RESTORE AND MAINTAIN AQUATIC ECOSYSTEMS

ISSUE STATEMENT

Sierra Nevada watersheds provide as much as 65 percent of freshwater used by California's population (Timmer 2003) and constitute the single greatest benefit to the State Economy (Goldman 2000). If healthy, Sierran watersheds can also provide a wide array of ecological goods and services that are critical to local and distant human populations *as well as* native flora and fauna. The chemical, physical and biological integrity of aquatic ecosystems[1] is the core element of watershed function and resilience. In addition to water storage and delivery, the lakes, rivers, streams, springs, seeps, wetlands, floodplains, meadows, and fens of the Sierra support a range of landscape processes and provide critical habitat for a diverse assemblage of biological communities and species. Meadows, for example, serve to recycle nutrients, purify water, attenuate floods, recharge ground water and provide habitat for wildlife (Loeb 1994). Flood plains provide critical forage for fish and other aquatic species that have evolved in conjunction with the dynamic flood pulse, while their dynamic hydrology and geomorphology creates heterogenous habitats supporting rich biodiversity and bioproduction (Tockner et al. 2000). The collective aquatic habitats of the Sierra Nevada and Cascade ranges support 61 fish species and 37 amphibians (California Department of Fish and Game 2007). Of these, there are 40 species of fish native to the Sierra Nevada, 11 of which are endemic (Moyle et al. 1996). The Institute for Bird Populations estimates that there are 37 species of birds in the Sierra Nevada that are either critically dependent or strongly associated with montane meadows (Siegel and DeSante 1999).

Maintaining ecological resiliency is critical to the long-term health of aquatic, ecosystems and the larger watershed processes and biotic communities they support. Healthy aquatic ecosystems can quickly become degraded when their ability to functionally respond to perturbations is compromised, and as such, can serve as early indicators for potential larger scale watershed change or degradation. Lakes, for example, act as sentinels, providing signals that reflect the influence of climate change in their broader catchments (Williamson et al. 2008, Williamson et al. 2009).

In the Sierras, aquatic ecosystems are recognized as being one of the most degraded of all ecosystem types (Centers of Water and Wildland Resources 1996). Twenty-four percent of the native fish in the Sierra Nevada are listed as threatened or endangered under federal or state endangered species acts, 26% were found to be in danger of extinction in the near future, and another 26% were vulnerable to extinction if present declining trends continue, 26% were in decline, and only 17% were found to be relatively stable (Moyle et al., 2008, Moyle et al. 2011). Fifty percent of native amphibians were already at risk of extinction well over a decade ago (Jennings 1996). Current trends suggest there is an urgent need to proactively address the threats to aquatic ecosystems throughout the Sierra Nevada in order to preserve the critical ecosystems, species and resources they support (California Trout 2008, Derlet et al, 2010).

Threats to Aquatic Ecosystems

Primary threats to aquatic ecosystems in the Sierra include poorly managed grazing, improperly designed and/or placed road systems, invasive species, excessive water withdrawal; timber harvest and tree removal in and around aquatic habitats, and erosion and sedimentation from fire, all of which are potentially exacerbated by the effects of climate change.

[1] Aquatic ecosystem types generally fall within three distinct categories: (1) Lentic-comprised of slow moving water, including pools, ponds and lakes, (2) Lotic- comprised of rapidly-moving water, for example streams and rivers and (3) Wetlands-areas where the soil is inundated or saturated for at least some portion of time.

Poor grazing practices can result in a series of negative impacts to aquatic resources (Derlet 2010). Hyper-eutrophication can occur resulting from excessive deposition of manure which in turn marginalizes nutrient dynamics associated with water. When compared to ungrazed areas of the southern Sierra, grazed areas have been shown to have negative impacts on native trout (Knapp and Matthews, 1996). Poor grazing practices have also been shown to negatively impact riparian vegetation stream bank structure, and channel morphology which in turn affects water temperature and quality, as well as aquatic habitat community structure and food-web dynamics. With proper management, grazing can be less detrimental to riparian ecosystems.

Improperly designed, maintained and/or placed road systems and elevated road densities all have negative physical and biological impacts on aquatic ecosystems, particularly hydrologic processes and water and substrate quality via sedimentation (Furniss et al. 1991, Trombulak and Frissell 2000, Gucinski et al. 2001). Roads often constitute the primary sediment source as well as comprising much of the surface with a higher degree of imperviousness, resulting in increased runoff, and accelerated slope failure and land sliding on many slope types (Montgomery 1994, Gucinski et al. 2001). The most prevalent and critical cause of harm from forest roads to Sierran streams is the chronic and/or episodic injection of road runoff into surface waters from both upland and riparian roads. Roads that should be identified as a high priority for decommissioning include roads built in riparian areas, on steep inner gorge slopes, across unstable or highly erodible soils, in tributary canyons where stream crossings and steep slopes are common, roads with high short-term or long-term maintenance costs and requirements, and abandoned roads containing large or numerous sediment delivery sites.

Recreation, while often considered a benign activity on National Forest lands, can negatively impact aquatic ecosystems in a number of ways. Depending on the site, unmanaged off-highway vehicle (OHV) use in the national forest can have serious impacts on land and water, among them: (1) damage to wetlands and wetland species, (2) severe soil erosion and compaction, (3) destruction of streambank vegetation and habitat (4) stream sediment deposition and (4) spread of invasive species. Off-highway vehicles and the use of combustion engines also pose threats from the associated potential for igniting fires. To a lesser degree, depending on the intensity of use, pack-stock animals pose similar threats as OHVs. Less intrusive recreational activities such as dispersed camping within meadows or along riparian corridors, mountain biking and even hiking that involves crossing of creeks and other waterways potentially threaten elements of aquatic ecosystems resulting from sedimentation and damage to stream banks and riparian vegetation.

Invasive species have the capacity to negatively impact native flora and fauna through aggressive direct and indirect competition, and direct predation altering food web dynamics, as well as through significant alterations to critical habitat. Additionally, invasive species can displace native and/or naturalized species as a result of hybridization. Invasive species can degrade natural resource aesthetics, recreational opportunities and water related infrastructure resulting in significant economic challenges.

Over-exploitation of fresh water for human consumption results in excessive diversions of freshwater, negatively impacting water quality parameters essential for aquatic flora and fauna. For example, water diversions can contribute to increased water temperatures as a result of lower instream flows. In some cases where water diversions prevent or significantly modify a previously unimpaired river system, such diversions can inhibit flushing flows that support geomorphic processes as well as transporting sediments further down stream. In other cases, dewatering of river and creek systems has resulted in an absolute loss of

fisheries resources altogether (e.g., Mono Basin). The human demand for water has also resulted in the construction of storage facilities (e.g., dams), and in doing so eliminated fish passage necessary for fundamental life-cycle stages and the basic wellbeing of affected flora and fauna.

Riparian logging can result in direct and cumulative adverse impacts. Although thinning is often portrayed as ecologically benign or restorative, there is little support in the scientific literature to conclude as a general matter that logging or mechanical removal of vegetation in riparian areas will achieve aquatic restoration goals. Due to the highly degraded status of many Sierra streams and their riparian areas, coupled with the reality of restoration thinning projects that have been inadequately justified and are likely inconsistent with protection of aquatic resources, we recommend that additional direction be provided in the forest plan to clarify when near-stream disturbance is appropriate.

Forest thinning that is primarily intended to reduce fuels and attenuate fire behavior, change forest stand species composition, or accelerate tree growth, is often inconsistent with aquatic and riparian ecosystem conservation and recovery. As a general rule, thinning along streams that goes beyond "light touch" removal of fuels to allow for the safe application of prescribed fire is neither ecologically necessary nor beneficial from an aquatic protection and restoration perspective (Frissell et al. 2012). More intensive actions to "restore" stream environments are rarely justified by the claimed benefits of accelerated growth of remaining trees or the eventual recruitment of large wood to streams when weighed against the immediate impacts of wood removed, delayed senescence, direct and delayed impacts of the treatments themselves on soils and sediment, and concomitant watershed-wide impacts of building, rebuilding, or operating on logging roads to do the work.[2] In terms of setting priorities for aquatic and riparian restoration—given competition for scarce watershed restoration resources—the best available science indicates that watershed restoration actions focused on the reintroduction of fire and other disturbance processes (e.g., flooding), road storm-proofing, and decommissioning have far more certain and direct benefits and far fewer risks for aquatic ecosystems.

