A Report by the South Yuba River Citizens League

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Executive Summary

This summary document, *A 21st Century Assessment of the Yuba River Watershed*, serves as a companion report to the Yuba River Watershed Information System (www.yubashed.org), and is written to serve a broad audience ranging from resource managers, citizen watershed stewards, SYRCL members, and residents of the Yuba Watershed looking to deepen their understanding of the place they call home.

These pages will take you through an astounding, devastating, but also inspirational story of renewal and possibility. This examination of the Yuba River Watershed demonstrates the interconnectedness of our environment and illustrates that even the scars on the landscape can be a part of the beauty of our place. The legacy of mining has inflicted enormous ecological and cultural damage to the watershed. In a matter of years headwaters were deforested, mountains were washed downstream, rivers were moved out of their channels, and the indigenous culture was nearly destroyed. But at the beginning of the 21st century there is reason for renewed hope in addressing this damage, built on recent decades of hard work by a community increasingly connected to the ecology of this place. However, the crisis in collapsing salmon populations puts us at a critical juncture, as action or in-action on the Yuba River may determine the fate of wild salmon and therefore the course of California’s ecological future.

The first sections of this report describe the process of *Assessing Watershed Health* and provide descriptions and perspectives of our home watersheds, or *Ways of Seeing the River*. Next, *Impacts to Watershed Health* synthesizes the major contributing factors—historic and contemporary—impacting watershed health in the Yuba Basin. We then articulate the next generation of ecological *Restoration Priorities* for the Yuba River, through a combination of remediating mining toxins, reforming water management and restoring the functions of the forests, meadows and floodplains that naturally provide clean and cold waters for living rivers and thriving communities.

The final section of this assessment is entitled *Toward a Regenerative Future*, and reflects the “21st Century” framing of this watershed assessment. We begin the section with a discussion of the return of salmon to their historic habitat in the Yuba Basin, an action that best exemplifies a regenerative future, as the removal of a single negative-value dam would open up over 100 miles of salmon habitat, an action critical to the recovery of California’s salmon. We then present essays on viable alternatives that circumvent organizational, regulatory and political barriers to effective watershed protection and restoration, as well as a discussion on the cultural aspects of watershed health – both critical components of manifesting a regenerative future.

This report is also borne out of our experiences as a river advocacy group that has participated in—if not spearheaded—numerous regulatory processes, collaborative scientific forums, and natural resource management planning exercises. This assessment reflects upon these experiences with the agencies and other decision-makers that influence the health of the Yuba River Watershed. Thus, we conclude this report with a *Vision for 2050* and offer a framework for a necessarily bold and restorative agenda to heal the land, water and people of the Greater Yuba Watershed from the cumulative impacts of the past. In this way, this *21st Century Assessment of the Yuba River Watershed* offers direction and orientation for the next generation of watershed stewards and river advocates, those committed to “becoming native to this place” so that together we might reconnect and strengthen the cycles that bind the human and ecological communities with the Yuba River Watershed.
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A watershed is simply a network of communities—human and ecological—drawn together by the commonality of a shared waterway.

Defining Watersheds

A simple and useful definition for the term watershed is “communities connected by water.” From a scientific perspective, a watershed is hydrologically defined as a precipitation catchment area that drains to a certain point. When used in lowercase “watershed” is a general term that can be applied to scales ranging from a backyard creek to the Amazon Basin. For the purposes of this assessment we will use the more precise terms “Watershed,” “Sub-Basin,” and “Basin,” to distinguish ascending stream-order hierarchies. For example, the seat of government for the County of Nevada (the Eric Rood Administrative Center) is in the Oregon Ravine Watershed in the Deer Creek Sub-Basin of the Yuba Basin (see Map 1, page 23).

Watershed Assessment Process and Purpose

Watersheds are fluid, dynamic, complex and impossible to fully comprehend. The watershed assessment process is an analytical tool for gathering, organizing and synthesizing relevant information on existing watershed conditions of a given area. The overarching purpose of this 21st Century Assessment of the Yuba Watershed is to assemble scientific, historical and cultural data into policy-relevant information that is suitable for decision making at the Basin scale and action at the Watershed level. The objective is to begin to make sense of the interconnections within a watershed – the relationship between human activities and the cascading and cumulative effects on biodiversity and water quality, the connections between histories of extraction and regulation, and the link between ecological impacts and impacts on the community.

In 2005, the California Resource Agency published their first California Watershed Assessment Manual (CWAM), which provides a clear framework for approaching watershed assessment as the initial phase of a three step process of watershed assessment, planning and implementation. The assessment within these pages follows the CWAM guidelines by identifying community concerns and goals, generating critical questions to address these concerns, and attempting to answer these questions with available information (see Table 1, page 4 for critical questions addressed; see Table 2, page 6 for critical questions for further research).

Developing a comprehensive and detailed scientific assessment of a watershed of the size and complexity of the Yuba Basin would be an ambitious exercise. This assessment makes no such claims of comprehensiveness, but instead is aimed at establishing a foundation and framework for ongoing assessment of select high-priority Watersheds within the basin.
Yuba Basin. This print version of our 21st Century Assessment of the Yuba River Watershed serves as a synthesis of our key findings of watershed impacts and conditions, a provocative inquiry into the possible, and—as much as anything—a recruitment and orientation tool for citizens of the Yuba to engage directly in building a “living,” interactive web-based assessment over the long term.

This basin-scale assessment, as well as the Yuba River Watershed Information System (known by its URL, YubaShed.org) and the River Monitoring Database (RiM Db) are inter-related products of SYRCL’s Yuba Strategy Program. “YubaShed” organizes data sets and bibliographical information (including all the information that has informed this report) to allow scientists, decision makers, and the general public an opportunity to better understand watershed health. The purpose of these watershed monitoring and assessment tools is to strengthen citizen capacities for locally-scaled, community-based watershed planning that translates to implementation of high-value habitat restoration projects. The Yuba Strategy is SYRCL’s approach to organizing citizens in support of a regenerative economy, watershed governance and the restoration of wild salmon throughout the Greater Yuba River Watershed. The overall intent is to promote broad public understanding and provide tools to elevate the level of dialogue about these complex and critical issues.

**Table 1**: Critical Questions Addressed in This Assessment by Topic and Reference Page within Assessment

<table>
<thead>
<tr>
<th>Topic</th>
<th>Question</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRM</td>
<td>What factors inhibit efficient, coordinated, and cohesive land management practices in the Yuba Basin?</td>
<td>11,43</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>How are native species abundance and habitat conditions altered by past and current human activities?</td>
<td>8,22</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>What species have declined or been extirpated?</td>
<td>8,22</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>What species have increased in abundance or been introduced?</td>
<td>20,36</td>
</tr>
<tr>
<td>Mining</td>
<td>What is the significance of the mining legacy in the Yuba Basin?</td>
<td>15,29</td>
</tr>
<tr>
<td>Mining</td>
<td>What are the landscape level effects of mining?</td>
<td>15,37</td>
</tr>
<tr>
<td>Water</td>
<td>What is the contribution of Yuba River water to state-wide water supply?</td>
<td>9</td>
</tr>
<tr>
<td>Water</td>
<td>What is the contribution of Yuba River water to state-wide agriculture?</td>
<td>10</td>
</tr>
<tr>
<td>Water</td>
<td>What is the contribution of Yuba River water to state-wide hydropower?</td>
<td>10</td>
</tr>
<tr>
<td>Water</td>
<td>How do dams and diversions affect the hydrology and ecology of the Yuba Basin and what are the associated impacts on water quality, water quantity, nutrient cycling, and habitat for aquatic and terrestrial organisms?</td>
<td>17,32</td>
</tr>
<tr>
<td>Water</td>
<td>What types of water quality problems exist at what locations in the watershed and what are the causes?</td>
<td>18,28,32</td>
</tr>
<tr>
<td>Water</td>
<td>Where are stream conditions in excess of the temperature criteria for native fauna and what is the potential to restore cooler conditions?</td>
<td>18</td>
</tr>
<tr>
<td>Land</td>
<td>How have historical and current land use practices shaped natural vegetation and soil regimes?</td>
<td>19</td>
</tr>
<tr>
<td>Land</td>
<td>What are the impacts of timber practices in the Yuba Basin (including all associated roads and transportation</td>
<td>19</td>
</tr>
<tr>
<td>Land</td>
<td>What are the impacts of grazing?</td>
<td>19</td>
</tr>
<tr>
<td>Land</td>
<td>What are the impacts of fire and fire suppression?</td>
<td>20</td>
</tr>
<tr>
<td>Land</td>
<td>How do forest cover patterns in the watershed influence wild fire risk?</td>
<td>20,34</td>
</tr>
<tr>
<td>Land</td>
<td>What are the approximate distribution, causes, and impacts of invasive species? What is the best approach to mitigating these impacts?</td>
<td>20,36</td>
</tr>
<tr>
<td>Water &amp; Land</td>
<td>How have the combined effects of land and water use practices affected the human ecology of the Yuba Basin?</td>
<td>21</td>
</tr>
<tr>
<td>Rest</td>
<td>How can habitats be restored or protected for the benefit of species of concern?</td>
<td>34-38</td>
</tr>
<tr>
<td>Water &amp; Land</td>
<td>How can private land owners in the watershed engage in collective stewardship of the public land?</td>
<td>43</td>
</tr>
</tbody>
</table>

**NRM**: Natural Resource Management
“Watershed management” is an interdisciplinary approach synthesizing our collective understanding of ecosystem function, systems thinking, communication technologies.

**Understanding Watershed Health**

Land and water use impacts tend to cascade trophically, expand spatially, and accumulate over time. Narrowly focused resource management is insufficiently suited to understand the integration of cumulative effects at a watershed scale. Comprehending the whole of the web of life may not be a realistic exercise, yet much of the conditions on the landscape are translated into the quality of the water below. Water quality measurements and ecological proxies provide information that can help diagnose inherently integrated ecological problems. Such monitoring is relatively inexpensive and simple to conduct. In addition to measuring parameters such as dissolved oxygen, turbidity (suspended sediment), pH, temperature, bacteria, and heavy metals in the water, we can also survey carefully chosen biotic communities to measure the overall state of the watershed downstream or downslope of land- and water-use impacts over time. These are termed “indices of biotic integrity” (IBI’s)\(^1,2\). This report attempts to assess the overall health of the watershed by emphasizing the analysis of this type of information.

In the *Impacts to Watershed Health* section we evaluate the effect of human activities on ecological systems at a variety of scales. As we articulate *Restoration Priorities*, it is clear that we must respond to these impacts with organizations or institutions that match the effects of the activities that generate them. Asking questions at different spatial or temporal scales will often yield different answers and insights as well as proposed actions. This assessment is meant to support scale based sensitivity as much as ecological literacy, while acknowledging this is often the same thing. Civic engagement can then operate effectively at local, regional, and global scales while approaching both short-term and multi-generational concerns, addressing the various scales at which an informed 21st century citizen recognizes the need for positive change.

Fundamentally, this is an ecological assessment of the Yuba River Basin, and therefore it is important to clearly define ecology. Ecology is the study of the *relationships* between organisms and their environment, which includes both the physical environment and other biological components of the ecological system. The Greek root word of both ecology and economy is *oikos*, meaning “household.” Economics limits itself to analysis of activities within the human household, while ecology takes a broader perspective on what constitutes the household. Ecology is a science, and its methods are subject to the rigorous rules of scientific methodology. It is this type of peer reviewed investigative science that informs the basis for this report’s conclusions and recommendations. All of the publications referenced in this report are available publically at www.yubashed.org.
Critical Questions for Further Research

The following critical questions were not addressed during this watershed assessment process. SYRCL, representing the citizens of the Yuba River Watershed, invites researchers to address these questions and pledges to support these research efforts through information sharing and the mobilization of citizen capacity.

Table 2: Critical Questions for Further Research

<table>
<thead>
<tr>
<th>Topic</th>
<th>Research Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>What is the yield of the Yuba Basin in terms of water supply, water quality and contributions to aquatic and riparian habitat?</td>
</tr>
<tr>
<td>Water</td>
<td>What are the trends and patterns in water availability and storage, and what is their approximate quantity?</td>
</tr>
<tr>
<td>Water</td>
<td>What are the effects of dams and diversions on groundwater infiltration and groundwater storage?</td>
</tr>
<tr>
<td>Water</td>
<td>If the upper watershed were allowed to flow freely what would be the effect on water quantity in the watershed?</td>
</tr>
<tr>
<td>Water</td>
<td>Where are the opportunities for “new” water supply (either through restored “natural infrastructure,” groundwater banking, home-scale storage, conservation and efficiency programs, and conventional water impoundments), and what is their approximate quantity?</td>
</tr>
<tr>
<td>Water &amp; Climate</td>
<td>How do “new” water supply options respond when analyzed through future climate and precipitation models for the Yuba Basin?</td>
</tr>
<tr>
<td>Land &amp; Water</td>
<td>How can forest cover patterns in the watershed best serve water supply and quality (consumptive and in-stream)?</td>
</tr>
<tr>
<td>Land &amp; Climate</td>
<td>How do forest cover patterns in the watershed influence the potential for carbon sequestration through forest restoration, wildlife habitat and corridors, and water supply and quality (consumptive and in-stream)?</td>
</tr>
<tr>
<td>Restoration</td>
<td>What types of restoration can be done to most efficiently restore natural soil &amp; vegetation regimes?</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>What would be the impact of salmon carcass delivery of nutrients to the upper watershed?</td>
</tr>
<tr>
<td>Water &amp; Econ</td>
<td>How does the contribution of Yuba water translate to percentage contribution to overall state economy?</td>
</tr>
<tr>
<td>Economics</td>
<td>In what ways can new economic activity in the watershed be tailored to the assets and constraints of our specific watershed?</td>
</tr>
<tr>
<td>Economics</td>
<td>What are pathways to vitalizing the regional economy through investigation and development of green collar jobs, including alternative sources of sustainable energy production and technology development associated with toxics and pollution reduction?</td>
</tr>
<tr>
<td>Economics</td>
<td>Analysis of costs and benefits of natural infrastructure/ecosystem services restoration versus engineering end point solutions: For example, is it more cost-effective to pay people to restore 10% of forest cover than to spend money on chemical water treatment for municipalities?</td>
</tr>
<tr>
<td>Economics</td>
<td>What are the public benefits (in economic and ecological terms) to be gained from reallocating a portion of the Yuba River water currently exported out of basin for hydropower production toward supporting improved instream flows in the Middle and South Yuba Rivers?</td>
</tr>
<tr>
<td>NRM</td>
<td>What have been the policy successes and failures of natural resource management plans within the Yuba Watershed? What are the underlying causes and/or trends that contribute to success or failure?</td>
</tr>
<tr>
<td>NRM</td>
<td>In what ways can uniting the decision making fabric of the Upper and Lower Yuba watershed benefit coordinated natural resource management in the Yuba Basin?</td>
</tr>
</tbody>
</table>

NRM: Natural Resource Management

• • • Above: South Yuba River; Hammon Backwater; Beaver (*Castor canadensis*) activity, Lower Yuba River
As a result of the complexity of the ecological and human systems within, there are many lenses in which to view the Yuba Basin – a topic we explore in the following section, Ways of Seeing the River.

