CHAPTER 5
Soil Conservation

Landscape modification and land use over the past 150 years have impacted the Region's soil resources. These impacts are especially prevalent in and around developed areas, and in areas influenced by Comstock era logging. Urban development in particular has physically altered the landscape, resulting in soil removal, grading, compaction, and higher erosion risk. These impacts have altered the ability of soils and vegetation communities to cycle nutrients and absorb and store water.

Soils provide a variety of key functions including sustaining vegetation, water filtration and storage, providing habitat for a wide variety of organisms, and providing a platform for development. The soil conservation threshold standards protect the Region's soil resources and provide their continued ability to filter and retain nutrients for a variety of purposes.

These goals are directly reflected in the policies of the Regional Plan, which serve to:

- Direct the location of impervious cover and limit its extent
- Prevent soil erosion from the Region's watersheds by focusing development on more suitable soil types and ensuring development activities occur when soils are less susceptible to erosion.
- Protect existing stream environment zones (SEZ) and restore modified SEZ

Stream environment zone (SEZ) is a term unique to the Tahoe Region, that the TRPA Code of Ordinances defines as "*Generally an area that owes its biological and physical characteristics to the presence of surface or ground water*" (TRPA, 2012a). This definition includes perennial, intermittent, and ephemeral streams; wet meadows, marshes, and other wetlands; and riparian areas or other areas expressing the presence of surface and ground water.

These policies also play a critical role in contributing to the water quality, vegetation, and wildlife goals of the region.

The soil conservation thresholds are grouped into two reporting categories, impervious cover and SEZ. Impervious cover is a primary indicator of land disturbance. Excessive impervious surface contributes to sediment and nutrient inputs to Lake Tahoe and its tributaries, alters surface hydrology and modifies groundwater recharge regimes. The results are often negative impacts on soil health, fisheries, wildlife habitat and vegetation growth(Lahontan & NDEP, 2010; Raumann and Cablk, 2008). SEZs provide a variety of critical services in the basin, including water quality maintenance through nutrient cycling and sediment retention, flood attenuation, infiltration and

groundwater recharge, open space, scenic and recreational enjoyment, wildlife habitat, and wildfire abatement, among many other functions and values (Roby et al., 2015).

This section provides an evaluation of the status of indicators relative to the 10 soil conservation targets related to impervious cover and one indicator related to SEZs (Table 5-1).

Table 5-1: *Summary of threshold standards for the soil conservation category*

Indicator Reporting Category	Standard	Type of Standard	Indicator
Impervious Cover	Impervious cover shall comply with the *Land-Capability Classification of the Lake Tahoe Basin, California-Nevada, A Guide for Planning*, Bailey, 1974. • Land Capability 1a (1% allowable cover) • Land Capability 1b (1% allowable cover) • Land Capability 1c (1% allowable cover) • Land Capability 2 (1% allowable cover) • Land Capability 3 (5% allowable cover) • Land Capability 4 (20% allowable cover) • Land Capability 5 (25% allowable cover) • Land Capability 6 (30% allowable cover) • Land Capability 7 (30% allowable cover)	Management (with Numerical Targets)	Percent of Impervious Cover within Each Land Capability District
Stream Environment Zone	Preserve existing, naturally functioning SEZ lands in their natural hydrologic condition. Restore all disturbed SEZ lands in undeveloped, un-subdivided lands. Restore 25 percent of the SEZ lands that have been identified as disturbed, developed or subdivided to attain a five percent total increase in the area of naturally functioning SEZ lands.	Numerical	Acres of SEZs restored, policy framework in place to protect and restore SEZs.

The results of the 2015 assessment for the status and trend of standards in the soil conservation reporting categories are summarized in Table 5-2, as well as the results from the 2011 Threshold Evaluation Report for comparison. Figure 5-1 provides a key to the symbols used to communicate status, trends, and confidence, and a detailed description of each is provided in the methodology section. The indicator sheets that follow contain more detailed assessment of the status and trend of each indicator and provide descriptions of the methods used and recommendations for modification of the standard or analytic approach used to assess the standard.

Table 5-2: *Comparison of soil conservation status and trend in the 2011 and 2015 Threshold Evaluation Reports.*

Standard	2011	2015
Impervious Cover		
Percent of Land Coverage Within Land Capability Class 1a (allow up to 1% impervious coverage)		
Percent of Land Coverage Within Land Capability Class 1b (allow up to 1% impervious coverage)		
Percent of Land Coverage Within Land Capability Class 1c (allow up to 1% impervious coverage)		
Percent of Land Coverage Within Land Capability Class 2 (allow up to 1% impervious coverage)		
Percent of Land Coverage Within Land Capability Class 3 (allow up to 5% impervious coverage)		
Percent of Land Coverage Within Land Capability Class 4 (allow up to 20% impervious coverage)		
Percent of Land Coverage Within Land Capability Class 5 (allow up to 25% impervious coverage)		
Percent of Land Coverage Within Land Capability Class 6 (allow up to 30% impervious coverage)		
Percent of Land Coverage Within Land Capability Class 7 (allow up to 30% impervious coverage)		
Stream Environment Zones		
Preserve and Restore Stream Environment Zones		

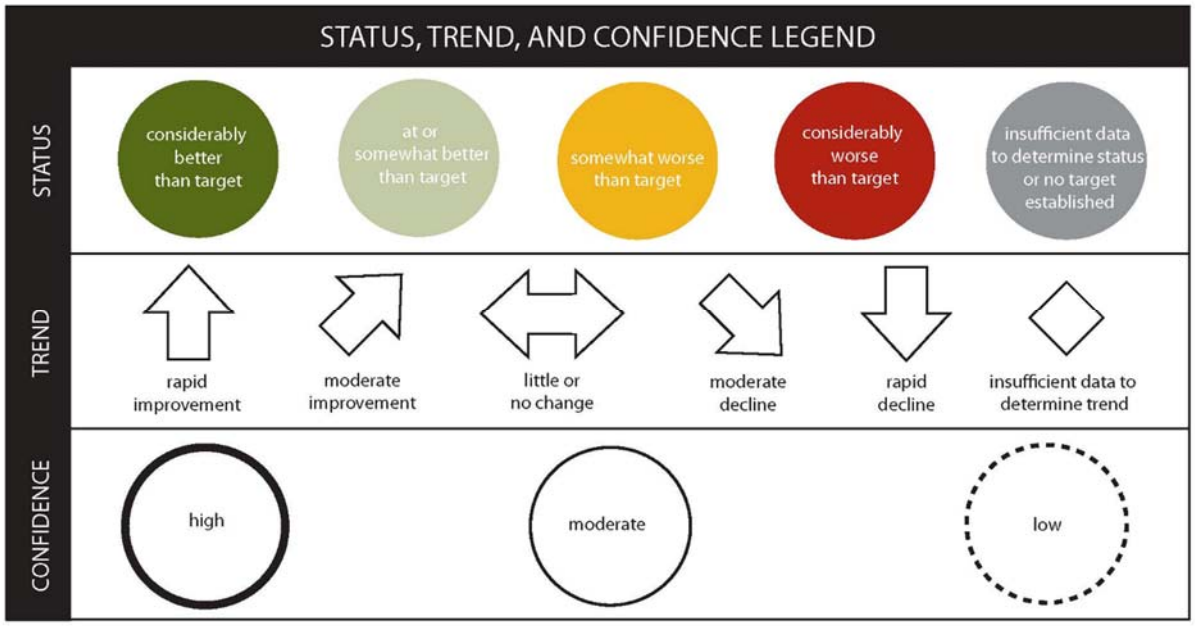


Figure 5-1: *A key to the symbols used to assess status, trends, and confidence levels.*

Impervious Cover

Impervious cover (also referred to as land coverage) is a primary indicator of land disturbance. Excessive impervious cover within a watershed 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.

