. No data was collected for the 2006 threshold evaluation as the TRPA was already undertaking efforts to improve its ability to assess stream condition (see Pathway 2007 Technical Supplement). In particular, an Index of Biological Integrity (Karr and Chu 1999) is currently being developed for the Lake Tahoe Basin using aquatic biological community indicators to better measure the condition of Lake Tahoe streams. Preliminary results suggest that the majority of streams sampled (n=10) are in good to excellent biological condition (see Pathway Technical Supplement for complete description of streams sampled). Degradation of stream habitat condition appears to be related to increased land use intensity (i.e., urbanization) at a localized scale. In addition to improving stream monitoring methods, the restoration programs of several Basin land management agencies are actively implementing stream restoration projects in order to enhance conditions for fish resources (see Soil Conservation [SC-2] section for summary of completed stream restoration projects). One example is that US Forest Service – Lake Tahoe Basin Management Unit is nearing completion of 0.43 miles of stream restoration along Big Meadow Creek at Cookhouse Meadow in the Upper Truckee watershed and restoring Blackwood Creek at Barker Pass Road.

### **2006 Status evaluation relative to threshold attainment schedules**

The contribution of compliance measures to threshold attainment and the achievement of interim targets are summarized in the Compliance Forms at the end of this chapter and Appendix A.

#### ***Threshold interim target status***

The interim targets from the 2001 Threshold Report were to: update threshold standards and indicators for stream habitat by 2006 and to develop an empirical stream habitat monitoring and evaluation protocol by 2006. Furthermore, by 2006 a total of 50 miles of stream were targeted to be classified as 'excellent' habitat quality for salmonid species (a result in 8 miles of stream habitat improvement since 1996) and a total of 50 miles of stream to be classified as 'good' for salmon species by 2006 (a result of 9 miles of stream habitat improvement since 1996) on TRPA designated threshold streams. Although stream restoration projects have been completed since the last Threshold Evaluation (2001), no field information

has been collected to empirically quantify whether a stream has moved from a 'good' condition to an 'excellent' condition.

The interim target for the next 5 years is to continue to develop and implement an empirical stream habitat monitoring and evaluation protocol by 2011. As described above and part of the Pathway 2007 process (Pathway 2007 - Wildlife and Fisheries Technical Supplement 2005), a new more scientifically supported approach to measuring stream condition has been proposed for TRPA adoption. Consequently, indicators and standards are in the process of being updated through the Pathway 2007 planning process.

### ***Threshold Target Dates***

The preliminary data from the index of biological integrity indicates that the majority of streams are in excellent condition. If the indicator for stream habitat is changed as part of the Regional Plan Update process, to allow for the use of this index and efficient evaluation of the majority of streams in the Basin,, then this threshold will be met by 2011. However, based on the existing threshold standards and indicators it is unlikely that this threshold will be met within the next 20 years.

## **6.3.3 F-3 INSTREAM FLOW**

### **Status of Indicators**

#### **Attainment**

Two sources of information were reviewed to determine the status of stream flow conditions relative to the established threshold standard 1) TRPA's permit tracking database and 2) Tracy and Rost (2003) report titled: "*Stream flow conditions of Lake Tahoe streams based on gauged flows and statistically modeled flow estimate: implications for salmonid fish population management.*"

TRPA's permit tracking database stores information relevant to permit applications and permit approvals for water diversion or exchange. A database query was conducted to reveal water diversion and water exchange permit activity between the years of 1996 and 2005. Between 1996 and 2005, no applications or permits were entered into the TRPA permitting database. Consequently, according to TRPA's records, there has been no degradation to in-stream flows as a result of TRPA project permitting.

In addition to TRPA permit database review, TRPA contracted the Desert Research Institute (Tracy and Rost 2003) to complete the following tasks to assist in understanding stream flow conditions relative to TRPA threshold standard and make progress toward establishing stream flow standards for each threshold stream:

- (1) The performance of a statistical analysis of stream flow rates for tributaries with continuous flow gauging records;
- (2) The development of a statistical model to predict daily stream flow rates of tributaries with little or no gauging records;
- (3) The development of a statistical model to predict instream flow needs for salmonid (trout) species in Lake Tahoe's streams; and

- (4) A field survey to locate and assess the level of anthropogenic disturbance to the hydrology of Lake Tahoe's streams.

The approach used in this study was to develop statistical relationships for gaged (i.e., monitored) and un-gauged tributaries in the Lake Tahoe Basin to describe their daily flow-exceedance-frequency relationships for each month of the year. These relationships were then compared to published optimal instream flow rates for trout species for several of Lake Tahoe's Threshold Tributaries. Optimal instream flow rates were only published for a limited number of stream reaches that does not include all of the Lake Tahoe Threshold Tributaries. Nonetheless, these comparisons indicated that only a limited number of streams meet defined optimal instream flow requirements (Snider et al. 1987), with Trout Creek and the Upper Truckee River showing the greatest potential for meeting optimal instream flow rates for both trout rearing and spawning periods. It should be clearly recognized that a larger proportion of streams provide 'suitable' stream flow for trout species as opposed to 'optimal' and that the maintenance of unrestricted stream flows, regardless of flow rates, are important to other aquatic dependent organisms, such as invertebrates, amphibians, and some reptiles. Tracy and Rost's (2003) analysis also suggested that the instream flow rates can be extrapolated to a larger number of tributaries within the basin based on the tributary's physical characteristics. Finally, a field assessment of Lake Tahoe's Threshold Tributaries shows that well over 50% of the tributaries have some type of man-induced disturbance (i.e., water diversion, impoundment, etc.) that can affect their hydrologic characteristics as well as limit an organism's ability to move within the stream corridor. However, the majority of disturbance is relatively small, and only affects the tributary's hydrologic characteristics on a short time scale.

Tracy and Rost's (2003) assessment of stream flow conditions stopped short of recommending minimum flow standards for Threshold streams, largely because only two streams have a high probability to provide optimal flow conditions. However, other recommendations were made including:

- If improving non-native trout fisheries is the goal, land management agencies should prioritize the restoration in Trout Creek and Upper Truckee River.
- Although there are a number of human generated stream flow impediments (50% of Threshold streams have 1 or more impediments), their effect on stream flow characteristics is mostly negligible. Thus removal of structures would only marginally improve hydrologic conditions, but would likely improve mobility for aquatic organisms.
- Methodologies for determining instream flow requirements for all of Tahoe Basin's fish species should be developed. At the current time, no published studies could be found that identified instream flow needs for Tahoe's native non-salmonid species. These species are an important element of the basin's aquatic ecology, and understanding their habitat needs should be placed on equal footing with those of the introduced trout species that have been the focus of previous studies within the basin.