Climate change scenarios include predictions for increased stream water temperatures. If warming stream temperatures reach critical thresholds, the health and viability of fish and other aquatic species can become threatened (Thompson et al 2011). As stream temperatures increase, a more conducive environment for the introduction of invasive species as well as other undesired aquatic vegetation and potentially toxic algae will be realized (Coats et al. 2006). In a related manner, climate change also has direct implications on timing of hydrologic processes and in particular, shorter duration but more intense precipitation patterns. As a result of changing climatic patterns, snowmelt will occur in shorter periods resulting in lower late-summer/early-fall flows when ambient air temperatures are at their peak.

[2] As NOAA-NMFS has noted, riparian thinning is only a potential benefit "where there is already sufficient instream wood already present to provide habitat functions during the lag between thinning a forest and recruitment of logs from the thinned forest to the stream, and where existing trees are too small to form pools when they fall into streams." (NMFS 2008, page 8). This is a rare situation, however, because research shows that small trees are effective and in fact critical to forming pools in smaller streams, citing e.g. Beechie et. al. 2000. Id. NMFS further finds there is no scientific basis to contend thinning outside 100 feet can't decrease steam shading (a contention we have seen made to justify riparian thinning) or that less shade than that provided by natural site-potential conditions is required to meet aquatic ecosystem needs. Id. at 14. The US Environmental Protect Agency ("USEPA") has concurred with these and other concerns about riparian thinning (USEPA 2008).

Mandate to Maintain and Restore Aquatic Health

The threats noted above are clear and present dangers that require actions on the part of state and federal land management agencies. As the single largest land manager throughout the Sierra Nevada[3] it is incumbent upon the Forest Service to proactively mitigate such threats in the forthcoming revisions to the forest plan for national forests in the Sierra Nevada. Specifically, the revised forest plans should adequately address ecosystem protection, restoration and maintenance in the following ways:

- Maintain native biodiversity, and biotic community structure and function within and adjacent to aquatic ecosystems
- Protect and restore meadow and riparian habitats
- Protect ecosystem resiliency and functionality by maintaining physical, chemical and biological processes as well as associated landscape dynamics (connectivity, heterogeneity, succession, disturbance) supporting aquatic ecosystems
- Establish thresholds for key biological, physical, and ecological parameters as indicators for ecosystem integrity
- Establish and implement adequate monitoring and evaluation protocols to ensure the integrity of aquatic systems and enable effective ongoing stewardship within an adaptive management context
- Ensure protection of critical habitat, resource areas and the associated listed flora and fauna at adequate ecological scales

Fortunately, there are recent planning directives that could be used together to effectively accomplish the needed protection and restoration of aquatic systems. We describe below three of these directives.

[3] The U.S. Forest Services manages 47% of the entire Sierra Nevada, compared to roughly 6% and 10% of lands managed by the National Parks Service and the Bureau of Land Management respectively and 31% privately owned.

2012 Planning Rule

Regulations were adopted in early 2012 that provide specific direction to protect and restore aquatic systems. Overall, the rule elevates the importance of aquatic and riparian resources and the maintenance and restoration of watershed resiliency as a priority for Forest Service management. There are significant requirements that support aquatic conservation in the new planning rule (36 CFR 219), including:

- The identification in revised plans of watersheds that are a priority for maintenance and restoration;
- The structure and function of "Aquatic Ecosystems and Watersheds" must be maintained and restored; the rule specifically states that standards and guidelines must be adequate to maintain and restore water quality and water resources;
- Riparian Area Standards and Guidelines and other plan components must be adequate to maintain or restore "ecological integrity" of riparian areas, direction which goes beyond the need to meet Clean Water Act standards;
- Plan components to protect and restore the ecological integrity of riparian areas must take into account the following 6 attributes: water temperature/chemical composition; blockages; sediment deposits; aquatic and terrestrial habitats; ecological connectivity; restoration needs and floodplain values/risk of flood loss;
- Requirement that riparian management zone widths be established for all lakes, perennial and intermittent streams, and open water wetlands; and
- Establishes a definition of riparian management zone which makes clear that the primary emphasis for these zones is to "maintain or restore riparian functions and ecological functions."

Watershed Condition Framework

The Watershed Condition Framework ("WCF")(USDA Forest Service Watershed Condition Advisory Team, 2011) was adopted by the Forest Service in mid 2011. This program lays out a six-step process whereby all 6th-field watersheds (10,000 to 40,000 acres) will be classified according to their condition and prioritized for restoration according to watershed action plans. Implementation will be tracked and monitored. Condition class is determined according to a standardized process that employs 12 metrics (Potyondy et al. 2011) that are aggregated to generate a single index of watershed condition that places every watershed in one of only three categories: *functioning*, *functioning at risk* or *impaired*. In general, the individual metrics are more informative about restoration needs than the index itself, and additional watershed-specific information is needed to craft management actions that effectively address aquatic restoration priorities. Although not a perfect system (see Scurlock and Frissell 2012 for additional discussion), the process raises the profile of watershed condition nationally and compels Forests to concentrate their restoration resources in specific watersheds for maximum effect. Specifically, it makes a direct connection between watershed condition, threats to watershed health and a specific program of work, i.e. "essential projects." The initiative also encourages collaboration and partnerships to leverage resources and achieve restoration goals.

Using the WCF, twenty-four priority watersheds have been selected for the eleven national forests in the Sierra Nevada.[4] Initial Watershed Actions Plans were developed in 2011 (e.g., FY2011 Transition Watershed Restoration Action Plan, Oak Creek Watershed, Mt. Whitney Ranger District, Inyo National Forest[5]).

Travel Management Planning: Subpart A

Subpart A of the Travel Management Rule requires each national forest unit to complete a Travel Analysis Report, identify and map the minimum necessary road system and list unneeded roads (36 CFR § 212.5(b) and implementing guidance at FSH 7709.55, Chapter 20). The link between the condition of the road system and aquatic health is undeniable. Because of this essential connection, these three assessment and planning processes must inform each other. For the Sierra Nevada, it appears for many of the Watershed Restoration Action Plans have taken the step to integrate travel planning with the WCF process (Scurlock and Frissell 2012). Moreover, as identified by Scurlock and Frissell (2012), "Travel Analysis, and effective decision-making about road system and watershed restoration, itself need to be informed by four strings of knowledge drawn together: 1) the environmental costs, damages and risks associated with particular routes and segments, and 2) the cost of maintenance to acceptable environmental and traffic standard of particular routes and segments, 3) the cost of decommissioning them, and 4) the strategic importance of particular routes and segments to support forest uses.

We find that the forest plan is the best fit as a planning level for the integration of WCF, travel management planning and other resource planning. Such an approach would address both the programmatic need and the ecological effectiveness of integration across affected programs and services (Scurlock and Frissell 2012). The revision process offers the best opportunity to complete a systematic analysis, make strategic decisions, and execute the watershed protection and restoration duties under the 2012 planning rule.

[4] http://www.fs.fed.us/publications/watershed/ and http://www.fs.fed.us/publications/watershed/maps/R05_WCC_FS_Lands_v2.pdf

[5] http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5343812.pdf

POLICY ACTIONS NEEDED

Proposal for Revision to Forest Plan Direction

We believe that it is essential for revised forest plans to include an aquatic conservation strategy that is well integrated to upland ecosystems. Accomplishing this integration is not a simple task. Similar to past direction in Region 5 (USDA Forest Service 2004) and Region 6 (USDA Forest Service 2008), we propose the adoption of the following elements to support an integrated strategy that evaluates aquatic resources and implements protective and restorative actions.

Landscape analysis: This is a process to evaluate baseline conditions and set the context for restoration; it incorporates WCF information, travel planning analysis, and establishes priorities for action over a large scale (10,000 to 50,000 acres areas). This analysis provides the context and factual support for cumulative effects analysis and includes the results of various evaluations – e.g., estimates of equivalent roaded acres and stream condition surveys – to identify and prioritize restoration measures needed to maintain and restore aquatic resource conditions. Landscape analysis is also discussed in Section II.A. Planning and Integration of this strategy document.

Aquatic Diversity Emphasis (ADEs): These are watersheds identified for their high quality and function (Moyle et. al. 1996, Williams and Spooner 1998). Management direction in these areas is designed to ensure that aquatic resource protection and restoration are the primary outcomes, with minimal risk of offsetting harms from active or extractive management (Scurlock and Frissell 2012). Actions proposed within ADEs must be designed to meet the stated Riparian Conservation Objectives (RCOs). This designation is similar to the "Key Watersheds" adopted by national forest in Region 6 (USDA Forest Service 2008).

Riparian Conservation Areas (RCAs): Default buffers are established to ensure protection of riparian areas and associated uplands.These buffers are not ecotypes and include lands adjacent to perennial, intermittent, and ephemeral streams, meadows and marshes, other areas of near surface water influence, and groundwater-dependent ecosystems such as marshes, springs and fens. Revision of the default buffers is allowed following site specific analysis. Actions proposed within RCAs must be designed to meet the stated RCOs.