Two types of impervious cover are defined by TRPA: hard and soft cover. These designations reflect degrees of imperviousness. Hard cover precludes any infiltration of water into the soil, whereas soft cover may allow limited infiltration into the soil. Hard cover refers to land that is artificially covered by materials such as buildings, pavement, and concrete. Soft cover refers to disturbed or degraded soils that are not covered by any type of structure or paved surface. Examples of soft cover includes soil compacted by vehicles or machinery parking or driving on unpaved areas, and repeated foot traffic over dirt trails and undesignated pathways. Both hard and soft cover impede infiltration altering the natural hydrologic regimes. Reduced infiltration reduces groundwater recharge, inhibits plant growth, and reduces water quality. A structure, improvement, or covering is not considered land coverage by TRPA if it allows at least 75 percent of normal precipitation to directly reach the ground, and allows growth of vegetation on the approved species list (TRPA, 2012a).

The impervious cover threshold standard is guided by the land capability classification system for the Lake Tahoe Basin (Bailey, 1974).[1] The system organizes the basin into land capability classes based on soil type, erosional hazard, soil drainage, and other features. The land capability classes reflect the amount of development an area can support without experiencing soil or water quality degradation. The land capability classes range from one to seven, with one being the most environmentally sensitive and seven having the highest capability for supporting development.

Bailey assigned each land capability class an allowable percentage of impervious cover, ranging from one percent for sensitive lands in classes 1a, 1b, 1c, and 2, to 30 percent for lands most suitable for development in classes 6 and 7 (Table 5-3). The impervious cover threshold standard requires compliance with Bailey's impervious cover limits set for each land capability class. This evaluation provides a characterization of the proportion of each land capability class that may be covered with impervious surfaces.

[1] *The complete report is available on the TRPA website at* http://www.trpa.org/wp-content/uploads/Bailey-Land-Capability-Report.pdf

Table 5-3: Basis of land capability classification for Lake Tahoe Basin lands (from Bailey 1974)

Capability Levels	Tolerance for Use	Slope Percent[2]	Relative Erosion Potential	Runoff Potential[3]	Disturbance Hazards
7	Most	0-5	Slight	Low to Moderately Low	Low Hazard Lands
6		0-16	Slight	Low to Moderately Low	
5		0-16	Slight	Moderately High to High	
4		9-30	Moderate	Low to Moderately Low	Moderate Hazard Lands
3		9-30	Moderate	Moderately High to High	
2		30-50	High	Low to Moderately Low	High Hazard Lands
1a	Least	30+	High	Moderately High to High	
1b	Least	Poor Natural Drainage			
1a	Least	Fragile Flora and Fauna[4]			

For the 2011 Threshold Evaluation Report, impervious cover was estimated using high-resolution Light Detection and Ranging (LiDAR) data and multispectral imagery (Worldview 2 Satellite, DigitalGlobe, Inc.) collected in August 2010. Specialists from the Spatial Informatics Group and the University of Vermont developed a preliminary algorithm (set of rules) to model the remote sensing data and create an automated assessment of land-cover mapping using object-based image analysis. This automated procedure systematically interpreted and classified the LiDAR and multispectral imagery data into two generic land cover types based on spectral (color) and landform (topography) information (O'Neil-Dunne et al., 2014). This map was then intersected with the Natural Resources Conservation Service (NRCS) land capability map (USDA-NRCS, 2007) to produce preliminary estimates of impervious surface by land capability type at the Tahoe Region scale.

The estimates of impervious cover must be taken as educated approximations based on best available data. TRPA and the consultant specialists are continuing to refine the estimates of impervious cover in the basin using advanced remote sensing data and the information collected through project permitting.

[2] *Most slopes occur within this range. There may be, however, small areas that fall outside the range given.*

[3] *Low to moderate low-hydrologic soil groups A and B; moderately high to high-hydrologic soil groups C and D.*

[4] *Areas dominated by rocky and stony land.*

2007 NRCS Soil Map

Since 1974, the available data and technology to delineate acreage in each land capability class has improved dramatically. NRCS completed an updated soil survey of the entire Tahoe Region in 2007 (Loftis, 2007; USDA-NRCS, 2007). The 2007 soil map replaced the 1974 soil map (Rogers, 1974)(Rogers 1974) used by Bailey (Bailey, 1974), to assign each soil map unit to a land capability class and while too late to be incorporated into the 2006 Threshold Evaluation Report, the updated soil information was recommended for use in subsequent threshold evaluations.

The mapping resolution of the 2007 map nearly doubled that of the 1974 map, providing a more refined estimate of the extent and location of all land capability classes. The higher resolution revealed that some areas assigned to a single class in 1974 may now be distinguished as several different classes. Most of the class refinements occurred outside of the urban boundary, for example, in Desolation Wilderness (Loftis, 2007). These class refinements were made possible by higher mapping resolution, additional data collection and better mapping technology, and standardization in mapping methodology. For instance, Global Positioning System (GPS) and Geographic Information Systems (GIS) tools now allow more accurate acreage accounting than was possible four decades ago.

In addition to higher mapping resolution and additional data, the land capability classification presented in Table 5-3 differs in two ways from the 1974 classification. First, erosion hazard was not included in the 2007 NRCS classification because it was effectively redundant with slope (Loftis, 2007). Second, the 2007 soil survey did not reclassify land capability classes based on surrounding soil classes. During the land capability analysis and mapping effort, Bailey found instances where pockets of high capability lands were fully enveloped within a geomorphic high hazard area. For example, there are small pockets of gently sloping, deep soils within the Desolation Wilderness. While high capability, these pockets are essentially inaccessible from a development standpoint as they are fully surrounded by high hazard areas with steep, erodible, rocky slopes. Bailey reclassified these pockets of high capability soils as low capability lands. These pockets were not reclassified in the 2007 soil survey.

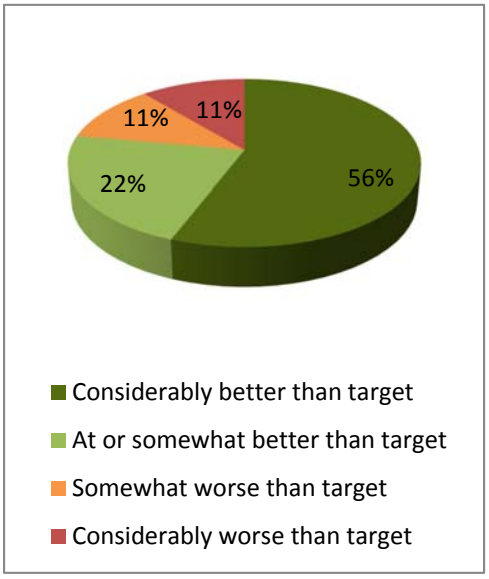
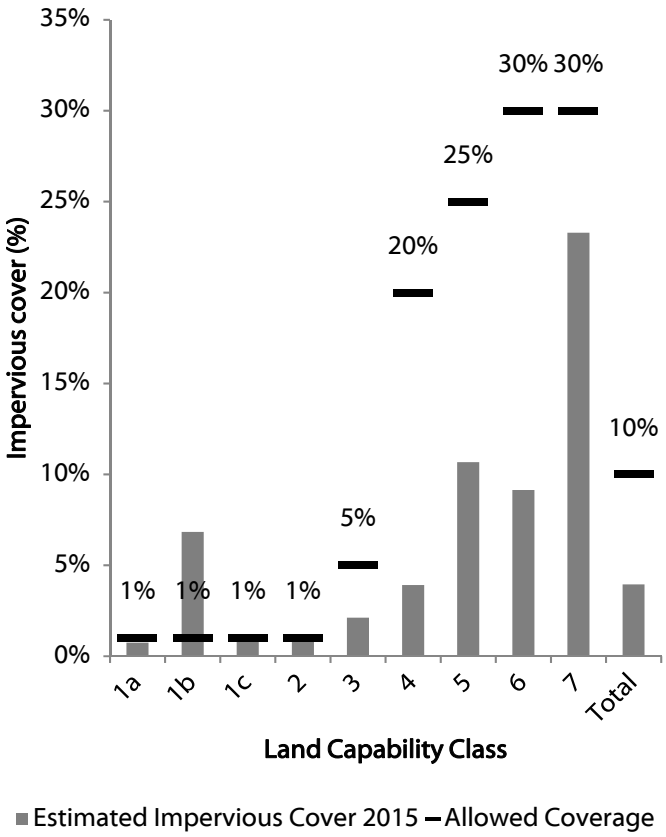
It is a common misconception to conclude that because the map used as the basis for standard assessment has been updated to reflect the best available science that the allowable impervious coverage has therefore also changed. In the original report on land capability, Bailey (1974) cautioned against overestimating the accuracy of land capability maps in the report: *"In addition, because of the small scale of the map and the maps from which it was compiled, land capability within individual map units may not be uniform… It is therefore necessary that the final land capability classification for individual parcels be based on detailed site evaluations and more detailed application of the classification criteria.* Site level verification has always been a fundamental component of the permitting process used by TRPA and partners to ensure that development adheres to the principles of Bailey. Prior to TRPA permitting development on a parcel, land capability verification determines its land capability class. Site assessment of land use capability within the Bailey framework ultimately dictates the extent of allowable impervious cover on a site.