### **2006 Status evaluation relative to threshold attainment schedules**

The contribution of compliance measures to threshold attainment and the achievement of interim targets are summarized in the Compliance Forms at the end of this chapter and Appendix A.

#### ***Threshold interim target schedules***

The interim target put forth in 2001 was to complete Desert Research Institute's research on in-stream flow characteristics and adopt minimum flow standard recommendations. Tracy of Rost (2003) of DRI completed research on instream flow conditions of Lake Tahoe streams, however, instream flow standards have not been adopted in response to this research.

An interim target for 2011 is to adopt instream flow measures as an attribute indicator of stream condition. A second target is to establish threshold goals consistent with USFS desired conditions to manage flow within the natural range of hydrologic conditions through the Pathway 2007 process.

#### ***Threshold Target Dates***

This threshold is in attainment with regional standards.

## **6.3.4 F-4 LAHONTAN CUTTHROAT TROUT**

### **Status of Indicators**

#### **Attainment**

The 2001 Threshold Evaluation reported that the region was in compliance with this threshold standard as a population of LCT has been reestablished in the headwaters of the Upper Truckee River. Since the last evaluation, efforts by the US Fish and Wildlife Service to reestablish LCT populations have been initiated at Fallen Leaf Lake (Allen et al. 2003).

During the summer of 2002, about 35,000 Lahontan Cutthroat Trout (LCT) were stocked in Fallen Leaf Lake (Allen et al. 2003). Subsequent stocking at this level has occurred each year between 2003 and 2005. Fish stockings are part of the U.S. Fish and Wildlife Service (USFWS) recovery effort for LCT in Northwestern Nevada and Eastern California

### **2006 Status evaluation relative to threshold attainment schedules**

The contribution of compliance measures to threshold attainment and the achievement of interim targets are summarized in the Compliance Forms at the end of this chapter and Appendix A.

#### ***Threshold interim target status***

The interim target to continue to support well-planned reintroduction efforts has been met. TRPA has continued to support USFWS and USFS effort to maintain and reintroduce LCT population in the Lake Tahoe Basin.

The interim targets for 2011 are to continue to support well-planned reintroduction efforts and to adopt Pathway 2007 proposal to include LCT as a special interest species and measure status of LCT populations in the future.

**Threshold Target Dates**

This threshold is currently in attainment.

**6.4 EIP IMPLEMENTATION STATUS**

Approximately 77 capital improvement projects focused on improving fish habitat have been identified in the environmental improvement program. TRPA Records indicate that 13 of these projects have been completed to date (Table 6-6). In general, these projects have reclaimed previously lost riparian habitat or have enhanced existing stream habitat condition. In some cases, it will take several years (up to 10 years) for aquatic species to respond to these projects because it will take time for vegetation to grow and other processes to become established.

An additional six research and evaluation projects have been completed that have resulted in an overall benefit to the fisheries program.

The EIP program is currently in the process of being updated. Therefore, recommendations for projects directed toward meeting attainment of the fisheries thresholds will be made through that process.

**Table 6-6: Completed EIP Capital Improvement Projects**

EIP Number	Title	Project Description	Status
327	Third Creek Migration Phase I – Stream Habitat Restoration	Habitat restoration for fisheries that includes the following elements: removal of man made barriers and/or the facilitation of fish migration through these barriers, e.g. culverts; the creation of step pools and stabilize eroding bank.	Completed
399	Upper Truckee River/ Lower Phase III - Stream Habitat Restoration	Upper Truckee stream channel reconstruction -stabilize stream banks and channel from Hwy 50 to river mouth. Improve substrate and vegetative cover.	Completed
406	Angora Creek through Subdivision - Stream Habitat Restoration	PROJECT: Adjust channel morphology in area of subdivision where creek has become entrenched, stabilize banks with vegetation, and improve passage at two existing culverts by baffling or bridging to improve stream habitat.	Partially complete

<b>EIP Number</b>	<b>Title</b>	<b>Project Description</b>	<b>Status</b>
407	Big Meadow Creek - Stream Habitat Restoration	Remove the cows from meadow area, reconstruct bridge in order to increase stabilization of banks, stabilize head cuts, and add flow in cobble to improve fish habitat.	Partially complete
437	Angora Creek through Meadow - Stream Habitat Restoration	1.7 miles of channel naturalization and meadow enhancement on lower reach of Angora Creek.	Completed
657	Blackwood Morphology Phase II - Stream Habitat Restoration	Remove culvert and construct bridge, return creek to original channel (2 miles), re-contour and stabilize banks to improve the condition of 3.9mi of stream.	Partially complete
658	Snow Creek - Stream Habitat Restoration	Fish habitat restoration and enhancement includes vegetation manipulation at mouth, creation of below grade pools to provide cooler water temps, and replace existing culvert under SR 28 with a bottomless arch culvert to improve passage.	Completed
883	Blackwood Creek Barrier Removal Phase I - Stream Habitat Restoration	Remove manmade barriers as well as beaver dams (develop a beaver management plan for this drainage) improve shade canopy, and restore bank stability where no other treatment is needed (e.g. channel morphology is adequate).	Completed
894	Habitat Restoration Incline Creek Phase II – Improvement	Remove barriers to fish passage, including culvert modification at state road crossing, improve channel morphology which includes pool development, improve vegetative cover and stabilize stream banks.	Completed
904	Habitat Restoration Trout/Pioneer to Martin Phase I	Reestablish the natural channel (re-contouring where incisement has occurred changing the elevation of the creek bed), improve shade canopy, stabilize banks, improve streambed substrates, and develop a beaver management plan for this tributary.	Completed
10132	Cookhouse	Construct stream channel, improve habitat, and increase stream bank stabilization.	Completed

EIP Number	Title	Project Description	Status
10133	Cookhouse Meadow	Restore eroding stream banks on Big Meadow Creek through Cookhouse Meadow. Possibly reconstruct section of channel, install grade control structures or build floodplains within the current incised profile to reconnect the stream with the floodplain.	Completed
10137	Saxon Creek	Reconstruct stream reach at forest road crossing. Existing culvert will be replaced with a bottomless arch culvert requiring reconstruction of stream channel; some debris management will also be included.	Completed

## 6.5 THRESHOLD NEED FOR CHANGE

A major conclusion of this evaluation is that many of the fisheries threshold standards, management standards and policies require extensive re-evaluations for either recalibration or amendment by the inclusion of additional indices. These changes also relate to updating the management system itself and coordination with other agencies. It is the recommendation of this report that TRPA should pursue the amendments to the environmental threshold carrying capacities developed and recommended as part of the Pathway 2007 process. The sections below summarize the proposed amendments. As noted, amendments are scheduled for action with adoption of the Regional Plan package in 2008, while others will require further development and analysis by TRPA. The proposed changes include specific threshold goal statements for Special Status Species and the biological integrity of aquatic and terrestrial ecosystems and the placing of these threshold goal statements under an all encompassing vision for fisheries and wildlife.

