

# THE COMEBACK OF CLEAR CREEK, REVISITED

## *The Lower Clear Creek Floodway Rehabilitation Project*

**I**N THE FALL OF 2002, more than fifteen thousand Chinook Salmon swam upstream from the Pacific Ocean into the San Francisco Bay and Delta, turned north at the Sacramento River, and finally reached their spawning grounds in Shasta County in the shallow waters and gravel beds of Lower Clear Creek. By contrast, between 1967 and 1991, the average fall-run Chinook population was less than seventeen hundred fish per year.



*A dredger mining for gold in a pond along Clear Creek.*  
Source: Shasta Historical Society

What accounts for the remarkable upswing in the fish population? It was not an accident of nature. Over the last decade, Lower Clear Creek has undergone a dramatic transformation from a severely damaged and degraded waterway toward a healthy and functional stream ecosystem.

The return of the salmon is part of the growing legacy of a visionary group of local leaders that have come together to restore the watershed. This multi-agency team, led by the Western Shasta Resource Conservation District, is implementing the Lower Clear Creek Management Plan. Their most ambitious project, the Lower Clear Creek Floodway Rehabilitation Project, is a working demonstration of an ecosystem-based approach to watershed management. It rehabilitates the natural form and function of a 1.8 mile channel and floodplain along the Lower Clear Creek corridor, providing improved habitat for salmon and steelhead, high quality riparian habitat for songbirds and native wildlife, as well as recreation and jobs for the people who live in the watershed.

### BACKGROUND

Clear Creek originates near 6,000 ft elevation in the Trinity Mountains. Upper Clear Creek flows into Whiskeytown Lake, 11 miles west of Redding. The lower section of Clear Creek flows south from Whiskeytown Dam for approximately eight miles, then east for eight miles before joining the Sacramento River five miles south of Redding.

The decline of the Lower Clear Creek watershed began over 150 years ago. The discovery of gold at Reading Bar in 1848 led to a 100-year legacy of alteration and degradation, beginning with placer mining and dredger mining up through the 1940s. Floodplains and terraces were “turned upside down”, removing all riparian and upland vegetation, leav-

ing piles of cobbles unsuitable for revegetation. Commercial in-stream aggregate mining began in the 1950s and continued through the mid-1980s, further destroying the natural channel and floodplain morphology. The aggregate mining removed most of the gravel within a 1.8-mile reach, leaving the channel bed surface exposed to the underlying clay hardpan, and creating large pits both in and around the stream that stranded adult and juvenile salmon and steelhead species.

Additional ecological degradation in the watershed occurred in 1963 with the construction of Whiskeytown Dam as part of the Trinity River Division of the Central Valley Project. Since Whiskeytown Dam was built, the amount of water flowing into Lower Clear Creek has decreased by 60%. All of the alluvial materials—cobbles, gravel and sand—that would normally wash down from the upper watershed during high water and flood events is now trapped by the reservoir. Large floods would normally occur every 10–20 years, but occur less frequently under the altered flow regime.

These changes have had a dramatic impact downstream. Gravel beds for spawning salmon and steelhead have become infiltrated with fine sediment, and riparian vegetation has encroached along the channel margins thereby fossilizing the banks and locking the channel in place. The natural cycle of floods that would transport sediment, scour the channel bed, and form new gravel bars has been disrupted and the natural migration of the channel has been severely impaired as well. These geomorphic processes are essential components in creating the dynamic river system necessary for high quality salmon and steelhead habitat and riparian habitat.

# FORMING A COLLABORATIVE TEAM WITH A COMMON VISION

## *Local Partnerships*

**I**RONICALLY, THE COMBINATION OF ISSUES FACING CLEAR CREEK began to gain prominence in the mid-90s in response to a forest planning process prompted by the listing of the Northern Spotted Owl as an endangered species. Although there is minimal habitat for the owl within the watershed, the President's 1994 Forest Plan prompted a shift in federal agencies toward ecosystem-based land management, focusing on entire watersheds and larger landscapes, rather than on the smaller individual parts that comprise the system.

At the same time, Western Shasta County's timber-dependent communities, which were hard hit by reductions in timber volume, became an area of focus for federal programs that sought to invest in watershed activities using displaced timber workers to do work. The Shasta-Tehama Bioregional Council, a group of local elected officials, industry representatives, and natural resource agency leaders recognized that a unique mixture of natural resource issues, public and private land, and social and economic circumstances would make Lower Clear Creek an excellent demonstration site for ecosystem-based management and community re-investment.