Watershed Study Area

The Yuba River Basin drains approximately 1340 square miles in the northern Sierra Nevada Mountains and foothills of California. It joins the Feather River at its mouth in Marysville which then joins the Sacramento River and flows through the Sacramento/San Joaquin Delta and to the Pacific Ocean through the San Francisco Bay (see also Figure 1, page 10). Within the Yuba Basin there are seven Sub-Basins, including the North, Middle, and South Yuba, Mainstem Yuba (aka Englebright Reservoir), Deer Creek, Dry Creek, and the Lower Yuba (the 24 mile reach below Englebright Dam). These Sub-Basins comprise numerous named and unnamed watersheds (Map 1, page 21). The Yuba Basin includes a diverse array of environments and conditions; from snow covered sub-alpine zones near the Sierra crest (Mt. Lola is the highest point at 9,148’) to dry oak woodlands below 1000’ elevation (elev. 60’ at confluence with Feather River in Marysville).

Among Sierra Nevada streams, the Yuba ranks first in unimpaired runoff per unit area\(^3\). However, precipitation regimes in the region are highly variable in timing and quantity, with unpredictable autumn rainfall and occasional winter deluges producing a considerable part of the average annual runoff (USGS gauge data 1858-2009). As one example, after heavy rains in December 1955 the Yuba River rose from 16,000 cubic feet per second (cfs) to 138,000 cfs in 24 hours, producing devastating downstream flooding. Average annual precipitation ranges from 80” on the ridge separating the North Yuba Sub-Basin from the South Fork Feather River to 20” at Marysville in the Central Valley floor. As a result of significant temporary water storage in the form of snowpack, there is a roughly two month delay in peak runoff (Jan-June) from peak precipitation (Nov-April). However, climate changes have begun to alter the amount and seasonal distribution of precipitation as rain or snow\(^4\).

The Yuba Basin is a landscape of superlatives and contrasts. The Yuba still has small patches of coniferous forests exhibiting old growth characteristics. In the Lower Yuba, roughly 10,000 acres of gravel deposits appear as wastelands, supporting limited life forms in a once-lush riparian cottonwood forest. Because the Yuba is home to distinct populations of self-sustaining salmon runs\(^5\), its condition is of particular concern to many within and outside the watershed. Compared to other watersheds in the Sierra Nevada the Yuba has been rated in “fair” to “poor” condition based on native fish population distributions and threats\(^6\) and rated as “extreme” in relation to the legacy effects of abandoned mines\(^7\).

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* Above: Sierra Buttes; South Yuba River Next Page: Dry Creek Sub-Basin; Valley Oaks near Smartsville

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Chinook Salmon and Steelhead were a critical element of this ecosystem, bringing a massive annual injection of nutrients from the ocean far upstream to nourish the soils of the riparian corridors, the abundant aquatic and terrestrial wildlife, and the human inhabitants.

The Yuba Before the Gold Rush

Recent insights from the fields of historical ecology and paleoecology have given us a way to view ecosystem structure prior to the significant changes that began with the Gold Rush. Broadly speaking, the forests of the Yuba Basin were actively managed by the Maidu people and their ancestors, who favored late seral stage or old growth forests, with open understories and large, widely spaced trees. This type of forest structure and associated meadow systems were maintained by active tending of plants, fungus, and soils on a local scale and the use of low-intensity burning every 3-10 years on a wider landscape scale. Evidence suggests that forests were managed to serve human needs on an immediate and multi-generational time-scale by providing an abundance of seasonal resources while maintaining the characteristics of a highly resilient ecosystem such as low fuel loads, maximized soil absorption rates, and high water quality. In this way the natural capacity of the land to renew itself was maximized in the face of the highly variable precipitation regimes and frequent natural disturbances characteristic of the western slope of the Sierra Nevada. Anadromous fisheries, in particular Chinook Salmon (*Oncorhynchus tshawytscha*) and Steelhead (*O. mykiss*), were a critical element of this ecosystem, bringing a massive annual injection of nutrients from the ocean far upstream to nourish the soils of the riparian corridors*, the abundant aquatic and terrestrial wildlife, and the human inhabitants.

The mid-19th century arrival of a culture focused on resource extraction disrupted nearly every aspect of this interdependent system. By the 21st century the cumulative effects of human practices have altered ecological function to such a degree that the natural system cannot be properly considered independent from its engineered features.

*The riparian corridor is often identified by the ribbon of streamside vegetation, yet is defined in hydrologic terms as the area where the water table is higher in elevation than adjacent areas where the groundwater is supplied by precipitation alone.*

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*The Yuba Before the Gold Rush*
The “Big Four” thirsty crops in California (alfalfa, rice, cotton and irrigated pasture) use roughly 1/3 of the water supply, have the highest evapotranspiration rates, yet generate less than 1% of the total value of all the goods produced by the state.

The Yuba in a Statewide Context

The Sacramento-San Joaquin Delta captures all 14 major rivers of the western slope of the Sierra Nevada (including the Yuba) and numerous streams of the eastern slope of the Coast Range before flowing out through the San Francisco Bay and into the Pacific Ocean. Depended on by 25 million Californians for drinking water, thousands of farmers, and the state’s commercial and sport salmon fishing industries, this river system was designated “America’s Most Endangered River” in 2009 by the national organization American Rivers due to its antiquated water supply and flood control systems and the environmental harm they cause.

Yuba Waters in a State-wide Context

In California, we have both real water and “paper water.” Although water is legally enshrined as belonging to the people of California as a “public trust” resource, a complex and arcane system allocates public and private entities a “water right” to store and deliver specified quantities of surface water to serve prescribed “beneficial uses”—such as municipal use, irrigation, hydropower production and environmental purposes. This legal arrangement dates back to the gold rush, with a “first in time, first in line” seniority system that, in dry years, gives special privileges to those entities that have held surface water rights since before 1914, such as PG&E’s water rights on the Yuba River (and elsewhere). It’s important to note that California’s groundwater resources are almost entirely unregulated and vigorously exploited, despite the fluidity with which groundwater and surface water interact in the physical world.

A major contributor to California’s water woes—Delta ecosystem collapse, species extinctions, and polluted rivers—is the fact that today we have significantly more “paper” water than real water. Indeed, allocations of surface water in the Sacramento and San Joaquin River watersheds amount to roughly eight times the average annual streamflow—and even three times the highest streamflow on record. A study by the California Department of Water Resources acknowledged that water used to

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*Above:* Colgate Penstock; Irrigation canal flowing west toward Sutter Buttes
maintain basic river health conditions are last on the priority list: whereas urban and agricultural water use generally varies by no more than 10-20% between wet and dry years, so-called “environmental water” allocations can drop by over 50% during droughts[14]. With river health de-prioritized, it’s worth briefly examining the beneficiaries of the existing structure. Here are two snapshots of Yuba River water uses.

**Agriculture**
Throughout the last century, California taxpayers subsidized the world’s most engineered water system and today roughly 80% of the captured fresh water (77% in 2005, DWR data) supports agriculture. Cheap, subsidized water has created an artificial market in which the state’s most precious resource is dedicated to some of the least valuable crops. The “Big Four” thirsty crops in California (alfalfa, rice, cotton and irrigated pasture) use roughly 1/3 of the water supply, have the highest evapo-transpiration rates, yet generate less than 1% of the total value of all the goods produced by the state (DWR data 1999-2001). A statewide, policy-oriented solution to California’s water crisis would prioritize maintaining healthy rivers, and the economic benefits they provide, while subsidizing water-wise sustainable farming practices instead of the demonstrably unsustainable “thirsty” crops grown in California’s arid regions.

In recent years 250,000-300,000 acre feet of Yuba water has gone to regional agriculture (rice and orchard crops) in the valley through Yuba County Water Agency deliveries to 8 local water districts (YCWA data). Through YCWA and the South Feather Water and Power Agency between 220,000-250,000 acre feet are currently delivered south of the Sacramento/San Joaquin Delta, primarily contributing to the “thirsty” crops mentioned above (pers. comm. YCWA & SFWPA, water years 2007-2009).

**Hydropower**
The hydropower generation facilities that use Yuba River water include the PG&E Drum-Spaulding Project, NID Yuba-Bear Project, YCWA Yuba River Project, and the South Feather Water and Power Agency’s Slate Creek Tunnel. Combined, these projects generate enough electricity to power 525,000 households, significantly more than the combined population of Nevada, Yuba, and Sierra Counties at 185,000. However, viewed in a statewide context, this same amount of electricity (over 3.3 million MWh per year) is the equivalent of just 39% of what the State Water Project uses annually to move water around California, primarily to pump water 2,000 feet over the Tehachapi Mountains – the highest lift of any water system in the world[15]. In effect, the hydropower generation that is commonly advertised by utility companies as “clean and green,” in this case is merely offsetting a percentage of the energy demands for transferring water for municipal and agricultural uses in the arid south.

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**Figure 1:** The “Greater Yuba Watershed” from Source to Sea.
By the 21st century, management decisions to balance “natural resources” have, in aggregate, pushed nearly every ecosystem towards functional collapse.

Conventional Approaches to Natural Resource Management

The field of “Natural Resource Management” that evolved throughout the last century aims to “balance” the competing goals of the extraction and the maintenance of a given resource (e.g. students of silviculture are taught “maximum sustainable yield” formulas that guide the amount of board-feet that can be taken from forests). Agencies were initially created to curb the most wanton destruction of specific resources while continuing to facilitate resource extraction, without the tools and methods to assess long term environmental consequences. Driven by citizen activism these regulatory mandates gradually evolved through 20th century legislation and legal challenges to emphasize more sustainable resource management. Despite these improvements, by the 21st century management decisions to balance “natural resources” have, in aggregate, pushed nearly every ecosystem towards functional collapse.

In the most general sense, “watershed health” is a function of the interrelationship between instream flows, migration barriers and upland land uses. Absent integrated planning of these elements—and assessment and prioritization of their relative impacts to overall watershed health—narrowly focused management plans will fail to enable human communities to accelerate the mending of broken ecological cycles and enhance the regenerative capacity of ecosystems to perform their stabilizing functions. A prerequisite to accomplishing this goal is the re-localization of as much of this management responsibility as possible and the democratization of resource management on wider geographic scales.

The multi-jurisdictional nature of resource management is well entrenched. At the federal level alone, agencies within the Department of Agriculture (e.g. US Forest Service), the Department of Commerce (e.g. National Marine Fisheries Service), and the Department of Interior (e.g. Bureau of Land Management) have responsibilities within the Yuba River Watershed. Each agency spends their scarce time and financial resources implementing their own mandates and plans, leaving few opportunities for inter-agency collaboration. In the Yuba Basin, holistic management opportunities are further complicated by the “checkerboard” pattern of public and private land ownership unique to this part of the Sierra Nevada, a result of the US Government granting alternate square miles of land to the Central Pacific Railroad during the building of the transcontinental railroad in the 1860’s16. Multi-jurisdictional dysfunction—despite the best intentions of individual managers within agencies—has led to myopic planning efforts, narrowing the range of inventive approaches to complex and interrelated watershed management issues.
While individual managers may favor inter-agency collaboration, implementing plans that span jurisdictions often occurs only when necessary and mandated by citizen actions. The South Yuba River Comprehensive Management Plan (SYRCMP) is a prime example where the South Yuba River Citizens League and other non-governmental groups successfully advocated for designation of 39 miles of the South Yuba as “Wild and Scenic” by the California Legislature in 1999. This triggered a mandate for developing a coordinated land management plan for the corridor. With robust public involvement, the SYRCMP was the product of county, state and federal cooperation. Yet five years after the adoption of the Final Plan, little progress has been made in implementing any of the scores of recommended actions. Only one informal status report has been delivered—verbally—to a group of stakeholders in the unfunded and voluntary information-sharing forum known as the Yuba Watershed Council. This jurisdictional complexity has resulted in an array of entities at times working at cross purposes in the Yuba Basin. In recent decades these separate mandates and responsibilities have coalesced into separate management plans. Table 3 lists some of the management plans in the Yuba Basin, a few of which notably try to integrate resource management goals and actions.

Beyond this sample list of plans that govern resource management of the lands within the Yuba Watershed, an entirely different set of management documents dictate the in-stream flows and out-of-basin water transfers of the Yuba River. These include hydropower dam licenses issued by the Federal Energy Regulatory Commission (FERC), Basin Plans established by the State Water Resources Control Board, and collaboratively developed flow schedules, groundwater substitution and south-of-Delta transfers such as those found in the Yuba County Water Agency’s Lower Yuba River Accord.

In recent years diligent staff at public agencies, as well as an increasingly informed and active citizenry operating through the umbrella of non-governmental organizations, have made an effort to improve these planning activities through increased coordination and cooperation. “Watershed management”—an interdisciplinary approach synthesizing our collective understanding of ecosystem function, systems thinking, communication technologies, and a proper dose of humility at the unknowable complexity of our place—is a necessary reframing that must reflect the cohesion of the natural systems we are attempting to manage. This reframing is necessary for more effective communication between the various communities of the watershed, as we will explore in the following page, *A Maidu Perspective*.