The following proposed Vision Statement and Threshold Goal Statements reflect the recommended basis for changing the existing threshold standard.

**Fisheries and Wildlife Vision Environmental** conditions in the Lake Tahoe Basin support healthy and sustainable native terrestrial and aquatic animal populations and vegetation communities.

In addition to the vision statement, two separate threshold goals relating to fisheries were developed. They include:

**Threshold Goal 2. Sustainability of Special Status Species:**  
Populations of, and environmental conditions and processes important to native threatened, endangered, rare, special interest or sensitive species are maintained at a level which insures sustainability.

The current Lahontan Cutthroat threshold (F-4) falls under this threshold goal.

**Threshold Goal 3. Biological Integrity of Aquatic Ecosystems:** The functional, physical, chemical and biological integrity of the Basin's aquatic ecosystem are maintained at or above a sustainable level.

The current lake habitat, stream habitat and flows thresholds (F-1, F-2, and F3) falls under this threshold goal.

Fundamental changes are needed to improve the Region's ability to assess social, economic, and environmental conditions. This section provides a proposal for updating TRPA fisheries threshold standards and indicators and provides a rationale for the proposed changes.

### **6.5.1 F-1 LAKE (LITTORAL HABITAT)**

#### **Threshold Recommended Changes**

The recommended change to the F-1 threshold is the development and adoption of a new approach to measure biological condition in Lake Tahoe based on direct measures of the aquatic community as proposed by the Pathway 2007 process, rather than the existing physical substrate indicator. The recommendation is to develop a standard based on a proportion of aquatic ecosystem component benchmarks as measured with various indexes of biological integrity and other relevant indicators. To achieve attainment of the proposed standard, all benchmarks for Lake Tahoe and small lakes aquatic ecosystem components would need to be met or exceeded within an evaluation period.

#### **Rationale for Change**

The standard for this threshold is not sufficient to maintain significant resource values, and additional threshold standards are required to maintain significant values (cf. criterion 4d of Resolution 82-11). The rationale for this change in threshold is that a direct method of measuring a biological community is more accurate and less subject to interpretation than a surrogate such as the often ambiguous "habitat" or, in this case, physical substrate. While measures of habitat are used as a surrogate in many systems, this is often due to the comparative ease of habitat data collection rather than any increase in precision over measures of the biological community. Unless the entire suite of habitat variables affecting populations are measured with great precision, and often these are unknown, direct measures of a biological community will be more accurate than the surrogate of measuring habitat. These direct measures are needed and would allow more effective determination of trends in biological condition and more certainty in the measurement and communication of the status of the resource.

### **6.5.2 F-2 STREAM HABITAT**

#### **Threshold Recommended Changes**

The recommended change to the F-2 threshold is the adoption of an empirical stream habitat monitoring and evaluation protocol as developed and proposed by the Pathway 2007 process. The recommendation is to develop a standard based on a proportion of aquatic ecosystem component benchmarks as measured with various indexes of biological integrity and other relevant indicators. To achieve

attainment of the proposed standard, all benchmarks for Lake Tahoe and small lakes aquatic ecosystem components would need to be met or exceeded within an evaluation period.

### **Rationale for Change**

The protocol proposed through the Pathway 2007 process would produce a measure that is more sensitive to changes in land use and management than the current methodology. This finding implies that existing threshold standards are not sufficient or that additional threshold standards are required to maintain a significant resource.

## **6.5.3 F-3 INSTREAM FLOW**

### **Threshold Recommended Changes**

The Wildlife and Fisheries Core Working Group, as part of the Pathway 2007 process, is recommending that the F-3 be retained as an indicator as part of the evaluation of the proposed biological integrity of aquatic ecosystems threshold goal rather than a stand alone threshold. The established benchmarks for stream flow would need to be met or exceeded within an evaluation period, to achieve attainment of the indicator standard,

## **6.5.4 F-4 LAHONTAN CUTTHROAT TROUT**

### **Threshold Recommended Changes**

The Wildlife and Fisheries Core Working Group, as part of the Pathway 2007 process, is recommending that LCT be added to the TRPA Special Interest species list. While this will not replace the existing threshold, the methodology for measuring the status of LCT populations would be amended based on the recommendations resulting from the Pathway 2007 process.

### **Rationale for Change**

The findings for the recommended changes to the F-4 threshold implies that existing threshold standards are not sufficient or that additional threshold standards are required to maintain a significant resource value.

## **6.5.5 ALL THRESHOLDS**

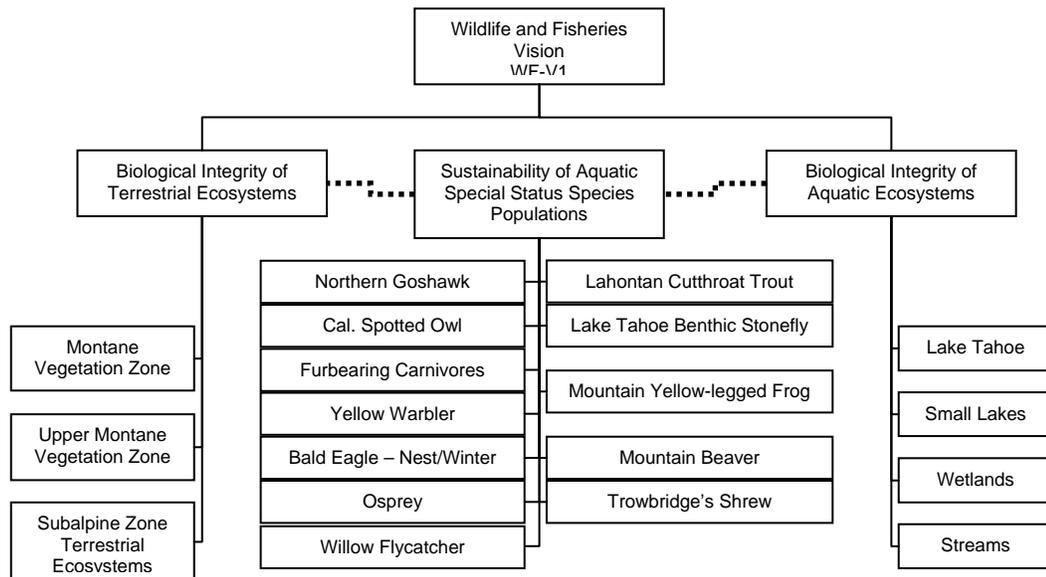
### **Threshold Recommended Changes**

The Wildlife and Fisheries Core Working Group, as part of the Pathway 2007 process, has made a recommendation that, if adopted, will significantly change the way in which fisheries threshold standards and indicators will be evaluated in the future. The recommended combined threshold standard and indicator package for fisheries and wildlife resources shifts the primary focus away from traditional fisheries management and strives to improve the biological integrity of aquatic ecosystems as well as recover listed wildlife and fish species. Fundamentally, recommended changes attempt to better recognize the interconnectedness of aquatic ecosystems for not only fish resources but for other important organisms such as invertebrates, amphibians, and aquatic reptiles, and other resources such