Species refuges: Specific land allocations are proposed to protect and restore specific at-risk species dependent upon riparian and aquatic ecosystems. The recommendations are provided in Section IV. E. Conservation of Species at Risk and Appendix A.

Objectives and Standards: These elements set the direction for protection and restoration.

A. Desired Condition *The following statements represent the desired future condition of the landscape and may not reflect the current conditions.*

Watersheds, the complex of rivers, streams, lakes, meadows, bogs, fens, wetlands, vernal pools, and springs, that comprise their networks, and the ecosystems they support function based on a suite of naturally occurring characteristics, features, processes, and dynamics. This assemblage maintains the physical and biological integrity of these nested systems, including water quality, stream channel stability, critical aquatic habitat, and biotic community structure. The integrity of these systems is the basis for their ability to respond and adjust to disturbances without long-term adverse changes. Desired conditions are those which maintain watershed integrity and promote resilience, at a range of spatial and temporal scales. Desired conditions should be 1) described relative to one or multiple appropriate reference sites or

conditions, 2) monitored for inter- and intra-annual variability and 3) adaptively managed to attain achievement.

Physical processes and dynamics

Desired Condition AQ-1. Physical (e.g., geomorphic, hydrologic) connectivity is maintained and associated surface processes (e.g., runoff, flood-pulse, in-stream flow regime, erosion, sedimentation, mass wasting) are functional.

Desired Condition AQ-2. In-stream, overland, and groundwater flows and natural storage (e.g., lakes, wetlands, aquifer, snowpack) operate based on a natural flow regime (including pattern, timing and flux rate of annual, seasonal, and daily maximum, minimum and mean flows) that is sufficient to provide for geomorphic maintenance of aquatic landscape, habitat structure, and ecosystem function.

Desired Condition AQ-3. Corridors and passage ensure that existing aquatic habitat and species fragmentation as a result of physical barriers or habitat alterations (e.g., temperature changes, loss of stream flow, non-native species predations/hybridization) does not exclude species from their historic habitat, or diminish historic range size.

Habitat

Desired Condition AQ-4. Critical habitat features and functionality are maintained to provide for the needs of all aquatic-dependent target species and species of concern.

Desired Condition AQ-5. Water quality is maintained across all aquatic habitat types meeting or exceeding state EPA water quality standards for designated use.

Desired Condition AQ-6. Sediment load and turbidity, as a component of water quality, are within the tolerance ranges of all target species as well as below established thresholds and within reference ranges. Potential drivers of increased sediment load (e.g., soil compaction, impervious surface, increased runoff) are monitored and mitigated. Specifically:

- Pollutants and nutrient load, as a component of water quality, are below the threshold for all adverse effects for all target species and productivity levels, and potential point and non-point sources of increased pollutants or nutrient load (e.g., cattle, wastewater, industry, mine drainage) are monitored and mitigated.
- Light, temperature, dissolved oxygen, and pH as components of water quality are within the tolerance ranges of all target species as well as below established thresholds and/or within reference ranges; and potential drivers of change to physical water quality (diversions, dams, levees, withdrawal, nutrient loading, upland land use, etc.) are monitored and mitigated.

Desired Condition AQ-7. Lotic aquatic habitats retain all of the necessary and appropriate attributes (including but not limited to adequate vegetation, landform, large woody debris, sediment load and quality) to function properly and support native biotic communities by: 1) dissipating stream energy associated with high water flows, 2) filter sediment, 3) capture bedload and aid floodplain development, 4) improve flood-water retention and ground-water recharge, 5) develop root masses that stabilize streambanks against cutting action, and 6) develop diverse ponding and channel characteristics to provide the habitat, water depth, duration and temperature necessary for greater biodiversity.

Desired Condition AQ-8. Lentic aquatic habitats retain all of the necessary and appropriate attributes (including but not limited to adequate vegetation, landform, large woody debris, sediment load and quality) to function properly and support native biotic communities by: 1) dissipating energies associated with wind action, wave actions, and

overland flow from adjacent sites, 2) filtering sediment and aiding floodplain development, 3) improving flood-water retention and ground-water recharge, 4) developing root masses that stabilize islands and shoreline features against cutting actions, 5) restricting water percolation and 6) developing diverse ponding characteristics to provide the habitat, water depth, duration and temperature necessary for fish production, waterfowl breeding, and greater biodiversity.

Desired Condition AQ-9. The ecological status of meadow vegetation is late seral (50 percent or more of the relative cover of the herbaceous layer is late seral with high similarity to the potential natural community). A diversity of age classes of hardwood shrubs is present and regeneration is occurring.

Biota and biotic communities

Desired Condition AQ-10. Aquatic habitats support well distributed, self-sustaining, and genetically diverse populations of appropriate native fauna, including species of concern, target species, and indicator species (vertebrates and invertebrates), relative to established reference sites and conditions.

Desired Condition AQ-11. Aquatic habitats support well distributed, self-sustaining, and adequately genetically diverse populations of appropriate aquatic algae, phytoplankton, macrophytes, riparian herbaceous and woody vegetation, and upland chaparral and forest species.

Desired Condition AQ-12. The full range of aquatic ecosystem types including physical habitats, habitat features, biotic communities, species, and associated processes, functions, and ecological interactions, are restored relative to established reference conditions including:

- Recovery of threatened, endangered, and sensitive aquatic and riparian-dependent species.
- Prioritization and conservation of remaining native aquatic species, native community strongholds, and high quality habitats.
- Improvement or maintenance of appropriate geomorphic and hydrologic conditions to support the needs of the physical habitat and biotic community

Management and stewardship

Desired Condition AQ-13. Watersheds, at all scales, are managed to restore and maintain native biotic communities, across all appropriate taxonomic groups and trophic levels and regardless of species listing or status.

Specific to Aquatic Diversity Emphasis (ADE) Watersheds

The general desired conditions for aquatic ecosystems apply in the RCAs and ADEs. In addition, the following desired conditions are applicable to the ADE land allocation.

Desired Condition AQ-14. ADEs exhibit natural streamflows, and dams and diversions are not present.

Desired Condition AQ-15. Aquatic organism passage is not impaired by road stream crossings except where barriers are necessary to protect native species from invasion by nonnative species.

Desired Condition AQ-16. ADEs are withdrawn from mineral entry.

Desired Condition AQ-17. Road density is 1.5 mi per mi^2 or less and the existing road density does not increase over time.

B. Objectives

The following objectives were adapted from USDA Forest Service and USDI Fish and Wildlife Service (1995) and recommendations in Scurlock and Frissell (2012).

Quantitative

These objectives are not intended to represent fixed threshold levels. They are intended to provide the basis from which to develop objectives that best fit the site, reach or subwatershed scale (USDA Forest Service 2001, Appendix I, p. 102).

Applicable to Low Gradient Streams (<2%) and Banks Comprised of Fine-Textured Material

Objective AQ-1. Upward trend in bank angle, with target of 100 degree average for reaches. Maintain streambanks to ensure protection of aquatic systems to which species are uniquely adapted.

Objective AQ-2. Upward trend in bank stability, with target of 90% stability for reaches.

Objective AQ-3. Upward or stable trend in width-to-depth measures, as compared to reference stream data, measured at flat water habitat types.

Objective AQ-4. Target is upward trend in vegetation, to target age classes, structural diversity and cover representative of good condition for the vegetative community.

Objective AQ-5. Target is connectivity evident on 90% of all alluvial reaches. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Generally Applied to Streams and RCAs

Objective AQ-6. The shade obtainable in the RCA is stable or trending upward relative to the potential natural vegetative community.

Objective AQ-7. Levels of large woody debris reflect potential natural condition in terms of frequency and distribution and mimic natural conditions. Large woody debris is sufficient to sustain physical complexity and stability.

Objective AQ-8. Establish acceptable proportions of fines within a pool tail using the following guidance (USDA Forest Service and USDI Fish and Wildlife Service 1995):

- Mainstem<10%
- Tributaries in non-rhyolitic soils <15%
- Tributaries in rhyolotic soils <20%

Objective AQ-9. Establish acceptable levels of embeddedness at riffles and pool tails using the following guidance (USDA Forest Service and USDI Fish and Wildlife Service 1995):

- Mainstem <10%
- Tributaries in non-rhyolitic soils <15%
- Tributaries in rhyolotic soils <20%

Objective AQ-10. Residual pool depth does not decrease over time due to management activities.

Objective AQ-11. Temperature does not increase beyond reference/historical values due to management activities.