<table>
<thead>
<tr>
<th>Plan</th>
<th>Geographic Area</th>
<th>Responsible Party</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Sierra Partnership</td>
<td>Cosumnes, American, Bear, Yuba &amp; Feather Watersheds</td>
<td>The Trust for Public Land, Feather River Land Trust, Sierra Business Council, The Nature Conservancy</td>
<td>2008</td>
</tr>
<tr>
<td>CABY Integrated Regional Water Management Plan</td>
<td>Cosumnes, American, Bear, &amp; Yuba Watersheds</td>
<td>CABY (diverse stakeholder group)</td>
<td>2006</td>
</tr>
<tr>
<td>Sierra Nevada Forest Plan Amendment</td>
<td>Tahoe National Forest lands, including those in the Yuba Watershed</td>
<td>USFS</td>
<td>2004</td>
</tr>
<tr>
<td>Sierra Resource Management Plan</td>
<td>230,000 acres of public land, including in Nevada and Yuba Counties</td>
<td>BLM</td>
<td>2008</td>
</tr>
<tr>
<td>South Yuba River Comprehensive Management Plan</td>
<td>39 miles of Wild &amp; Scenic South Yuba River</td>
<td>USFS, BLM, California State Parks, County of Nevada</td>
<td>2005</td>
</tr>
<tr>
<td>Yuba River Conceptual Area Protection Plan (draft)</td>
<td>81,000 acres in the Lower Yuba River Watershed</td>
<td>California Department of Fish and Game</td>
<td>2009</td>
</tr>
<tr>
<td>Deer Creek Coordinated Resource Management Plan</td>
<td>Deer Creek Sub-Basin</td>
<td>Friends of Deer Creek</td>
<td>2004</td>
</tr>
<tr>
<td>'Inimim Forest Management Plan</td>
<td>1,813 acres on the San Juan Ridge, Middle and South Yuba Sub-Basins</td>
<td>Yuba Watershed Insitute, Timber Framer’s Guild of North America, BLM</td>
<td>1996</td>
</tr>
<tr>
<td>Lake Vera Round Mountain Fire Safe Plan</td>
<td>South Yuba Sub-Basin</td>
<td>Nevada County</td>
<td>2002</td>
</tr>
</tbody>
</table>
One of the greatest challenges facing Maidu groups in terms of cultural survival is the inability to enact self-determination in relation to stewarding land and culturally important resources.

**A Maidu Perspective**

The Maidu are a people whose homeland extends roughly from the southernmost reaches of the Cascade Mountain Range to the north, the crest of the Sierra Nevada to the east, the North Fork of the Consumes River to the south, and to the Sacramento River to the west. “Maidu” is a word that means “people” in their own language. Anthropologists have divided the Maidu into three basic groups based upon language variations: Nisenan (foothill or southern Maidu), Konkow (valley or northwestern Maidu) and mountain or northeastern Maidu.

Prior to colonization the Maidu enjoyed the benefits of one of the most refined subsistence patterns to have existed on this planet. The Maidu subsistence pattern depended on utilizing intimate knowledge and understanding of the ecosystem of which they were a part. Indeed, the Maidu not only knew how to benefit from these resources but they also acted as stewards, utilizing what has come to be known as “traditional ecological knowledge” to enhance ecosystem health and resource abundance. The use of fire, as well as pruning, digging and seed burial were some of the techniques employed by the Maidu to maintain sustainable foods and other resource availability within their homeland since time immemorial.

Maidu language, song, dance, material production, and thought patterns are all rooted in the ecosystem of the homeland. The Maidu have survived extreme challenges of history, from state-sponsored genocide of the 19th century through the continued erosion of land and resource rights in the 20th century, to emerge in the 21st century as a living culture perpetuating the ancestral traditions. Still, one of the greatest challenges facing Maidu groups in terms of cultural survival is the inability to enact self-determination in relation to stewarding land and culturally important resources. Damaged ecosystems or outright denial of access to private or even public land that was formerly part of the homeland are results. For example, Big Leaf Maple (*Acer macrophyllum*, or “Dapi” in Maidu) is a vital component of riparian and canyon forest structure and also a material vital to the making of Maidu water-tight coiled style basketry bowls and plates. Unfortunately, in these times this material is nearly impossible to acquire in the quantity and of the quality of the past because ecosystem management decisions are beyond Maidu control.

Perhaps one of the greatest obstacles facing many Maidu groups in their efforts at self-determination is US Federal policy which refuses to acknowledge and recognize the existence of the majority of the Maidu people. There were once thousands of Maidu living in the Yuba River Watershed and there are still (at least) hundreds of their descendants
living within the Maidu homeland. Yet there is no Maidu group acknowledged and recognized by the Federal Government in the area. Within the Yuba Basin there are at least three groups seeking Federal recognition and the resulting government-to-government relationship of sovereignty and self-determination: the Colfax-Todds Valley Miwok-Maidu Consolidated Tribe, The Nevada City Rancheria-Ustuma Tribe, and the Tsi-Akim Maidu of Taylorsville Rancheria.

Despite all obstacles, Maidu sense of place and of self remains strong. Ceremonies not only continue but some, like the “Calling Back the Salmon” Ceremony, are being rejuvenated (see page 39, and www.callingbackthesalmon.com). For the first time in several generations the number of Maidu language speakers is increasing with classes available in the Yuba Watershed, and worldwide social ties are being formed with other place-based cultures. Through this ceremony and other collaborations, the Tsi-Akim Maidu perspective has deeply influenced the work of SYRCL in the last decade.

Table 4: Select Maidu Language Place Names

<table>
<thead>
<tr>
<th>English</th>
<th>Maidu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yuba River</td>
<td>Puda Duom Sayo</td>
</tr>
<tr>
<td>Major Villages in the Yuba Basin</td>
<td>Wokodat</td>
</tr>
<tr>
<td></td>
<td>Kokokeha</td>
</tr>
<tr>
<td>Sierra Buttes</td>
<td>Chitakam Yamanmanto</td>
</tr>
<tr>
<td>Sutter Buttes</td>
<td>Estom Yamani</td>
</tr>
</tbody>
</table>

Paintings: by Farrell Cunningham

YOKOLI 2008. Yokoli similar to this are used to indicate significant events and places.

WOLOLOKUM EKDADOIDI (Flicker at Sunrise), 2007. For many Maidu the Northern Flicker (Colaptes auratus) is of great cultural importance

Contribution by Farrell Cunningham

Tsi-Akim Maidu Tribal member Farrell Cunningham (not pictured) regularly shares the valuable knowledge which has been passed down to him through the generations at the Maidu Active Cultural Center, Lake Vera Rd., Nevada City. From his father and other tribal elders, he learned the importance of having a relationship with the land and the forest. Says Farrell, “Man should enter into natural treaties with the land, with fire, with plants and honor those treaties.” For more information visit www.tsi-akim.org

Above: Smudge Ceremony, Lower Yuba River; Bedrock Mortar Placement, Nevada City
Past and present human activities have had severe impacts on watershed condition and in some cases are the primary forces that have shaped today’s Yuba River Basin. The following section, *Impacts to Yuba Watershed Health*, explores this topic in detail.

**Mining**

The impacts of mining and its associated activities have significantly altered riverine and ecological functions within the Yuba Basin. Hence, it is impossible to fully grasp the 21st century ecological conditions within the watershed without a historical understanding of this massive upheaval and its persistent cumulative legacy.

In the early days of the California gold rush non-mechanical extraction through placer mining certainly degraded the riparian corridors of the watershed. However, with the advent of hydraulic mining in the mid-1850s, devastating landscape-level effects were wrought on the watershed that are discernible from outer space even today. With the use of high pressure water cannons, hillsides and mountaintops were literally dismantled in the relentless search for gold. The remaining “waste,” laden with mercury used to extract gold from the sediment, was dumped directly into the tributaries and main channels of nearly every stream in the basin. An estimated 685 million cubic yards of sediment (close to four times the amount removed to build the Panama Canal) washed down the Yuba River during the peak era of hydraulic mining, which was curtailed—but not eliminated—by a court order from the 1884 “Sawyer Decision.” The effect of this massive alteration of river channels and water flow disrupted all riparian life in the main stem river corridors and tributaries from the

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*Figure 2*: Similar view of the Lower Yuba River above Parks Bar. Photo on left taken by G.K. Gilbert in 1908. The light color filling the river channel beyond flood stage is sediment; the thin darker strip in the middle is the watercourse moving above the sediment. Almost a quarter century after the majority of upstream hydraulic mining ceased in 1884, the channel at this location in 1908 is still near maximum level of aggradation, indicating the slow movement of this sediment pulse downstream. Photo on right taken by Alan James in 2003. From 1908 forward this sediment continued to move downstream so that by 2003 the main river channel at this location is largely cleared of sediment.

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*Above: Malakoff Diggings, 1876; Manzanita Mine, 1908*
middle elevations of the watershed to the river mouth in Marysville (Figure 2). Through the 20th century this tremendous instream sediment load either washed out to the San Francisco Bay or settled in upland tributaries, behind barriers, or in engineered off-channel piles in the lower Yuba (see page 37).

Significant mining related activities continued in the Yuba Basin well into the 20th century. Gold dredging operations, primarily from 1900-1920, lucratively re-mined hydraulic mining sediment deposits in the lower Yuba River while executing a plan designed by the California Debris Commission to mitigate for this sediment problem through the creation of enormous “training walls” to contain the river in an unnatural single channel. These activities denuded the landscape of life forms typical of lowland riparian ecosystems resulting in a state of biotic desolation that persists to this day. Hydraulic mining continued on a smaller scale until as late as the 1930s in certain places. Concurrent to surface level mining activities, underground hard rock mining carved tens of thousands of feet of tunnels in the bedrock of the Yuba Basin from the mid 19th century through the late 1950s, leaving behind some of the most toxic tailings piles. There are an estimated 47,000 abandoned mines in California, all of which present some form of chemical and/or physical hazard (CA DOC data, 2007).

Mining today is a mostly dormant industry in the Yuba Basin. However, because very few mines accomplished any appreciable cleanup effort, the legacy effects of thousands of abandoned mine lands (AMLs) and millions of cubic yards of their associated tailings piles remain significant. In a report on the magnitude of the impacts of abandoned mines throughout the Sierra Nevada, the California Department of Conservation ranked the North Yuba, Middle Yuba, and South Yuba Sub-Basins 1st, 3rd, and 4th respectively, and identified the problem in these watersheds as “Extreme”. Open mine shafts present a physical danger to forest workers, recreational users, and fire fighters. The effects of chemical hazards may be less obvious but more widespread because of the transport of contamination off site and into the aquatic ecosystem. Other than physical hazards on the landscape, chemically toxic tailings are the primary mining legacy on watershed health in the Yuba Basin. Threats from these toxic tailings include:

- Mercury contamination: Elemental mercury was used to extract gold from mined gravels. Millions of pounds were “lost” to the environment. Certain bacteria convert this inorganic form of mercury into a more toxic, organic form known as methylmercury. Once methalyzed, usually a result of anoxic conditions (common in stagnant water high in organic matter), mercury enters the food web and negatively affects the health of each organism progressively as it bioaccumulates while moving up the food chain. Fish with high mercury levels consumed by humans can cause serious health problems, damaging the brain, nervous and immune systems.

- Acid mine drainage: When oxygenated groundwater and rainfall seep into abandoned mines or pass through tailings piles, a number of chemical reactions take place releasing previously immobile toxic metals. During periods of high rainfall acid mine drainage can be released into streams and rivers proving potentially lethal to local aquatic communities and threatening to the water supply.

- Arsenic, lead, and asbestos contamination: Arsenic, lead, and asbestos are naturally occurring minerals that can be greatly concentrated in crushed mine tailings piles. Arsenic, lead and asbestos can be inhaled as dust particles when working or recreating. Arsenic and asbestos are known to cause cancer and lead ingestion causes neurological disorders.

For more information see Mining’s Toxic Legacy, published in 2008 by The Sierra Fund, available at www.yubashed.org

Above: Gold Dredge on Lower Yuba River, middle 20th century; Eureka Claim near North San Juan, 1870’s
History and Overview of Water Control

For more than 160 years Yuba waters have seldom been allowed to flow undisturbed down the natural channels carved before 1849. The practice of engineering for water control and profit began concurrently to mining in the Yuba Basin—without water to work it, gold in the ground was useless. At the peak of the hydraulic mining era in the 1870s virtually the entire summer flow of many upper watershed streams was diverted. These ridgetop canals would rejoin the river canyon later, via some gully or tunnel made suddenly torrential by the periodic pulses of water and tailings from hydraulic gold diggings. By 1879 in Nevada County alone nine water companies owned 900 miles of ditches, with smaller ditches pushing the total to 1,000 miles. These great delivery systems were fed by hundreds of reservoirs created by the construction of wood, earth or stone dams, large and small.

With the end of the peak of the hydraulic mining era in 1884, water control (and water rights and capital investment) moved seamlessly to the purposes of irrigation and hydropower. Control of North Yuba water near Bullards Bar created one of the first irrigation districts in the State in 1892, the Browns Valley Irrigation District (BVID). By 1896 the BVID was in partnership with the engineers and investors which would go on to found Pacific Gas and Electric Company (PG&E) in 1906. In 1921 the Nevada Irrigation District (NID) formed, based largely on the South Yuba Canal Co. infrastructure, to deliver Middle and South Yuba water both within and outside the Yuba Basin for domestic and agriculture use, while also partnering with PG&E for hydropower generation.

Several factors converged to initiate the final phase of water control in the Yuba Basin: the construction of large dams in the lower watershed and the raising of dams in the upper watershed, with their associated diversion canals, tunnels, and penstocks that could capture, hold, and transport entire rivers. Design and construction materials improved, while hydraulic mining interests considered large dams to control debris the best path to resume their ecologically disastrous industry. Population growth and development patterns in the historic floodplains of the Sacramento Valley from 1900-1930 greatly increased the credibility of the flood control argument for large dams while also creating a substantially larger market for the sale of electricity. As a result, from the completion of (new) Spaulding Dam in 1919 through New Bullards Bar in 1970 the Yuba Basin became one of the most comprehensively dammed and diverted river systems in the world; a water molecule from the Yuba was at times more likely to flow into the western San Joaquin Valley than into one of its own tributaries. With six dams over 150’ in height, there are more than 50 additional substantial dams in the Yuba Basin.

Impact of Dams and Diversions

The impact of dams and altered flow regimes on river function and ecological integrity are well known and documented. Barriers block movement of the physical and biological constituents of the river system and water diversions substantially de-water streams of the Yuba River Basin, dramatically affecting physical river system balance, water quality, aquatic and riparian habitat, and anadromous fisheries.