In response, a partnership between local, state, and federal agencies and local stakeholders came together with the goal of reversing the large-scale ecosystem disruption that occurred in the Clear Creek drainage system over the previous 150 years. The resulting Lower Clear Creek Restoration Team compiled a Watershed Analysis in 1996, gathering the best available data concerning the physical, biological, and economic conditions in the watershed.

The Western Shasta RCD, a participant on the Restoration Team, was a small District, with only one part-time employee at the time. However, the Board of Directors recognized the need for voluntary-based, local leadership to coordinate and implement the growing partnership on Clear Creek. Members of the board volunteered their personal time and

reputation to fundraising, successfully obtaining a grant from the newly authorized Central Valley Project Improvement Act. They soon hired the District's first full-time manager.

The District then formed the Lower Clear Creek Coordinated Resources Management and Planning (CRMP) group, providing a consensus-based forum for all stakeholders—private landowners, recreation groups, industry representatives, agencies, and other community members—to provide input on an equal basis concerning issues in the watershed.

The CRMP took on initial projects that would make an immediate impact at first, such as augmenting gravel in the creek to create spawning habitat for the dwindling salmon population. The Bureau of Reclamation, represented by Jim DeStaso on the Restoration Team and the CRMP, initiated controlled flow releases from Whiskey-town Dam in 1996 for the benefit of the fall-run Chinook salmon. Early success helped keep the group motivated, and built the reputation of the Western Shasta RCD as a group that could get things done.

By 1998, the group had completed a consensus-based management plan, providing the vision for the future restoration and management of the watershed.

Entitled the *Lower Clear Creek Management Plan*, the document laid the foundation for many of the projects currently underway in the watershed. The Lower Clear Creek Floodway Rehabilitation Project is designed to reverse the impacts of historic gold mining, in-stream gravel mining, and the installation of Whiskeytown Dam.

*The Comeback of Clear Creek*, a video produced by the Western Shasta RCD in 2001, contains beautiful images of the stream and documents the early phases of the project.

Click [here](#) to view the video!

*Members of the board  
volunteered their personal  
time and reputation to  
fundraising.*



# RECONSTRUCTING AN ALTERED FLOODWAY: AN ECOSYSTEM-BASED APPROACH

## *Anatomy of a Conservation Project*

**T**HE PURPOSE OF THE LOWER CLEAR CREEK FLOODWAY Rehabilitation Project is to promote the recovery and maintenance of resilient, naturally reproducing salmon and steelhead populations and to restore riparian plant and animal communities on the floodplain by revitalizing critical hydrologic, geomorphic, and ecological processes within the current flow and sediment conditions system of Lower Clear Creek.

Prior to the project, BLM owned many small, isolated parcels scattered across north-central California that were difficult and costly to manage. Led by Francis Berg, Chief of Resources for the BLM's Redding Resource Area, the agency put together a Resource Management Plan in 1993 that recommended selling these parcels in order to acquire land in several key areas large enough to be managed more intensively. The Lower Clear Creek watershed, particularly the floodway and areas along the creek in the upper canyon, was identified as an area to acquire lands for restoring anadromous fisheries.

Consolidation of land ownership was a critical step that allowed geomorphologists to design a project to rehabilitate the entire floodway.

The Restoration Team completed a conceptual design for the floodway rehabilitation site in 1999. The conceptual design calls for major construction activities to recreate functional channel segments, increase salmon spawning habitat, repair the floodplain, and improve riparian habitat and wetlands for the benefit of both wildlife and recreation. The project includes three phases:

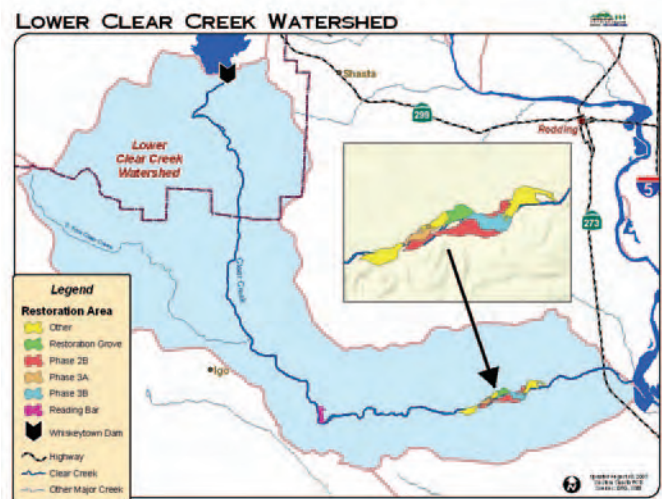
- **PHASE 1: REDUCTION OF SALMON STRANDING**
- **PHASE 2: FLOODPLAIN CREATION**
- **PHASE 3: IN-STREAM CHANNEL WORK**