Objective AQ-12. The target for large wood recruitment is an upward trend that reflects the age classes and structural diversity of unmanaged stands of the similar community type. Riparian Conservation Areas (RCAs) trend toward the natural range of variability appropriate for the site and local conditions.

Objective AQ-13. Maintain ground covering litter, duff, and/or vegetation on at least 90% of non-rocky riparian areas.

General

Objective AQ-14. All Forest Service projects and decisions meet state and federal water quality

requirements, including the Porter-Cologne Water Quality Control Act (PCA), water quality control regulations, plans, policies, and program plans approved by the State Water Resources Control Board (SWRCB) pursuant to the foregoing federal and state statutes.

Objective AQ-15. Applicable Best Management Practices (BMPs) are fully implemented and monitored for their effectiveness. The monitoring system is transparent, informs the State Water Board and the public of failures, and is effective in applying adaptive management to improve future projects.

Objective AQ-16. Degraded or impaired water bodies are identified and prioritized for the remediation and a schedule adopted for remediation.

Objective AQ-17. Maintain resiliency through redundancy of key habitat types (e.g. lakes, streams, rivers, fens, wet meadows) and features (e.g. riffles, pools, emergent vegetation), and maintenance of ecosystem services, refugia, and connectivity.

Objective AQ-18. Restore or improve the ecological balance and connectivity within and across habitats that are negatively affected by non-indigenous invasive or problem species

Objective AQ-19. All Forest Service projects and decisions improve or maintain and do not degrade aquatic ecosystems.

Objective AQ-20. Spread of diseases and non-native species through direct or indirect anthropogenic vectors is eliminated.

Objective AQ-21. Management activities focus on the restoration of landscape dynamics (e.g. connectivity, heterogeneity, succession, disturbance) and associated processes (e.g. fire regime, flood regime) to promote long-term ecosystem sustainability and resilience, while minimizing mechanical alterations to habitat and other highly invasive and resource intensive approaches to landscape management, except those of an emergency, short term nature necessary to reestablish landscape functionality.

Objective AQ-22. Identify and implement restoration actions to maintain, restore or enhance water quality and maintain, restore, or enhance habitat for riparian and aquatic species.

Riparian Conservation Objectives

The general objectives above for the aquatic ecosystem apply in the RCAs and ADEs. In addition, the following objectives are applicable to RCAs and more generally applied in the ADE land allocation.

Objective AQ-23. Ensure an adequate, renewable supply of large down wood, while recognizing and accommodating natural variation in time and space due to fire, floods, disease, and other natural disturbances. Large wood must be able to reach the stream channel and provide suitable habitat within and adjacent to the RCA. Natural recruitment processes for large wood remain functional and large wood is not removed as a result of management in RCAs, excepting that which is consumed by wildfire or prescribed fire.

Objective AQ-24. Maintain or restore: 1) the geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, and springs; 2) streams, including in stream flows; and 3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.

Objective AQ-25. Ensure that management activities, including fuels reduction actions, within RCAs and ADEs enhance or maintain physical and biological characteristics associated with aquatic- and riparian-dependent species.

Objective AQ-26. Meadows, streams and other aquatic features are hydrologically functional. Projects are designed to stabilize and recover sites from accelerated erosion. Such sites, e.g., gullies and headcuts, are identified and projects implemented to stabilized or recover them.

Objective AQ-27. Road reduction and remediation is a high priority for action in ADEs.

C. Standards

The following standards were adapted from USDA Forest Service and USDI Fish and Wildlife Service (1995), USDA Forest Service (2008) and recommendations in Scurlock and Frissell (2012).

General Management in Riparian Conservation Areas (RCAs)

Standard AQ-1. Project activities in RCAs:

- When RCAs are properly functioning,[6] project activities should maintain those conditions.
- When RCAs are not properly functioning, and to the degree that project activities would drive or contribute to improper function, project activities should improve those conditions.
- Project activities in RCAs should not result in long-term degradation to aquatic and riparian conditions at the watershed scale. Limited short term or site-scale effects from activities in RCAs may be acceptable when they support, or do not diminish, long-term benefits to aquatic and riparian resources.

Standard AQ-2. Apply herbicides, insecticides, pesticides and other toxicants, and other chemicals only when long-term effectiveness can be clearly demonstrated, to maintain, protect, or enhance aquatic and riparian function and composition.

Standard AQ-3. Trees that are felled within RCAs should be retained onsite to maintain, protect, or enhance aquatic and riparian resources.

Standard AQ-4. Locate water drafting in sites that present the least harm to aquatic and riparian resources and manage sites to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat.

Standard AQ-5. Pumps shall be screened at drafting sites to prevent entrainment of fish and shall have one-way valves to prevent back-flow into streams.

Vegetation Management

Standard AQ-6 Timber harvest and thinning should occur in RCAs only as necessary to maintain, restore or enhance conditions that are needed to support aquatic and riparian dependent resources.

Standard AQ-7. Fuelwood cutting shall not be authorized in the active floodplain or within primary source areas for large woody debris. Active floodplain is the area bordering a stream that is inundated by flows at a surface elevation defined by two-times the maximum bankfull depth (i.e., bankfull depth measured at thalweg).

[6] Assessment of properly functioning or fully functioning condition is a concept originally developed by the BLM to assess the natural habitat forming processes of riparian and wetland areas (Pritchard et al. 1994). Ecosystems at any temporal or spatial scale are in a properly functioning condition when they are dynamic and resilient to perturbations to structure, composition and processes of their biological and physical components (USDA Forest Service 1998). Primary elements typically include hydrologic characteristics, physical structure/form, vegetative characteristics, water quality and aquatic/riparian biological community characteristics. The general methodology provides an integrated measure of condition and can be used at a variety of scales from individual reaches to watersheds. The basic approach is used to assess a wide range of process-based, riparian and aquatic conditions. The current process in Region 6 is to assess watershed condition, which uses the Ecosystem Management Decision Support (EMDS) model used at the sub-watershed and watershed scales. This general methodology has also been used for salmonid systems by the NMFS (1996) and as a tool in salmon conservation and recovery planning (e.g., Ecosystem Diagnosis and Treatment Model (EDT) described by Lestelle et al. 2004).

Standard AQ-8. The salvage of dead or dying trees following wildfire is limited to activity necessary to address safety concerns.

Standard AQ-9. Avoid locating new landings, designated skid trails, staging or decking in RCAs. If no alternatives exist and the management activities are necessary to maintain, restore or enhance conditions that support aquatic and riparian dependent resources, design these features to:

- Be of minimum size;
- Be located outside the active floodplain; and
- Minimize effects to large wood, bank integrity, temperature, and sediment levels.

Road Management

Standard AQ-10. Avoid new road construction in RCAs except where necessary for stream crossings.

Standard AQ-11. Avoid side-casting (placement of unconsolidated earthen waste materials resulting from road construction or maintenance) in RCAs.

Standard AQ-12. Avoid placing fill material on organic debris in RCAs.

Standard AQ-13. Minimize or avoid disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow when constructing or reconstructing any roads or landings.

Standard AQ-14. Avoid wetlands and unstable areas when reconstructing existing roads or constructing new roads and landings.

Standard AQ-15. New or replaced permanent stream crossings shall accommodate at least the 100-year flood, including associated bedload and debris.

Standard AQ-16. Construction or reconstruction of stream crossings should avoid diversion of streamflow out of the channel and down the road in the event of crossing failure.

Standard AQ-17. In fish bearing streams, construction or reconstruction of stream crossings will provide and maintain passage for all fish species and all life stages of fish.

Standard AQ-18. Construction or reconstruction of stream crossings should allow passage for other riparian dependent species.

Standard AQ-19. Fish passage barriers should be retained where they serve to restrict access by undesirable non-native species and are consistent with restoration of habitat for native species.

Standard AQ-20. Minimize hydrologic connectivity of the road system and delivery of sediment from roads to watercourses. This includes roads inside and outside of RCAs.

Standard AQ-21. Road drainage should be routed away from potentially unstable channels, fills, and hillslopes. This applies both inside and outside of RCAs.

Standard AQ-22. Protect fish habitat and water quality when withdrawing water for administrative purposes.

Grazing Management

Standard AQ-23. Avoid locating livestock handling, management or watering facilities in RCAs.

Standard AQ-24. Prohibit livestock trailing, bedding, loading, and other handling activities in RCAs.

Standard AQ-25. Permit livestock and packstock use of RCAs and ADEs where aquatic and riparian resources are maintained, protected, or enhanced and where allowing such activities does not retard or prevent attainment of aquatic conservation objectives.