Barriers are not simply used as storage structures to save and then deliver water off season or during periods of drought downstream through existing river channels. Water operations on the Yuba, built upon the legacy of unregulated mining infrastructure, divert a majority of water to never return to the same river basin (inter-basin transfers) or to return to the river miles downstream after any number of uses. Map 2 (page 25) shows the points of major diversion in the watershed, as well as the annual average of total acre feet of water taken in the diversion and at selected gauges in the natural waterways for water years 1995-2004.

• • • Above: Flume, South Yuba Sub-Basin; Daguerre Point Dam; New Bullards Bar Dam
During dry years the flow released immediately downstream of diversions can be miniscule, creating a severely degraded riparian and aquatic zone for several miles until new tributaries and streams renew the flow. As the Bowman-Spaulding Canal arcs southward across the upper South Yuba Sub-Basin from Bowman to Spaulding Lake, it completely intercepts the flow of Texas, Clear, Fall, Trap, and Rucker Creeks (Map 2). The only flow in these tributaries (aside from accretion and seepage) downstream of the canal comes in the form of blasts of overflow released during high water flows in the canal (Figure 3). Other particularly de-watered stretches of river include the South Yuba below Spaulding Dam, the North Yuba below New Bullards Bar, and the upper Middle Yuba below the Milton Diversion Dam. When looking down the face of these dams it can appear to the eye like a small garden hose is releasing water into a dry canyon. Additionally, significant diversions occur at and upstream of Daguerre Point Dam in the Lower Yuba, where in recent years diversions for regional irrigation to eight Yuba and Butte County water districts have totaled about 300,000 acre-ft. annually.

Ecological Impacts of Dams and Diversions

- Dams of significant size are complete barriers to the physical factors that maintain dynamic equilibrium in river systems, primarily sediment supply and discharge. Near total cessation of sediment deliveries create dramatic adjustments in the profiles, patterns, and cross sections of the waterway downstream.

- Reduced discharge and lack of sediment lead to armored river channels immediately below dams, decreasing or devastating the quality of habitat for aquatic organisms and the growth of riparian vegetation.

- Changes in discharge alter annual hydrographs, significantly increasing the lag time and decreasing the magnitude of peak discharges while changing the character of summer and fall flows – in essence disconnecting the majority of the riparian zone from riverine influence.

- Dams are also a barrier impeding the movement of nutrients, woody debris, and the migration of all anadromous fish species. Distinct salmon and steelhead populations, as well as green sturgeon and pacific lamprey are affected by water management activities and structures, and are completely blocked from their migration to the majority of upstream spawning grounds in the Yuba River. The “terminal rim dams” (TRDs) that block the migration of anadromous fisheries from every major river draining the Sierra Nevada have contributed significantly to the near extinction of the evolutionarily distinct Central Valley anadromous fisheries. Map 2 (page 25) displays the dams furthest downstream in the Yuba Basin which therefore represent the furthest upstream migration point of anadromous fish species.

- The combined impacts of water diversions (e.g. dewatering the stream channel and the corresponding loss or direct removal of shade-providing riparian vegetation) have elevated the temperature of many waterways in the Yuba Basin to levels that kill aquatic life. Dramatically lowered water levels cause previously cold mountain streams to be heated by solar radiation. This situation has been documented on reaches of the South Yuba River, which was listed by the State Water Resource Control Board as temperature impaired under the Clean Water Act (section 303(d)) in January 2010, as a direct result of the submission of temperature data collected by the SYRCL River Monitoring program (see www.yubashed.org for graphics and data).

Figure 3: Rucker Creek upstream of the Bowman-Spaulding Canal (left). Rucker Creek downstream of canal (right). The only water released below the canal and downstream into Rucker Creek during the year comes in the form of blasts of overflow released during high water, creating alternately bone dry or blown out stream conditions unsupportive of riparian or aquatic life. See Map 2 (p.25) for location of Bowman-Spaulding Canal.
Impacts to the terrestrial watershed cascade to impact soils, aquatic systems, wildlife habitat, and air quality.

**Land Use Practices**

In addition to the Impacts of Mining and Water Control, Land Use Practices in the Yuba Basin have altered ecological function in ways that have reduced ecosystem resilience and have resulted in forest structure with reduced capacity for moisture retention that is prone to high intensity fire.

**Timber Extraction**

In the first few decades following the Gold Rush, forests near settlements, mines, or within miles of streams in the Yuba Basin were systematically harvested for timber. A thousand miles of ditches and canals, numerous large wooden dams, and thousands of miles of underground tunnels all required timber. In 1848 California consumed roughly 20 million board feet per year. By 1878 timber production had increased to 700 million board feet annually, mostly to support mining operations. At the turn of the 20th century, scientists with the United States Geological Survey (USGS) conducted extensive vegetation surveys which estimated that 57% of the Yuba River drainage had been logged, far more than any other region in California. The late 20th century saw a dramatic increase in logging, particularly in the form of destructive clearcutting, which accounted for most of the volume taken in the Sierra Nevada from 1983 to 1987. Timber extraction levels in 1990 were near their historic peak. Clearcutting has now ceased on public lands, with the Forest Service adopting selective harvesting methods. However, on private lands, primarily those owned by Sierra Pacific Industries (SPI), clearcutting continues. As a result of timber extraction, very little old growth forest stands remain in the Yuba Basin (<5%) and most trees exist in relatively even-aged stands less than 100 years old.

Intensive timber extraction, particularly clearcutting, leads to on-site ecological effects, including:

- Vegetation removal causing loss of evapotranspiration, and root decay which leads to increased landslides;
- Soil exposure and compaction which leads to a reduced water infiltration and soil moisture; and
- Road building leading to erosion (sediment yield is commonly more than ten times that of unlogged areas) and increased fine sediment supplies delivered to streams.

**Grazing**

Beginning in the 1860s and continuing for decades, the entire Sierra Nevada was intensively overgrazed by sheep. Grazing peaked in 1876 when more than 6 million sheep grazed state-wide. These activities were particularly destructive to high altitude meadows, ecosystems critical in maintaining water quality. During this era the historical literature illustrates stark accounts of the impacts of over grazing, placing them in equal or greater proportion to mining impacts.

*Above:* Fire on ridge between Middle and South Yuba River August 15, 2009; Two clear-cuts on south slope of South Yuba River on SPI-owned land, 2008. Green stripe in middle of image represents “streamside protection.”
At the turn of the 20th century, the intensity of 40 years of high elevation sheep grazing impacted vegetation stand structure and regeneration patterns, producing lasting changes in mixed communities of grasses, forbs, and shrubs. In areas that had not been logged, the effects of grazing significantly changed forest structure, removing generations of new growth so that only large trees and small seedlings remained. The causative effect of overgrazing and increases in sediment loads and discharge in rivers is remarkably similar to the effects of logging in watersheds.

The lower foothill region of the Yuba Basin has been the site of livestock grazing and fuelwood harvesting for well over a century. Extensive amounts of woodland conversion and oak tree removal have altered the nutrient cycling, wildlife habitat, and hydrology of this area. Although nothing like the effects of late 19th century higher elevation overgrazing, cattle, goat, and sheep grazing in the foothills has had a damaging effect on plant communities and springs.

Fire Suppression

The 20th century was the era of fire suppression, whereby policies derived from forest management practices in the eastern United States were applied without an understanding of the critical ecological role that fire plays in Sierra Nevada forests. Policies that have excluded fire have facilitated unprecedented tree recruitment. The result has been the creation and maintenance of historically unprecedented, excessive fuel loads through dense stand conditions and accumulated dead woody debris on the forest floor. Historically, fires burned at an average interval of 3 to 15 years below 5000’ elevation, which moderated tree recruitment. Due to lack of fire for up to 100 years, 80-90% of the forest below 5000’ in the Yuba Watershed is classified by USFS scientists as in a state of “severe departure” from historical conditions relative to fuel loads. Above 5000’ historic fire intervals were approximately 50 years, therefore these forests are classified in a state of “moderate departure” (G. Fildes, pers. comm.). The “49er Fire” in 1988 in the Middle and South Yuba Sub-Basins burned 33,500 acres and hundreds of homes, and underscored the drawbacks of fire suppression to natural resource managers and the public.

Invasive Species

In recent decades the potential for invasive species to alter ecosystem structure and function has become widely recognized. Invasive species contribute significantly to loss of native species and decline of habitat. Most invasive plant species (noxious weeds) occur along main travel routes and in areas that have been disturbed. Weeds that are currently significant and increasing in the Yuba Basin include Scotch Broom (Cytisus scoparius), Yellow star thistle (Centaurea maculosa), Himalayan Blackberry (Rubus discolor), Skeleton weed (Chondrilla juncea), and Cheatgrass (Bromus tectorum). Invasive plant species, in particular Scotch Broom, are currently expanding their range by moving upslope in the Yuba Basin. Bullfrogs (Rana catesbeiana) are a widespread non-native amphibian that has contributed to the significant decline in native frog populations.
Human Development Patterns

The majority of urbanization and associated non-point source pollution issues occurs in the Deer Creek Sub-Basin, where Nevada City (pop. 3,100) sits as the largest municipality in the Yuba Basin. The organization Friends of Deer Creek has monitored and documented the impacts of stormwater runoff, wastewater discharge and other water quality impacts associated with urbanization and impermeable surfaces\textsuperscript{33} (Map 1, page 23). A significant percentage of the population in the Yuba Basin resides in a rural setting. Nevada County went through a period of intensive subdivision of parcels in the 1960s and 70’s, resulting in many areas divided into small parcel sizes (and relatively dense housing clusters) in unincorporated wildlands throughout the watershed\textsuperscript{34}. This expanded and exacerbated land use practices common in rural areas (e.g., road building, septic systems, animal grazing, tree-cutting), which have had a wide range of impacts on watershed conditions.

Impact of Roads on Aquatic Ecosystems

Roads and other land disturbances increase the rate of waterway sedimentation while simultaneously decreasing the particle size of sediments\textsuperscript{35}. This can send fine sediment pulses to downstream waterways\textsuperscript{36}, disrupting food availability\textsuperscript{37} and degrading spawning gravel qualities for downstream salmonids\textsuperscript{38}. When combined with low flows from water management activities, fine sediment inputs can become a persistent problem. The presence of roads and the crossing of streams by roads are strongly correlated with loss of aquatic biotic integrity\textsuperscript{6}. The Yuba Basin has some of the highest road densities of any watershed in the Sierra Nevada, measuring 2.4 miles of road per square mile of land\textsuperscript{39}.

Combined Effect of Land Use Impacts on Upland Forest Condition

The combined effects of logging, grazing, and fire suppression over 160 years have changed the upland forest system of the Yuba Basin from one dominated by large, old, widely spaced trees to one dominated by dense, fairly even-aged stands in which most of the largest trees are only 80-100 years old. Forests today are denser with generally smaller trees, have more woody debris on the forest floor, and have a higher density of white fir and incense cedar than were present historically\textsuperscript{31}. The loss of spatial and age-class heterogeneity, increased fuel loads, and damage to soil systems resulting from these land use practices have stressed the forests of the region and left them prone to high intensity fires and pest infestations, and diminished species diversity. Their capacity for moisture retention and absorption, linked to the maintenance of healthy groundwater and surface flows, has been reduced.
“Endangered species are not just accidents of our way of living. They are the necessary consequences of our way of living.” – Charles Bergman

### Biodiversity Decline

The combined effects of human practices in the past 160 years have resulted in the loss or severe decline of key elements of the biota. In particular, large predators which require significant amounts of habitat, native amphibians, and anadromous species have disappeared completely or exist in severely reduced remnant populations. When assessing watershed health, it is important to honor the “ghost of relationship” we have with these former drivers of watershed condition (Table 5). Biodiversity operates at multiple scales. As a result, maintenance of biodiversity requires maintenance at all levels: genetic, species, populations, communities, ecosystems, landscapes, and regions.

Due to a lack of information on the ecology of most species, biodiversity may be even more endangered by human impacts than has been previously recognized. For the Yuba Watershed in particular, the arrival of human settlers on a historically unprecedented scale following the discovery of gold resulted in significant and undocumented changes in the size and distribution of populations of the existing biota. Initial attempts at surveying the ecology occurred after this massive perturbation. This has likely resulted in consistently conservative estimates of historical, pre-mining populations. In the case of wildlife, for example, the upper elevation limits to California Chinook salmon have been presented by Yoshiyama et al. only where they could be established by direct evidence and contemporary historical accounts. “Direct evidence” translates to a scientist of the dominant culture and “historical accounts” translates to a literate individual of the dominant culture writing down a story. The perspectives, knowledge and oral histories held by Indigenous Californians were ignored in most historical accounts of the region, an omission that remains embedded in modern science.

#### Table 5: Biodiversity Loss: A Sample of species Extirpated from or in Severe Decline in the Yuba Watershed

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grizzly Bear (Ursus arctos horribilis)</td>
<td>Extirpated</td>
</tr>
<tr>
<td>Wolverine (Gulo gulo)</td>
<td>Thought to be extirpated since 1920. Recent sighting of solitary male north of Truckee</td>
</tr>
<tr>
<td>Pacific Fisher (Martes pinanti)</td>
<td>Extremely rare</td>
</tr>
<tr>
<td>Sierra Nevada Red Fox (Vulpes vulpes necator)</td>
<td>Extremely rare</td>
</tr>
<tr>
<td>California Red-legged Frog (Rana draytonii)</td>
<td>Extremely rare</td>
</tr>
<tr>
<td>Sierra Nevada Yellow-legged Frog (Rana sierrae)</td>
<td>Extremely rare</td>
</tr>
<tr>
<td>Harlequin Duck (Histrionicus histrionicus)</td>
<td>Most likely Extirpated</td>
</tr>
<tr>
<td>Chinook Salmon (Oncorhynchus tshawytscha)</td>
<td>Extirpated above Englebright Dam; low numbers below Dam</td>
</tr>
<tr>
<td>Steelhead Trout (Oncorhynchus mykiss)</td>
<td>Extirpated above Englebright Dam; low numbers below Dam</td>
</tr>
<tr>
<td>Pacific Lamprey (Lampetra tridentate)</td>
<td>Extirpated above Englebright Dam; low numbers below Dam</td>
</tr>
<tr>
<td>Green Sturgeon (Acipenser medirostris)</td>
<td>Thought to be extirpated until a pair was photographed below Daguerre Point Dam in 2007.</td>
</tr>
<tr>
<td>Green-flowered wintergreen (Pyrola chlorantha)</td>
<td>Most likely extirpated</td>
</tr>
</tbody>
</table>
Map 1: Yuba River Basin, showing hydro-geographic boundaries and community stewardship activities.