as water and soils. Proposed Indicators to measure the biological condition of aquatic ecosystems are primarily based on the community of organisms that depend on the health or quality of these systems to survive. The proposed changes challenge the existing “stove-pipe” or independent resource threshold evaluation approach (e.g., water quality, wildlife, fisheries, soil) by recommending that monitoring and evaluation be undertaken such that different resources are considered concurrently just as would be done in order to assess the overall condition of the Lake Tahoe ecosystem.

Wildlife and fisheries desired condition statements were organized into three main branches stemming from the wildlife and fisheries vision statement (Figure 6-1; see also Pathway 2007 - Wildlife and Fisheries Technical Supplement). The first level of organization provides a regional vision of wildlife and fisheries resource condition. The vision statement identifies restoration and maintenance of biological integrity of the Lake Tahoe Basin as primary goals. In doing so, many statutory requirements are fulfilled as well as meeting goals for other resource areas, and the public.

**Figure 6-1: Generalized Organizational Framework for Use in Developing Standards and Indicators - for Biological Resources.**



Wildlife and Fisheries resource areas are currently recognized independently. This Threshold Evaluation Report proposes to change the way these resources are viewed by crafting desired condition statements based on the condition of aquatic and terrestrial ecosystems, the systems which wildlife and fish populations depend on. The Wildlife and Fisheries Vision statement provides the foundation for desired conditions statements for the Biological Integrity of Aquatic and Terrestrial Ecosystems and the sustainability of Special Status Species (Figure 6-1). Branching from the wildlife and fisheries vision statement into aquatic and

terrestrial ecosystems narrows the resolution of desired conditions to the landscape level of biological integrity, while Special Status Species focuses on the population level of biological integrity.

In order to assess whether desired condition and their related standards are being attained, an approach that provides indicators of condition at multiple spatial scales of interest is proposed: 1) the Lake Tahoe region, 2) ecosystem component (e.g., vegetation zone, streams, individual species of interest), and 3) sample site. For each desired condition there are related components (Table 6.7). For each component, a diagnostic indicator has been identified. For example, for the Special Status Species desired condition, species of interest are the components and the diagnostic indicators may reflect either: 1) presence/absence, 2) abundance, or 3) fecundity/productivity. Diagnostic indicators are essentially response variables to management activities and land use policy. For each component, a benchmark will be set that: represents a level consistent with a sustainable or optimal biological condition, meets statutory requirements, and is consistent with the public's desires (Figure 6-2). A benchmark can be thought of as a point of reference below which conditions are not acceptable and above which conditions are acceptable and consistent with desired conditions. Progress is currently being made by the Core Working Group to identify benchmarks for each ecosystem or special status species component. Benchmarks will be based on field data, peer-reviewed literature and local reports, technical working group input, public input, and decision-maker input.

**Table 6-7: Components and Diagnostic Indicators for Wildlife and Fisheries Desired Conditions.**

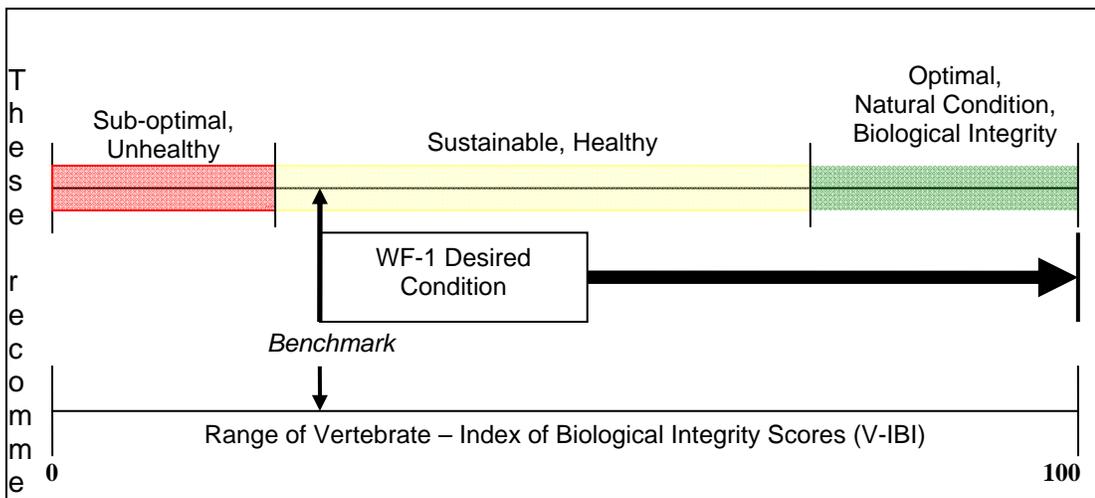
Desired Condition	Component	Diagnostic Indicator(s)
<b>Biological Integrity of Terrestrial Ecosystem</b>	Montane Vegetation Zone	<ul style="list-style-type: none"> <li>• Vertebrate – Index of Biological Integrity (V-IBI). Based on small mammal, bird, and medium to large mammal community characteristics</li> </ul>
	Upper Montane Vegetation Zone	
	Subalpine Vegetation Zone	
<b>Sustainability of Special Status Species</b>	List of Special Interest Species (each assigned to appropriate diagnostic indicator)	<ul style="list-style-type: none"> <li>• Productivity</li> <li>• Abundance</li> <li>• Presence/Absence</li> </ul>
<b>Biological Integrity of Aquatic Ecosystems</b>	Streams	<ul style="list-style-type: none"> <li>• Benthic Macroinvertebrate – Index of Biological Integrity (B-IBI)</li> <li>• Biological Pollution Index</li> </ul>
	Wetlands	<ul style="list-style-type: none"> <li>• Waterbird Index of Biological Integrity (W-IBI)</li> <li>• Herpetological Index of Biological Integrity (H-IBI)</li> <li>• Biological Pollution Index</li> </ul>
	Lake Tahoe	<ul style="list-style-type: none"> <li>• Zooplankton Assemblage</li> <li>• Biological Pollution Index</li> <li>• Catch Per Unit Effort</li> <li>• Littoral Fish Life History Index</li> <li>• Lake Clarity</li> </ul>
	Small Lakes	<ul style="list-style-type: none"> <li>• Waterbird Index of Biological Integrity (W-IBI)</li> <li>• Herpetological Index of Biological Integrity (H-IBI)</li> <li>• Biological Pollution Index</li> </ul>

In addition to diagnostic indicators, “attribute indicators” have been identified, and are currently being further developed. These attribute indicators relate to the ‘attributes’ of desired conditions. Like diagnostic indicators, attribute indicators are measurable parameters which can be important in understanding whether a desired condition is being achieved. For each attribute indicator, a benchmark will be consistent with the desired condition. Benchmarks have not yet been set for attributes; additional technical and public input will be required. Thus, the attainment of diagnostic and attribute benchmarks will largely determine attainment of the desired conditions and related standards for wildlife and fisheries resources.