The Western Shasta RCD, with a team of restoration specialists and field staff, is implementing the project in partnership with the Restoration Team and the Lower Clear Creek Watershed/CRMP Group. Currently, two phases and a portion of the third have been completed. Annual monitoring of fish, songbirds, geomorphic changes and riparian vegetation is underway.

### THE SCIENCE OF RIVERS: KEY CONCEPTS

Hydrology is the study of water and the way it courses through landscapes. Geomorphology is the study of the evolution and configuration of landforms. In the case of Lower Clear Creek we are interested in fluvial geomorphology. The term "fluvial" is a derivation of the Latin word "fluviu" meaning river. Fluvial geomorphology examines the processes that operate in hydrologic systems and the landforms which they create.

Hydrology and fluvial geomorphology are important tools in the "ecosystem approach" used to rehabilitate the channel and the floodplain of Lower Clear Creek. For example, these concepts are helping land managers understand how changes in the flow of water resulting from Whiskeytown Dam cause the shape of the channel to change over time, and how changes to the shape of the channel can interact with spawning gravel for salmon or with the riparian vegetation growing on the floodplain around the creek.



Source: Western Shasta RCD

## PHASE 1: REDUCTION OF SALMON STRANDING

The history of mining left a complex of large pits and ponds along the lower reaches of the creek that become isolated from the main channel each time the flow drops below 2000cfs. As a result, both adult and juvenile salmon and steelhead get stranded, causing the next generation to perish before it can get back to the river and migrate downstream.

The Western Shasta RCD completed Phase 1 during the beginning of overall project design phase as an interim measure to prevent fish from getting into the most severe stranding locations.



Above: Fill material was obtained from an upstream "borrow site" called Reading Bar, where the elevated floodplain was rarely inundated, which was then used to isolate a large salmon and steelhead stranding pit downstream. By removing the fill and leveling the site, Reading Bar has been lowered to an elevation that is more likely to receive floodwater under the controlled flow regime established by the dam. The trees at the center show the original grade of the site. Reading Bar has been restored with native riparian vegetation in a later phase of the project. • Source: Western Shasta RCD



Left: Forty-foot end-dumps were used to transport fill material. They used the fill to raise the elevation and regrade the "plug area" between the main channel and the ponds to prevent the likelihood of stranding adult and juvenile salmon and steelhead. Source: Western Shasta RCD



Below: Earthen berms were constructed to filter the water as it exited the plug area. Berms were also built across the high flow channel

that lured salmon and steelhead into the adjacent pond and caused them to get stranded when the water subsided. Source: Western Shasta RCD



Above: Phase One completed. The plug area (center of photo) was put into place to prevent salmon and steelhead from reaching the pond (left side of photo) during high water and getting stranded after flows subside. • Source: Western Shasta RCD

## PHASES 2 AND 3: FLOODPLAIN CREATION AND IN-STREAM CHANNEL WORK

In a natural condition, Lower Clear Creek would be in a dynamic process of continual change, exhibiting expected functions such as a meandering channel, scouring and transport of gravel and sediments, and periodic inundation of the floodplain. These functions are essential to maintaining high-quality in-stream and riparian habitat.

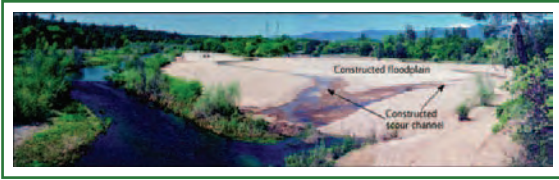
The second and third phases of the Floodway Rehabilitation Project focus on recreating these processes within the altered hydrologic and geomorphic conditions brought about by human activity in the watershed. During the implementation of these phases, the Western Shasta RCD is:

- restoring a historical meander to the channel;
- reconstructing an appropriately confined channel to improve the transport, storage, and routing of gravel;
- reconstructing floodplains to encourage natural processes of floodplain creation, deposition, and inundation;
- encouraging natural channel migration and floodplain processes; and
- restoring the stream grade and reducing exposed clay hardpan by increasing gravel supply.