For a better viewing or downloading of this map, go to www.yubased.org.
Yuba River Basin showing hydro-geographic boundaries and community stewardship activities

For a better viewing or downloading of this map, go to www.yubahed.org

Map by Lisa Lackey, 2010
Hydropower Licensees and Owners of Dams and Diversions:

NID - Nevada Irrigation District (FERC #2266)
PG&E - Pacific Gas and Electric (FERC #2310)
YCWA - Yuba County Water Agency (FERC #2246)
SFWPA - South Feather Water and Power Agency (FERC #2088)
USACE - U.S. Army Corps of Engineers
BVID - Browns Valley Irrigation District

Data from USGS, PG&E, NID and YCWA

TAF = thousand acre feet [1 TAF = 1.373 cfs annually]

<table>
<thead>
<tr>
<th>Major Diversions</th>
<th>River Hydrography</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAF</td>
<td>TAF</td>
</tr>
<tr>
<td>0 - 14</td>
<td>0 - 14</td>
</tr>
<tr>
<td>14.01 - 65</td>
<td>14.01 - 65</td>
</tr>
<tr>
<td>65.01 - 125</td>
<td>65.01 - 125</td>
</tr>
<tr>
<td>125.1 - 145</td>
<td>125.1 - 145</td>
</tr>
<tr>
<td>145.1 - 215</td>
<td>145.1 - 215</td>
</tr>
<tr>
<td>215.1 - 375</td>
<td>215.1 - 375</td>
</tr>
<tr>
<td>375.1 - 500</td>
<td>375.1 - 500</td>
</tr>
<tr>
<td>500.1 - 600</td>
<td>500.1 - 600</td>
</tr>
<tr>
<td>600.1 - 750</td>
<td>600.1 - 750</td>
</tr>
<tr>
<td>750.1 - 900</td>
<td>750.1 - 900</td>
</tr>
<tr>
<td>900.1 - 1,000</td>
<td>900.1 - 1,000</td>
</tr>
<tr>
<td>1,001 - 2,004</td>
<td>1001 - 2004</td>
</tr>
</tbody>
</table>
Yuba River Average Annual Flow Volumes (WY 1995-2004) in Total Acre-feet (TAF)

TAF=Thousand Acre Feet (1 TAF= 1.373 cfs annually)

For a better viewing or downloading of this map, go to www.yubashed.org

Map by Ben Chambers, 2010
Restoration Ecology

As the previous *Impacts* section of this assessment demonstrates, systematic research is answering critical questions about how human activities affect ecological systems. This section, *Restoration Priorities*, demonstrates that systematic research can also inform critical questions about how these systems can be restored from a degraded state. Restoration ecology, by necessity, integrates the biological and physical elements of ecological systems. Recognizing that living systems function within a physical structure of geology, soils, hydrology, and climate, restoration ecology focuses on the relationship between these physical processes and the function of the biological elements in the overall system. In practice, restoration ecology goes beyond preservation and protection of native biodiversity to proactively restore the capacity of systems to support natural ecological cycles.

In the three year period of conducting this assessment we have also assessed the human ecology, or community capacity, to begin to address these impacts. Therefore, included in the *Restoration Priorities* section are specific suggestions for how citizen capacity can address these impacts, both on the ground in terms of local and approachable impacts, and through advocacy to address large scale impacts or institutional impediments to watershed restoration.

**Summary of Restoration Priorities in the Yuba Basin**

1. **Remediation of Legacy Mining Effects**
   a. Addressing issues associated with the physical and chemical hazards of abandoned mine lands (AMLs)
   b. Removal of mercury from sediment trapped behind in-stream barriers
   c. Rehabilitation of the radically altered Lower Yuba River (see restoring floodplain function)

2. **Reformin Water Management**
   a. Improve the timing and amount of in-stream flows through the FERC process and multi-basin water planning
   b. Removal of instream barriers where appropriate and most beneficial

3. **Restoring Forest Function**
   a. Fuel load reduction
   b. Encouragement of a biodiverse, mixed-aged forest structure with fewer – yet larger diameter– trees and greater herbaceous species richness
   c. Soil rehabilitation
   d. Cessation of clearcutting and logging in riparian corridors
   e. Curbing unsustainable commercial logging practices
   f. Road removal
   g. Containment and control of invasive species

4. **Restoring Meadow Function**
   a. High elevation meadow restoration
   b. Containment and control of invasive species

5. **Restoring Floodplain Function**
   a. Rehabilitation of the lower Yuba River
      i. Enhancement of riparian and off-channel rearing habitat for juvenile salmonids
      ii. Managing reservoir releases to support riparian forests and floodplain connectivity
Measuring Cumulative Effects

Water quality measurements and ecological proxies provide information that can help diagnose inherently integrated ecological problems and direct restoration priorities. Indices of biotic integrity (IBI’s) are carefully chosen biotic communities surveyed to measure the overall state of the watershed downstream or downslope of land and water-use impacts over time. An example of an IBI used in the Yuba Basin by SYRCL’s River Monitoring Program is the assessment of communities of aquatic insects, or benthic macroinvertebrates (BMI’s). Certain organisms in this broadly classified community are more tolerant than others of specific impacts such as heavy metal pollution, turbidity, or temperature. Assessing the mere presence or absence of members of this community can give us information about the overall ecological health of a particular sub-watershed while pointing us in the direction of the most severe specific impacts. Assessments of periphyton (types and quantities of algae), fish and amphibian populations, and physical characteristics of the river channel also indicate specific watershed impacts and suggest their causes.

By 2011 the South Yuba River Citizens League will have accomplished its 10th year of collecting water quality data and 6th year of collecting BMI data at sites throughout the Yuba Basin. As well as already identifying trends over time, these data provide an invaluable baseline of information to track future changes. Figure 4 displays composite BMI scores at select locations in the Yuba watershed, suggesting integrated and/or cumulative impacts affecting aquatic life at Lang’s Crossing, Bridgeport, and Parks Bar. Additionally, other organizations in the watershed (such as Friends of Deer Creek) as well as the ongoing FERC related studies (see page 32) have significantly augmented the collection of this type of data. All of this natural resource data is to be made available to the public through the Yuba River Watershed Information System, found at www.yubashed.org.

Figure 4: BMI composite scores at select sites in the Yuba Basin. (2004-2008)
The terms Unsuitable, Suboptimal, and Suitable are used only to rank relative condition and not to infer conclusions. For more explanation, see www.yubashed.org
Source: SYRCL water quality monitoring program

Above: Acid mine drainage, North Yuba Sub-Basin; SYRCL River Monitor measures water quality
Remediation of Legacy Mining Effects

It is difficult to overstate the severity of the toxic legacy of mining in the Yuba Basin, and the existing and persistent threats to the ecological communities (including human) that reside here. However, it is feasible to address these problems, and recent advancements in methods and technologies offer solutions to formerly intractable problems. Using proven methods we recommend accelerating the recent trend of public agencies and citizen groups to systematically locate and contain the highest toxicity sources that are proximate to where we live, work and recreate.

The priorities for restoration of legacy effects of mining fall into three areas:

1. Addressing issues associated with the physical and chemical hazards of abandoned mine lands (AMLs) with a focus on watershed-scale from the most toxic mine tailings;
2. Removal of mercury from sediment trapped behind in-stream barriers; and
3. Rehabilitation of the radically altered Lower Yuba River (see page 37).

Restoration Priorities for AMLs and Toxic Tailings

The Abandoned Mine Lands Unit (AMLU) of the California Department of Conservation (CDOC) performed an AML Assessment of the North Yuba Watershed from 2001-2003. Starting with a list of 400 mines generated from USGS topographic map symbols (Figure 5) they physically visited 128 sites. There they conducted physical surveys, tested water quality for acid mine drainage, and at certain mines analyzed soil samples for arsenic, lead, and mercury. The results of this assessment generated two priority lists for remediation. The data clearly isolate a small number of mines with the highest orders of toxicity. These studies have identified acid mine drainage, arsenic, and lead as the principal concerns. This methodology offers a template for systematically approaching a widespread and complex problem while minimizing the investment of time and other resources.

The North Yuba Sub-Basin

Based on the data from the CDOC assessment, the immediate priorities in the North Yuba Sub-Basin are to attract funding to implement remediation actions at the mine sites in Table 6. Brandy City Diggings, Keystone, St. Lewis Debris Dam, and particularly Tennessee Mine require immediate
Table 6: Mine sites to target for remediation in North Yuba Sub-Basin. See Map 1 (page 23) for locations.

<table>
<thead>
<tr>
<th>Mine Name</th>
<th>Arsenic (ppm)</th>
<th>Lead (ppm)</th>
<th>Mercury (ppm)</th>
<th>Chemical PAR ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brandy City Diggings</td>
<td>3.3</td>
<td>6.5</td>
<td>nd</td>
<td>10,052</td>
</tr>
<tr>
<td>Davis Motor</td>
<td>36</td>
<td>1000</td>
<td>.31</td>
<td>108</td>
</tr>
<tr>
<td>Ironsides</td>
<td>130</td>
<td>590</td>
<td>47</td>
<td>41</td>
</tr>
<tr>
<td>Ironsides</td>
<td>80</td>
<td>42</td>
<td>.34</td>
<td>10,044</td>
</tr>
<tr>
<td>St. Lewis Debris Dam</td>
<td>nt</td>
<td>nt</td>
<td>nt</td>
<td>9,919</td>
</tr>
<tr>
<td>Tennessee Mine</td>
<td>nt</td>
<td>nt</td>
<td>nt</td>
<td>20,349</td>
</tr>
<tr>
<td>Union Keystone</td>
<td>600</td>
<td>130</td>
<td>.63</td>
<td>42</td>
</tr>
</tbody>
</table>

¹ Chemical PAR Score is a combination of chemical water quality parameters indicative of acid mine drainage. nt: not tested; nd: not detected

Source: CDOC Abandoned Mine Land Assessment of the North Yuba Watershed, 2003

attention as a result of their ongoing threat to downstream water quality (as identified by Chemical PAR scores). Davis Motor, Ironsides, and Union Keystone Mines require containment of toxic levels for arsenic and lead in the mine sites’ debris. Ironsides requires further investigation to determine the degree to which high levels of mercury are methalyzing on-site. These mines are the most urgent sites for remediation in the North Yuba Sub-Basin. Techniques, costs, and feasibility for clean-up will vary depending upon the principal contaminant and land ownership. Pursuit of remediation at the mines listed in Table 6 (and identified on Map 1) will thus provide a path for future clean-up efforts throughout the watershed.

The Deer Creek Sub-Basin

The City of Nevada City received funding from the Environmental Protection Agency to conduct a community wide Brownfield Assessment. Phase II Assessments of the Providence and Stiles Mines have just been completed. Extensive samples from each site were tested for heavy metals, resulting in recommendations to remove an old wall at Providence Mine with extremely high lead content and possible remediation at Stiles Mine for high arsenic levels. It is essential that funds for the recommended remediation of this clearly identified public health hazard be allocated as soon as possible, as well as funding for the continuation of assessments of this nature for all mine sites near human population centers.

Remaining Sub-Basins

The AMLU assessment of the North Yuba cost $200,000 to complete over two years. In collaboration with the AMLU, an assessment of this type should be conducted for the South Yuba, Middle Yuba, Main Stem, and Dry Creek Sub-Basin’s. Costs can be substantially reduced by engaging citizen monitors already trained in basic AML identification and safety through SYRCL’s Yuba Stewards Program. An AML assessment of the South Yuba Basin is the first priority. Tasks that can be accomplished by citizen volunteers include:

1. With USGS topographic maps identify all mine symbols and attempt to locate inactive mines in the field. GPS the site location, describe access, and perform basic physical survey. Report immediately any mine tailings discoveries in wetland environments.
2. Perform historical literature review for each mine to integrate into the bibliographic references in the Yuba River Watershed Information System, (“YubaShed”).
3. Work with SYRCL scientists and AMLU to determine locations to conduct water and soil samples. Take samples according to defined protocols and submit for lab testing.

By engaging in a citizen-based approach in partnership with SYRCL, the AMLU can produce the final assessment expeditiously and at a cost savings. If highly toxic mine sites are identified during the assessment process, funds for remediation of the sites should be pursued immediately as assessment and remediation can occur concurrently.
In our region, the Nevada Irrigation District (NID) is piloting a technique that could safely remove mercury entrained in the sediment that accumulates behind reservoirs.

**Removal of Mercury from Sediment in Reservoirs**

Addressing concerns of small barriers associated with mining activities can be accomplished through the aforementioned protocol for AML identification. Larger water supply reservoirs in heavily mined areas are routinely dredged to remove accumulated sediment to maintain water storage capacity. In the past, the sediment disturbance caused by these dredging activities may have contributed to the methalyzation of mercury. In our region, the Nevada Irrigation District (NID) is piloting a technique that could safely remove mercury entrained in the sediment that accumulates behind reservoirs. In the summer of 2009 NID used a giant centrifuge to successfully remove mercury from sediment samples from Combie Reservoir in the Bear River Basin. The results of these tests indicated that the mercury treatment process was 94% effective at removing mercury from reservoir sediments at Combie Reservoir and the process is still being refined. In order to continue this effort over the next 3-5 years, NID has asked for a $3.5 million appropriation from the Federal government, for fiscal year 2011. The overall project is estimated to cost approximately $9M and will remove and treat 200,000 cubic yards of sediment from Combie Reservoir removing approximately 150 kg of mercury from the Bear River. An integral aspect of this proposed project includes intensive monitoring and study of the process to ensure its local and downstream effectiveness and safety. Demonstration of benefits downstream would support requests for long-term funding through offsets or pollution credits. If successful, this technique for safe removal of mercury could be used in Yuba Basin reservoirs and could constitute a critical restoration priority for the legacy effect of mining in the Yuba watershed. Indeed, significant public investment into the quantity, location and characteristics of the sediment trapped behind Englebright Dam has already been conducted by the US Geological Survey (see page 34). Englebright Dam captures sediment from the South Yuba and Middle Yuba Rivers and its tributaries, making it an excellent potential candidate for this mercury removal technique.