The 2011 Threshold Evaluation Report used the 2007 updated soil survey to assess the extent of impervious cover in each land capability class defined by Bailey (1974), and the higher resolution data from the 2007 NRCS survey is also used in the 2015 Threshold Evaluation Report (Table 5-4).

Table 5-4: *Estimated impervious cover in each Bailey land capability class in the Lake Tahoe Region in 2015. Impervious cover in land capability class 1b and 2 are estimated to exceed allowable cover by 659.6 and 43 acres, respectively. Cover in all other land capability classes is below the allowable level. Land capability data is based on the 2007 NRCS Soil Survey (USDA-NRCS 2007). Impervious cover estimates based on evaluations of high resolution LiDAR and multispectral data collected in August 2010 and permitted development between August 2010 and August 2015.*

Land Capability Class	Total Acres Within Class	Allowable Impervious Cover	Estimated Impervious Cover 2010	Change August 2010-August 2015 (Acres)	Estimated Impervious Cover 2015	Acres above or Below Allowable Cover
1a	23,558	236 (1%)	175 (0.7%)	0.82 removed	174 (0.7%)	61.8 below
1b	11,304	113 (1%)	783 (6.9%)	10.39 removed	773 (6.8%)	659.6 above
1c	53,957	540 (1%)	505 (0.9%)	0.17 added	505 (0.9%)	34.8 below
2	23,648	236 (1%)	279 (1.2%)	0.03 removed	279 (1.2%)	43.0 above
3	16,920	846 (5%)	358 (2.1%)	0.06 added	358 (2.1%)	487.9 below
4	32,386	6,477 (20%)	1,263 (3.9%)	2.42 added	1265 (3.9%)	5,211.6 below
5	10,347	2,587 (25%)	1,099 (10.6%)	4.90 added	1104 (10.7%)	1,483.1 below
6	24,308	7,292 (30%)	2,214 (9.1%)	6.93 added	2221 (9.1%)	5,071.1 below
7	5,525	1,658 (30%)	1,283 (23.2%)	3.52 added	1287 (23.3%)	371.5 below
Total	**201,953**	**19,984 (9.9%)**	**7,959 (3.9%)**	**6.75 added**	**7974 (3.9%)**	**12,010.2 below**

Soil Conservation: **Percent of Land Coverage within Land Capability Classes**

Status	Data
PERCENT OF LAND COVERAGE WITHIN LAND CAPABILITY CLASSES  Summary of the status of the nine individual land capability class indicators in the reporting impervious cover reporting category.	 Percent cover in each Bailey land capability class relative to the allowable coverage in class.

Data Evaluation and Interpretation

BACKGROUND

Relevance – This indicator measures the percent of land coverage on different land capability classes as described by Bailey (Bailey, 1974) and updated with the most recent soil survey by the Natural Resources Conservation Service (NRCS) in 2007 (Loftis, 2007; USDA-NRCS, 2007). Impervious cover is a primary indicator of land disturbance. Excessive impervious surface within a watershed 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. Impervious surfaces include hard coverage such as roads, buildings, driveways, and parking lots, and soft coverage with soil compaction as a result of use, but where no structure is in place.

TRPA Threshold Category – Soil Conservation

TRPA Threshold Indicator Reporting Category – Impervious Cover

Adopted Standard – Impervious cover shall comply with the *Land-Capability Classification of the Lake Tahoe Basin, California-Nevada, A Guide for Planning*, (Bailey, 1974).

Type of Standard – Management Standard with Numerical Standard

Indicator (Unit of Measure) – Percent impervious cover within each land capability class.

Human & Environmental Drivers – Impervious cover is created through use or development on natural lands. This could be for commercial, residential, recreational, and other activities, and encompasses the spectrum of human uses that involve physical modification of the environment. The economy plays a large role in the housing market and the business environment, which are both among the most important drivers of new land coverage in the basin.

MONITORING AND ANALYSIS

Monitoring Partners – California Tahoe Conservancy, Nevada Division of State Lands, El Dorado County, Placer County, City of South Lake Tahoe, Washoe County.

Monitoring Approach – The base impervious coverage layer for the Region was sourced from a LiDAR survey completed in August 2010. LiDAR is a remote sensing technology that uses laser and light refraction to image objects and terrain. The 2010 LiDAR analysis mapped the extent of hard and soft impervious cover in the Region. The cost of acquiring LiDAR data for the Region makes quadrennial LiDAR surveys infeasible. To assess change in impervious cover without the benefit of new LiDAR imagery, information collected from project permitting by TRPA and partners was used to determine added/new coverage. Land capability as defined in the 2007 soil survey was used as the primary unit to measure coverage in a land capability class, both because it was used in the 2011 Threshold Evaluation Report (TRPA, 2012b) and because it is more detailed than the 1974 Bailey report (Loftis, 2007). Information about coverage removed was provided by the California Tahoe Conservancy (CTC), Nevada Division of State Lands (NDSL) and the TRPA parcel tracker tool.

Analytic Approach – Indicator status is assessed through simple aggregation.

INDICATOR STATE

Status – See summary in Table 1. All land capability classes are in attainment except for class 1b and class 2. Since August 2010, 19.09 acres of hard impervious cover have been permitted within the basin and 10.4 acres of cover in class 1b have been removed. Commodity transfers by private parties as part of the Transfer of Development Rights Program accounted for 8.08 acres removed from class 1b and 2.45 acres were removed by the CTC and NDSL. No estimate is provided for changes in unpermitted impervious cover. Unpermitted cover refers to cover that may have been added or created in the Region, for which no permit was acquired.

Table 1: *Status determination by land capability class including percent of target*

Land Capability Class	Percent of Target	Status Determination
1a	26% below	Considerably better than target
1b	584% above	Considerably worse than target
1c	6% below	At or somewhat better than target
2	18% above	Somewhat worse than target
3	58% below	Considerably better than target
4	80% below	Considerably better than target
5	57% below	Considerably better than target
6	70% below	Considerably better than target
7	22% below	At or somewhat better than target

Trend – See summary in Table 2. The percent change relative to target across all land capability classes over the four-year analysis period was 0.01 percent. The largest percent change relative to target was the 1.84 percent decrease in the 1b class, which would be classified as moderate improvement (see

methodology section). Percent change relative to target for all other land capability classes was less than 0.07 percent indicating little or no change. The added coverage amounts to an increase of 0.01 percent in coverage basin-wide, which indicates little or no change overall.

Table 2: Summary of trend determination by land capability class

Land Capability Class	Percent Change Relative to Target	Trend Determination
1a	-0.07	Little or No Change
1b	-1.84	Moderate Improvement
1c	0.01	Little or No Change
2	0.00	Little or No Change
3	0.00	Little or No Change
4	0.01	Little or No Change
5	0.04	Little or No Change
6	0.02	Little or No Change
7	0.04	Little or No Change

Confidence –

Status – Moderate. The 2011 Threshold Evaluation Report assessed the accuracy of the impervious cover map as moderate (TRPA, 2012b). The rigorous tracking and permitting process of TRPA and partners in the Region is extensive and would yield a high confidence if assessed independently.
Trend – High. Even though a statistical analysis was not used to test if trends were significant, there is high confidence in the cumulative accounting of acres of cover added in each land capability class.
Overall Confidence – Moderate. Overall confidence takes the lower of the two confidence determinations.