During Phase 2, the Western Shasta RCD filled off-channel mining pits to eliminate the worst salmon and steelhead stranding areas and reconstructed over 60 acres of floodplain and replanted 36 acres. An additional 7 acres of reconstruction and approximately 2 acres of revegetation took place upstream at the Reading Bar "borrow site." The implementation of Phase 2 took place between 1999 and 2001.



## RECREATING THE FLOODPLAIN AT RESTORATION GROVE



Above: At "Restoration Grove," a 12-acre floodplain was constructed in an area that was previously a death-trap for salmon and steelhead. The constructed scour channels were designed to intercept spring groundwater to encourage natural recruitment of riparian vegetation. • Source: Western Shasta RCD



Above: Restoration Grove was replanted with native trees and shrubs, creating a patch of riparian habitat (second year growth) for songbirds and other wildlife. Source: Western Shasta RCD



Above: Restoration Grove during spring flooding with the floodplain functioning as designed. • Source: Western Shasta RCD



Above: A portion of the Lower Clear Creek Floodway Restoration Site with Restoration Grove in the background and a newly created 51-acre floodplain in the foreground. • Source: Western Shasta RCD

PRBO Conservation Science conducted avian monitoring while restoration was in progress to determine the optimum conditions for native songbird habitat. In response to their findings, the Restoration Team incorporated mosaics of vegetation into the revegetation plan. Data suggest planting dense shrub patches, interspersed with tree/shrub patches, can achieve a semi-open canopy which invigorates the

understory and middle story growth required for many of the songbird species nesting in the area.

## IN-STREAM CHANNEL WORK

The goal of Phase 3 is to convert a barren bedrock channel back to a cobble-bedded stream with natural gravel bars, pools and riffles. The Western Shasta RCD relocated and reconstructed the channel in the uppermost 1,500 ft of the project site and installed large trees and root-wads that protect the new bank and provide shelter for juvenile fish.



Above: Before implementation, the creek followed a barren bedrock channel.



Above: The Western Shasta RCD redirected the Creek into the cobble-bedded channel that provides much better spawning habitat for fish.



## ROOTWAD BANK STABILIZATION

Left: Using root-wads as biotechnical bank stabilization structures to armor the banks of the new channel and provide habitat for juvenile salmon and steelhead.

Source: Western Shasta RCD



## FLOODPLAIN AND CHANNEL

Left: Newly created floodplain and cobble-bedded channel.

Source: Western Shasta RCD

Future phases will return the creek to its historic location at the downstream end of the project reach where it had been diverted for past gravel mining operations. Additional work will involve relocating and reconstructing the channel in the lower portion of the project reach and constructing and revegetating additional floodplain areas.

### RELATED PROJECTS

The Floodway Rehabilitation Project is just one element in a concert of actions to restore Lower Clear Creek. In keeping with the ecosystem-based approach of the Lower Clear Creek Management Plan, related projects are happening throughout the watershed:

- The gravel augmentation project initiated by the CRMP continues. Since 1996, 95,000 tons of gravel have been added to Lower Clear Creek, helping reverse the loss of spawning habitat for fall, late fall, and spring-run Chinook salmon and steelhead.
- The Bureau of Reclamation CVPIA (b)(2) Program is continuing controlled flow releases from Whiskeytown Dam, providing increased flows for the benefit of fall-run Chinook salmon. They began modifying the flows for the spring-run Chinook Salmon in 2000 as well.
- The McCormick-Seltzer Dam, a 15-foot-high structure built in 1903, was a barrier to fish spawning and rearing habitat

in the upper 10 miles of Clear Creek. It also blocked the transport of important spawning gravels to Lower Clear Creek. In October of 2000, Interior Secretary Bruce Babbitt and California Secretary of Resources, Mary Nichols, presided over demolition of the dam to improve habitat and river functions in the watershed.

- Management of upland areas in a watershed has a profound affect on fisheries and the healthy functioning of streams. The District and its many partners are involved in a wide variety of projects to inventory and manage upland erosion, prevent catastrophic wildfires, and implement projects to improve the condition of the watershed as a whole.