**Advocacy for Mine Clean Up Efforts**

The responsible parties have not been held accountable for the legacy impacts of historic mining. Based on an analysis of estimated dollars spent since 2000 to address abandoned mines under existing State and Federal laws, the most likely remediating entities for these sites are the Environmental Protection Agency, Department of Toxic Substance Control, U.S. Forest Service, CA Department of Fish & Game, State Water Resources Control Board, and Potentially Responsible Parties. We recommend a coordinated effort with local, state and federal entities to develop a mining toxics remediation and restoration plan for the entire Yuba Basin. Citizen advocacy in strong recognition of the severity of the issue could translate to necessary funds for remediation.
Reforming Water Management

While much of the infrastructure for water management in the Yuba Basin serves human needs of high importance, the rivers and creeks are excessively dammed and diverted, some for no other reason than historical legacy and inertia. The following are priorities for water management reform:

1. Improve the timing and amount of in-stream flows through regulatory and planning processes

The FERC Process

Eighty percent of California’s hydropower dams are regulated through 30-50 year licenses issued by the Federal Energy Regulatory Commission (FERC). The process to successfully renew licenses includes mechanisms to improve flow regimes, water quality and fish passage, and to restore aquatic and riparian ecosystems. All major projects in the Yuba Basin require license renewal in the next 6 years, including the PG&E Drum-Spaulding Project (license expiration in 2013), the Nevada Irrigation District’s Yuba-Bear Project (exp. 2013), and the Yuba County Water Agency’s Yuba River Project (exp. 2016). A fourth project on the Middle Fork American River (exp. 2013) is undergoing relicensing by Placer County Water Agency, which receives roughly 110,000 acre-feet of Yuba River water through a long standing contract with PG&E. Even small percentages of the significant diversions outlined earlier in this report returned to the river could provide essential cold water habitat for salmon and trout. In particular, the locations identified earlier in this assessment as dewatered “dead zones” immediately downstream of major dams and intercepting canals must have basic instream flow requirements established and maintained (Map 2, page 25).

To address the FERC process, multiple NGOs are organized under the umbrella of the Foothills Water Network (www.foothillswaternetwork.org). Additionally, citizens organized through “watershed guilds” (see page 43) can advocate for improved conditions in hydropower-impacted creeks and river reaches by documenting impacts to river reaches, attending public re-licensing meetings, and observing field studies required by the FERC process.

Multi-Basin Water Planning

Another pathway toward improved in-stream flows takes advantage of existing inter-basin plumbing to improve overall efficiency and flexibility in the timing of water release through regional-scale water management. An Integrated Regional Water Management Plan (IRWMP) for the Cosumnes, American, Bear and Yuba (CABY) Basins was initiated and completed in 2006 by a wide range of stakeholders, including SYRCL and water agencies as Coordinating Committee members. This plan represents a noteworthy achievement toward collaborative, bioregional, watershed-based planning and water management reform to meet multiple objectives. Despite California voters authorizing over $1 billion for implementation of IRWMPs statewide in 2006, only ancillary funding has supported the implementation of the multi-basin water management reform objectives agreed to in the CABY Plan. This lack of funding threatens to render this robust four watershed-based planning effort impotent to affect any real change to the status quo.

* * * Above: South Yuba River; Our House Dam, Middle Yuba River
If we are to move toward a future that is both sustainable and resilient to climate change, the water distribution system in the Yuba Basin and statewide needs reform so that more water flows unblocked and in natural watercourses, thus supporting the full array of ecosystem services upon which all life depends.

2. Barrier removal where appropriate and most beneficial

Both large and small in-stream dams should be assessed for the current and future value they provide society. An important variable in this analysis is the well-documented detrimental ecological consequences of blocking physical and biotic constituents of the river system. Building from dam data compiled and mapped by SYRCL, all small barriers in the Yuba Basin should be identified, and a priority list for their removal generated. As most of these barriers are associated with abandoned mine lands (AMLs), this process can occur as part of the AML survey recommended in the previous section of this assessment.

Additionally, statewide and regional reform of water management should aggressively seek to solve the multiple and interacting river and water quality impacts resulting from the era that built the ring of “terminal rim dams” (TRDs) in the Sierra Nevada foothills. As indicated by the precedent set on the Klamath River to the north, the FERC process mentioned above can instigate negative-value dam removal. One of the strongest indicators of ecosystem collapse in California is the decline of salmon populations. According to a report by scientists at the National Marine Fisheries Service, “To recover Central Valley salmon and steelhead..., some populations will need to be established in areas now blocked by dams or insufficient flows.” The Yuba is widely considered by fisheries biologists as a prime candidate for salmon reintroduction into historic Sierra Nevada river habitats. In addition to allowing for the migration of anadromous fish to ancestral spawning grounds, barrier removal would support healthy river functions and geomorphic processes (such as gravels and woody material transport to downstream habitats).
Healthy, fully functioning forests are resilient to disturbances, generating clean surface and ground water, clean air, healthy soil, and wildlife habitat.

Restoring Forest Function

As the Land Use Impacts section earlier in this assessment articulates, at a broad scale the forests of the Yuba Basin exist in a degraded state, inhibited from providing the full suite of ecosystem services they are capable of generating.

The following forest management goals support improved upland forest condition:

1. Fuel load reduction
2. Encouragement of a biologically diverse, mixed-age forest structure with fewer—yet larger diameter—trees and greater herbaceous species richness.
3. Soil rehabilitation

Treatments that begin with mechanical removal of dense stands of small diameter trees, followed by a regime of burning, are an effective approach to meeting these goals. However, because this can also favor alien species invasion at some sites, monitoring and control need to be a part of the prescription when using this treatment. Mechanical removal must be accomplished with a focus on minimal soil disturbance. The re-introduction of fire as an ecosystem process is critical to the achievement of healthy forests. However, because of excessive fuel loads due to 100 years of fire suppression, significant mechanical removal should precede initial controlled burning in a given area. A forest gap model developed for forests in the Sierra Nevada that integrates fire, climate, and forest dynamics predicts that pre-suppression forest basal area, species composition, and spatial structure would be restored quickly if fires that caused substantial tree mortality were allowed to burn or were re-introduced. Post-fire practices should be monitored to determine which post-fire actions best serve soil health. Additionally, inoculation of mycelium can be pursued as an option for accelerating soil rehabilitation and moisture retention in more severely disturbed forest environments.

Cessation of Clearcutting and Logging in Riparian Corridors

Despite the fact that we now understand quite well how to improve forest function, some logging practices in the Yuba Basin not only fail to apply these principles, but perpetuate the most obvious form of ecological devastation—the practice of clearcutting (see image page 20). Areas that have been clearcut represent a relatively small percentage of total logged areas, yet supply a disproportionate amount of the total sediment associated with logging. Therefore, on a Basin-scale the most urgent priorities for maintaining forest function are a cessation of clearcutting (and associated use of herbicides) in favor of intermediate harvest styles which still allow for timber production and profits, and a cessation of logging within riparian corridors, because of the critical role these ecosystems play in maintaining watershed health. These forest management practices—and others that promote the goals of restoring forest function—are enshrined in the international and independent certification processes of the Forest Stewardship Council (FSC). Based on the research that went into this report, no land is managed under FSC guidelines in the Yuba Basin.
Industrial Logging Practices and Sierra Pacific Industries

Although there is still room for improvement, in recent years forestry practices on publically owned land (Tahoe National Forest) in the Yuba Basin are getting better as a result of agency-wide mandates to emphasize ecological function and best management practices. However, due to the checkerboard ownership pattern in the upper Yuba Basin – a relic of the building of the transcontinental railroad – large amounts of land are privately owned by a single timber company, Sierra Pacific Industries (SPI). With 1.5 million acres, SPI is the largest private landowner in California. SPI is aggressively logging its land with widespread clearcutting, followed by bulldozing, herbicide treatments, and the planting of single species tree plantations—practices that degrade public trust resources. Between 1997 and 2006 SPI submitted plans and received approval to log nearly a quarter of a million acres of California’s forests through clearcutting and other forms of plantation conversion.

Curbing Unsustainable Commercial Logging Practices

The Board of Forestry of Cal Fire (formerly the California Department of Forestry) enforces the laws that regulate commercial logging on privately owned lands in California. These laws are found in the Forest Practice Act, enacted in 1973 to ensure that logging is done in a manner that will preserve and protect our fish, wildlife, forests and streams. Timber Harvesting Plans (THPs) represent the environmental review document submitted by landowners (prepared by a registered professional forester) to Cal Fire outlining what timber he or she wants to harvest, how it will be harvested, and the steps that will be taken to prevent damage to the environment. Despite seemingly effective language, including required sections within THPs addressing cumulative impacts and ecosystem health, extensive clearcuts are consistently approved. This clearly indicates the existing regulatory culture (similar to off-shore oil drilling and Wall Street) is insufficient to protect forest-generated ecosystem services that promote long-term watershed health. Indeed, 3 of 9 members of the Board of Forestry are current managers of industrial timber companies, including SPI. As a result, continued consumer and public advocacy campaigns are likely the most effective approach to addressing this issue. Compelling SPI to voluntarily adopt FSC-certified forestry practices, or introducing endangered salmon in the waterways immediately downstream of SPI lands, are two ways to ensure cessation of clearcutting on these private lands.

Within the Yuba Basin the Forest Issues Group (www.forestissuesgroup.org) and the Sierra Forest Legacy (www.sierraforestlegacy.org) are actively engaged in THP review and advocacy for improved forest practices. The Forest Guild (www.forestguild.org) is a resource for sustainable land management services. The development of Watershed Guilds (discussed on page 44) in the Yuba Basin would be an excellent approach to support systematically curbing the most destructive logging practices.

Road Removal

Because the presence of roads and the crossing of streams by roads are strongly correlated with loss of aquatic biotic integrity, road decommissioning is one major restoration action that can benefit fish and other aquatic biota. Citizen engagement in the road inventory and off-road vehicle route prioritizations conducted by the Tahoe National Forest’s Travel Management Rulemaking have resulted in protections of watershed health in some areas. However, lack of federal funding to implement Legacy Roads and Trails Remediation has resulted in a significant backlog of deferred maintenance and decommissioning of roads within the Tahoe National Forest. Citizen groups should contribute to the implementation of sanctioned road and trail decommissionings, including pre- and post-restoration water quality monitoring.

Above: Citizen volunteers conduct meadow assessment; High elevation wetland, South Yuba Sub-Basin
Preliminary assessments indicate that restored northern Sierra mountain meadows, which serve as water purification zones and natural reservoirs, could have the groundwater storage capacity of approximately 190,000 acre feet per year\(^{56}\)

**Restoring Meadow Function**

Meadows provide refuge habitat conditions for a wide variety of rare plants and animals (such as Willow Flycatcher and Great Grey Owl). They also serve an ecological function of cleansing and storing cold water for release late in summer. This “service” is lost when the water table drops due to incised stream banks. Restoring meadows involves eliminating or minimizing the causes of the forces of degradation (such as grazing and stream flow manipulation) and implementing actions to raise the water table. In the Feather River Basin to the north a great deal of experimental meadow restoration has occurred through various techniques (such as “plug and pond”), experience which can inform meadow restoration in the Yuba Basin.

American Rivers (www.americanrivers.org) and its partners are assessing and prioritizing Sierra meadows for restoration. SYRCL is a partner in this effort through citizen-based meadows monitoring and ecological health assessments conducted in seven montane meadows in the Yuba Watershed since 2008 (Map 1, page 23). Preliminary assessments indicate that restored northern Sierra mountain meadows, which serve as water purification zones and natural reservoirs, could have the groundwater storage capacity of approximately 190,000 acre feet per year\(^{56}\). This is roughly three times the storage capacity of PG&E-operated Spaulding Reservoir. Based on the opportunities for increased biodiversity and water storage function, the meadow health assessments lead us to recommend prioritizing the restoration of Loney Meadows (Texas Creek Watershed, South Yuba Sub-Basin), Van Norden Meadow (South Yuba headwaters), and Pauly Creek Meadow (North Yuba Sub-Basin)\(^{57}\). Citizen volunteers can contribute to the restoration efforts listed above by volunteering time to participate in meadow restoration projects.

**Invasive Species**

An important restoration priority is the containment and control of undesirable non-native species (and native species unnaturally encroaching on rare ecotypes) in both meadow and forest systems. Many non-native and invasive plants impact biodiversity, increase fire risk, and become nuisance plants in working landscapes. Areas for treatment should be prioritized by focusing on locations where outlying populations occur, or where source populations threaten intact plant and animal communities. In degraded meadow systems that lose their water table, encroachment by pine trees can cause further degradation of native meadow plant communities. Currently, invasive plant removal is coordinated with the Natural Resources Conservation Service and the Nevada County RCD on private lands, and on public lands through efforts by agencies such as the Tahoe National Forest. Citizen volunteers can contribute by participating in invasive species removal projects such as the Scotch Broom Challenge coordinated by the Nevada County Firesafe Council, or Greater Yuba Restoration Days coordinated by SYRCL.

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\(^{56}\) Preliminary assessments indicate that restored northern Sierra mountain meadows, which serve as water purification zones and natural reservoirs, could have the groundwater storage capacity of approximately 190,000 acre feet per year.

\(^{57}\) American Rivers (www.americanrivers.org) and its partners are assessing and prioritizing Sierra meadows for restoration. SYRCL is a partner in this effort through citizen-based meadows monitoring and ecological health assessments conducted in seven montane meadows in the Yuba Watershed since 2008. Preliminary assessments indicate that restored northern Sierra mountain meadows, which serve as water purification zones and natural reservoirs, could have the groundwater storage capacity of approximately 190,000 acre feet per year. This is roughly three times the storage capacity of PG&E-operated Spaulding Reservoir. Based on the opportunities for increased biodiversity and water storage function, the meadow health assessments lead us to recommend prioritizing the restoration of Loney Meadows (Texas Creek Watershed, South Yuba Sub-Basin), Van Norden Meadow (South Yuba headwaters), and Pauly Creek Meadow (North Yuba Sub-Basin). Citizen volunteers can contribute to the restoration efforts listed above by volunteering time to participate in meadow restoration projects.
A primary limitation to the abundance of salmonids in the Yuba River is the lack of off-channel and riparian habitat to support the growth and survival of young “fry” into healthy juveniles ready to make their arduous journey to the sea.