The proposed approach is a considerable improvement over the existing approach because it provides a more thorough review of biological conditions. Because more biological parameters are measured it will be possible to identify which

biological parameters are not functioning according to desired conditions and where on the landscape degradation exists.

**Figure 6-2: Terrestrial Ecosystem Diagnostic Indicator – Montane Vegetation Zone Example.** A diagrammatic representation (adapted from Karr and Chu, 1999) of the relationship of the diagnostic indicator to the desired condition as applied to a terrestrial ecosystem component (e.g., Jeffrey Pine Dominated Forest Type). A benchmark based on the range of Vertebrate – Index of Biological Integrity scores would demarcate where conditions are in attainment with the desired condition for that component. A V-IBI score can be generated for each sample site. If a sub-population of sites is properly selected, these site-level assessments can then be combined to provide a true measure of the larger population of sites within the Tahoe Basin



ded changes will go into effect following the completion of the Pathway 2007 process and adoption of the revised Region Plan.

### **General Rationale for Change**

Several opportunities exist to improve the way environmental conditions are evaluated in the Lake Tahoe Basin including:

- Reduce indicator evaluation redundancy by improving the evaluation framework. Avoid measuring the same things differently (e.g., Stream Environment Zone (SC-2), Riparian Habitat (W-2), and Stream Habitat (F-2)).
- Identify thresholds standards that are based on real data and are attainable. This finding implies that current threshold standards may not be achievable.

- Select indicators that effectively and efficiently measure environmental conditions and respond to land management and policy (See also Tracy and Barrett 2005). This finding implies that existing threshold standards are not sufficient or that additional threshold standards are required to maintain a significant resource.
- Identify and adopt standardized field monitoring and evaluation protocols to reduce subjective threshold standard attainment determinations.
- Fund the implementation of adopted standardized monitoring and evaluation protocols.

### ***Indicators***

The following is a general summary of the need for change for existing indicators.

- The statistical behavior of existing indicators is not adequately understood or documented. It is unknown if existing indicators vary with natural environmental variation or whether they are responsive to or indicative of management actions and policies put forth by participating management agencies. Ultimately, indicators that are selected for this current effort need to vary with the activities that various agencies are responsible for regulating (e.g., development) or managing (e.g., recreation), or restoring (e.g., LCT). It is important to know how people and management actions affect biological resources in order to better inform the conservation planning of Lake Tahoe's biological resources.
- Many current indicators are based on subjective determinations (e.g., criteria to judge stream habitat conditions) and may be biased to a specific group of biota (e.g., trout species, birds of prey). Indicators and the means to measure them need to be carefully and clearly articulated such that there is no room for variation in interpretation from one agency to the next, or one individual to the next. Consequently, the development of comprehensive monitoring and evaluation protocols concurrently with environmental quality indicators is critical to ensure that monitoring and evaluation bias, as a result of subjective measurements, is reduced to greatest extent possible.
- Existing indicators primarily measure surrogates of biological condition (e.g., littoral lake substrate) rather than biota itself to determine condition. A direct measure of biota does not allow room for anecdotal interpretation of biological conditions. If surrogates of biological condition are proposed, surrogate measures should statistically describe the strength of their measure to biological condition (e.g., How strong is the relationship between the acreage of littoral substrate types and the health of different fish species populations?).
- Existing indicators are categorized either by agency or resource (or threshold) area and evaluated independent of each other. Consequently, inherent ecological relationships can go undetected (e.g., soil, vegetation, wildlife) and monitoring efficiency is lost.

- Multiple threshold (resource) categories may address related or even identical targets differently (e.g., existing indicators for SEZ, stream habitat, riparian habitat, and tributary water quality).

### **Standards**

These new or modified indicators will require that associated standards are updated concurrently.

- “Non-degradation” standards are meaningless without providing a reference condition to measure divergence from the desired state. There are many examples where “non-degradation” standards (e.g. TRPA’s non-degradation of riparian habitat) that exist in planning documents could be improved by applying quantifiable reference parameters to compare degraded conditions to.
- Assumptions that formed the basis of many of the original standards are unsupported by new information (e.g., supporting a population of Peregrine Falcon). As a result some standards are not achievable because they are based on ambiguous or unsupported information.
- Achievement of non-numeric standards is open for interpretation and achievement determination is not necessarily repeatable by different evaluators (e.g., Governing Board support of a particular policy such as the reintroduction of LCT populations).
- New regulations (such as the National Forest Management Act (NFMA) 2005), will require partner agencies to update environmental targets (e.g., USFS Special Interest Species) and thus the TRPA standard should also be adjusted to be consistent.
- Some standards are poorly articulated (e.g., no definition of wildlife “population sites” provided in planning documents). Providing a clear record of vocabulary is critical for all to understand and interpret.

## 6.6 RECOMMENDATIONS

### 6.6.1 ALL THRESHOLDS

#### Status of the 2001 Threshold Recommendations

**Table 6-8: Status of 2001 Threshold Recommendations**

Recommendation	Comments	Status
Update shorezone ordinance to reflect fish research	Align shorezone development policies (TRPA Code of Ordinances) with fisheries research conducted by Tahoe Research Group between 1989 and 1996 (i.e., Do not base prohibition of shorezone development solely on impacts to fish habitat).	Will be completed with the adoption of Shorezone Ordinance expected in winter 2006- 2007.
Identify desired future condition of Lake Tahoe fisheries (research)	Identify desired future composition of Lake Tahoe's fishery. Completion will require a scientifically derived fisheries community condition that is tempered with a feasibility assessment to determine whether fisheries management can accomplish the identified desired fisheries community condition. Completion may require a consensus approach that includes USFWS, USFS, Cal. Fish and Game, Nevada Division of Wildlife and other research institutions. Completion will include stream and lake habitats. This recommendation represents a critical step in directing future fisheries policy.	Completed as part of the Pathway 2007 process. See Wildlife and Fisheries Technical Supplement for more detail.
Review and revise all TRPA threshold standards and indicators for fisheries	Based on the identified desired future condition for Lake Tahoe fisheries assessment, assess existing TRPA threshold standards and indicators for consistency with desired future condition and make recommendations for revising threshold standards and indicators. Consideration should be given to developing "Indexes of Biological Integrity" (Karr and Chu 1999) for identifying indicators of lake and stream health. Consideration for this assessment should include 1) classification of aquatic environments, 2) selection of measurable attributes that provide reliable and relevant signals about the biological effects of human activities, 3) sampling protocols that ensure attributes are measured accurately and precisely, 4) analytical procedures to understand patterns in the data.	Completed as part of the Pathway 2007 process. See Wildlife and Fisheries Technical Supplement for more detail.