### RESULTS

The Lower Clear Creek Floodway Rehabilitation Project and related restoration efforts in the Clear Creek Watershed are increasing riparian habitat and rehabilitating the most degraded area of Lower Clear Creek. Success to date has included:

- Increased fall-run and spring-run Chinook salmon
- Increased riparian habitat
- Reduced juvenile fish stranding
- Improved fish passage
- Increased spawning habitat

[View the Lower Clear Creek Floodway Rehabilitation Budget](#)

## Floodway Rehabilitation Project Partners

**T**HE LOWER CLEAR CREEK FLOODWAY REHABILITATION PROJECT is being implemented by the Western Shasta Resource Conservation District on public lands managed by the Bureau of Land Management (BLM). The Lower Clear Creek Restoration Team, with input from the Lower Clear Creek CRMP, developed the project's objectives. They are consistent with the goals of the CALFED Bay-Delta Ecosystem Restoration Program, Central Valley Project Improvement Act—which both provide funding for implementation—as well as the US Fish and Wildlife Service's Anadromous Fish Restoration Program and the California Department of Fish and Game. Through this unique partnership, the watershed and its salmon and steelhead populations are now being restored.

### CALFED & CVPIA

The majority of the funding for the project has been provided by the CALFED Bay-Delta Program. Additional funding has also been provided by the Central Valley Project Improvement Act (CVPIA) administered by the Bureau of Reclamation, the USFWS, and the Bureau of Land Management.

### RESTORATION TEAM

Provides technical assistance and overall project direction.

#### Members

- CA Dept of Fish & Game
- CA Dept of Water Resources
- Natural Resource Conservation Service
- National Marine Fisheries Service
- National Park Service
- Shasta Co Environmental School
- USDI Bureau of Land Mngmt
- USDI Bureau of Reclamation
- US Fish & Wildlife Service
- Western Shasta Resource Conservation District

#### Consultants

- Graham Matthews & Assoc
- Pt Reyes Bird Observatory Conservation Sciences
- Souza Environmental Solutions

### CRMP / WATERSHED GROUP

The CRMP drafted the Lower Clear Creek Management Plan in 1998 and provided input and cooperation with implementation of the plan. The CRMP recently changed its name to the Lower Clear Creek Watershed Group.

#### Members

- Lower Clear Creek Restoration Team
- Landowners
- Shasta Co
- City of Redding
- Regional Water Quality Control Board
- Horsetown Clear Creek Preserve
- Other Local Stakeholders



## A COMPREHENSIVE STRATEGY FOR MONITORING AND ADAPTIVE MANAGEMENT

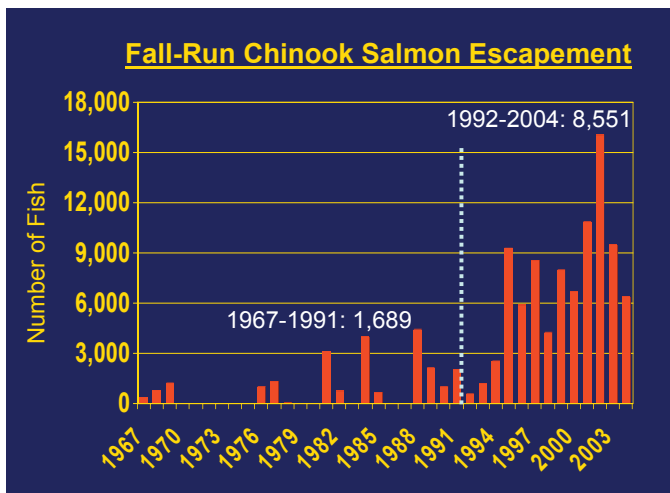
**A**LL ASPECTS OF THE LOWER CLEAR CREEK FLOODWAY REHABILITATION PROJECT are being carefully monitored, and information collected is part of an adaptive management feedback loop.

*Geomorphic Monitoring* at the project site is being conducted by Graham Matthews and Associates to determine how the channel location and morphology is adjusting during high flow events. The consultant is helping the Western Shasta RCD develop a detailed sediment budget for the entire Lower Clear Creek watershed in order to properly route coarse sediment through the system. Proper routing will ensure that the ecological function at the restoration sites and stream-wide is restored effectively.

The District hired Souza Environmental Solutions to conduct *Riparian Revegetation Monitoring* of woody vegetation, herbaceous vegetation, exotics, groundwater, and wetlands. For example, the consultant is monitoring the survival and productivity of woody vegetation in the "active" restoration plantings on the constructed floodplains as well as the "passive" recruitment of volunteer seedlings on the constructed floodplains, scour channels, and stream channels. Future monitoring will include exotic woody vegetation throughout the entire 100-year floodplain in the lower eight river miles of Clear Creek as well. Measurements of groundwater fluctuations on the constructed floodplains and in the scour channels will enable the Restoration Team to study the relationship between annual hydrologic fluctuations and the

natural recruitment of herbaceous and woody vegetation in the scour channels and on the floodplain.