**Restoring Floodplain Function**

**Rehabilitation in the Lower Yuba River**

To say the lower Yuba River is a physically altered river system is a fantastic understatement. Of the estimated 685 million cubic yards of sediment dislodged by hydraulic mining, 331 million was stored in the valleys of the Yuba Basin (Gilbert 1917 quoted in James et al. 2009). Much of this material settled where the grade of the river flattened as it entered the Central Valley, creating what is known today as the Yuba Goldfields. Nearly all the organic matter from this sediment was removed by a second extraction of gold through dredging. The large-scale arrangement of the remaining barren gravel included “training walls,” an unengineered conveyance system that has redirected and contained the river within a 500’ wide channel. Compounded by a significantly altered annual hydrograph due to upstream dams, it is remarkable that this area supports life at all, much less the best remaining naturally-produced salmon run of any major river draining the Sierra Nevada.

The Central Valley populations of salmon are the most southerly occurring Chinook salmon runs in the Pacific. The spring-run Chinook of the Central Valley were listed as Threatened with extinction in 2001, and now the fall-run has reached catastrophically low levels. In 2009, a record low estimate of 39,500 adult salmon returned throughout the entire Central Valley. While most were hatchery fish, a solid 10% were naturally-produced Yuba River fish. These alarming trends compel immediate action to improve fisheries habitat in the lower Yuba River. Further supporting this objective, an independent assessment of 42 major stakeholders of widely diverse interests conducted by the Center for Collaborative Policy (at CSU Sacramento) in 2008 concluded that the desire to improve fisheries habitat in the Yuba was unanimous.

**Enhancement of Riparian and Off-channel Rearing Habitat for Juvenile Salmonids**

Aside from access to habitat above barrier dams, a primary limitation to the abundance of salmonids in the Yuba River is the lack of off-channel and riparian habitat to support the growth and survival of young “fry” into healthy juveniles ready to make their arduous journey to the sea (see photo this page). In the past, diverse habitats supported larger smolts at a greater variety of ages. This diversity in the juvenile populations assured good returns in any year, despite environmental change. This type of restoration strives as much toward greater resilience of salmon populations as it does greater abundance. Techniques for this type of physical restoration include riparian planting (primarily willows and cottonwoods), re-grading terraces to expand functional floodplains, importing organic material to encourage natural recruitment and establishment, bank scalloping, creation of additional backwater or side-channel habitat, and levee setbacks. The most effective rehabilitation approach will likely utilize a combination of these techniques.

* Above: Upper Gilt Edge Bar, Lower Yuba River; Juvenile Chinook salmon reared in main stems of rivers (L) versus rearing in off-channel and floodplain habitats (R) of the Cosumnes River; Illustration of backwater enhancement at Upper Gilt Edge Bar
Before embarking on expensive projects that are at risk of change from floods, it is important to understand existing habitats and the river processes that affect them through inspection of historic aerial photography and field observations. Land owners and other stakeholders began collaborating in 2008 to fund studies to help determine the most appropriate pilot rehabilitation projects on the Lower Yuba. A Rehabilitation Concepts report outlining 10 possible projects was released in 2010 by SYRCL and cbec eco engineering.

These projects range in location, complexity and expense. Distributed riparian planting and large wood placement have a cost-to-benefits ratio lower than any other type of projects, but likely will not generate benefits that match the scale of the habitat problem in the lower Yuba. High benefit and high expense projects of side channel creation and setback of gravel “training walls” retain a high degree of uncertainty until further studies are complete. Two projects represent a middle path that merit immediate further study, and potential implementation as pilot projects as soon as possible. First, side channel re-creation at Hidden Island (Figure 7) aims to rejuvenate a historic side channel by lowering its elevation to allow connectivity at fall baseline flows. Second, backwater expansion at Upper Guilt Edge Bar would enhance the backwater and increase the extent and species richness of the existing riparian stand by excavation of sediment to allow for inundation at fall baseline flows (see illustrated image previous page). The outcome of these efforts would provide a variety of aquatic and riparian habitat at frequently occurring discharge levels, and a modest amount of sediment would need to be excavated. Further details (and graphics) on these proposed projects, as well as a detailed history of the lower Yuba are contained in the report commissioned by SYRCL and available at www.yubashed.org.

Modifying Reservoir Releases
The Lower Yuba Accord, fully implemented in 2009 by the Yuba County Water Agency (YCWA), is a landmark agreement 20 years in the making where no less than 17 diverse entities agreed on instream flows for the 25-mile stretch of the Yuba River below Englebright Dam. The new flow regime immediately improves conditions for aquatic organisms while funding substantially increased monitoring and evaluation of salmon and steelhead populations and habitat under the direction of a River Management Team. New information collected, including evaluating habitat improvements beyond the current operational limits of the Yuba Accord flows (<5,000 cfs) can and should be integrated into the salmon flow requirements established in the Lower Yuba Accord and under review and re-articulation in the FERC re-licensing of hydropower operations (see page 32).

Controlled releases from dams upstream of the Lower Yuba River result in artificially increased summer and fall conveyance flows for agriculture as well as dramatic reductions in peak flows to fill reservoirs in the winter and spring (Figure 6). Limited woody riparian plant diversity is most likely due to changes in the magnitude and timing of flow releases combined with a reduction in fine sediment supply and channel incision following the construction of Englebright and New Bullards Bar Dams, as well as altered soil texture due to mining activities. Modifying reservoir releases (flow magnitude and rate of change) in the spring, summer, and fall has the potential to improve natural and sustainable regeneration of desired woody riparian plant species along the entire lower Yuba.

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**Figure 6:** Lower Yuba River Hydrologic Alteration 1904-2006 (Pasternack, 2008)

**Figure 7:** Side channel re-creation concept at Hidden Island (cbec eco-engineering, 2010)
What is a Regenerative Future?

The final section of this assessment is entitled Toward a Regenerative Future, which reflects the “21st century” framing of this assessment. The underlying philosophy refutes the separation of the human and natural world, instead asserting that in achieving watershed health, people and ecological systems must be integrated for mutual benefit. The actions herein are aimed at setting in motion the return (or even the acceleration) of natural regenerative cycles, while limiting engineered solutions to those that accomplish multiple, stacked functions at an appropriate scale. The ultimate aim is to generate communities, economies and ecosystems that are reciprocally nourishing and co-evolutionary.

We begin the section with a discussion of the return of salmon to their historic habitat in the Yuba Basin, an action that best exemplifies a regenerative future. The millions of pounds of highest-grade nutrients delivered to the upper watershed would rejuvenate terrestrial and aquatic ecosystems better than any expensive and labor intensive engineered restoration regime - all from simply releasing a recently impeded natural cycle. In truth, it is disingenuous from an ecological perspective to consider the Yuba Basin a “restored” watershed without the return of salmon, the most elemental biological driver in the evolution of the Yuba Basin over hundreds of millenia.

Social, as well as ecological, resiliency must be built into the framework of watershed assessment, planning and implementation in the 21st century. This section identifies social, regulatory and political barriers to effective watershed protection and restoration. Just as improvements in biodiversity, micro-habitats and ecosystem function promote resilience in natural systems, a resilient social fabric requires diversity, attention to the local, and functional and responsive civic institutions. From this perspective, it’s difficult to measure which systems are currently more “broken” in California—our natural environments or our institutions of governance. In the 21st Century, diminished and declining ecosystem health and the impotence of government to meet these challenges squarely are interdependent conditions that are reinforcing a downward spiral. Transformation of culture, and the institutions and organizational structures that are an extension of culture, become critical components of manifesting a regenerative future, and thus the following section imbeds cultural ecology into our analysis and prescriptions. The 21st century regenerative future concludes with a vision statement 40 years from today, crafted in the form of a “State of the Yuba” watershed address.

“The world will not evolve past its current state of crisis by using the same thinking that created the situation.” – Albert Einstein
The Yuba River is unique in that a single major barrier blocks over 100 miles of upstream spawning habitat for Chinook salmon and steelhead trout.

The Englebright Dam Question: The Yuba River as a Solution to California’s Salmon Crisis?

The collapse of Central Valley Chinook salmon in this first decade of the 21st century (from estimates of 800,000 returning spawners in 2002 to 39,500 in 2009) is a result of multiple and interacting impacts to the ecological health of our freshwater, estuarine and marine environments. Regardless of where and to what degree blame is ascribed to these causes (e.g., “ocean conditions,” pumping from the Delta, loss of functional floodplains, pollution from municipal and agricultural discharges, degraded riparian habitat, dams, etc.), the prospect of salmon extirpation within the greater San Francisco Bay-Sierra Nevada Watershed is an ecological crisis with severe implications to the biotic integrity of California. The magnitude of the problem warrants bold recovery measures, well beyond the typical compromises that derive from protracted negotiations that attempt to accommodate a broad range of “interests.” Such decision-making processes have brought our most ecologically beneficial, culturally important, and economically valuable species to the edge of extinction.

The Damage from the Dam Age

While often providing essential services to society, dams are the most significant factor contributing to the environmental degradation of watershed integrity in California. As a result, scientists increasingly agree that dams built solely for recreation or debris should be targeted for ecological and economic cost-benefit analysis, as dam removal may provide the greatest net benefit to society. The era of dam construction in the mid-20th century lined the Sierra Nevada foothills with terminal rim dams (TRDs) thereby severing California’s natural water cycle and blocking upstream migration of anadromous fisheries. These dams are made from impermanent materials with a life expectancy of less than 200 years. Absent significant investment by future generations to maintain this extremely expensive infrastructure, these TRDs risk being flushed, as the forces of nature attempt to reconnect hydrological cycles.

The Yuba River is unique in that a single major barrier blocks over 100 miles of upstream spawning habitat for Chinook salmon and steelhead trout. Englebright Dam was built in 1941 to store debris from new hydraulic mining operations that never materialized. Owned by the People of the United States under the stewardship of the U.S. Army Corps of Engineers, the dam is a complete barrier to fish migration and has no water supply or flood control benefit. The current utility of the dam consists of reservoir recreation and ancillary hydropower production. As a result, the removal of Englebright Dam, although cloaked in the bureaucratic language of “upstream passage” of anadromous fisheries, has been under some sort of feasibility review by federal agencies for over a decade. With a mandate to recover species listed under the Federal Endangered Species Act, scientists at the National Marine Fisheries Service have determined that passage above TRDs is essential to recovering threatened salmonid species from extinction. Upstream passage above Englebright Dam, by all existing accounts, would provide more habitat with less lost value of dam related services than any barrier in the San Francisco Bay Watershed.
A key design consideration for any dam removal scenario is managing for sediment trapped behind the dam. Because much of the stored material behind Englebright Dam is derived from historical gold mining, the sediment contains unnaturally high concentrations of mercury that were lost during gold mining operations. A rigorous quantification of the contents of the sediment behind the dam was conducted from 2001-2003 by USGS scientists. These studies established the location of different types of mercury within the sediment profile and demonstrated that the accumulation rate of sediment behind Englebright Dam has significantly declined in the last 30 years. Ongoing studies on mercury removal, methalyzation, and transport by the same group of USGS scientists working on the Combie Reservoir (discussed on page 31 of this report) will provide information that can inform design plans for a joint project of legacy mining toxic remediation and safe decommissioning of Englebright Dam.

The question of fish passage at Englebright Dam was played out in an 8-year “feasibility” exercise from 1999 to 2007 known as the Upper Yuba River Studies Program (UYRSP). $9M of state and federal funding supported the completion of a few reports of some value. This “interest-based” process eventually went bankrupt attempting to keep involved those supporting the status quo. While assuring those parties that the existing benefits they derived from the public trust would not be altered in any way, participants were in fact learning that salmon recovery in the Yuba likely requires adjustments to the practices and profit margins of PG&E, Yuba County Water Agency and Sierra Pacific Industries. From a citizens-perspective, this was the central teaching of the UYRSP. Setting aside the sparring parochial interests, restoration of Chinook salmon to their upper habitats is a question of public values and political will. Over the next 5 years, action or in-action on the Yuba River by state and federal agencies and the elected officials they report to will determine the course of California’s ecological future. Will our region become forever exiled from the great “Salmon Nation” of the Pacific Northwest, or will we choose to take bold and immediate actions to reconnect our Central Valley rivers with the ancestral upland habitats that can provide refuge and habitat resiliency in a changing climate? This is the essence of the Englebright Question.

Over the next 5 years, action or in-action on the Yuba River... will determine the course of California’s ecological future.
Above: Englebright Dam; Artist's Concept of Englebright Dam removal
Toward a regenerative future

Organizing Watershed Democracy

At the close of the first decade of the 21st Century in the Yuba River watershed, it is clear that the economic systems and structures of governance are ill-equipped to meet the needs of a flourishing society. It’s difficult to imagine scenarios of a regenerative ecological future without re-envisioning the structural reforms to civic life that are necessary to better facilitate watershed stewardship. Habitat restoration strategies must acknowledge the problems inherent in a civic structure that fails to elevate ecosystem health as a public policy priority.

Perhaps traditional watershed assessments ignore this element because the solutions are intractably complex. Further, advancing untested prescriptions for civic reform is a risky proposition for watershed scientists or natural resource managers. Yet, the historical importance of the Yuba Basin calls us to outline some innovative components that have potential to manifest a more resilient civic structure that is better positioned to respond and adapt to the changing environments that are upon us.

Key Elements:

Thinking Like a Watershed: To break through the inertia of multi-jurisdictional dysfunction, comprehensive ecosystem planning should take place within a watershed-delineated framework. Depending upon the nature of the planning goals, Watershed Plans can be scaled from the micro to the macro. The ‘Inimim Forest Community-based Management Plan for the headwaters of Shady Creek and Spring Creek (South Yuba River Sub-basin; a nearly 20 year project of The Yuba Watershed Institute) is a laudable example of micro-scaled watershed assessment, planning and implementation that is now being replicated elsewhere in the Yuba Basin. The Integrated Regional Water Management Plan for the inter-plumbed watersheds of the Cosumnes, American, Bear and Yuba Rivers is an encouraging collaborative enterprise operating at a multi-basin, almost bioregional level.

