A Regional Collaboration in Natural Resources Conservation

Arroyo de la Laguna Streambank Restoration Project

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Biotechnical Information

Project background

Arroyo de la Laguna is the main tributary to Alameda Creek, the second largest drainage to the San Francisco Bay, with a total watershed encompassing approximately 400 square miles. The watershed is comprised of numerous land use sectors including protected parks and wildlife areas, private and public rangeland, urban development, suburban development and drinking water lands. Upstream, Tri-Valley development and other factors, including channel's natural characteristics have caused severe instability in the lower 5 miles of the Arroyo de la Laguna. The problem is worsened during peak storm events. This has resulted in streambank erosion and channel widening of the Arroyo and increased sedimentation of Alameda Creek and the San Francisco Bay. This rapid erosion has adversely affected on-site wildlife habitat and continues to degrade upstream and downstream habitat particularly salmonid habitat in lower Alameda Creek. High sediment loads and the lack of vegetation present on the streambanks have severely modified the hydrologic function of this stream and have created adverse conditions for wildlife species that occur in the watershed.

Figure 1.

Project Background

Eucalyptus trees salvaged from another stream restoration project in the area are being used in the project

Project Goals

The overall goal of the project is to demonstrate the use of NRCS approved bioengineered stream restoration practices that will reduce soil erosion and improve riparian habitat in the Arroyo de la Laguna and Alameda Creek watersheds. This demonstration project, central to the success of the entire watershed plan will be the first effort to reach fruition since the beginning of the planning process over 4 years ago. Reduced sedimentation and re-vegetation will greatly improve the habitat for steelhead and other riparian wildlife and vegetation. The proposed treatment approach is intended to encourage the natural creation of vegetated terraces along the toe of the banks to provide stability for moderate storm events.

Figure 2.

Wildlife habitat improvement.

A male mallard preening on a fallen tree in the Arroyo de la Laguna

Biotechnical Engineering Description

This proposed demonstration project will focus on the control of stream flow within the Arroyo de la Laguna utilizing a variety of relatively low cost biotechnical and bioengineered practices intended to prevent erosion, establish vegetation on the stream banks and improve wildlife habitat on the site.

Conservation practices selected for this demonstration are included in both the NRCS Stream Corridor Restoration Guide and the California Department of Fish and Game Salmonid Stream Habitat Restoration Manual. These demonstration practices include:

- Rootwads
- Log Rock Barbs
- Log or Brush Barbs
- Pin Dikes (Soldiers in Formation)
- Tree Revetment
- Bank Shaping and Planting

Rootwads

A major concern with the use of structural approaches to streambank stabilization is the lack of vegetation in the zone directly adjacent to the water. One biotechnical practice that addresses this concern is the use of large trees in conjunction with stone to provide bank protection as well as improved aquatic habitat. Large logs with intact root wads are placed in trenches cut into the bank, such that the root wads extend beyond the bank face at the toe. The logs are overlapped and/or braced with stone to ensure stability, and the protruding rootwads effectively reduce flow velocities at the toe and over a range of flow elevations. A major advantage of this approach is that it reestablishes one of the natural roles of large woody debris in streams by creating a dynamic near-bank environment that traps organic material and provides colonization substrates for invertebrates and refuge habitats for fish.

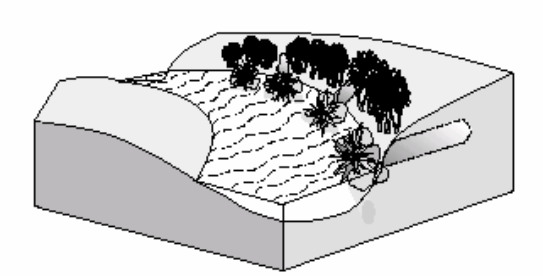


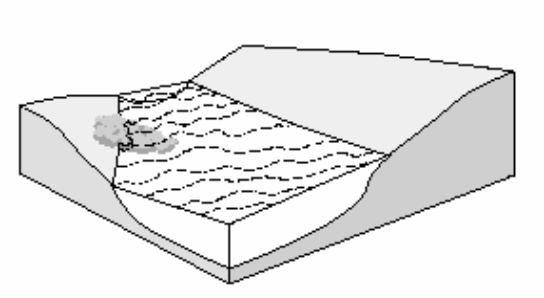
Figure1.
Boulders and logs with root masses attached placed in and on streambanks to provide streambank erosion, trap sediment, and improve habitat diversity.

Applications and Effectiveness

- Will tolerate high boundary shear stress if logs and rootwads are well anchored.
- Suited to streams where fish habitat deficiencies exist.
- Should, where appropriate, be used with soil bioengineering systems and vegetative plantings to stabilize the upper bank and ensure a regenerative source of streambank vegetation.
- Will enhance diversity in riparian areas when used with soil bioengineering systems.
- Will have limited life depending on climate and tree species used. Some species, such as cottonwood or willow, often sprout and accelerate colonization.
- Might need eventual replacement if colonization does not take place or soil bioengineering systems are not used.
- Use of native materials can sequester sediment and woody debris, restore streambanks in high velocity streams, and improve fish rearing and spawning habitat.
- Site must be accessible to heavy equipment.
- Materials might not be readily available at some locations.
- Can create local scour and erosion.
- Can be expensive.

Log and Rock Barbs

Log and Rock Barbs are utilized to restore instream habitat structure. Most urban streams have poor instream habitat structure, often typified by indistinct and shallow low flow channels within a much larger and unstable storm channel. The goal is to restore instream habitat structure that has been destroyed by erosive floods. Key restoration elements include the creation of pools and riffles, confinement and deepening of the low flow channels, and the provision of greater structural complexity across the streambed.