Standard AQ-26. Suspend grazing in RCAs that contain perennial saturated meadows with non-cohesive soils which only contain shrubs, grasses, and forbs. Prevent grazing in seeps, springs, fens, and other unique wetted areas.

Standard AQ-27. Eliminate livestock access to spawning reaches of streams during the spawning and incubation period.

Standard AQ-28. Permit grazing only where livestock can be prevented, through fencing or other means, from entering riparian and wet meadow areas that are off limits to grazing.

Standard AQ-29. Mineral extraction, including hard-rock mining and suction dredging, in RCAs shall be permitted in situations where such activities do not impede the attainment of aquatic and riparian conservation objectives, as determine through landscape analysis. In situations where the conservation objectives have been met or are exceeded, the effects of mineral extraction shall not contribute to a decline in the existing condition.

Standard AQ-30. Develop ecological objectives for aquatic and riparian habitats affected by livestock and packstock management during landscape analysis or allotment planning. Until such standards limit grazing and packstock use to:

- 40% utilization for upland areas in good condition;
- 20% utilization for upland areas in poor condition;
- 5-inches stubble height for meadows and riparian areas in good condition;
- 7-inches stubble height for meadows and riparian areas in poor condition;
- 5% maximum annual utilization on new growth on riparian browse species and oaks;
- 15% maximum annual utilization on new growth on highly palatable upland browse species; and
- 5% limit on streambank alteration.

Standard AQ-31. On each national forest establish a minimum of six water quality monitoring stations for *E. coli* and other potential pathogens impacting public health and safety in high use recreation areas and meadows where high levels of grazing currently occur and spot monitoring of streamcourses witin all allotments.

Standard AQ-32. Restrict grazing in monitored areas where level of *E. coli* or others pathogens persist after 2 years of mitigation failure where there is a risk to public health as determined by basin plans.

Recreation Management

Standard AQ-33. Avoid placing new facilities or infrastructure within expected long term channel migration zone. Where activities inherently must occur in RCAs, e.g., road stream crossings, boat ramps, docks, interpretive trails, locate them to minimize impacts on riparian dependent resources (e.g., within geologically stable areas, avoiding major spawning sites).

Standard AQ-34. Remove or relocate existing recreation facilities that are in conflict with maintaining, protecting, or enhancing aquatic and riparian resources.

Standard AQ-35. Remove or relocate all existing OHV routes within meadow systems during the first decade of implementation of the new forest plan.

Minerals Management

Standard AQ-36. Avoid adverse effects to aquatic and other riparian dependant resources from mineral operations and do not allow activities that retard or prevent attainment of aquatic conservation objectives in the short or long term.

Standard AQ-37. Locate structures and support facilities for mining outside RCAs.

Standard AQ-38. Locate mine waste outside of RCAs.

Standard AQ-39. Do not issue new permits for suction dredge operations on National Forest Lands.

Fire Management

Standard AQ-40. Temporary fire facilities (e.g., incident bases, camps, wheelbases, staging areas, helispots and other centers) for incident activities should be located outside RCAs. When no practical alternative exists, all appropriate measures to maintain, restore, or enhance aquatic and riparian dependent resources should be used.

Standard AQ-41. Aerial application of chemical retardant, foam, or other fire chemicals and petroleum should be avoided within 300 feet of waterways.

Standard AQ-42. Water drafting sites for emergency response should be located and managed to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat.

Standard AQ-43. Pumps for emergency response shall be screened at drafting sites to prevent entrainment of native and desired non-native fish and shall have one-way valves to prevent back-flow into streams.

Standard AQ-44. Portable pump set-ups for emergency response shall include containment provisions for fuel spills and fuel containers shall have appropriate containment provisions. Vehicles shall be parked in locations that avoid entry of spilled fuel into streams.

Standard AQ-45. Generally locate and configure fire lines to minimize sediment delivery, creation of new stream channels and unauthorized roads and trails.

Standard AQ-46. Use Minimum Impact Suppression Tactics (MIST) during fire suppression activities in RCAs (NWCG 2006).

Lands and Special Uses, including Hydropower

Standard AQ-47. Authorizations for all new and existing special uses including, but not limited to water diversion or transmission facilities (e.g., pipelines, ditches), energy transmission lines, roads, hydroelectric and other surface water development proposals, shall result in the re-establishment, restoration, or mitigation of habitat conditions and ecological processes identified as being essential for the maintenance or improvement of habitat conditions for fish, water and other riparian dependent species and resources. These processes include in-stream flow regimes, physical and biological connectivity, water quality, and integrity and complexity of riparian and aquatic habitat.

Standard AQ-48. Locate new support facilities outside of RCAs. Support facilities include any facilities or improvements (e.g., workshops, housing, switchyards, staging areas, transmission lines) not directly integral to the production of hydroelectric power or necessary for the implementation of prescribed protection, mitigation or enhancement measures.

Standard AQ-49. If existing support facilities are located within the RCAs, they should be operated and maintained to restore or enhance aquatic and riparian dependent resources. At time of permit reissuance, consider removing support facilities, where practical.

Aquatic Diversity Emphasis (ADE)

Standard AQ-50. Allow no net increase in the mileage of roads in any ADE unless doing so results in a reduction in road-related impact and risk to watershed condition. The term “no net increase” means that for each mile of new road constructed at least one mile of road must be decommissioned to a hydrologically stable and self-maintaining condition. The

decommissioning must occur at the same time or before the road construction. Priority for decommissioning should be given to roads that pose the greatest relative ecological risks to riparian and aquatic ecosystems.

Standard AQ-51. Hydroelectric and other water development authorizations shall include requirements for in-stream flows and habitat conditions that maintain or restore native fish and other desired aquatic species populations, riparian dependent resources, favorable channel conditions, and aquatic connectivity.

Standard AQ-52. New hydroelectric facilities and water developments shall not be located in an ADEs unless it can be demonstrated they have minimal risks and/or no adverse effects to fish and water resources for which the key watershed was established.

Restoration

Standard AQ-53. Design and implement watershed restoration projects in a manner that promotes the long-term integrity of ecosystems, conserves the genetic integrity of native species, and contributes to attainment of desired conditions and achieve objectives.

Standard AQ-54. Cooperate with Federal, State, local, and Tribal agencies, and private landowners to develop watershed-based Coordinated Resource Management Plans (CRMPs) or other cooperative agreements to meet desired conditions and achieve objectives.

Standard AQ-55. Do not use planned restoration as a substitute for preventing habitat degradation (i.e., use planned restoration only to mitigate existing problems, not to mitigate the effects of proposed activities with restoration activities).

Standard AQ-56. Apply appropriate erosion control measures to landings, skid trails and other sediment source areas. Obliterate or decommission source areas on sensitive landforms such as RCAs and steep slopes. Emphasize use of prescriptions that require little to no maintenance. Where revegetation is used, use native species (or non-native species that are not persistent). Priorities areas for such activities are areas:

- Within RCAs;
- That drain to and exacerbate road drainage and erosion problems;
- In subwatersheds that drain directly to anadromous holding and spawning habitat; and
- In rhyolitic soils.

Special Habitats

Standard AQ-57. Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum moss (*Spagnum spp*.), (2) mosses belonging to the genus *Meessia*, and (3) sundew (*Drosera spp*.) Complete initial plant inventories of bogs and fens within active grazing allotments prior to re-issuing permits (USDA Forest Service 2004).

Standards and Conservation Measures for Species Associated with Aquatic and Riparian Habitats

Species-specific standards and conservation measures are presented in Appendix A for the species listed in Table IV D-1.

Table IV D-1. Species associated with riparian or aquatic habitats for which standards and conservation measures have been included in Appendix A.

Scientific Name	Common Name	Reason for Inclusion
Strix nebulosa	Great gray owl	Species at risk
Rana sierrae	Sierra Nevada yellow-legged frog	Species at risk
Bufo canorus	Yosemite toad	Species at risk
Oncorhychus mykiss aguabonita	California golden trout	Species at risk
Oncorhychus mykiss aquilarum	Eagle Lake rainbow trout	Species at risk
Oncorhychus mykiss subsp	Goose Lake redband trout	Species at risk
Mylopharodon conocephalus	Hardhead	Species at risk
Lampetra hubbsi	Kern brook lamprey	Species at risk
Oncorhynchus clarki henshawi	Lahontan cutthroat trout	Species at risk
Catostomus platyrhynchus	Mountain sucker	Species at risk
Rinichthys osculus. subsp	Owens speckled dace.	Species at risk

D. Land Allocations

Table IV D-2. Land allocations primarily focused on aquatic ecosystems.