IMPLEMENTATION AND EFFECTIVENESS

Programs and Actions Implemented to Improve Conditions – Parcel level verification of sites' land capability class is the primary mechanism by which TRPA and partners ensure that development in the basin adheres to the Bailey system and that excess coverage is not added within a land capability class. Removal of coverage from sensitive lands is primarily facilitated by Environmental Improvement Program (EIP) implementation partners and the California and Nevada land banks through the Excess Coverage Mitigation Program. In addition to the actions of EIP partners, the Transfer of Development Rights Program is a central part of TRPA's growth management system and an important strategy used to attain multiple environmental thresholds, by providing an incentive to transfer coverage to less sensitive lands. Within the program, if 10 tourist accommodation units (TAUs) were removed from a SEZ and transferred to a town center, an additional 20 TAUs would be awarded for this transfer, for a total of 30 TAUs (i.e. 1:3 transfer ratio). TRPA is actively seeking new mechanisms to encourage removal of excess coverage on sensitive lands. For example, the TRPA Governing Board recently took action to allow coverage transfers across Hydrologically Related Area (HRA) boundaries. With this update, coverage can be transferred across HRA boundaries if it is removed from sensitive lands in one HRA and sent to lands that are non-sensitive and not located along the shoreline of Lake Tahoe. In addition, the new Excess Coverage Mitigation Program usage requirements state that the land banks should give preference to the retirement of coverage in sensitive lands. Both actions were taken at the Dec. 16, 2015 meeting of the

TRPA Governing Board.

Effectiveness of Programs and Actions –Physical removal of impervious cover is readily verifiable and contributes to standard attainment. 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.

Interim Target – The class 1b target is not expected to be attained in the foreseeable future, given the magnitude of change needed and public funding levels. The rate of coverage removal from class 1b lands over the last four years averaged 2.5 acres annually. At this rate the 1b target would not be attained for 264 years. Continuing this rate over the next four years would result in the removal of an additional 10 acres from class 1b. Impervious cover in class 2 lands is currently 43 acres above the target level. Removing 43 acres of cover is potentially achievable within 10 to15 years if sufficient funding is available and focused on attainment of the class 2 target. While it is conceivable that the class 2 target could be achieved if actions were targeted solely to promote attainment of the individual threshold standard, project prioritization should also consider the potential for projects to contribute to threshold gains in any number of categories. For example, consideration of the multiple threshold benefits may result in prioritizing restoration projects in SEZ lands (which are generally class 1b) because their restoration may also result in greater benefits to water quality, wildlife and vegetation thresholds than restoration efforts on class 2 lands. Such a prioritization framework is more consistent with the intent of land capability classes, which are described as a means to achieve a range of objectives rather than an end point in and of themselves. "Criteria were developed for classifying lands – according to their inherent physical capability to provide for use without endangering achievement of the goals established in the Bi-State Compact (P.L. 91-148) for protection of environmental qualities of the basin (Bailey, 1974)."

Interim Target Attainment Date – 2019 Threshold Evaluation Report.

RECOMMENDATIONS

Analytic Approach – Evaluation of the effectiveness of the individual policies or programs implemented to facilitate removal of coverage is challenging because of the diversity of contributing factors, but is essential to informing program design and should remain a priority.

Monitoring Approach – Detailed LiDAR analysis like the one conducted in 2010 is the most reliable method for determining the extent of impervious cover in the Region and should be acquired at regular intervals. The next LiDAR analysis could also be used to assess the accuracy of coverage estimates obtained through permit accounting. To improve the accuracy of the Region-level maps of land capability, information collected during parcel land capability verifications could be integrated into the gross scale maps of land capability.

Modification of the Threshold Standard or Indicator –The 2007 NRCS soil survey, produced at field verified scale of 2.5 acres is significantly more detailed than the previous Bailey map at a 10-acre scale, is the highest quality and most accurate estimate of basin-level land capability classes. It is the best available information for use by TRPA as the base map for standard evaluation and its adoption should be considered. Its adoption was also recommended in the 2011 Threshold Evaluation Report (TRPA, 2012b).

Attainment of the impervious cover standard for the 1b land capability class would require the removal and/or relocation of 659 acres of impervious cover, roughly 8.3percent of all impervious cover in Region. Removal or relocation of this magnitude may be infeasible in a reasonable time-frame. It would also likely require removal and buyout (with transfers or retirement) of large portions of existing private development (residential, tourist, commercial) in the Region's local communities.

Attain or Maintain Threshold – Existing land use policies and regulations should continue to evolve and may need to be amended to better facilitate the transfer and restoration of urban development-oriented coverage from less suitable land capability classes that historically supported wetland and meadow vegetation to areas with a greater land capability.

Stream Environment Zone

Stream environment zone (SEZ) are defined by hydrology, soil, and water-associated vegetation. Although SEZ plant communities constitute only a small portion of the basin's total land area, they are extremely rich and productive. SEZs provide a variety of critical services in the basin, including water quality maintenance through nutrient cycling and sediment retention, flood attenuation, infiltration and groundwater recharge, open space, scenic and recreational enjoyment, wildlife habitat, and wildfire abatement, among many other functions and values (Roby et al., 2015). The water quality benefits of functioning SEZ areas in the basin were empirically documented more than 40 years ago, when estimated nutrient and sediment load reductions were between 72 percent to 94 percent of loading (TRPA, 1977). Protecting and restoring SEZs is essential for improving and maintaining the environmental amenities of the basin, and contributes to the attainment and maintenance of threshold standards for water quality, vegetation preservation, fisheries, and wildlife.

Large scale SEZ disturbance in the Region likely began in the 1800s through activities like logging, grazing, stream and river channelization, damming, and fire suppression, with environmental consequences that are still evident in the landscape today. Legacy impacts, and continuing development pressure, are being addressed through a comprehensive SEZ program with regulations and policies that limit development and other disturbances in SEZs and support public acquisition and restoration of these sensitive parcels.

Threshold Standard: *Preserve existing naturally functioning SEZ lands in their natural hydrologic condition, restore all disturbed SEZ lands in undeveloped, un-subdivided lands, and restore 25 percent of the SEZ lands that have been identified as disturbed, developed, or subdivided, to attain a 5 percent total increase in the area of naturally functioning SEZ lands.*

Challenges in Standard Evaluation: Three factors complicate evaluation of the SEZ standard:

1. Ambiguous objectives - The standard contains a number of terms that are not uniformly understood. These include: a) “preserve,” b) “naturally functioning,” c) “disturbed,” d) “developed or subdivided”, and “restore.” While these terms may seem clear, the interpretation of the terms has varied in past threshold evaluations.

2. Absence of an accepted baseline against which the standard can be assessed - Consistent and objective evaluation requires the spatial delineation of all SEZ lands and classification of the SEZ lands based on the following criteria: a) “disturbed” or “undistributed,” b) “naturally functioning” or “functionally impaired,” c) “developed” or “non-developed,” and d) “subdivided” or “non-subdivided.”

3. The presence of multiple clauses within the standard - The numerous clauses in the standard make interpretation and consistent evaluation of the standard challenging. Clarification that addresses the relation of the targets specified in the clauses to one another is necessary to ensure consistent and objective evaluation.