Perhaps no single regulatory or management process has more to contribute to river health than the re-licensing of the several hydropower projects in the Yuba Basin for the first time since the 1960s. The highly circumscribed and rigid “Integrated Licensing Process (ILP)” with its narrowly delineated “project boundaries” is—by itself—a prescription for failure to meet the broad goals of watershed health. That is, unless a parallel process, operating within a watershed-wide framework, is created to bring all licensees and stakeholders in the Yuba Basin together. In February 2010 a facilitated “Yuba Basin Multi-party Forum” was initiated by the National Marine Fisheries Service, with great promise for eliciting and evolving a salmon and watershed restoration plan developed by all major public agencies and a diverse cross-section of representatives from public-benefit organizations. Perhaps, we need to go more deeply and ask: which watershed restoration scenarios provide the greatest benefit to our shared ecosystems, and how can the allocation of financial resources derived from utilizing a publicly-shared asset (water) best meet our region’s consumptive electricity and water demands?

Just as improvements in biodiversity, micro-habitats and ecosystem function promote resilience in natural systems, a resilient social fabric requires diversity, attention to the local, and functional and responsive civic institutions.

Above: Kids at play in the South Yuba headwaters
Re-purposing Watershed Councils: At the turn of the 21st century, California began to nurture local “watershed councils” through modest seed funding to local collaboratives. While the Yuba Watershed Council accomplished several worthwhile projects in its early years, since 2005 it has operated without direct funding and without a clear mandate for responding to the social, economic and ecological imperatives arising from these current transitional times. At this time, the Yuba Watershed Council meets the modest purpose of an informal forum for information exchange about isolated projects. However, the basin-wide assessment, planning and implementation that is called for in this Yuba Watershed Assessment, requires a forum that operates with a degree of authority and focus of purpose that is lacking in the current fabric of the Council. We promote an approach that emphasizes resource sharing, project integration, and greater inclusion of local citizens, landowners and public agencies in the Council with a declared purpose of developing and implementing community-based watershed management plans for key tributaries of the Yuba Basin.

Watershed Guilds: Models of cooperatively-developed, appropriately-scaled watershed management plans currently exist in the South Yuba Sub-Basin. The ‘Inimim Forest Management Plan developed by the Yuba Watershed Institute was the first example to form, with rigorous and detailed ecological assessment, local utilization of sustainably managed forest products, and public-private “neighborhood” partnerships as the cornerstones of the Plan. Since then, the Round Mountain Firesafe Plan was developed across the river from the ‘Inimim Forest by an alliance of neighbors and public agencies. Downstream, a collection of neighbors in the vicinity of Owl Creek has begun a process of coordinated watershed assessment, resource sharing and cooperative management with neighboring public agencies. With a name to unify such independently emergent activities—and an approach to watershed organizing that shares lessons learned and that aggregates beneficial impacts—we have the beginnings of watershed governance in the South Yuba Sub-Basin. These efforts comprise the nucleus of “watershed guilds,” an assembly of landowners, representatives from public agencies, and other interested parties organizing activities within an easily demarcated geographic landscape. These guilds can provide a structure for the voluntary sharing of resources, local ecological knowledge, and articulations of “watershed health” that bring meaning and shared purpose to land and water stewardship. Rather than managers or staff from agencies (often headquartered outside the watershed) dominating the representation at the Watershed Council, these Watershed Guilds—and many others yet to be developed for key tributaries such as Kentucky Ravine, Rush Creek, Shady Creek and Scotchman Creek (see Map 1, page 23), for example—would have representation on the Watershed Council and help steer a more integrated, collaborative and ecological indicator-based agenda for the Yuba Watershed Council.

These modest reformulations of existing processes are not particularly ground-breaking. It is a big leap to move from these recommendations to the 2050 Vision articulated in the following pages of this assessment. However, it is our evaluation that such locally-emphasized reformulations of individual watershed stewardship and collaborative watershed management hold great promise toward larger scale transformations of the institutions and planning frameworks that currently govern management in the Yuba Basin. With environmental change upon us, a locally responsive approach to restoring ecosystem integrity is the most effective prospect in building social, economic and ecological resilience to the unpredictable and unstable time horizon of the next 40 years.
“We are unlikely to achieve anything close to sustainability in any area unless we work for the broader goal of becoming native in the modern world, and that means becoming native to our places in a coherent community that is in turn embedded in the ecological realities of its surrounding landscape.”

- Wes Jackson. Becoming Native to this Place, 1994

Culture, Indigenous Identity, and Becoming Native to the Greater Yuba River Watershed

Sustainable management of the Yuba Watershed should be well informed by the cultural and ecological practices of those who have resided in this landscape for millennia. It is now broadly understood that much of California’s native plant diversity was “managed” and “tended” by the first peoples of this land; that many elements of our localized and landscape-scale ecology co-evolved with human utilization.19

The current resurgence of Indigenous Californians’ cultural practices is a remarkable and generous gift to current and future generations of all Californians. Local to the Yuba and Feather watersheds, the Tsi-Akim Maidu tribe began the new millennium with the establishment of celebration, commemoration and storytelling through an Indigenous Peoples’ Days weekend, which has taken place each October since 2000. The Tsi-Akim Maidu resurgence, under the leadership of Tribal Chairman Don Ryberg, is remarkable in its intention to heal cultural and historical wounds. “Indian and non-Indian” people reach across the table as partners with a common destiny and come together to work on projects as a necessary condition for improving river and watershed health. The story of this powerful community healing work as an integrative dimension of ecological restoration is documented in the one hour audio documentary by Estrella Acosta in 2009 entitled “Blood, Gold and Medicine: Healing...
Maidu Country.” This Maidu invitation to healing, to collaborative work with Californians with indigenous roots, and to experience the lifeways and practices of traditional ecological management is also an invitation to each person living in the Yuba watershed today to “become native to this place.”

Humans of all cultural backgrounds have ancestry that was at one time indigenous to a place (or nomadic range), necessitating the cultivation of skills to steward resources to meet their daily needs. This Watershed Assessment acknowledges that for many residents of the Yuba Watershed (and beyond) we exist within a society with a profound loss of place-based cultural knowledge. Drawing upon universal indigenous wisdom, we can more deeply appreciate that our own health is derived from—and contributes to—the health of the watershed. This notion of reciprocity, as practiced by many intact place-based cultures, is a central tenant guiding an individual’s or society’s management of their surrounding environment. Indeed, practiced in its highest form, reciprocity is simply the way of being.

A central and fundamental impediment to improved watershed condition, then, requires citizens of the watershed to re-learn “the ecological realities of our surrounding landscape,” as Wes Jackson frames our modern challenge. A good place to begin is by listening and carefully observing, while cultivating a shared relationship among the people and natural communities who may be indigenous or endemic to this place, or new or migratory. The cultivation of this ecological literacy is a prerequisite to restoration.

Living as we are with an abundance of “under-tended” public land, it is clear that the citizenry of the Yuba watershed is re-establishing deep ceremonial linkages to this landscape. New cultural practices and experiences here could set a regional example of how ecologically literate communities can more directly engage in managing the ecologies that sustain our community.

In 2010 there is a distinct opportunity to continue these sustainable practices, but it requires that communities invest in the long term practice of assessing the inter-relationship of human and ecological networks. Through attentively observing and sharing insights to our distinct place in earth, 21st century societal and cultural concepts of watershed health can emerge.
The painful history of this narrative of California’s founding is now broadly understood by the citizenry. Thanks to the transformational effort by individual Californians of all backgrounds to heal the historical, cultural and ecological wounds of the era, we know our history—even its darkest chapters—much better. By working together in becoming people indigenous to this place, a new, perhaps more authentic California has finally come into its own.

The Yuba River Basin is the birthplace of the Bioregional movement, owing to the expansion of watershed consciousness by resident thinkers and practitioners such as poet Gary Snyder, and the establishment of citizen-led organizations such as the Yuba Watershed Institute and the South Yuba River Citizens League (SYRCL). The more recent successful movement—known initially as the Yuba Strategy—drew upon a broad coalition that integrated localized restoration economics and watershed governance, salmon regeneration, and cultural rehabilitation as interdependent goals in response to the instability and breakdown of natural and human systems at the turn of the 21st century.

**Restoration Economy & Watershed Governance**

With California on the brink of insolvency as it entered the second decade of the millennium, economic de-centralization became the driving force behind our recovery. While “green tech” industries have provided technologies that have transformed our energy and transportation systems, investments in “green infrastructure” have put people to work restoring the ecological integrity of California’s true wealth, our natural capital. A grassroots citizens’ movement led the US Congress to pass sweeping reforms that have corrected an economic blind spot that persisted for hundreds of years, and now national economic policy places value on ecosystem services and has ended the practice of externalizing the costs of industry onto the environment. In California, and particularly in the Yuba River Basin, this has created incentives and new opportunity for investing in a robust service economy emphasizing physical restoration of ecological functions.

What began simply as a collection of state-sponsored citizen-led river monitoring projects has become a rural re-vitalization program resulting in thousands of jobs supporting earth-based enterprises that restore public lands, sustainably produce forest and agricultural products, and mitigate against the causes and consequences of climate destabilization. Recognizing the long-term consequences of legacy mining toxins in the environment, significant investment has been focused on toxic remediation, a public health industry which currently employs nearly 10% of the people living in the Yuba Watershed.
In the first decade of the 21st century, California experienced chronic budget problems and a legislature plagued by voter antipathy and cynicism. Declared “ungovernable” in its current incarnation, a “People’s Constitutional Convention for this Watershed Moment” led to numerous reforms, including a legal re-assertion that corporate rights are subordinate to those of local municipalities and individuals. California also adopted provisions granting legal rights to ecosystems and species, following models of constitutional reform conducted by other nations early in the 21st Century. Due to reforms targeting the anti-democratic nature of the gerrymandered districts and governmental jurisdictions, we speak today of The Yuba River Watershed as both a delineated catchment basin on the west slope of the northern Sierra Nevada, as well as a Watershed Governance Unit (WGU) within the Shasta/Northern Sierra Bioregion, the largest of the six recognized Bioregions that comprise the Third House of the California Legislature. The Yuba WGU is comprised of over 40 local Watershed Guilds organized around tributaries to the North, Middle, South and Mainstem Yuba, including Deer Creek. Private citizens and public land managers now come together—neighbor to neighbor—to share practical experience in the implementation and assessment of cooperative projects that heal the land, clean the water, and provide a regenerative resource base for rural communities. Wild, self-sustaining populations of Sierra salmon are, naturally, an indicator of our success.

Wild Salmon Regeneration

The story of wild salmon regeneration in California is well known, as it has shaped our identity and policy objectives for the past several decades, and has served as a barometer of success in our ability to rebalance human enterprise within the limits and processes of our natural world. After roughly a century and a half of re-engineering our hydrological cycle to serve exponential growth of industry and agriculture, the near total collapse of the Sacramento and San Joaquin Delta and the salmon populations of interior California became a harbinger that continuing such trends would ultimately destroy our ecological systems and the underpinnings of our over-extended economic systems.

While many fundamental changes to the economic and political systems were necessary to redesign human patterns on the California landscape, the regenerative salmon ecology of today is characterized by the re-introduction of salmon into headwater rivers of the Sierra Nevada mountains and upper Sacramento River Basin. The Yuba River is exemplary due to the coordinated and inventive basin-wide initiatives implemented to support vibrant salmon populations, which included removal of negative-value dams, restoration of ecological functions (particularly in forest, meadow, riparian and floodplain ecosystems), integrated water management, and a wide range of localized actions aimed at land use practices that improve—rather than degrade—instream water quality.

Significantly, the Tsi-Akim Maidu “Calling Back the Salmon” ceremony was re-constituted in 2006 as a conscious invitation for “Indian and non-Indian” people to come together to heal intergenerational wounds stemming from the Gold Rush era through watershed healing projects. By sharing traditional ceremonial practices that empowered all peoples in becoming indigenous to their place, it is clear now that the rehabilitation of California Indian culture in the past 50 years has created the preconditions that were necessary for the ecological and economic transformations that have served California so well in recent decades.

Specifically to the Yuba, since the decommissioning of Englebright and Daguerre Point Dams in 2020, the Yuba River flows without artificial barriers for approximate 160 miles from the high elevation reservoirs on the upper Middle and South Yuba Rivers to the Pacific Ocean. The re-operation of hydropower dams in the upper Yuba Basin have also become a model for cold water management to support healthy river function and watershed biodiversity during the more erratic climate patterns that now characterize our region. Here on the 200th anniversary of the founding of California and the Yuba River’s upheaval, the Yuba Basin now supports tens of thousands of self-sustaining Chinook salmon and steelhead in hundreds of river and stream miles. Of the over 160 species of animals benefiting from their return to the mountains, salmon have once again provided Homo sapiens cultural and physical nourishment, guiding us toward the regenerative economy and responsive governance we enjoy today. The Calling Back the Salmon Ceremony persists as one of the largest annual community gatherings in the Yuba Watershed, conducted in simplicity on the banks of the South Yuba River.
49. City of Nevada City Community Wide Brownfield Assessm.ent (2010). Stiles Mine Phase II Assessment. Funded by the Environmental Protection Agency.

* for access to most of these references in pdf form go to www.yubashed.org
The South Yuba River Citizens League exists to protect and restore the Yuba River and the greater Yuba Watershed. We envision a free-flowing Yuba River that supports wild salmon, trout, and other native fish in their ancestral waters. We envision a thriving Yuba Watershed rich in native biological diversity. We envision a human community that cherishes and celebrates the Yuba's unique environmental, cultural and spiritual heritage.

“This assessment is the citizen and user’s guide to the Yuba: its history, its challenges, its possible futures, and what we can do to assure its regeneration. Everyone with a stake in the future of all its tributaries should read it, follow it to the links providing more detailed information, and then take action to realize its optimistic vision.”

Dr. Tim Duane, Associate Professor of Environmental Studies, University of California, Santa Cruz and Associate Professor of Law, Vermont Law School

“The document is extremely well written and creatively presented, striking the appropriate balance between presenting enough information without inundating the reader with too much technical jargon.”

Rich Walkling, MLA, Restoration Design Group, LLC

“This assessment is a true accomplishment, and will undoubtedly serve as a useful tool for citizen groups pushing for change.”

Dr. Anne Marie Todd, Associate Professor, Communication Studies, San Jose St. University