Land Allocation	Definition	Management Objective
Riparian Conservation Area (RCA)	Defined by stream type and condition Ranges from 150 feet to 300 feet from the midpoint of the stream. The RCA widths below may be adjusted at the project level if a landscape analysis has been completed and a site-specific assessment of the riparian conservation objectives (RCOs) demonstrates a need for different widths. Perennial Streams: 300 feet on each side of the stream, measured from the bank full edge of the stream. Seasonally Flowing Streams (includes intermittent and ephemeral streams): 150 feet on each side of the stream, measured from the bank full edge of the stream Streams in Inner Gorge: top of inner gorge (Inner gorge is defined by stream adjacent slopes greater than 70 percent gradient) Special Aquatic Features or Perennial Streams with Riparian Conditions extending more than 150 feet from edge of streambank or Seasonally Flowing streams with riparian conditions extending more than 50 feet from edge of streambank: 300 feet from edge of feature or riparian vegetation, whichever width is greater. Special Aquatic Features include: lakes, wet	Restore ecological process where doing so does not threaten critical values. Maintain, restore, enhance, and protect. Limited levels of ground and vegetation disturbance allowed. Avoid actions that retard or prevent attainment of aquatic conservation objectives.

Land Allocation	Definition	Management Objective
	greater. Special Aquatic Features include: lakes, wet meadows, bogs, fens, wetlands, vernal pools, and springs. Other hydrological or topographic depressions without a defined channel: RCA width and protection measures determined through project level analysis. Inner gorge is defined by stream adjacent slopes greater than 70 percent gradient. Special Aquatic Features include: lakes, wet meadows, bogs, fens, wetlands, vernal pools, and springs.	
Aquatic Diversity Emphasis (ADE)	Watershed in which protecting or maintaining aquatic diversity is the priority.	Restore ecological process where doing so does not threaten critical values. Avoid actions that retard or prevent attainment of aquatic conservation objectives.
Yosemite Toad (YT)	Habitat around sites with YT including wet meadows with standing water and saturated soils, streams, springs, important upland habitat, and habitat identified as "essential habitat" in the conservation assessment for the Yosemite toad.	Provide habitat conditions to support successful reproduction and persistence. Maintain hydrologic function of meadow system. Limit human uses in areas not currently in excellent condition.
Willow Flycatcher: Occupied and Emphasis (WF)	**Occupied habitats** are meadows or riparian sites with documented willow flycatcher. **Emphasis habitat** are defined as meadows larger than 15 acres that have standing water on June 1 and a deciduous shrub component.	Provide habitat conditions to support successful reproduction and persistence. Limit human uses in areas not currently in excellent condition. Maintain hydrologic function of meadow system.
Great gray owl Protected Activity Center (PAC)	Designation around known nesting sites for great gray owl (50-200 acres). Inclusion in PAC of area within 300 feet of structures is avoided.	Provide habitat conditions to support successful reproduction. Manage for very low risk of loss of occupancy.

Recommended Actions at the National Forest Level Not Directly Addressed in the Forest Plan

- Encourage citizen watershed monitoring groups to collaborate with the Forest Service to establish ongoing water quality and trend and condition monitoring for riparian and aquatic resources on each national forest.

Recommendations for New Regional Direction or Policy

- Establish and implement scientifically proven methodologies that include monitoring and evaluation mechanisms to guide protection and restoration of aquatic ecosystems.

- As a means to more effectively adapt to climate change, ensure that principles of ecological resiliency guide protection and restoration of aquatic and adjacent ecosystems. It is essential to address the need for resilience associated with aquatic ecosystems through the provision of refugia, maintenance of critical habitats, and the functional connectivity between various habitats supporting aquatic species.

- Provide direction on aquatic conservation planning based on sound science, rigorous research, open and inclusive planning processes, collaborative monitoring, and input from a broad and diverse group of stakeholders.

- Provide guidance to national forest on how to manage aquatic ecosystems across relevant scales, including guidance on how to integrate planning at the reach-level with the larger watershed scale.

- Secure consistent and adequate institutional financial and technical support to support proper management of aquatic systems.

- Provide regional assessments and conservation strategies for use in forest planning that are based on sound science, rigorous research, ongoing resource monitoring, open and inclusive planning processes, and input from a broad and diverse group of stakeholders.

Additional Recommendations

- Cooperate with Federal, Tribal, State and local governments to secure in-stream flows needed to maintain, recover, and restore riparian resources, channel conditions, and aquatic habitat. Maintain in- stream flows to protect aquatic systems to which species are uniquely adapted. Minimize the effects of stream diversions or other flow modifications from hydroelectric projects on threatened, endangered, and sensitive species.

- California Department of Fish and Game should be allocated the resources to monitor and enforce the distribution of sensitive fish and other aquatic species populations and to engage effectively in water-rights decision processes, water diversion issues, land-management planning and conservation planning actions to restore and enhance aquatic systems (California Department of Fish and Game 2007).

- Promote the involvement of California Department of Fish and Game during the FERC relicensing process to pursue changes in operations of hydropower projects that will provide more water for wildlife, mandate that water flows be managed as close to natural flow regimes as possible, and ensure that the new license agreements provide the best possible conditions for ecosystems and wildlife (California Department of Fish and Game 2007).

- During relicensing of FERC hydroelectric projects, evaluate modifications to the natural hydrograph caused by the project. Determine and recommend in stream flow requirements and habitat conditions that maintain, enhance, or restore all life stages of native aquatic species, and that maintain or restore riparian resources, channel integrity, and fish passage. Provide written and timely license conditions to FERC. Coordinate relicensing projects with the appropriate State and Federal agencies.

- Promote to the California Department of Fish and Game the establishment of trout-free sub-basins and lakes across the high Sierra and Cascades to restore amphibians and other native species while concurrently improving trout fisheries in other lakes (California Department of Fish and Game 2007).

Table IV.D-3. Conservation status of forest-dwelling aquatic and riparian-dependent species of special concern on national forests in the Sierra Nevada (updated from USDA Forest Service 2001, Appendix R, Tables R.3, R.4, R.5) (Scurlock and Frissell 2012, Appendix A).

Common Name ***Latin name***	**National Forest Occurrence** (if known)	**Conservation Status**
Bigeye marbled sculpin *Cottus klamathensis macrops*	Lassen, Shasta-Trinity, Modoc?	CA Species of Special Concern AFS Vulnerable
Black toad *Anaxyrus exsul*	Not known to occur on national forest lands (USDA Forest Service 2000).	CA Threatened CA Fully Protected
Blue chub *Gila coerulea*		CA Species of Special Concern
Breckenridge Mt. Slender salamander *Batrachoseps spp.*	Sequoia (but "possibly extinct") (USDA Forest Service 2000).	CA Species of Special Concern FS Sensitive Species
Bull trout, *Salvelinus confluentus*	Shasta-Trinity (Extinct)	Considered extinct CA Endangered Species
California red-legged frog, *Rana aurora draytonii*	Plumas (Butte County), near Eldorado, maybe on Tahoe (USDA Forest Service 2000)	Federal ESA threatened CA Species of Special Concern
California tiger salamander *Ambystoma californiense*	Lassen, Plumas, Sierra, Sequoia within range, but no FS records of presence. (USDA Forest Service 2000)	Federal ESA Threatened Species CA Threatened Species CA Species of Special Concern
Cascade Frog *Rana cascadae*	Lassen, Modoc	CA Species of Special Concern FS Sensitive Species
Central Valley fall run Chinook salmon *Oncorhynchus tshawytscha*	Lassen	CA Species of Special Concern NMFS Species of Concern FS Sensitive Species AFS Vulnerable
Central Valley late fall run Chinook salmon *Oncorhynchus tshawytscha*	Lassen	CA Species of Special Concern NMFS Species of Concern FS Sensitive Species AFS Vulnerable
Central Valley spring run Chinook salmon, *Oncorhynchus tshawytscha*	Lassen	Federal ESA Threatened CA Threatened AFS Threatened
Central Valley winter run Chinook salmon, *Oncorhynchus tshawytscha*	Lassen	CA Threatened
Central Valley winter steelhead *Oncorhynchus mykiss irideus*	Lassen	Federal ESA threatened AFS Threatened Species
Cowhead Lake tui chub *Siphateles bicolor vaccaceps*	Modoc vicinity, but found outside areas of national forest influence	CA Species of Special Concern AFS Endangered
Eagle Lake rainbow trout *Oncorhynchus mykiss aquilarum*	Lassen	CA Species of Special Concern FS Sensitive Species AFS Threatened
Eagle Lake tui chub *Siphateles bicolor*	Lassen	CA Species of Special Concern