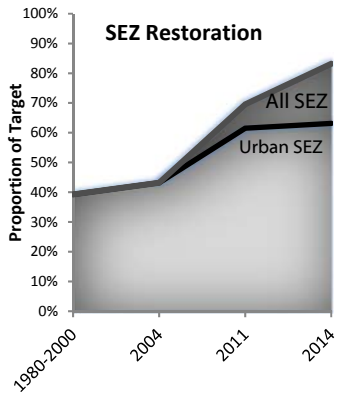
Soil Conservation: **Stream Environment Zones**

Status

STREAM ENVIRONMENT ZONES

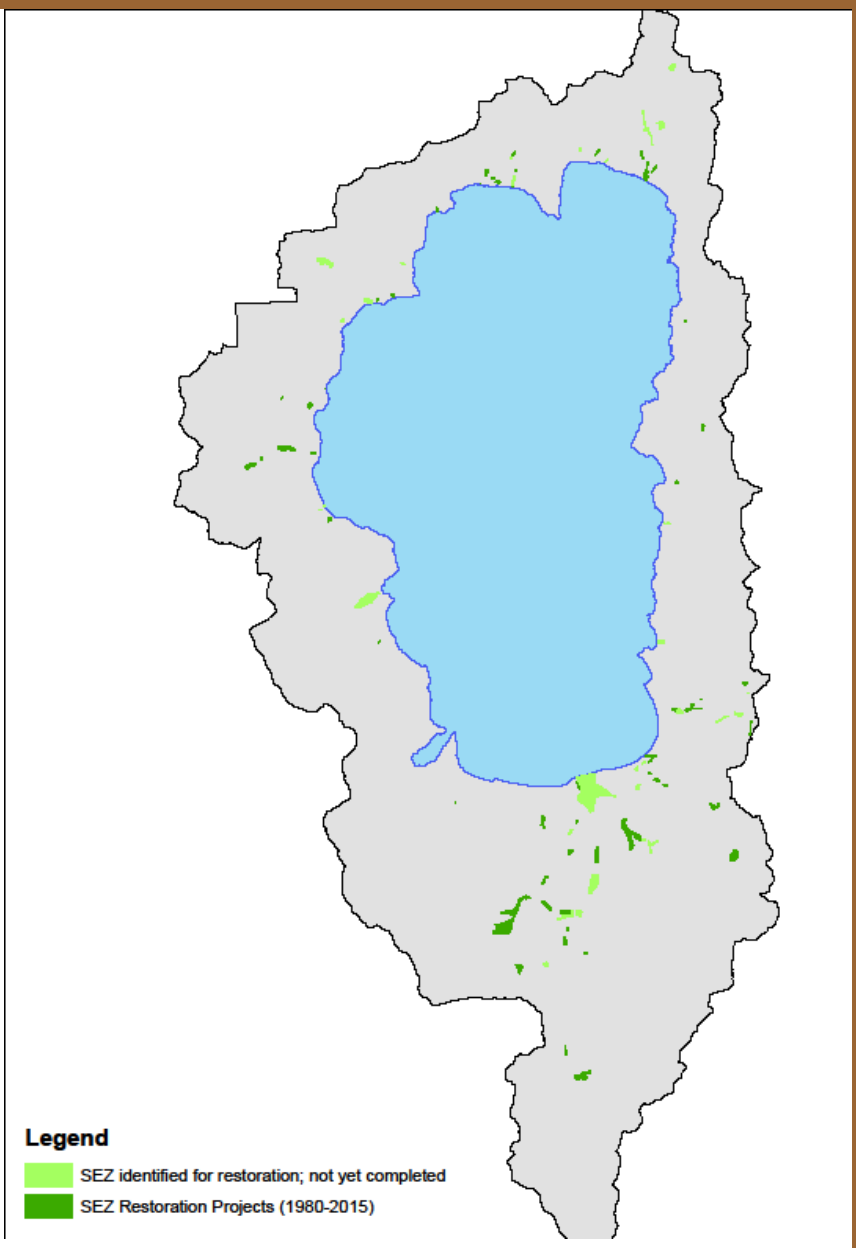
Status – **Considerably Worse than Target**
Trend - **Moderate Improvement**
Confidence - **Moderate**

Trend



Cumulative SEZ restoration in the Lake Tahoe Region between 1980 and 2015 as a proportion of SEZ restoration target achieved.

Map



Planned and completed SEZ Restoration Projects in the Tahoe Basin 1980-2015. Note: some projects listed in the table of SEZ Restoration Projects are not shown on the map because their exact location is unknown (mostly pre-1990 projects). Projects listed as planned were identified in the 1988 TRPA Water Quality Plan and may not be included on the EIP list.

Data Evaluation and Interpretation

BACKGROUND

Relevance – This indicator measures protection, restoration and enhancement of stream environment zones (SEZ). SEZs play a variety of critical roles including natural water filtration, storage, and conveyance of surface runoff (Roby et al., 2015). Encroachment on these areas reduces their potential to filter sediment and nutrients and the amount of surface runoff they can effectively treat. Naturally functioning SEZs also provide open space, flood flow capacity, riparian vegetation, fish and wildlife habitat, and buffer urban uses in developed areas. SEZ protection and restoration can also contribute to the achievement of other environmental threshold standards, including water quality, wildlife, fisheries, vegetation preservation, recreation, and scenic resources. Even seemingly unrelated threshold standards such as air quality and noise are affected by SEZs. For instance, aspen stands in SEZs next to roadways have been shown to moderate roadway noise and help block particulates from spreading to adjacent areas.

TRPA Threshold Category – Soil Conservation

TRPA Threshold Indicator Reporting Category – Stream Environment Zones

Adopted Standard – Preserve existing naturally functioning SEZ lands in their natural hydrologic condition, restore all disturbed SEZ lands in undeveloped, unsubdivided lands, and restore 25 percent of the SEZ lands that have been identified as disturbed, developed or subdivided, to attain a 5 percent total increase in the area of naturally functioning SEZ lands.

Type of Standard – Numerical Standard

Indicator (Unit of Measure) – Acres of SEZs restored, policy framework in place to protect and restore SEZs.

Human & Environmental Drivers – Disturbance and degradation of SEZs in the Tahoe Region began in the 1800s through logging, grazing, stream and river channelization, development, damming, fire suppression, and other activities, with environmental consequences that are still evident today. Higher temperatures and altered precipitation regimes forecasted as a result of climate change (Coats et al., 2010) further threaten to alter the dynamics of SEZs in the basin.

MONITORING AND ANALYSIS

Monitoring Partners – California Tahoe Conservancy, U.S. Forest Service, Nevada State Lands, El Dorado County, Placer County, City of South Lake Tahoe and other Environmental Improvement Program (EIP) partners.

Monitoring Approach – Information sourced from EIP implementing partners. Implementation agencies submit information to TRPA through the EIP Project Tracker website. TRPA validates reported project information prior to the information being posted on the website. The information is publicly available on the website: https://eip.laketahoeinfo.org/

Analytic Approach – Indicator status is assessed through simple aggregation. The basis for evaluation of the 25 percent restoration standard for "disturbed, developed, or subdivided" is drawn from the 1991 Threshold Evaluation Report which estimated that there were 4,400 acres of "disturbed, developed, or subdivided" lands in the Region. and the basis for target attainment (1,100 acres).

INDICATOR STATE

Status – Considerably worse than target. The standards for SEZ restoration are evaluated individually below**.** The standards include a management standard and three numerical standards for SEZ restoration. The numeric SEZ restoration standards are written as percentage based targets that have historically been evaluated against an estimate of the extent of SEZ in the basin from 1991. There have been numerous attempts to develop maps of SEZ in the basin (Roby et al., 2015), but TRPA has not formally adopted an SEZ map. Basin wide maps of SEZ are often referred to as "potential" SEZ areas because many of the mapped

SEZ lands have not been field verified. The two soil (and associated land capability) maps of the basin (Bailey, 1974; USDA-NRCS, 2007), are often referred to or confused with SEZ maps. While soil type is recognized as an indicator of SEZ, it is not a direct surrogate for SEZ (Roby et al., 2015). The lack of a detailed uniformly accepted SEZ map or potential SEZ map for the Region means that the percentage targets are subject to change as the estimated extent of SEZ in the basin is revised based on new information. The individual subparts of the standard are numbered and evaluated below:

1. *Preserve existing naturally functioning SEZ lands in their natural hydrologic condition*. This element of the threshold standard is a management directive that can be evaluated with respect to the polices and regulations adopted by TRPA and partners. While neither "preservation" nor "naturally functioning" is commonly defined, preservation is interpreted to mean that no new development should occur in naturally functioning SEZs. This interpretation was used in the 2011 Threshold Evaluation Report and it is used again in this report (TRPA, 2012c). In addition, when the standard was recommended it was suggested that it could be "attained with existing ordinances and compliance with the 208 Plan (TRPA 1982a)." Since the adoption of the 1987 Regional Plan, new coverage or even temporary disturbance in SEZ has been prohibited. The Regional Plan was updated in 2012 and included similar protection for SEZ lands (TRPA, 2012d)(TRPA 2012d). These restrictions are supported by predevelopment land capability verification which prevents development on actual SEZ even when not identified on the map. Exceptions are granted on a limited basis for public outdoor recreation, public service, and water quality control facilities. In the rare instances where permitted projects include coverage in an SEZ, the permitting requirements include both mitigation and include design requirements intended to ensure natural hydrologic conditions are not disturbed. Projects that include coverage in SEZ are primarily those of the EIP that are designed to deliver environmental benefits and are subject to appropriate environmental review, that includes exploration of alternative to avoid or minimize SEZ disturbance. Land acquisition of SEZs by TRPA partner agencies also aids in achieving this element of the threshold standard. Overall Region-wide policies and programs are in place that recognize and protect the myriad of critical functions of SEZs. This standard is in attainment.