Matt Brown of the US Fish and Wildlife Service is conducting fish monitoring, using a variety of methods to evaluate the quantity and quality of spawning habitat for adult salmon and steelhead and rearing habitat for juveniles. Incidences of juvenile stranding are being monitored as well. Fish populations have risen dramatically in Lower Clear Creek.



Source: US Fish and Wildlife Service

Ryan Burnett of PRBO Conservation Science is leading an *Avian Monitoring* effort that includes nest monitoring, territory mapping, point count surveys, and mist netting. This data is helping determine abundance and species richness of native songbird in the watershed, as well as the breeding density, nesting success and adult survival of focal species in restoration areas.

The 2004 Point Reyes Bird Observatory Songbird Monitoring Report showed a marked increase in the number of territories and nests found in revegetation sites for three of the focal species: Black-headed Grosbeaks, Song Sparrows and Yellow-breasted Chats. Proportional nest success for all nests combined was the highest recorded in the six years of songbird monitoring at Clear Creek. Of special note, in 2004 a single California Endangered Yellow-billed Cuckoo was observed at the Reading Bar restoration in mid-June. It is the first confirmed record of this species in Shasta County.



Song Sparrows are a focal species for avian monitoring at Lower Clear Creek • Photo by PRBO Conservation Science

## Critical Steps to Success

**WORKING WITH THE LOWER CLEAR CREEK RESTORATION TEAM** and the Lower Clear Creek CRMP enabled the Western Shasta RCD to take local leadership to a whole new level. Faced with a relentlessly declining ecosystem around the creek, a powerful partnership is rehabilitating the creek and creating a new legacy of stewardship in the watershed.

**VISION:** The project is founded on a bold but achievable vision to re-establish the critical hydrologic, geomorphic and ecological processes of Lower Clear Creek within the current regulated flow and sediment conditions.

**COLLABORATION:** This is central to the project. As Mary Schroeder, District Manager for the RCD explains, "There aren't too many projects that we do where we don't have a technical advisory committee. Before we begin, we contact all the interested local groups and agencies, get everyone together, explain what the project is about, and solicit both professional and community input."

**RESOURCES:** By identifying where local priorities and the broad public interest intersect, the District generated strong support from state and federal partners for restoration efforts on Lower Clear Creek. The project's goals are explicitly aligned with major state and federal program goals such as the CALFED Bay-Delta Ecosystem Restoration Program, Central Valley Project Improvement Act, and the Anadromous Fish Restoration Program.

**PLANNING:** The Restoration Team completed a Watershed Analysis and a Management Plan for the entire area, and worked with the RCD to design site-specific projects that have complementary effects in the watershed. By consolidating land ownership in the floodway, the BLM made it possible for the Restoration Team to design a project covering the entire floodway. The ecosystem-based approach is both

drawing on and contributing to the science of hydrology, fluvial geomorphology and ecology.

**IMPLEMENTATION:** The RCD is implementing the Floodway Rehabilitation Project in three phases, each with a clear objective: reducing salmon stranding, repairing the floodplain, and improving in-channel habitat. Other projects in the watershed, including gravel augmentation, flow adjustments, barrier removal and upland management complement and reinforce the floodway rehabilitation project.

**EVALUATION:** In keeping with the ecosystem-based approach, the project includes a comprehensive adaptive management process with ongoing monitoring of vegetation, songbirds, fish and geomorphic changes. In addition to generating vital project data, monitoring results gain credible information so that management activities can be adapted and improved.

**EDUCATION:** *The Comeback of Clear Creek* video exemplifies the importance of educational outreach and maintaining local support for the project. Through newsletters, watershed group meetings, school field trips and events such as educational "Kids in the Creek Days", the community is kept informed, gives input, and is educated on Clear Creek and the Rehabilitation Project.

### RECOMMENDATIONS/LESSONS LEARNED

Even success brings new and unexpected challenges. For example, because the entire restoration area historically had gold mining operations, concerns arose over the potential presence of mercury in the project area and the materials used for fill. Uncertainty over these concerns has required additional research, a longer construction schedule and cost increases. A Mercury Synthesis and Data Summary is now in development to aid and guide future management decisions.

*Case study written by Leslie Bryan and Ben Wallace.*



### CONTACT INFORMATION

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