Common Name ***Latin name***	**National Forest Occurrence** (if known)	**Conservation Status**
Foothill Yellow-Legged Frog *Rana boylii*	Eldorado, Lassen, Plumas, Sequoia, Sierra, Stanislaus, Tahoe	CA Species of Special Concern FS Sensitive Species BLM Sensitive species
Goose Lake lamprey *Lampetra tridentate ssp.*	Modoc	CA Species of Special Concern AFS Vulnerable
Goose Lake redband trout *Oncrohynchus mykiss ssp.*	Modoc	CA Species of Special Concern FS Sensitive Species AFS Vulnerable
Goose Lake sucker *Castomus occidentalis lacusanerinus*	Modoc	CA Species of Special Concern FS Sensitive AFS Vulnerable
Goose lake tui chub *Gila bicolor thalassina*	Modoc	CA Species of Special Concern FS Sensitive AFS Threatened
Hardhead *Mylopharodon conocephalus*	All	CA Species of Special Concern FS Sensitive Species
High Rock Spring tui chub, *Gila bicolor ssp.*	Plumas NF is contributing area to Honey Lake Basin http://www.dfg.ca.gov/habcon/info/fish_ssc.pdf,]	Considered extinct CA Species of Special Concern
Inyo Mountains Salamander *Batrachoseps campi*	Inyo, Sequoia (?)	CA Species of Special Concern BLM Sensitive Species FS Sensitive Species
Kern brook lamprey *Lampetra hubbsi*	Sierra, Sequoia, Stanislaus, Eldorado	CA Species of Special Concern AFS Threatened
Kern Canyon Slender Salamander *Batrachoseps simatus*	Sequoia	CA Threatened Species FS Sensitive Species
Kern Plateau Salamander *Batrachoseps robusts*	Inyo, Sequoia	FS Sensitive Species
Kern River rainbow trout *Oncorhynchus mykiss gilberti*	Sequioa	CA Species of Special Concern AFS Threatened
Klamath largescale sucker *Castomus snyderi*	Modoc (partial contributing area, Lost R.)	CA Species of Special Concern AFS Threatened
Lahontan cutthroat trout *Oncorhynchus clarki henshawi*	Tahoe	Federal ESA Threatened AFS Threatened
Lahontan Lake tui chu *Gila bicolor pectinifer*	Tahoe, Lake Tahoe Basin	CA Species of Special Concern FS Sensitive
Limestone salamander *Hydromantes brunus*	Sierra, Stanislaus	CA Threatened Species CA Fully Protected Species FS Sensitive Species
Little Kern golden trout *Oncorhyncus mykiss whitei*	Sequioa	Federal Threatened AFS Endangered
Lost River Sucker *Deltistes luxatus*	Modoc (partial contributing area, Lost R.)	Federal Endangered CA Endangered CA Fully Protected AFS Endangered
McCloud River redband trout	Shasta-Trinity	CA Species of Special Concern FS Sensitive Species AFS Vulnerable

Common Name ***Latin name***	**National Forest Occurrence** (if known)	**Conservation Status**
Modoc sucker *Castomus microps*	Modoc	Federal ESA Endangered CA Endangered CA Fully Protected AFS Endangered
Mount Lyell Salamander *Hydromantes platycephalus*	Potentially on 8 national forests (SNFPA DEIS 2000)	CA Species of Special Concern
Mountain sucker *Castomus platyrhynchus*	All	CA Species of Special Concern
Mountain whitefish *Prosopium williamsoni*	Tahoe, Eldorado	"near threatened" (Moyle 2011)
Mountain Yellow-legged Frog complex *Rana sierrae and R. muscosa*	Eldorado, Inyo, Lassen, Plumas, Sequoia, Sierra, Stanislaus, Tahoe, Lake Tahoe Basin (4500-12,000 feet elevation).	Warranted, Federal ESA Endangered CA Endangered -Candidate CA Species of Special Concern FS Sensitive Species
Northern Leopard Frog *Lithobates pipiens*	Eldorado, Inyo, Modoc, Plumas, Lake Tahoe Basin	CA Species of Special Concern FS Sensitive Species
Owens pupfish *Cyprinodon radiosus*	Inyo	Federal ESA Endangered CA Endangered California Fully Protected AFS Endangered
Owens speckled dace *Rhinichthys osculus ssp.*	Inyo	CA Species of Special Concern AFS Threatened
Owens sucker *Castomus fumeiventris*	Inyo	CA Species of Special Concern
Yosemite toad *Bufo canorus*	Stanislaus, Sierra	FC, FSS, CSSC

A list of the sources for conservation status for species noted in Table IV.D-3.

Federal ESA threatened, endangered or candidate (original decision or most recent status review)

California red-legged frog, *Rana aurora draytonii*: 61 Fed. Reg. 25813 (May 23, 1996)
California tiger salamander, *Ambystoma californiense*: 69 Fed. Reg. 47212 (Aug. 4, 2004)
Central Valley spring run Chinook salmon, *Oncorhynchus tshawytscha*: 64 Fed. Reg. 50394 (Sept. 16, 1999), 70 Fed. Reg. 37160 (June 28, 2005)
Central Valley winter steelhead, *Oncorhynchus mykiss irideusi*: 63 Fed. Reg.13347(March 19, 1998), 76 Fed. Reg. 50447 (Aug. 15, 2011).
Lahontan cutthroat trout, *Oncorhynchus clarki henshawi*: 35 Fed. Reg. 13519 (Aug. 25, 1970), 40 Fed. Reg. 29863 (July 16, 1975), 75 Fed. Reg. 28636 (May 21, 2010)
Lost River sucker, *Deltistes luxatus*: 53 Fed. Reg. 27130 (July 18, 1988), 73 Fed. Reg. 11945 (March 5, 2008)
Modoc sucker, *Castomus microps*: 50 Fed. Reg. 24526 (June 11, 1985), 75 Fed. Reg. 28636 (May 21, 2010).
Mountain yellow-legged Frog, *Rana muscosa*: 72 Fed. Reg. 34657 (June 25, 2007), 76 Fed. Reg. 66370 (Oct. 26, 2011)
Owens pupfish, *Cyprinodon radiosus*: 32 Fed. Reg. 4001 (March 11, 1967), 75 Fed. Reg. 28636 (May 21, 2010).

Owens tui chub, *Gila bicolor snyderi:* 50 Fed. Reg. 31592 (Aug. 5, 1985), 75 Fed. Reg. 28636 (May 21, 2010).
Paiute cutthroat trout, *Oncorhynchus clarki seleniris*: 32 Fed. Reg. 4001 (March 11, 1967), 74 Fed. Reg. 12878 (March 25, 2009)
Shortnose sucker, *Chamistes brevirostris*: 53 Fed. Reg. 27130 (July 18, 1988), 73 Fed. Reg. 11945 (March 5, 2008)
Spotted frog, *Rana pretiosa*: 58 Fed. Reg. 27260 (May 7, 1993), 76 Fed. Reg. 66370 (Oct. 26, 2011)
Yosemite toad, *Bufo canorus*: 67 Fed Reg. 75834 (Dec. 10, 2002), 76 Fed. Reg. 66370 (Oct. 26, 2011).

California Endangered Species: threatened or endangered

Cal. Code. Regs. Title 14, §670.5 available at http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome; http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/TEAnimals.pdf

California Fully Protected Species

Cal Fish & Game Code §5050 available at http://leginfo.legislature.ca.gov/faces/codes.xhtml
Cal Fish & Game Code §5515 available at http://leginfo.legislature.ca.gov/faces/codes.xhtml
Cal. Code. Regs. Title 14, §5.93 available at http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome

California Species of Special Concern:

Moyle et al. (1995)
Jennings and Hayes (1994)

Forest Sensitive Species (defined in FSM 2670.5)

USDA Forest Service (2007)

BLM sensitive species

BLM Manual §6840, available at http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/im_attachments/2009.Par.13736.File.dat/IM2009-039_att1.pdf
http://www.blm.gov/ca/pdfs/pa_pdfs/biology_pdfs/SensitiveAnimals.pdf

NMFS Species of Concern

http://www.nmfs.noaa.gov/pr/species/concern

AFS status (vulnerable, threatened endangered)

Jelks et al. (2008)

"near threatened"

Moyle et al. (2011)

REFERENCES

Cagney, J. 1993. Riparian area management. *Greenline Riparian-Wetland Monitoring*. Technical Reference 1737-8. U.S. Department of the Interior, Bureau of Land Management. Denver, CO.

California Trout 2008. *SOS: California's Native Fish Crisis. Status of and solutions for restoring our vital salmon, steelhead and trout populations*. Available online at http://caltrout.org/pdf/SoS-Californias-Native-Fish-Crisis.pdf

California Department of Fish and Game 2007. *California's Wildlife: Conservation Challenges. California's Wildlife Action Plan*. Prepared by UC Davis Wildlife Health Center for California Department of Fish and Game. Available online at http://www.dfg.ca.gov/wildlife/wap/report.html.