2. *Restore 25 percent of the SEZ lands that have been identified as disturbed, developed or subdivided.* This component of the standard is a numerical standard. Over five threshold evaluation reports and three decades it has not been consistently quantified or evaluated. The last two threshold evaluation reports (2006 and 2011) provided different interpretations of "disturbed, developed, or subdivided" with implications for which SEZ restoration projects contribute toward attainment of the threshold standard (TRPA, 2012c, 2007). The 2006 Threshold Evaluation Report suggests a narrower reading of the standard, and that SEZ restoration projects on "un-subdivided lands should be excluded from the tally of projects that contribute towards the objective of restoring *25 percent of the SEZ lands that have been identified as disturbed, developed, or subdivided* (TRPA, 2007)*."* The 2011 Threshold Evaluation Report suggests that the criteria used in 2006 Threshold Evaluation Report imposed an unstated requirement that restored SEZ be located inside the urban boundary in order to count towards achievement of the standard. The 2011 Threshold Evaluation Report suggests a broader reading of the standard: "*It seems reasonable to conclude that the 25 percent threshold standard goal does not have to be attained exclusively within the 'urban areas,' but does need to be attained adjacent to, or associated with, disturbed, developed, or subdivided lands in the Region* (TRPA, 2012c). "There is little evidence within the standard to support the application of a strict location-based criteria where restoration of 25 percent of the SEZ must occur. Such a reading seems to be based on an improper juxtaposition of the two clauses in the standard that treats restoration of "*all disturbed SEZ lands in undeveloped, un-subdivided lands*," and "*restore 25 percent of the SEZ lands that have been identified as disturbed, developed, or subdivided*" as mutually exclusive objectives. Treating the standards as mutually exclusive rather than supporting seems to have its origin in the 2006 Threshold Evaluation Report (TRPA, 2007). Earlier threshold evaluation reports treated the two objectives as concordant and self-reinforcing rather than mutually exclusive (TRPA, 2001, 1996, 1991). While the 2006 and 2011 Threshold Evaluation Reports read the standard differently, no accompanying adjustment of the numeric target was made to accommodate the new spatial criteria. The total

amount of SEZ inside urban boundaries is estimated to be 3,496 acres (including beaches and the Tahoe Keys), significantly less than the 4,400 acres of disturbed developed or subdivided SEZ that has historically been used as the benchmark for standard assessment. If all SEZ inside urban boundaries was disturbed or developed, then the restoration of 25 percent would require restoration of 874 acres. The first Threshold Evaluation Report (1991) estimated that there were 4,400 acres of "disturbed, developed, or subdivided" lands in the basin and the basis for target attainment (1,100 acres) has historically been calculated using this number. Of this amount, it was estimated 2,500 acres were developed or disturbed and that 1,900 acres were subdivided but not developed and still retained their natural hydrologic regime (TRPA, 1988). This baseline for target attainment can be found in the 1988 208 plan for the basin, which provided a project roadmap for attainment of the 25 percent restoration standard. To attain the 1,100-acre target, the 208 plan identified 452 acres of restoration projects inside the urban boundary and an additional 701 acres of restoration opportunity outside urban areas (TRPA, 1988). The report establishing the thresholds in 1982 suggested that there were 4,376 acres of developed or subdivided SEZ that could be preserved or restored to their natural state, which also suggests that restoration would not be required on all 4,376 acres because some could simply be preserved (TRPA, 1982).

Given the ambiguities in the standard and its interpretation, the data presented in Appendix E of the 2015 Threshold Evaluation Report allow for evaluation using any of the prior interpretations. The status determination icon follows the conventions of the 2011 Threshold Evaluation Report. It used the 25 percent restoration target for disturbed, developed, or subdivided SEZ as the primary basis for standard evaluation, and limits SEZ restoration projects that count towards that standard to those that are inside or adjacent to urban areas (TRPA, 2012c). The choice to follow the conventions of the 2011 Threshold Evaluation Report for status icon determination was made in the interest of consistency and improving the ability of readers to compare results between threshold evaluation reports. It should not be seen as an endorsement of the 2011 interpretation of the standard. Earlier documents including, 1988 208 plan, the 1991, 1996, and 2001 threshold evaluation reports all interpreted the standard to include all SEZ restoration projects (TRPA, 2001, 1996, 1991, 1988). The threshold standard establishes a 25 percent target for restoration of the 4,400 acres of disturbed, developed, or subdivided SEZ, or 1,100 acres. Between 1980 and 2014, 546 acres of SEZ were restored in projects completed in or adjacent to urban areas in the Region. An additional 369 acres of SEZ have been restored outside urban boundaries, resulting in a total of 924 acres of SEZ restored in the Region. If only SEZ restoration inside urban areas is used to assess standard attainment (and the standard is still assessed against the 1,100-acre benchmark), the target is about 50 percent achieved; thus, the threshold standard status is designated "considerably worse than target." If all SEZ restoration contributes to target attainment, the target is 83 percent achieved; thus, the threshold standard status is designated "somewhat worse than target." In addition to the projects listed in Appendix E that have historically formed the basis for standard evaluation, the U.S. Forest Service restored 680 acres of SEZ between 1984-1987, and the Forest Service and California Tahoe Conservancy acquired and protected over 900 acres of SEZ (TRPA 1988). In total 2,495 acres of SEZ have been restored or acquired since 1980.

3. *Restore all disturbed SEZ lands in undeveloped, un-subdivided lands*. The restoration goal for undeveloped and unsubdivided lands, all, is considerably higher than the goal for developed or subdivided because of the recognized cost to benefit trade-off of restoration. "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.(TRPA, 1978)" Because "*all disturbed SEZ lands in undeveloped, un-subdivided lands*," does not have a commonly understood, defined or mapped baseline. Prior threshold evaluation reports have not made a status determination relative to this part of the standard. The 2011 threshold evaluation report wrote that no status determination was made "because this element of the Threshold Standard is not the focus of the Threshold Standard." Earlier threshold evaluation reports provided no indication for why the standard was not evaluated. The SEZ component of the 1988 water quality management plan suggests this target may relate to 200 acres of National Forest land of SEZ that the U.S. Forest Service identified in 1987 as requiring restoration (TRPA, 1988). The plan

suggests that between 1984 and 1987, 680 acres were rehabilitated by the U.S. Forest Service and that the standard could be attained shortly (TRPA, 1988). The status is "unknown due to insufficient data."

4. *Attain a 5 percent total increase in the area of naturally functioning SEZ lands.* There are approximately 21,944 acres of SEZ in the Region, comprising about 11 percent of the basin area (TRPA, 2001). About 4,400 acres of SEZ are estimated to be disturbed, developed, or subdivided. If it is assumed that the 4,400 acres of disturbed, developed, or subdivided SEZ are not naturally functioning, then the basis for evaluation of the standard is 17,544 acres (21,944-4,400 acres). If we assume that the SEZs reported as restored are naturally functioning, then the standard established a goal of 877 acres of SEZ restoration (5 percent of 17,544). A 5 percent increase would require an increase to 18,421 acres of SEZ. Since the standard was adopted, 924 acres of SEZ have been restored. This standard is "at or somewhat better than target" and is in attainment.