Recommendation	Comments	Status
Develop threshold standards and indicators for sensitive amphibians	Develop a threshold standard and indicator for sensitive amphibians. Identify amphibians and habitats that need special consideration in the permit process. Develop monitoring protocol that is capable of accurately determining threshold status. Identify potential impediments to achieving such a threshold standard.	Completed as part of the Pathway 2007 process. See Wildlife and Fisheries Technical Supplement for more detail.
Identify effects of non-native fish and aquatic vegetation on native fish	Conduct an assessment on the effect of non-native fish and vegetation on Lake Tahoe's aquatic community. Which species have the potential to reduce TRPA's ability to achieve the desired future condition of Lake Tahoe fisheries identified in recommendation 2. Research should provide recommendations on what management options are available to reduce potential impacts.	University of Nevada Reno (UNR) and Tahoe Environmental Research Center (TERC) initiated research in Summer 2006.
Identify the distribution and extent of lagoon habitats, past and present	Identify the historic and current distribution and extent of lagoon habitats in Lake Tahoe. Research will identify the extent of nursery habitats for native species and identify potential locations for restoration.	Not initiated
Re-map Lake Tahoe fish habitat and research the effect of rock clearing on desired fish sustainability	Conduct appropriate scale mapping of fish habitat in Lake Tahoe and use information to update TRPA GIS for fish habitat. Assess the effect of rock clearing in the shorezone on the survivorship and sustainability of desired littoral fish populations.	Completed, Metz, J. and M. Harold. 2004. Using IKONOS imagery to map near-shore substrates, fish habitats, and pier structures in Lake Tahoe, CA/NV.
Effect of polycyclic aromatic hydrocarbons (PAH) on desired fish community	Identify the distribution, concentrations, and management implications of gasoline constituents and PAH on Lake Tahoe's desired fish community. Improve managers' and policy makers' understanding of chemical constituents available to fish community, how aquatic community may be affected, and what can be done to mitigate (if necessary).	Not initiated

### **Recommended Changes for 2006**

The recommendations for changes to fisheries thresholds are described in section 6.5 and also included in the Draft Pathway 2007 Evaluation Report (Version 1.1, 2006) and Technical Supplement. Some of the recommended changes will be addressed in the 2008 Regional Plan Update. The specific changes to be brought

forth in the update will be evaluated in an Environmental Impact Statement to be completed before public hearings and requests for Governing Board action. The Compliance Measure updates listed in this document are intended to provide new information on monitoring, interim targets and to correct previous grammatical and factual errors. Potential changes to threshold standards and indicators will be addressed in the Threshold Update portion of the EIS for the Regional Plan Update.

It is therefore recommended that existing compliance measures and supplemental measures (identified in the 2001 Threshold Evaluation) for fisheries are observed until Pathway 2007 recommendations are adopted.

**Implementation of supplemental compliance measures.**

No additional supplemental compliance measures are recommended at this time.

**Modification or deletions of past compliance measures.**

No modifications or deletion of past compliance measure are recommended at this time.

## 6.7 REFERENCES

- Allen, B. and J. Reuter. 1996. Shorezone spawning in Lake Tahoe: the effects of shorezone structures and associated activities on the spawning success of native minnows. Report to the Tahoe Regional Planning Agency.
- Allen, B. C., S. Chandra, J. Vander Zanden, J. E. Reuter, and Z. Hogan. 2003. An evaluation of the re-introduction of native Lahontan cutthroat trout, *Oncorhynchus clarki henshawi*, in Fallen Leaf Lake, California.
- Beauchamp, D.A., W.A. Wurtsbaugh, B. Allen, P. Budy, R. Richards, and J. Reuter. 1990. Lake Tahoe fish community structure investigation: phase II report. University of California, Davis, Institute of Ecology
- .Beauchamp, D.A., W.A. Wurtsbaugh, B. Allen, P. Budy, R. Richards, and J. Reuter. 1991. Lake Tahoe fish community structure investigation: phase III report. University of California, Davis, Institute of Ecology Publication 38.
- Byron, E.R., B. Allen, W. Wurtsbaugh, and K. Kuzis. 1989. Final report: littoral structure and its effects on the fish community of Lake Tahoe. Institute of Ecology, Division of Environmental Studies, University of California, Davis.
- Karr, J. R. and E. Chu. 1999. Restoring life in running waters: better biological monitoring. Island Press, Washington DC.
- Metz, J. and M. Harold. 2004. Using IKONOS imagery to map near-shore substrates, fish habitats, and pier structures in Lake Tahoe, CA/NV.
- Murphy, D. D. and C. M. Knopp., editors. 2000. Lake Tahoe watershed assessment: Volume II. Appendixes. Gen. Tech. Rep. PSW-GTR-176. Albany, CA: Pacific Southwest Research Station, Forest Service, U. S. Department of Agriculture, 407p.
- Pathway 2007 - Wildlife and Fisheries Technical Supplement. 2005. [www.pathway.org](http://www.pathway.org)
- SNEP. 1996. Sierra Nevada ecosystem project - Lake Tahoe case study: final report to Congress, Center for Water and Wildlife Resources Report No. 40, University of California, Davis.
- Snider, W.M., J.L. Kershner, G.E. Smith. 1987. Instream Flow Requirements; Lake Tahoe Basin, California and Nevada. Department of Fish and Game Stream Evaluation Report, Report no. 87-1
- TRPA. 1982a. Study report for the establishment of environmental threshold carrying capacities. Tahoe Regional Planning Agency, Zephyr Cove, NV