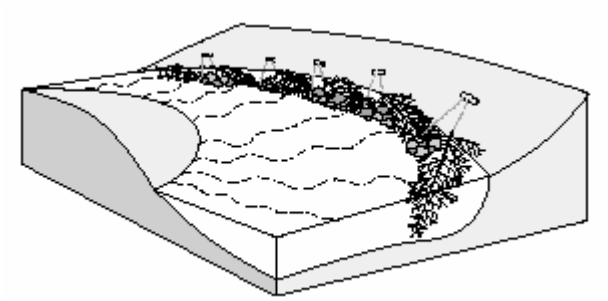
Structures that protrude from either streambank but do not extend entirely across a channel. They deflect flows away from the bank, and scour pools by constricting the channel and accelerating flow.

Applications and Effectiveness

- Should be designed and located far enough downstream from riffle areas to avoid backwater effects that would drown out or otherwise damage the riffle.
- Should be sized based on anticipated scour.
- The material washed out of scour holes is usually deposited a short distance downstream to form a bar or riffle area. These areas of deposition are often composed of clean gravels that provide excellent habitat for certain species.
- Can be installed in series on alternative streambanks to produce a meandering thalweg and associated structural diversity.
- Rock and rock-filled log crib deflector structures are most common.
- Should be used in channels with low physical habitat diversity, particularly those with a lack of stable pool habitat.
- Deflectors placed in sand bed streams may settle or fail due to erosion of sand, and in these areas a filter layer or geotextile might be needed underneath the deflector

Tree Revetment

Tree revetments are made from whole tree trunks laid parallel to the bank, and cabled to piles or deadman anchors. This use of large tree revetments in combination with other woody practices can significantly reduce the use of stone for toe protection while reintroducing woody material natural to the stream ecosystem. We are looking at utilizing Christmas trees for this practice.



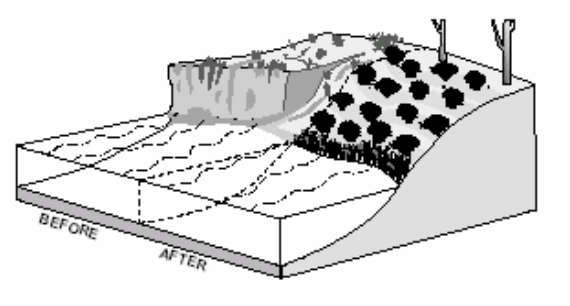
A row of interconnected trees attached to the toe of the streambank or to deadmen in the streambank to reduce flow velocities along eroding streambanks, trap sediment, and provide a substrate for plant establishment and erosion control.

Applications and Effectiveness

- Design of adequate anchoring systems is necessary.
- Wire anchoring systems can present safety hazards.
- Use inexpensive, readily available materials.
- Capture sediment and enhances conditions for colonization of native species particularly on streams with high bed material loads.
- Not appropriate for installation directly upstream of bridges and other channel constrictions because of the potential for downstream damages should the revetment dislodge.
- Should not be used if they occupy more than 15 percent of the channel's cross sectional area at bank full level.
- Not recommended if debris jams on downstream bridges might cause subsequent problems.
- Species that are resistant to decay are best because they extend the establishment period for planted or volunteer species that succeed them.
- Requires toe protection where toe scour is anticipated.
- Should, where appropriate, be used with soil bioengineering systems and vegetative plantings to stabilize the upper bank and ensure a regenerated source of streamside vegetation.

Bank Shaping and Planting

The streambank will be shaped and planted according to the requirements associated with each practice installation. Wetland plantings along with upland plantings will include grasses, forbs, brush and tree species as appropriate. Due to the near vertical 25 foot banks and the need to protect nearby upland trees, bank layback and shaping will be limited to that necessary to support the goals of the project.



Re-grading streambanks to a stable slope, placing topsoil and other materials needed for sustaining plant growth, and selecting, installing and establishing appropriate plant species.

Applications and Effectiveness

- Most successful on streambanks where moderate erosion and channel migration are anticipated.
- Reinforcement at the toe of the embankment is often needed.
- Enhances conditions for colonization of native species.
- Used in conjunction with other protective practices where flow velocities exceed the tolerance range for available plants, and where erosion occurs below base flows.
- Streambank soil materials, probable groundwater fluctuation, and bank loading conditions are factors for determining appropriate slope conditions.
- Slope stability analyses are recommended.

Pin Dikes (Soldiers in Formation)

(No diagram available at this time.) Pin Dikes are utilized to restore stream flow characteristics and protect streambanks by driving eucalyptus logs vertically into the streambottom in a series of rows. The goal is to restore stream flow characteristics by dissipating the energy of the flowing water along the edge of the channel and forcing the stream flow back into the center of the channel. Key restoration elements include the creation and protection of new streambank and confinement and deepening of the low flow channels.

Implementation

During construction each practice will be monitored individually for effectiveness in achieving the stated goals as well as collectively to determine how the practices work in combination. The eucalyptus trees from another project will provide much of the woody structural work. Native Oaks and other trees currently dead and down in the work area will also be utilized.

This project will provide a demonstration of potential restoration and protective practices that can be utilized over the remaining 5 miles of the Arroyo once the additional funding sources are secured. The project will not only address the serious habitat issues both on-site and downstream but will lead to additional habitat restoration throughout the watershed as these demonstrated practices are applied watershed-wide.

Conclusion

This demonstration project will provide the NRCS and the project partners an opportunity to evaluate the potential cost-effective practices for stream bank restoration and habitat enhancement in an urban/rural setting. When successful, these practices may be utilized throughout the watershed in restoring and protecting larger reaches of this and other streams. This project will put conservation on the ground while meeting local agency and community goals for the Arroyo de la Laguna and Alameda Creek watersheds.