The SEZ standard has never been assessed to be in attainment since adoption, even though the individual parts of the standard have been identified as being in attainment. The evaluation criteria used in this evaluation largely follows the convention of the 2011 Threshold Evaluation Report to facilitate comparisons between the reports as required by the TRPA Code of Ordinances (TRPA, 2012a). As it was in the 2011 Report, the SEZ standards are determined to be considerably worse than target. This determination is based on the reading that the primary focus of the standard is the second part of the standard, *"restore 25 percent of the SEZ lands that have been identified as disturbed, developed or subdivided*." The conventions of the 2011 Threshold Evaluation Report are followed for this report to enable comparison of progress between reporting cycles and should not be read as an endorsement of the interpretation of the standard that places attainment of the second part of the standard (*restore 25 percent of the SEZ lands that have been identified as disturbed, developed or subdivided*) above the other parts. Further recommendations are included below.

Trend – Moderate improvement. The average rate of SEZ restoration in the Region from 1980 through 2014 was 26.9 acres per year, which represents a 2.95 percent increase relative to the target and yields a determination of rapid improvement. The average restoration rate for urban SEZ in the Region between 1980 and 2014 was 20 acres per year, which represents a 2.24 percent increase relative to the target and yields a determination of moderate improvement. Between 2010 and 2014, the SEZ restoration rate has been 37 acres per year, which represents a 4.06 percent increase relative to the target and yields a determination of rapid improvement. More recently (2010 to 2014), the average restoration rate for urban SEZ was 11 acres per year, equivalent to a restoration rate 0.49 percent, which yields a determination of little to no change. A trend determination of moderate improvement was made in this evaluation to reflect the underlying ambiguity in interpretation and application in the threshold standard and the different analytic methods used in prior threshold evaluations.

Confidence –

Status – Moderate. There is high confidence in the current status determination for SEZ restoration acreage because the project information was provided directly from EIP partner agencies and previous threshold evaluation reports that documented verified completed projects. There is also high confidence that the policies implemented by partners in the Region are protecting SEZ lands from development. There is lower confidence in the estimates for the extent of SEZ in the Region or the baseline for assessing attainment. The effectiveness of these projects in achieving the restoration objective of restoring natural hydrologic function is unknown because of lack of ongoing effectiveness monitoring. Additionally, ambiguity in the standard lowers confidence in our ability to objectively assess its status.

Trend – Moderate. Even though a statistical analysis was not used to test if trends were significant, there is high confidence in the cumulative accounting of acres restored because trusted partner agencies regularly track and report project information.

Overall Confidence – Moderate.

IMPLEMENTATION AND EFFECTIVENESS

Programs and Actions Implemented to Improve Conditions – Currently, the preservation of naturally functioning SEZ is accomplished through TRPA, Lahontan Regional Water Quality Control Board, and Army Corps of Engineer regulations that limit development and other disturbances in these areas. In addition, Nevada State Lands, California Tahoe Conservancy, U.S. Forest Service, California State Parks, City of South Lake Tahoe, and other entities preserve SEZs through strategic acquisition of identified SEZ parcels. Disturbed SEZs occur in both urban and non-urban environments and actions to restore these are ongoing. The Environmental Improvement Program, in partnership with the California Tahoe Conservancy, U.S. Forest Service and others, acquires and restores priority environmentally sensitive lands, with a primary focus on protecting and enhancing meadows, wetlands, rivers, streams. Since 1997, more than 3,099 acres of SEZ/sensitive lands have been acquired by state and federal agencies in the Region (TRPA, 2016, 2010).

Effectiveness of Programs and Actions – The SEZ program and policies have successfully limited new development in SEZs (Raumann and Cablk, 2008). Acquisition of private parcels in SEZs by the U.S. Forest Service, California Tahoe Conservancy, and Nevada State Lands has increased contiguous SEZ areas, allowed for restoration, and provided buffers to urban development. Vegetation enhancement projects such as fuels reduction may also improve the biologic and hydrologic functions of SEZ and help restore natural hydrologic regimes of the Region. In the past they have not been considered SEZ restoration and have not counted towards target attainment.

Interim Target – Two large SEZ restoration projects are currently moving forward in the Region. The Upper Truckee marsh restoration project will restore 500 acres of SEZ and is scheduled to begin in 2019 and be completed in 2023. The project was approved by the California Tahoe Conservancy Board on December 18, 2015 and the TRPA governing board certified the EIS for the project on February 24, 2016. The completion of the Upper Truckee marsh restoration project will result in the attainment of the *Restore 25 percent of the SEZ lands that have been identified as disturbed, developed or subdivided* sub-component of the standard. A USFS restoration project in the Taylor-Tallac area is also expected to restore or enhance 250-300 acres of SEZ (Muskopf et al., 2009).

Interim Target Attainment Date –2023 Threshold Evaluation Report.

RECOMMENDATIONS

Analytic Approach – No changes recommended.

Monitoring Approach – Consideration should be given to the development of a monitoring plan that enables assessment of SEZ condition.

Modification of the Threshold Standard or Indicator – Standard revision should consider the establishment of specific and measurable targets that address the three factors identified below to facilitate objective and consistent evaluations of status. At present, evaluation is complicated by three factors: 1) ambiguous objectives, 2) absence of an accepted baseline against which the standard can be assessed, and 3) the presence of multiple clauses within the standard. Complications arising from these factors are discussed below.

1. *Ambiguous objectives*: The standard(s) contains a number of terms that are ambiguous and subject to interpretation. These include: a) "preserve," b) "naturally functioning," c) "disturbed," d) "developed or subdivided," and e) "restore." Their interpretation has varied in past threshold evaluations. Prior to the 2006 report, no location-based criteria were used in defining the set of SEZ that were "disturbed, developed or subdivided." The 2006 Threshold Evaluation Report interpreted "disturbed, developed or subdivided" to mean "within the urban boundary" (TRPA, 2007), while the 2011 Threshold Evaluation Report reinterpreted "disturbed, developed or subdivided" to include areas adjacent to the urban boundary (TRPA, 2012b). Further, the relationship among the individual terms should be clearly articulated. For example, does disturbance (drawing from the

Thresholds Study Report (TRPA, 1982) and the 208 Plan (TRPA, 2013)) include any and all instances of filling, grading, draining, encroaching, removing vegetation, altering or blocking drainage, channelizing streams, grazing, and off-road vehicle use? And do these actions always impair the natural function of an SEZ? Or can the potential impacts of all or some of the above activities be mitigated sufficiently to ensure natural function is retained?

Consistent application of terms such as "disturbed" or "naturally functioning" may require clarifying objectives or establishing criteria for differing qualities of SEZ in the basin. Riparian areas, wet meadows, and beaches are all classified as SEZ, yet their functions and values are likely type specific (Roby et al., 2015).

2. *Absence of an accepted baseline against which the standard can be assessed*: Consistent and objective evaluation requires the spatial delineation and classification of all SEZ lands based on the criteria enumerated in the standard: a) "disturbed or undisturbed," b) "naturally functioning" or "functionally impaired," c) "developed or non-developed," and d) "subdivided or non-subdivided."

   The lack of spatial representations of areas that fall into the above categories has caused confusion and inconsistency in past evaluations. For example, the 1991 Threshold Evaluation Report estimated that there were 4,400 acres of disturbed, developed or subdivided SEZ (TRPA, 1991). This estimate has generally served as the basis for assessing attainment. While the basis for assessing attainment has remained consistent, the interpretation of contributing SEZ restoration projects has varied (as described above). While the 2006 and 2011 Threshold Evaluation Reports changed the reading of the standard, no accompanying adjustment of the numerical target associated with disturbed, developed or subdivided SEZ was made to accommodate the new spatial criterion. Thus the overall target remained the same (1,100 acres, based on a 25 percent target) while the project's -- potential, planned and implemented--that would count toward attainment was reduced.