- TRPA. 1982b. Environmental impact statement for the establishment of environmental threshold carrying capacities. Tahoe Regional Planning Agency, Zephyr Cove, NV.
- TRPA. 1986. Regional plan for the Lake Tahoe Basin: goals and policies. Tahoe Regional Planning Agency, Zephyr Cove, NV.
- TRPA. 1987. Regional plan for the Lake Tahoe Basin: code of ordinances, rules of procedure. Tahoe Regional Planning Agency, Zephyr Cove, NV.
- TRPA. 1991. 1991 evaluation: environmental threshold carrying capacities and the regional plan package. Tahoe Regional Planning Agency, Zephyr Cove, NV.
- TRPA 1996. Draft 1996 evaluation report: environmental carrying capacities and the regional plan package for the Lake Tahoe Basin. Tahoe Regional Planning Agency, Zephyr Cove, NV.
- TRPA 2002 Final Draft 2001 Threshold report Tahoe Regional Planning Agency, Zephyr Cove, NV.
- Tracy, J. C. and A Rost. 2003. Stream flow conditions of Lake Tahoe streams based on gaged flows and statistically modeled flow estimate: implications for salmonid fish population management.
- Tracy J. C. and G. Barrett. 2005. Final Report for the Adaptive Management Framework Development Project: Phase I

***Personal communications***

- Shade, C. 2001 Senior Planner, Tahoe Regional Planning Agency, Zephyr Cove, NV.

**Category: fisheries**

**Parameter: lake habitat**

1. STANDARD: A non-degradation standard shall apply to fish habitat in Lake Tahoe. Achieve the equivalent of 5,948 total acres of excellent habitat.
2. INDICATOR (UNITS): Physical disturbance of rocky (spawning and feed/cover habitats) substrate (acres).
3. MONITORING SUMMARY: In 1989, lake habitat was inventoried in conjunction with a research project titled "Final Report: Littoral Structure and Its Effects on the Fish Community of Lake Tahoe", Byron et al., 1989. During 1993 and 1994, the shoreline of Lake Tahoe was surveyed for a number of characteristics, including lake substrate disturbance. In 1997, TRPA staff performed habitat verifications with the assistance of Cal. Dept. of Fish and Game. This information was integrated into TRPA's GIS. Since 1997, no additional fish habitat surveys have been conducted beyond fish habitat verifications performed prior to permit approval for shorezone projects. For the 2001 Threshold Evaluation, The Lake Tahoe Fisheries Technical Advisory Group (FTAG), representing fisheries professionals in the Basin, were queried about the status of Lake Tahoe habitat conditions. Their professional opinion was used to conclude whether the F-1 standard was in compliance. [Metz and Harold \(2004\) analyzed IKONOS imagery to assess the distribution and abundance of different littoral habitats. This report was used to make a determination on the 2006 F-1 evaluation.](#)
4. ATTAINMENT STATUS: Non-attainment, [Near Attainment. Metz and Harold \(2004\) analyzed IKONOS imagery and found that the proportion of different littoral habitats is similar to acreages reported by Byron \(1989\). Byron et al.'s \(1989\) work established the standard for F-1. The lake habitat threshold standard is not in attainment according to the FTAG \(2001\). However, a GIS analysis revealed that fish habitat is much closer to meeting the threshold standard than previously reported in the 1996 Threshold Evaluation. A conservative estimate of undisturbed 'Prime'](#)

~~fish habitat revealed that a minimum of 4,288 acres occurs in Lake Tahoe as of the last GIS data update in 1997.~~

5. TARGET DATE: ~~2006~~ [2011](#)
6. EVALUATION INTERVAL: Five years
7. INTERIM TARGETS: ~~Survey and map lake habitat by 2005 and recalculated extent and distribution of different shorezone substrates. Interim target is to achieve 5,948 acres of 'prime' fish habitat (spawning and feed/cover) by 2006 following an assessment of activities that degrade fish habitat. Reassess threshold standard and indicator for lake fishery by 2005. The recommended interim target for completion by 2011 is the development and assessment of a new approach to measure biological condition in Lake Tahoe, based on direct measures of the aquatic community rather than physical substrate as proposed by the Pathway 2007 process. Should a new process for measuring biological condition fail to be adopted the recommended interim target for "prime" fish habitat is 5,948 acres. This may be achievable through mitigation and restoration connected to projects within the shorezone, and through EIP projects.~~
8. COMPLIANCE MEASURES:
  - a. MEASURES IN PLACE: FISHERIES: 158, 160, 161, 162, 168, 169, 170, 171, 172, and 173; Also see Appendix A.
  - b. EFFECTIVENESS OF MEASURES IN PLACE: In general measures in place are effective.
  - c. SUPPLEMENTAL MEASURES: Implement non-native fish depredation program. Restrict emissions of Polycyclic Aromatic Hydrocarbons if it is shown to impact the sustainability Lake Tahoe fish populations.
  - d. EFFECTIVENESS OF SUPPLEMENTAL MEASURES: Since supplemental measures were not identified in 1996 threshold evaluation, not applicable to comment of effectiveness supplemental measures.
9. ADEQUACY OF COMPLIANCE MEASURES: In general measures in place are effective.

**Category: fisheries**

**Parameter: stream habitat**

1. STANDARD: maintain 75 miles of excellent, 105 miles of good, and 38 miles of marginal stream habitat as indicated by the map on page 76 of the EIS for the Establishment of Environmental Thresholds (TRPA, 1983).
2. INDICATOR (UNITS): Miles of stream habitat in the various categories based on field inspections of habitat.
3. MONITORING SUMMARY: Limited stream habitat sampling has occurred since the conclusion of USFS-LTBMU effort in 1996. Because limited stream habitat data were available for this evaluation, TRPA relied on the expert opinion of the Lake Tahoe Fisheries Technical Advisory Group (FTAG) to make conclusions on the condition of Basin streams. Their conclusions were based on the role of precipitation effects on habitat and progress made on restoration. In 2000, TRPA initiated a stream habitat restoration needs inventory. The goal of the inventory was to spatially document all man-made features and other degraded features along the main stem of threshold streams. Inventory was expected to be completed in Fall 2002. No data has been collected since the 1996 Threshold Evaluation to specifically assess the condition of streams as originally envisioned at threshold adoption in 1986. Consequently for the 2006 F-2 assessment, a determination of threshold attainment was not made.
4. ATTAINMENT STATUS: Unknown. No data available to make a determination. Efforts are currently underway to develop an improved system to assess biological integrity of Lake Tahoe streams. Non-attainment. Threshold streams were re-evaluated in for the 1996 Threshold Evaluation using data collected by USFS-LTBMU between 1989 through 1996. This is the most recent set of information available. Because there has not been any significant changes to streams as a result of precipitation or restoration, FTAG concluded that stream are likely similar to conditions reported in 1996.
5. TARGET DATE: 2006 2011
6. EVALUATION INTERVAL: 5 years