Coats, R., Perez-Losada, J., Schladow, G., Richards, R. and Goldman, C. 2006. The warming of Lake Tahoe. J. *Clim. Change* 76:121–148.

Centers for Water and Wildland Resources. 1996. *Sierra Nevada Ecosystem Project, Final Report to Congress, Vol. 1, Assessment Summaries and Management Strategies*. University of California, Davis.

Derlet, R. W., Goldman, C. and Conner, M. J. 2010. Reducing the impact of summer cattle grazing on water quality in the Sierra Nevada Mountains of California: a proposal. *Journal of Water and Health* 8(2):326-333.

Furniss, M., Roelofs, J. T. D. and Yee, C. S. 1991. Road Construction and Maintenance. In: *Influences of Forest and Rangeland Management*. Meehan, W. R. ed. Bethesda, Maryland: American Fisheries Society Special Publication 19. pp. 297-324.

Frissell, C.A., Scurlock, M. and Kattelman, R. 2012. *SNEP Plus 15 Years: Ecological & Conservation Science for Freshwater Resource Protection & Federal Land Management in the Sierra Nevada*. Summary report for a scientific workshop held at Davis, California, 12-13 December 2011. Pacific Rivers Council Science Publication 12-001. 39 pp. Available online at http://www.sierraforestlegacy.org/Resources/Conservation/FireForestEcology/ThreatenedHabitats/Aquatic/RETROSNEP_PRC_Report_2012.pdf

Gucinski, H., Furniss, M. J., Ziemer, R. R. and Brookes, M. H. 2001. *Forest Roads: A Synthesis of Scientific Information*. Gen. Tech. Rep. PNWGTR-509. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Goldman, C. R. 2000. Four decades of change in two sub Alpine lakes. Baldi Lecture. Verhandlungen Internationale Vereinigung. *Limnologie* 27: 7-26..

Jelks, H.L., Walsh, S. J., Burkhead, N. M., Contreras-Balderas, S., Díaz-Pardo, E., Hendrickson, D. A., Lyons, J., Mandrak, N. E., McCormick, F., Nelson, J. S., Platania, S. P., Porter, B. S., Renaud, C. B., Jacobo Schmitter-

Soto, J., Taylor, E. B. and Warren, Jr., M. L. 2008. Conservation status of imperiled North American freshwater and diadromous Fishes. *Fisheries* 33(8):372-407.

Jennings, M. R. 1996. Status of Amphibians. *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options*. University of California, Davis.

Jennings, M.R. and Hayes, M. P. 1994. Amphibian and Reptile Species of Special Concern in California. Prepared for California Department of Fish and Game, available at http://www.dfg.ca.gov/wildlife/nongame/publications/docs/herp_ssc.pdf

Knapp, R. A. and Matthews, K. R. 1996. Livestock grazing, golden trout, and streams in the Golden Trout Wilderness, California: impacts and management implications. *North American Journal of Fisheries Management* 16:805-820.

Lestelle, L.C., Mobrand, L.E., and McConnaha, W.E. 2004. *Information Structure of Ecosystem Diagnosis and Treatment (EDT) and Habitat Rating Rules for Chinook Salmon, Coho Salmon, and Steelhead Trout*. Mobrand Biometrics, Inc. 29 p. + Appendices.

Loeb, Stanford L. and Stacie, A. 1994. *Biological Monitoring of Aquatic Systems.* CRC Press. 400 p.

Montgomery, D. R. 1994. Road surface drainage, channel initiation, and slope instability. *Water Resources Research* 30(6):1925-1932.

Moyle, P., Yoshiyama, R. M. and Knapp, R. A. 1996. Status of Fish and Fisheries. *Sierra Nevada Ecosystem Project, Final Report to Congress, Vol. II, Assessments and Scientific Basis for Management Options*. University of California, Davis.

Moyle, P.B., Yoshiyama, R. M., Williams, J. E. and Wikramanyake, E. D. 1995. Fish Species of Special Concern in California. Second Edition. Department of Wildlife & Fisheries Biology. University of California, Davis. Prepared for California Department of Fish and Game, available at http://www.dfg.ca.gov/wildlife/nongame/publications/docs/fish_ssc.pdf

Moyle, P., Israel, J. A., and Purdy, S. 2008. SOS: California's Native Fish Crisis, Status of and solutions for restoring our vital salmon, steelhead and trout populations. California Trout Inc.

Moyle, P. B., Katz, J. V. E., and Quiñones, R. M. 2011. Rapid decline of California's native inland fishes: a status assessment. *Biological Conservation* 144: 2414-2423.

[NMFS] National Marine Fisheries Service 1996. Making Endangered Species Act determinations of effect for individual or grouped actions at the watershed scale. Habitat Conservation Division, Portland, Oregon.

[NMFS] National Marine Fisheries Service 2008. Comments on Western Oregon Plan Revisions. January 11, 2008.

Potyondy, J.P. and Geier, T. W 2011. *Watershed Condition Classification Technical Guide*. USDA Forest Service . FS-978. April 29, 2012.
http://www.fs.fed.us/publications/watershed/watershed_classification_guide.pdf

Prichard, D., Bridges, C., Leonard, S., Krapf, R. and Hagenbuck, W. 1994. *Riparian area management: process for assessing proper functioning condition for Lentic riparian-wetland areas.* Technical Reference 1737-11. U.S. Bureau of Land Management, National Applied Resource Service Center, Denver, CO.

[NWCG] National Wildfire Coordinating Group. 2006. Incident Response Pocket Guide. NFES #1077. 104 pp.

Scurlock, M. and Frissell, C. 2012. *Conservation of Freshwater Ecosystems on sierra Nevada National Forests: Policy Analysis and Recommendations for the Future*. Pacific Rivers Council. June, 2012.

Siegel, R. B. and DeSante, D. F. 1999. Draft avian conservation plan for the Sierra Nevada Bioregion: conservation priorities and strategies for safeguarding Sierra bird populations. Institute for Bird Populations report to California Partners in Flight. Version 1.0.

Thompson, L.C., Escobar, M.I., Mosser, C.M., Purkey, D.R., Yates, D., Moyle, P.B. 2011. Water management adaptations to prevent loss of spring-run Chinook salmon in California under climate change. *J. Water Resour. Plann. Manage.*, 10.1061/(ASCE)WR.1943-5452.0000194.

Timmer, K. L. 2003. *Troubled Water of the Sierra*. Sierra Nevada Alliance.

Tockner, K., Malard, R. and Ward, J. V. 2000. An extension of the flood pulse concept. *Hydrological Process* 14:2861-2883.

Trombulak, S.C. and Frissell, C. A. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14:18-30.

USDA Forest Service. 1998. Properly functioning condition rapid assessment process—October 23, 1998 version. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Region (www.fs.fed.us/r4/goshawk/r4-pfcprocess. pdf). 33 p.

USDA Forest Service 2000. . *Sierra Nevada Forest Plan Amendment*. Draft Environmental Impact Statement. Pacific Southwest Region. July, 2000.

USDA Forest Service 2001. *Sierra Nevada Forest Plan Amendment*. Final Environmental Impact Statement. Pacific Southwest Region. January 12, 2001.

USDA Forest Service 2004. *Sierra Nevada Forest Plan Amendment*. Record of Decision. Pacific Southwest Region. January 21, 2004.

USDA Forest Service 2007. *Sensitive Animal Species by Forest*. Pacific Southwest Region. October 15, 2007.

USDA Forest Service 2008. *Aquatic and Riparian Conservation Strategy*. Pacific Northwest Region. August 13, 2008.

USDA Forest Service and USDI Fish and Wildlife Service 1995. *PACFISH - Implementation of Interim Strategies for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and portions of California.* February 24, 1995.

USDA Forest Service Watershed Condition Advisory Team 2011. *Watershed Condition Framework: A Framework for Assessing and Tracking Changes to Watershed Condition, FS-977*. (http://www.fs.fed.us/publications/watershed/Watershed_Condition_Framework.pdf)

[USEPA] United States Environmental Protection Agency 2008. Comments on Western Oregon Plan Revisions. January 9, 2008.

Williamson, C. E., Dodds, W., Kratz, T. K., and Palmer, M. A. 2008. Lakes and streams as sentinels of environmental change in terrestrial and atmospheric processes. *Front. Ecol. Environ*. 6:247–254.

Williamson, C. E., Saros, J. E., and Schindler, D. W. 2009. Sentinels of change. *Science* 323:887–889.