   Similar issues exist with the target related to "a 5 percent total increase in the area of naturally functioning SEZ." The 1991 Threshold Evaluation Report estimated that there were 4,400 acres of disturbed, developed or subdivided SEZ. Assuming all SEZ areas not identified as "disturbed, developed or subdivided" are "naturally functioning", then when the standard was written it was believed that there were 17,544 acres of "naturally functioning" SEZ (the total estimated area of SEZ in the Basin, 21,944 - 4,400 acres of disturbed, developed or subdivided SEZ). A five percent increase in "naturally functioning" SEZ would thus require restoration of 877 acres (0.05 multiplied by 17,544). This would result in a standard of 84 percent of the SEZ in the Region being in a naturally functioning state. However, the use of the 4,400 acres of disturbed, developed or subdivided may result in an underestimate of the total standard for SEZ restoration, because of the implicit assumption that subdivided SEZ are currently not functioning naturally. Subdivided but undeveloped SEZ could be naturally functioning. That would mean there are more than the standard's estimate of 18,421 acres of naturally functioning SEZ, and require more SEZ restoration than previously calculated.

   A 1998 report estimated the extent of disturbed, developed or subdivided SEZ in the Basin at 5,379 acres, almost 1,000 acres more than the 4,400 acres generally used to assess attainment (Huffman & Associates, Inc., 1998). If the 5,379-acre estimate was used to assess the percentage based targets, then;

   - The 25 percent target for SEZ restoration would increase to 1,345 acres (5,379 acres multiplied by 0.25), rather than the 1,100-acre target used today
   - The five percent target for increase in "naturally functioning" SEZ would decrease to 828 (21,944 acres minus 5,379 multiplied by 0.05), from the 877 acres used in the evaluation.

3. *Presence of multiple clauses within the standard:* Numerous clauses in the standard make consistent and objective evaluation of the standard challenging. The clauses and their targets need to be clarified and reconciled. This clarification should either split the standard into individual standards that can be independently evaluated or specifically state the criteria that should be used to aggregate the clauses in order to arrive at an attainment determination. The 2011Threshold Evaluation Report recommended removing the fourth part of the standard, "…to attain a 5 percent total increase in the area of naturally functioning SEZ lands" because it saw the target as redundant with the threshold standard 25 percent restoration goal in disturbed, developed or subdivided lands (i.e. 1,100 acres) (TRPA, 2012c). That reading is clearly inconsistent with this Threshold Evaluation Report, which interprets the two goals as concordant and self-reinforcing, further highlighting the need for clarification.

Revision or clarifications of the standards should also consider the findings and recommendations contained in the Roby (2015) SEZ review project. The review recommended numerous modifications to SEZ field delineation protocols to ensure they can be consistently applied to delineate SEZ (Roby et al., 2015). The project also developed a high resolution SEZ map for the basin that provides a typology of SEZ types with associated functions and values for each (Roby et al., 2015). The effort described and mapped the extent of eight types of SEZ: fens, forested, freshwater estuarine, lacustrine (beach), lacustrine (lakes/ponds), meadows, riverine, and seeps/springs. The map estimates that there are 29,391 acres of SEZ in the basin, covering 12.9 percent of the basin excluding the area of Lake Tahoe (Roby et al., 2015). It has previously been recognized, and this review supports the notion, that the establishment of standards for SEZ and management of SEZ towards those standards requires a detailed understanding of how SEZs function, the services individual SEZ provide, the value people place on those services, society's goal for those services, and how those services are impacted by human activities (Huffman & Associates, Inc., 1998; Roby et al., 2015; TRPA, 2012b).

Attain or Maintain Threshold – Maintain policies that limit activities on SEZ lands and continue to support the restoration of degraded SEZ lands. Review policies to further encourage the transfer of coverage from SEZ to higher capability lands. Revise field verification protocols to ensure consistency and compliance with the latest science (Roby et al., 2015)

Chapter 5 Soil Conservation References

Bailey, R.G., 1974. Land-Capability Classification of the Lake Tahoe Basin, California-Nevada, A Guide For Planning. USFS, USDA, TRPA, South Lake Tahoe, CA.

Coats, R., Reuter, J., Dettinger, M., Riverson, J., Sahoo, G., Schladow, G., Wolfe, B., Costa, M., Cabral-Cabral, M., 2010. The Effects Of Climate Change On Lake Tahoe In The 21st Century: Meteorology, Hydrology, Loading And Lake Response.

Huffman & Associates, Inc., 1998. Draft report of a classification system for stream environment zones within the Lake Tahoe Basin, Nevada and California. Huffman & Associates, Inc. / TRPA, Reno, NV.

Lahontan & NDEP, 2010. Final Lake Tahoe Total Maximum Daily Load Report. California Regional Water Quality Control Board, Lahontan Region & Nevada Division of Environmental Protection, South Lake Tahoe, California & Carson City, Nevada.

Loftis, W.R., 2007. Report to Tahoe Regional Planning Agency on revision of Tables 1, 2, 4, 5 and Appendix in Land-Capability Classification of the Lake Tahoe Basin, California-Nevada, A Guide for Planning (Bailey, 1974). USDA, Natural Resources Conservation Service1, Davis, California.

Muskopf, S., Vacirca, R., Gross, S., Oehrli, C., Cressy, D., 2009. Taylor-Tallac Ecosystem Restoration Plan. US Forest Service, Lake Tahoe Basin Management Unit, South Lake Tahoe, CA.

O'Neil-Dunne, J., Saah, D., Moody, T., Freed, T., Chen, Q., Moghaddas, J., 2014. Mapping hard and soft impervious cover in the Lake Tahoe Basin using LiDAR and multispectral images: a pilot study of the Lake Tahoe Land Cover and Disturbance Monitoring Plan. Spatial Informatics Group, LLC, Pleasanton, CA.

Raumann, C.G., Cablk, M.E., 2008. Change in the forested and developed landscape of the Lake Tahoe basin, California and Nevada, USA, 1940–2002. For. Ecol. Manag. 255, 3424–3439. doi:10.1016/j.foreco.2008.02.028

Roby, K., O'Neil-Dunne, J., Romsos, S., Loftis, W., MacFaden, S., Saah, D., 2015. A Review of Stream Environment Zone Definitions, Field Delineation Criteria and Indicators, Classification Systems, and Mapping – Collaborative Recommendations for Stream Environment Zone Program Updates. Spatial Informatics Group, LLC, Pleasanton, CA.

Rogers, J.H., 1974. Soil survey of the Tahoe basin area, California and Nevada. USDA Soil Conservation Service.

TRPA, 2016. Lake Tahoe Environmental Improvement Program Project Tracker.

TRPA, 2013. Lake Tahoe (208) Water Quality Management Plan Final U.S. EPA Adopted Plan. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 2012a. Code of Ordinances. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 2012b. 2011 Threshold Evaluation. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 2012c. 2011 Threshold Evaluation. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 2012d. Regional Plan. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 2010. Restoration in Progress, Environmental Improvement Program Update. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 2007. 2006 Threshold Evaluation Report. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 2001. Regional Plan for the Lake Tahoe Basin: 2001 Threshold Evaluation Draft. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 1996. 1996 Evaluation: Environmental Threshold Carrying Capacities and the Regional Plan Package for the Lake Tahoe Region. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 1991. 1991 Evaluation: Environmental Threshold Carrying Capacities and the Regional Plan Package. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 1988. Water Quality Management Plan for the Lake Tahoe Region. Vol. 3. Stream Environment Zone Protection and Restoration Program. Tahoe Regional Planning Agency, Zephyr Cover, NV.

TRPA, 1982. Study Report for the Establishment of Environmental Threshold Carrying Capacities. Tahoe Regional Planning Agency, Stateline, NV.

TRPA, 1978. Lake Tahoe Basin Water Quality Management Plan: Vol I Water Quality Problems & Management Problems. Tahoe Regional Planning Agency, Zephyr Cover, NV.

TRPA, 1977. Stream Environment Zones and Related Hydrologic Areas of the Lake Tahoe Basin. Tahoe Regional Planning Agency.

USDA-NRCS, 2007. Soil Survey of the Tahoe Basin Area, California and Nevada. United States Department of Agriculture, Natural Resources Conservation Service.