7. INTERIM TARGETS: ~~Update threshold standards and indicators for stream habitat by 2006-2011. Develop empirical stream habitat monitoring protocol and analysis protocol by 2006/2011 (see discussion in ATTAINMENT STATUS). A total of 50 miles of stream shall be classified as 'excellent' habitat quality for salmon species by 2006 (a result in 8 miles of stream habitat improvement since 1996) and a total of 50 miles of stream shall be classified as 'good' for salmon species by 2006 (a result of 9 miles of stream habitat improvement since 1996) on TRPA designated threshold streams. A qualified fisheries biologist using empirical data should make determinations of stream quality. The interim target for the next 5 years is to continue to develop and implement an empirical stream habitat monitoring and evaluation protocol by 2011. As described above and as part of the Pathway 2007 process (Pathway 2007 - Wildlife and Fisheries Technical Supplement 2005), a new more scientifically supported approach to measuring stream condition has been proposed for TRPA adoption.~~ The interim target for the next 5 years is to continue to develop and implement an empirical stream habitat monitoring and evaluation protocol by 2011. As described above and as part of the Pathway 2007 process (Pathway 2007 - Wildlife and Fisheries Technical Supplement 2005), a new more scientifically supported approach to measuring stream condition has been proposed for TRPA adoption.
8. COMPLIANCE MEASURES: See Appendix A.
  - a. MEASURES IN PLACE: FISHERIES-158, 159, 163, 164, 165, 166, 167, 168, 170, 171, 172, and 173.
  - b. EFFECTIVENESS OF MEASURES IN PLACE: In general, measures in place are effective in maintaining stream habitat quality.
  - c. SUPPLEMENTAL MEASURES: Implementation of EIP fisheries and SEZ restoration project shall be considered as supplemental measures.
  - d. EFFECTIVENESS OF SUPPLEMENTAL MEASURES: Supplemental measure identified in 1996 Threshold Evaluation has been completed as part of the EIP. Effort on identifying opportunities for stream habitat restoration should continue.
9. ADEQUACY OF COMPLIANCE MEASURES: In general, measures in place are effective at maintaining stream habitat quality.

**Category: fisheries**

**Parameter: instream flows**

1. STANDARD: TRPA - Until instream flow standards are established in the Regional Plan to protect fishery values, a non-degradation standard shall apply to instream flows.
2. INDICATOR (UNITS): Interim indicator - Number of permits issued that allows long-term reductions to stream flow and degradation to riparian community. Permits shall not be issued unless it is proven that riparian community will not be impacted. Long-term indicator – stream flows on basin streams shall not unnaturally drop below seasonal flow standards established by TRPA supported by research conducted by Desert Research Institute.
3. MONITORING SUMMARY: Since 1996, the TRPA permit database revealed that TRPA has not issued any permits that would contribute to reduced stream flows, nor are there records of permits allowing for the exchange of water diversion from stream to lake in-take lines. ~~Starting in 2000, Desert Research Institute initiated research to identify seasonal stream flow fluctuation on basin streams. Upon completion in 2002, recommendation resulting from this work will be used to establish stream flow standards.~~ Tracy and Rost (2003) from Desert Research Institute, reported results on the stream flow conditions of Tahoe streams and their ability to support trout species. Results indicated that only two streams in the basin provide 'optimal' condition for trout. They also noted that other streams are still important to Tahoe's fishery and many likely provide 'suitable' flow conditions as well as provide habitat for a number of other organisms, such as amphibians, aquatic reptiles, and wide variety of freshwater invertebrates.
4. ATTAINMENT STATUS: Attainment – no permits have been issued that would allow for a reduction of stream flows in basin streams. 2006 status – the region is in attainment with respect to this standard as no new permits that would allow for the reduction in natural stream flows have been issued.
5. TARGET DATE: ~~2006~~-Not applicable
6. EVALUATION INTERVAL: Five years
7. INTERIM TARGETS: The interim target for 2011 is to examine adoption of instream flow measures as an indicator of stream condition. Establish desired conditions consistent with USFS to manage flow within the natural range of hydrologic conditions through the Pathway 2007 process.
8. COMPLIANCE MEASURES: See Appendix A.
  - a. MEASURES IN PLACE: FISHERIES-- 158, 159, 170, 171, 172, and 173
  - b. EFFECTIVENESS OF MEASURES IN PLACE: In general, measures in place are effective at maintaining minimum stream flows.
  - c. SUPPLEMENTAL MEASURES: Added as necessary
  - d. EFFECTIVENESS OF SUPPLEMENTAL MEASURES: Not applicable
9. ADEQUACY OF COMPLIANCE MEASURES: In general, compliance measures are adequate for maintaining threshold standard.

**Category: fisheries**

**Parameter: Lahontan Cutthroat Trout (LCT)**

1. STANDARD: It shall be the policy of the TRPA Governing Board to support, in response to justifiable evidence, state and federal efforts to reintroduce Lahontan cutthroat trout.
2. INDICATOR (UNITS): The successful establishment of a Lahontan cutthroat trout population in the Lake Tahoe Region.
3. MONITORING SUMMARY: Since the initial reintroduction of LCT in 1990 to the headwaters of the Upper Truckee River, the USFS-LTBMU and Cal. Dept. of Fish and Game annually monitors the status of the population. More recently (2001), UC Davis - TRG has documented the occurrence of LCT in the Cascade Creek watershed. [Starting in 2002, the USFWS in partnership with USFS, CDFG, and UC Davis, Allen et al. \(2003\) reported results on the reintroduction of a population into Fallen Leaf Lake. As of 2006, restocking efforts continue at Fallen Leaf with positive results, as it appears the population is successfully becoming established.](#)
4. ATTAINMENT STATUS: Attainment. Evidence suggest that a least two separate populations of LCT occur in the basin.
5. TARGET DATE: Not applicable
6. EVALUATION INTERVAL: Five years
7. INTERIM TARGETS: Continue to support well-planned reintroduction efforts. [As part of the Regional Plan Revision, propose retaining LCT as a Special Status Species. Also propose methodologies to quantitatively measure its status and pursue the species recovery into Lake Tahoe's aquatic ecosystems.](#)
8. COMPLIANCE MEASURES: See Appendix A.
  - a. MEASURES IN PLACE: FISHERIES- 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, and 173.
  - b. EFFECTIVENESS OF MEASURES IN PLACE: In general, measures in place are effective.

- c. SUPPLEMENTAL MEASURES: Not identified
  - d. EFFECTIVENESS OF SUPPLEMENTAL MEASURES: Not applicable
9. ADEQUACY OF COMPLIANCE MEASURES: In general, compliance measures are adequate for maintaining threshold standard.